APPENDIX D: SPECIALIST REPORTS

ANNEXURE A:Terrestrial Ecology Report Ross Portion 4

ECOREX
CONSULTING ECOLOGISTS

246B Penguin Crescent
Postnet Suite #192,
Private Bag X2
Raslouw 0109
Tel: (012) 660-1160

14 May 2020

Att: Steven Henwood

Comments regarding the destruction of a raptor nest on the farm Ross 55 KU

ECOREX Consulting Ecologists performed a baseline ecological survey for Henwood Environmental Services (HES) in February 2020 on the farm Ross 55 KU within the Klaserie Private Nature Reserve where a lodge development was planned. During the survey an unused raptor nest was located within the proposed footprint of the development and, with the application of the precautionary principle, the recommendation was made that construction be delayed until after winter 2020 so that it can be established whether the nest was a) occupied and b) by which species of raptor, considering many potentially occurring species are threatened or near threatened. A photograph of the nest was included in the baseline ecological report submitted to HES in March 2020.

ECOREX then received correspondence from HES on the 12th May 2020 pertaining to the nest. The correspondence included a signed letter from the Warden of the Klaserie in which it was indicated that a severe storm had damaged the nest and that it was no longer in use. Several photographs were also submitted as evidence, and one is included at the end of this letter.

In light of this information we therefore retract our recommendation of “no development” till after the winter of 2020, and therefore have no objection to development commencing as soon as authorisation is granted. However, we would like to reiterate that the remaining recommendations are still valid, and include:

- No trees with a diameter of 30 cm or more should be removed by any construction, whether protected or not. Protected trees with a diameter of less than 30 cm should also be avoided. The access roads should be routed around these trees and the proposed lodge should be constructed around all larger trees.

- The small erosion gully in the northern portion of the study area appears to be relatively newly established and actively eroding. It is suggested that erosion control actions be implemented.

This may include the construction of a concrete drift, drainage pipes or gabion baskets, as well as packed branches.

- The septic tank and grey-water systems of the proposed lodge should regularly be inspected to ensure that no pollutants are entering the adjacent drainage line.
- All waste and litter generated at the proposed lodge should be removed and recycled.
- Weeds will inevitably establish around bare soil around the construction site and it is important that weed control, if involving herbicides, be managed correctly so as to reduce the impact on the adjacent natural vegetation.

Please do not hesitate to contact me if there are any questions pertaining to this matter.

Regards

Duncan McKenzie

Terrestrial Ecologist

ECOREX Consulting Ecologists CC

Photograph supplied by HES of the remains of the raptors nest on Ross (left of the Buffalo Weaver nests)

ROSS LODGE

TERRESTRIAL ECOLOGICAL ASSESSMENT

March 2020

Prepared for: Steven Henwood
Henwood Environmental Solutions
PO Box 12340
Steiltes
Nelspruit
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

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

List of Tables

List of Figures

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

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 61
✓	(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	page 62
✓	(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 39
✓	(g) an identification of any areas to be avoided, including buffers;	page 42
✓	(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 40
✓	(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 41
✓	(k) any mitigation measures for inclusion in the EMPr;	page 42
✓	(l) any conditions for inclusion in the environmental authorisation;	page 42
✓	(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	page 42
	(n) a reasoned opinion-	
✓	(i) as to whether the proposed activity or portions thereof should be authorised; and	page 43
✓	(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 43
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
(083) 231-5632 warren@ecorex.co.za

Abbreviations

BODATSA	Botanical Database of Southern Africa
GKNP	Greater Kruger National Park
IBA	Important Bird Area
IUCN	International Union for Conservation of Nature
mamsl	Metres Above Mean Sea Level
MNCA	Mpumalanga Nature Conservation Act (No. 10 of 1998)
NEMBA ToPS	National Environmental Management: Biodiversity Act Threatened or Protected Species Lists (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 2530 BD
SABAP2	Southern African Bird Atlas Project 2
SANBI	South African National Biodiversity Institute
SCC	Species of Conservation Concern
TGR	Timbavati Game Reserve

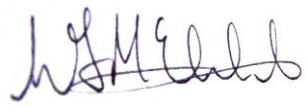
Terminology

Alien	Introduced from elsewhere: neither endemic nor indigenous.
Biodiversity	The structural, functional and compositional attributes of an area, ranging from genes to landscapes.
Geophyte	Plants that produce their growth points from organs stored below the ground, an adaption to survive frost, drought and / or fire.
Palaearctic	Ecozone consisting of North Africa, Europe and Asia north of the Himalayan foothills.
Transformed	Transformed ecosystems are no longer natural and contain little or no indigenous flora. Examples include agricultural lands, plantations, urban areas, etc.

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

1. INTRODUCTION

Steven Henwood of Henwood Environmental Solutions appointed ECOREX Consulting Ecologists CC to perform a biodiversity survey for terrestrial ecosystems (flora, mammals, birds, reptiles and frogs) for a lodge in the Klaserie Private Nature Reserve (KPNR), Mpumalanga Province, South Africa. This study will provide a basis for the assessment of the potential impacts of the developments on the terrestrial ecology of the study area as well as providing a baseline description of untransformed vegetation. The key objectives for this study were a report on terrestrial ecosystems and an integrated Ecological Importance Assessment.

The study team was as follows:

Duncan McKenzie (Terrestrial Ecologist). Duncan has been involved in biodiversity assessments for ECOREX for 12 years and countries of work experience include Lesotho, Swaziland, Mali, Mozambique, Sierra Leone, Guinea, South Africa, Tanzania and Democratic Republic of the Congo. Duncan has previously worked as a Regional Coordinator for the Mondi Wetlands Project and has lectured 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, is co-author of The Birds of Mbombela and is a co-author on the Wildflowers of the Kruger National Park project. A more detailed CV is presented in Appendix 6.

Linda McKenzie (GIS Specialist). Linda is a GIS Specialist/GIS Analyst with over 14 years' experience in the industry. For the last five years she has operated her own GIS Consultancy called Digital Earth. She has extensive experience in both the private and public sector, as has worked on a wide variety of projects and GIS applications. These include, most recently, 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 formerly served as Vice Chairperson and Treasurer for GISSA Mpumalanga and is a registered Professional GISc Practitioner (PGP0170).

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

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 importance 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
(083) 231-5632 warren@ecorex.co.za

3. STUDY AREA & PROJECT DESCRIPTION

The survey took place on the Remainder of Portion 4 of the farm Ross 55 KU, situated within the KPNR, approximately 30 km east of the town of Hoedspruit in the Ehlanzeni District, Mpumalanga Province, South Africa (Figure 1). The KPNR is in turn situated within the Associated Private Nature Reserves (APNR), which comprises the Balule Private Nature Reserve, Kapama Game Reserve, Timbavati Private Game Reserve, Thornybush Game Reserve and Umbabat Game Reserve, together protecting 180 000 ha of land to the west of the south-central portion of the Kruger National Park (KNP). These protected areas collectively form part of the Greater Kruger National Park (GKNP). This assessment covers the following proposed project description:

The owners of Portion 4 of the Farm Ross 55 KU would like to develop a camp, within a 2ha area that will constitute the following:

- A swimming pool
- 2 x lapa's
- A main area/lounge
- 8 x chalets
- 1 x gym
- 2 x staff quarters
- 2 x garage and storerooms
- 5 x under roof parking bays

The total area surveyed measured 5.5 ha.

The application site is situated within the Quarter Degree Grid Square (QDGS) 2431AC, at an altitude of approximately 440 meters above mean sea level (mamsl). The topography of the general area area is flat to gently undulating with shallowly incised drainage lines.

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

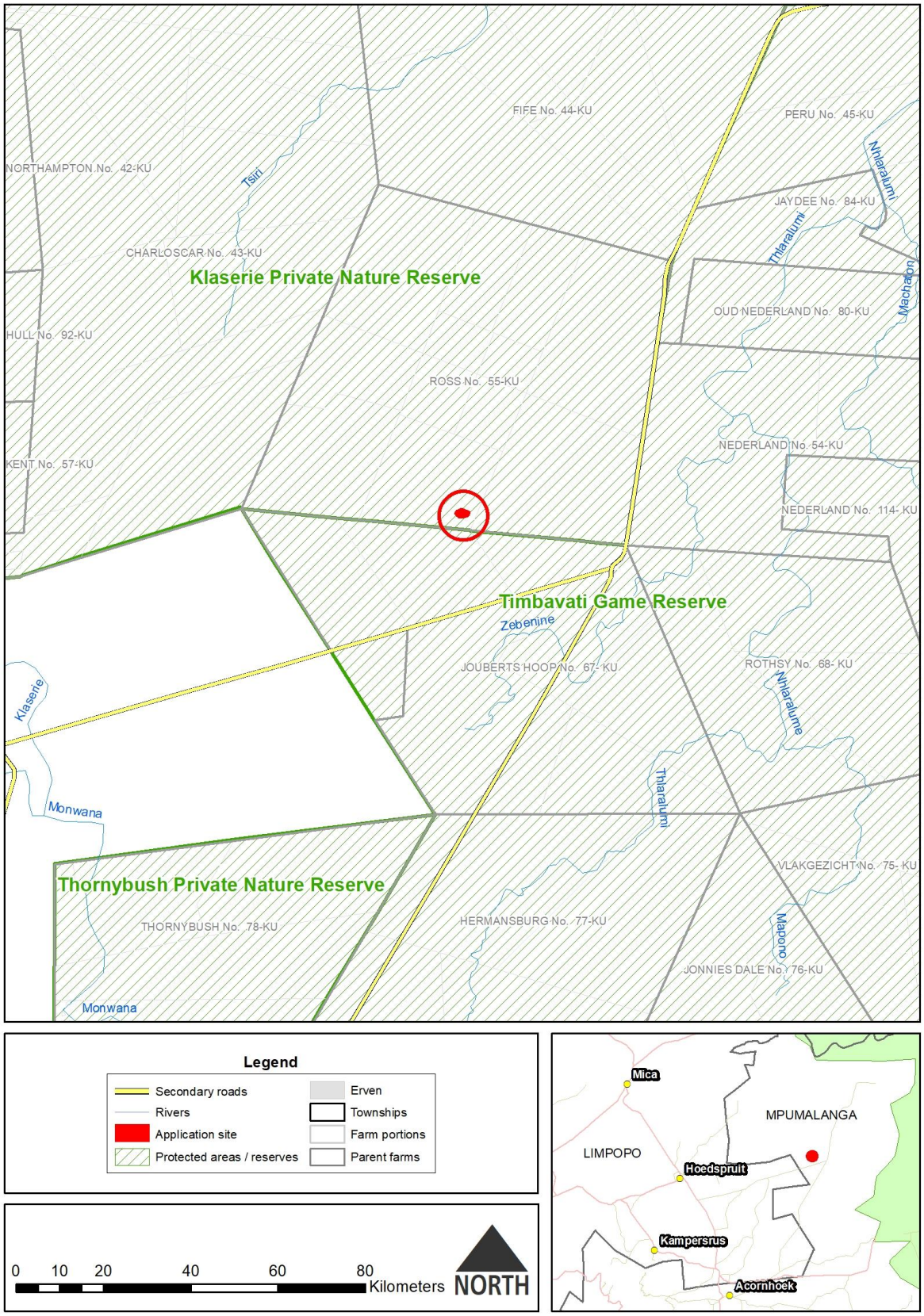


Figure 1. Location of Study Area

ECOREX Consulting Ecologists CC
Postnet Suite #192, Private Bag X2 Raslouw 0109
(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 most of 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 present within the study area 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 mid-February 2020. The boundary of the study area was supplied by HES and pre-loaded onto a Samsung S10 phone using LocusMap Pro™ software. This area was 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
(083) 231-5632 warren@ecorex.co.za

4.2 Fauna

Desktop

Lists of mammal, bird, reptile and frog SCC 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) (NEMBA ToPS)
- Mpumalanga Nature Conservation Act (No. 10 of 1998) (MNCA)

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 Bushnell 10x42 binoculars. Observations were made incidentally during the time that the vegetation survey was conducted, and limited to birds seen and heard within the application sites and immediate surrounds. Mammals, reptiles and frogs were recorded incidentally as they were encountered during the survey through direct evidence (sightings) and indirect evidence (spoor, dung).

ECOREX Consulting Ecologists CC
Postnet Suite #192, Private Bag X2 Raslouw 0109
(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
(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.

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

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
(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.

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

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 SEI values for each vegetation community / proposed development site are indicated spatially in Figure 8.

ECOREX Consulting Ecologists CC
Postnet Suite #192, Private Bag X2 Raslouw 0109
(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 a single day in the wet season. 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
(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 the current National Vegetation Map (SANBI, 2018), only one vegetation type is present within the study area, namely Granite Lowveld. This vegetation type occurs in a narrow strip from Phongola in northern KwaZulu-Natal in the south, through central Swaziland, and to Giyani in Limpopo Province in the north. Granite Lowveld originally covered about 19 838 km^2, of which 21% has been transformed, mostly through agriculture and urbanisation. Mucina & Rutherford (2006) assessed this community to be Vulnerable, but it is not situated within any Threatened Ecosystems as listed in Government Gazette No. 34809 of 9 December 2011 (DEAT, 2011).

Typical Granite Lowveld is dominated by tall trees such as *Acacia nigrescens* and *Sclerocarya birrea*, as well as a variety of smaller trees and shrubs such as *Combretum zeyheri* and *C. apiculatum*, *Terminalia sericea, Euclea divinorum* and *Peltophorum africanum*. Common herbaceous plants include *Waltheria indica, Aspilia mossambicensis, Commelina* species and *Kohautia virgata*. Dominant grasses are *Digitaria eriantha, Panicum maximum* and *Pogonarthria squarrosa* (Mucina & Rutherford, 2006).

5.1.1.2 Centres of Plant Endemism

The study area is not situated within any centres of plant endemism as defined by Van Wyk & Smith (2001).

5.1.1.3 Threatened Ecosystems

The study area is not situated within any Threatened Ecosystems as listed in Government Gazette No. 34809 of 9 December 2011 (DEAT, 2011).

5.1.2 Local Context – Plant Species Richness and Description of Development Sites

SANBI's Botanical Database of Southern Africa (BODATSA) lists 393 plant taxa from 85 families for a 20 km radius around the study area. A total of 96 taxa from 35 families were recorded from the study area during February 2020 fieldwork, representing 24% of the

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

BODATSA total. The true plant species diversity of the sites is likely to be slightly higher as few herbs that flower at the end of the dry season were recorded. The full list of 96 plant taxa confirmed to occur during fieldwork is presented in Appendix 1. The dominant plant families in the flora are Poaceae (18 spp), Malvaceae (15 spp) and Fabaceae (13 spp).

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.). One community is present within the study area, and is described briefly below.

5.1.2.1 *Acacia nigrescens – Terminalia prunioides* Closed Woodland

Acacia nigrescens – Terminalia prunioides Closed Woodland occurs across the entire study area (Figure 4). Vegetation structure is mostly Short to Tall Closed Woodland (*sensu* Edwards, 1983) (Figure 2). The canopy layer is dominated by the trees *Acacia nigrescens* and *Terminalia prunioides.* Additional canopy species include *Combretum hereroense, C. apiculatum, Lannea schweinfurthii, Sclerocarya birrea, Peltophorum africanum* and *Ziziphus mucronata.* The shrub layer contains *Acacia exuvialis*, *Grewia bicolor, Gymnosporia maranguensis, Maerua parvifolia, Dichrostachys cinerea* subsp*. africana* and *Ximenia caffra* var*. caffra*. The ground layer is dominated by a diverse assemblage of grasses, including *Brachiaria serrata, Digitaria eriantha, Panicum maximum, Aristida adscensionis, A. congesta* subsp*. barbicollis*, *Tragus berteronianus, Cenchrus ciliaris*, *Schmidtia pappophoroides* and *Eragrostis rigidior*. Herbs included *Dicoma tomentosa, Agathisanthemum bojeri, Kyphocarpa angustifolia, Tribulus terrestris, Indigofera rhytidocarpa* and *Heliotropium ciliatum.*

Figure 2. Photographs of Closed Woodland

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

5.1.3 Conservation-Important Flora

A total of 96 plant species in 35 families was recorded during fieldwork (Appendix 1). One of these is considered to be Near Threatened (NT) and is discussed below.

***Elaeodendron transvaalense* (Burtt Davy) R.H.Archer** Bushveld Saffron
This is a small to medium-sized evergreen tree occurring in northern and eastern South Africa, and further afield through Namibia, Botswana, Zimbabwe, Mozambique and Zambia. The species is heavily harvested in South Africa for traditional medicine and some sub-populations have declined as a result; as such it has been assessed as NT (Williams *et al*., 2008a). A single plant was located within the study area (Figure 3).

Five plant species recorded during fieldwork are protected under the NFA, namely *Sclerocarya birrea, Elaeodendron transvaalense, Philenoptera violacea, Combretum imberbe* and *Balanites maughamii* (Table 7).

Five additional plant SCC potentially occur in the KPNR, with only one species having a moderate likelihood of occurrence. This species is described below.

***Drimia sanguinea* (Schinz) Jessop** Red Drimia
This small bulb is invisible for most of the year either through dormancy or being inconspicuous due to its grass-like leaves. It is only in the flowering season that they are visible. This takes place in early spring and it is therefore likely that this bulb was not located during fieldwork due to the timing of the survey. This plant is listed as NT due to over-collection for the medicinal plant trade[1].

The remaining potentially occurring SCC all have a low likelihood of occurring within the study area due to fieldwork coverage, unsuitable habitat present or regional rarity (Table 8).

The co-ordinates of the SCC and protected plants located within the study area during fieldwork are presented in Table 9. These points are spatially presented in Figure 4.

[1] Williams *et al*., 2008b

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

Figure 3. Photograph of *Elaeodendron transvaalense* (NT) recorded during fieldwork

5.1.4 Endemic Species

No plants endemic to Mpumalanga were recorded during fieldwork.

5.1.5 Invasive Alien Species

Only one alien plant species was recorded during fieldwork, namely * *Mollugo nudicaulis,* which occurs in moderate numbers. No plants listed in the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983, CARA) were recorded during fieldwork. However, the bare or disturbed soil resulting from construction activities and frequent human access may encourage the establishment of at least a few invasive alien species.

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

Table 7. Conservation-important plant species confirmed during fieldwork

Taxa	Growth Form	Red Data	Protected	MPU Endemic	Closed Woodland
Family Anacardiaceae *Sclerocarya birrea* (A.Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro	tree		NFA		r
Family Balanitaceae *Balanites maughamii* Sprague subsp. *maughamii*	tree		NFA		r
Family Celastraceae *Elaeodendron transvaalense* (Burtt Davy) R.H.Archer	tree	NT	NFA		r
Family Combretaceae *Combretum imberbe* Wawra	tree		NFA		r
Family Fabaceae *Philenoptera violacea* (Klotzsch) Schrire	tree		NFA		r
TOTAL	**5**	**1**	**5**	**0**	**5**

NFA - National Forests Act	r = rare
NT - Near Threatened	

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

Table 8. Potentially occurring plant SCC

Adenium swazicum	Apocynaceae	CR	Lowveld savanna, often on sodic soils	Very Low	No suitable habitat present, no plants located during fieldwork, very rare in the APNR
Ansellia africana	Orchidaceae	VU‡	Hot dry mixed deciduous woodlands at medium to low altitudes, in riverine vegetation and miombo woodlands near rivers	Very Low	Suitable habitat present but no plants located during fieldwork
Bowiea volubilis subsp. *volubilis*	Hyacinthaceae	VU	Thickly vegetated river valleys and in boulder screes	Very Low	No suitable habitat present, no plants located during fieldwork, very rare in the APNR
Dalbergia melanoxylon	Fabaceae	NT‡	Savanna	Very Low	Suitable habitat present but no plants located during fieldwork
Drimia sanguinea	Hyacinthaceae	NT	Open veld and scrubby woodland in a variety of soil types.	Moderate	Suitable habitat present but grass-like leaves of sterile plants are easily missed
Elaeodendron transvaalense	Celastraceae	NT	Savanna or bushveld, from open woodland to thickets, often on termite mounds.	Confirmed	

NT - Near Threatened
VU - Vulnerable
CR - Critically Endangered
‡ - IUCN assessment

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

Table 9. Co-ordinates of plant SCC and protected plants

Species	Protected Status	Red Data	No. of Plants	GPS Co-ordinates	
				Lat	Long
Balanites maughamii	NFA		1	-24.306097	31.248589
Combretum imberbe	NFA		1	-24.306403	31.247578
Elaeodendron transvaalense	NFA	NT	1	-24.306168	31.248985
Philenoptera violacea	NFA		1	-24.305832	31.247586
Sclerocarya birrea	NFA		1	-24.306811	31.247277
Sclerocarya birrea	NFA		1	-24.305961	31.249202

NFA - National Forests Act (30 of 1998)
NT - Near Threatened

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

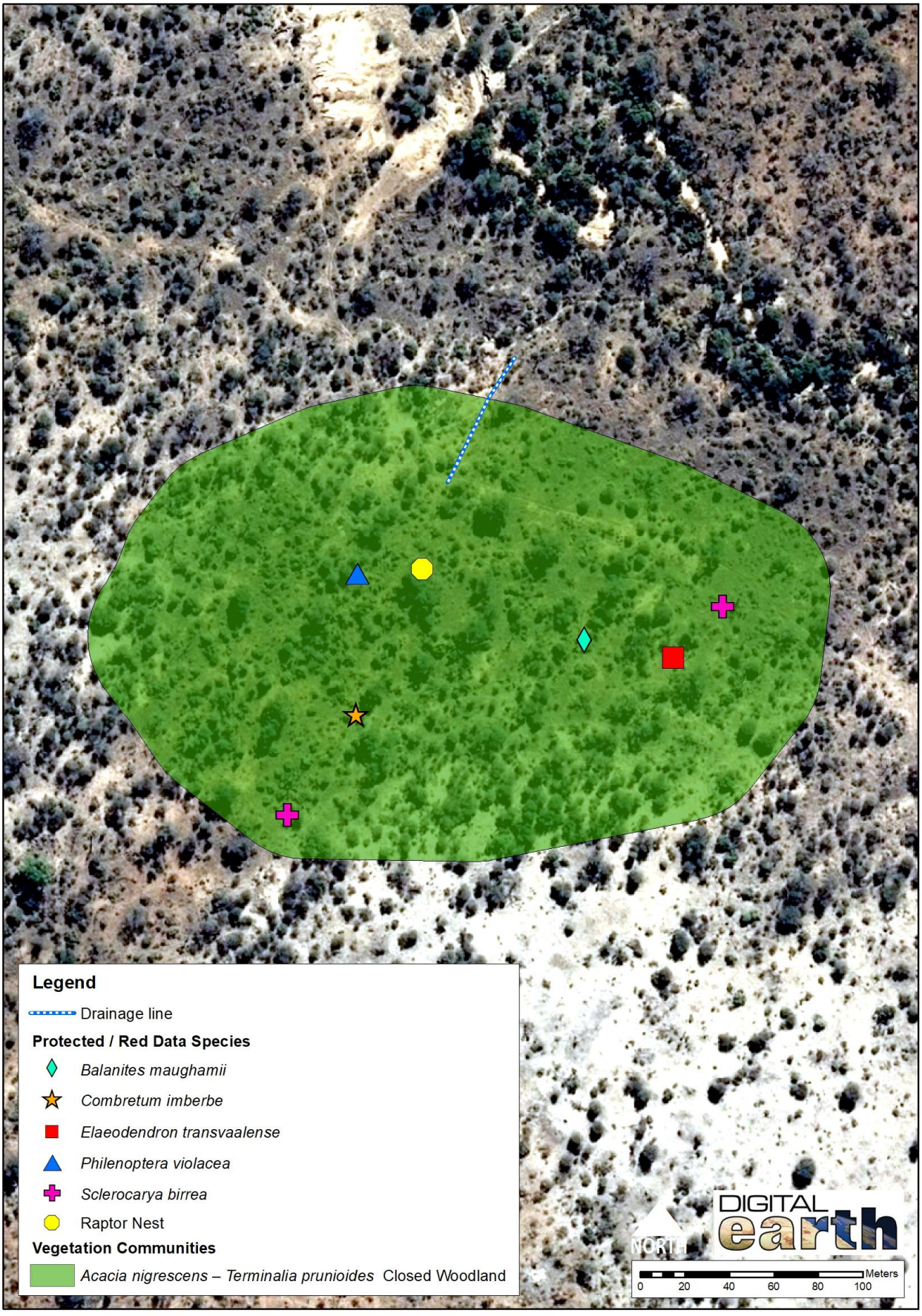


Figure 4. Vegetation community within the study area

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

5.2 Terrestrial Fauna

5.2.1 Mammals

5.2.1.1 Regional Overview

Ross 55 KU is situated within the savanna biome within the KPNR, which in turn is situated within the GKNP and therefore has very high mammal diversity, relatively low numbers of endemics and a relatively high number of Red Data species[3]. The surrounding area is all formally conserved with strict access controls in place and mammal populations are therefore well protected and reasonably secure. A cumulative total of 131 mammals have been recorded in the degree square 2431, with 61 recorded in the QDGS 2431 AC in the Animal Demography Unit's Virtual Museum's database[4]. As all Virtual Museum submissions require the inclusion of at least one photograph of the mammal, the actual number of species present is likely to be significantly higher as many mammals are small, cryptic or nocturnal in habit and therefore difficult to photograph.

5.2.2.2 Confirmed Species

Seven mammal species were recorded from the study area during fieldwork (Appendix 2). These included both common and widespread savanna species such as Impala *Aepyceros melampus*, Greater Kudu *Tragelaphus strepsiceros* and Plains (Burchell's) Zebra *Equus quagga burchelli,* as well as a single threatened species, namely African Elephant *Loxodonta africana* (Vulnerable VU). Additional sampling, including small mammal trapping, bat sampling and camera traps, would result in additional species but would not change the findings of the report.

5.2.1.3 Conservation-Important Species

An estimated 29 conservation-important mammals potentially occur within the project area (Appendix 3), which is an extremely high total but this is due to the study area being situated within a large, formally protected conservation area in the savanna biome. Several cave-roosting bat species of conservation concern are 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.

[3] Child *et al*., 2016
[4] http://vmus.adu.org.za/vm_sp_list.php accessed 26/02/2020

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

Of the 29 potentially occurring species, 16 are considered to be SCC[5] with nine considered threatened (Appendix 4). Of these, one was confirmed during fieldwork and is discussed in more detail below:

African Elephant *Loxodonta africana*

Despite South Africa only supporting 4% of Africa's elephant population, they are the best protected and most intensely managed[6]. Elephants are now mostly restricted to conservation areas in South Africa and the GKNP area supports an estimated 17 000 animals[7]. The world's largest land mammal is listed as VU by the IUCN due to poaching for ivory and meat, loss and fragmentation of habitat and conflict with humans in agricultural areas[8]. Extensive evidence of the presence of these animals in the form of faeces was observed across the study area.

Of the remaining threatened species, the following have a moderate likelihood of regularly occurring within the study area:

Leopard *Panthera pardus*

Upgraded to VU in the latest Red Data assessment[9], leopards are severely threatened outside protected areas mainly due to habitat loss, direct and indirect persecution including hunting and extermination from wildlife ranchers and for traditional attire (Child *et al*, 2016). The adjacent GKNP supports the largest population of these large cats in South Africa[10], and they would probably regularly forage in and around the study area.

Lion *Panthera leo*

Although assessed as Least Concern in South Africa, Africa's largest member of the cat family is listed as VU by the IUCN due to indiscriminate killing in defense of human life and livestock, habitat loss, and prey base depletion[11]. It probably regularly hunts in and around the study area but would not remain for long durations due to the small size of the footprint.

[5] 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)
[6] Blanc, 2008
[7] Ferreira *et al*., 2017
[8] Blanc, 2008
[9] Child *et al.*, 2016
[10] Child *et al.*, 2016
[11] Bauer *et al*., 2016

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

African Wild Dog *Lycaon pictus*

Africa's largest canid has experienced a rapid decline in range and is listed as Endangered (EN) due to a multitude of threats such as persecution from stock farmers, road mortalities, infectious disease from domestic dogs and snaring (Child *et al*., 2016). The population in the GKNP is stable at around 250 individuals[12]. This species forages widely and will occasionally do so within and around the study area.

The remaining potentially occurring threatened species have a Low likelihood of occurrence due to general scarcity or absence in the APNR (Appendix 3).

Seven potentially occurring species are assessed as NT, which are species close to or likely to soon qualify for the status of Vulnerable. Two of these have a moderate or high likelihood of occurring within the study area:

Spotted Hyaena *Crocuta crocuta*

This large carnivore is dependent on conservation areas in South Africa for survival as it is frequently persecuted by stock farmers outside[13]. An estimated 2000-5340 animals reside within the adjacent GKNP (SANParks, 2011), and it is likely to regularly forage in and around the study area.

White Rhinoceros *Ceratotherium simum*

A continued and increased threat from poaching and increasing illegal demand for rhino horn has resulted in this species being assessed as NT[14]. This is a resident species in the APNR and is expected to forage regularly across Ross 55 KU.

The remaining potentially occurring NT mammal species all have a low likelihood of occurring within the study area due to regional scarcity or a lack of suitable habitat present.

Twenty-six potentially occurring species are protected under the MNCA or the NEMBA ToPS, four of which were confirmed during fieldwork (Appendix 4).

[12] Child *et al*., 2016
[13] Child *et al*., 2016
[14] Child *et al*., 2016

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

5.2.2 Birds

5.2.2.1 Regional Overview

The savanna biome supports the highest diversity of bird species within the Southern African sub-region. The GKNP supports the largest birdlist of all conservation areas in South Africa with an estimated 57% of the birds found within the entire southern African sub-region[15]. The study area, situated across the QDGS 2431 AC, is especially diverse with a total of 352 species recorded during the second Southern African Bird Atlas Project (SABAP2)[16], which is currently in progress. At a finer scale, data from SABAP2 indicate that the study area is moderately well sampled, with 193 bird species from 38 full protocol lists[17] having been recorded from the pentad (mapping unit) in which the study area is situated (2415_3110)[18]. A pentad covers an area of approximately 77 km^2, which is considerably smaller than a QDGS and thus a better indication of which species occur in the study area.

The study area falls within the Kruger National Park and Adjacent Areas Important Bird and Biodiversity Area (IBA) and qualifies as a Global IBA under criteria A1, A2, A3 and A4i. Eleven globally threatened species are resident within the GKNP, in addition to fourteen resident regionally threatened birds. A number of migratory and vagrant threatened species also occur[19].

5.2.2.2 Local Avifaunal Assemblages

A total of 74 bird species were confirmed to occur in the study area during fieldwork (38% of the combined pentad species list), and are listed in 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 in summer is likely to increase the species richness of the assemblage but is unlikely to identify additional assemblages. One assemblage was present and is dealt with below.

[15] Taylor *et al*., 2015
[16] Data accessed from http://sabap2.birdmap.africa/coverage/qdgc/2431ac on 26/02/2020
[17] Full protocol lists require at least two hours of coverage per list
[18] http://sabap2.adu.org.za/coverage/pentad/ 2415_3110,accessed 26/02/2020
[19] Taylor *et al*., 2015

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

Closed Woodland Assemblage

Closed Woodland covers most of the APNR, whether dominated by *Acacia nigrescens*, *Colophospermum mopane, Sclerocarya birrea* or various *Combretum* spp. This is by far the largest and most diverse bird assemblage in the general TGR area. This community supports a number of common and conspicuous savanna species, including Magpie Shrike *Urolestes melanoleucus*, Crested Francolin *Dendroperdix sephaena,* Southern Yellow-billed Hornbill *Tockus leucomelas,* White-browed Scrub Robin *Erythropygia leucophrys*, Arrow-marked Babbler *Turdoides jardineii,* Grey Go-away-bird *Corythaixoides concolor*, Red-billed Buffalo Weaver *Bubalornis niger*, Blue Waxbill *Uraeginthus angolensis* and Southern Grey-headed Sparrow *Passer diffusus* (Appendix 2).

5.2.2.3 Conservation-Important Species

An estimated 36 conservation-important birds potentially occur within the KPNR (Appendix 3). Twenty-six of these are considered threatened, three of which were confirmed to occur during fieldwork and are discussed below:

Bateleur *Terathopius ecaudatus*

The Bateleur is listed as Endangered (EN) in South Africa primarily due to habitat loss and is now mostly restricted to larger conservation areas, at least as a breeding species[20]. An estimated 550 – 650 breeding pairs are found within the GKNP[21]. Single birds were regularly observed flying over the study area and suitable nesting locations (tall trees such as *Acacia nigrescens*) are present, although no active nests were located during fieldwork.

White-backed Vulture *Gyps africanus*

This vulture is assessed as Critically Endangered (CR) due to anthropogenic impacts such as habitat loss, poisoning, electrocution and collision with powerlines, drowning in concrete farm reservoirs and collection for the medicinal trade[22]. Birds were regularly observed flying over the study area and suitable nesting locations (tall trees such as *Acacia nigrescens*) are present, although no active nests were located during fieldwork.

Hooded Vulture *Necrosyrtes monachus*

This vulture is threatened due to similar anthropogenic impacts as the White-backed Vulture described above such as habitat loss, poisoning, electrocution and collision with powerlines,

[20] Taylor *et. al*., 2015
[21] Barnes, 2000
[22] Taylor *et. al*., 2015

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

drowning in concrete farm reservoirs and collection for the medicinal trade[23]. A pair was observed flying over the study area during fieldwork. It is resident within the APNR and potentially forages within the study area on a regular basis. Suitable breeding trees are present, although no active nests were located.

A single inactive raptor nest was located in close proximity to a few nests of Red-billed Buffalo Weavers during fieldwork (Figure 5), and may belong to any medium-sized species of raptor, such as Bateleur. Medium and large raptors nest in the drier winter months (egg-laying dates mostly from April to July) and it is therefore not surprising that no birds were seen on the nest during the time of the survey.

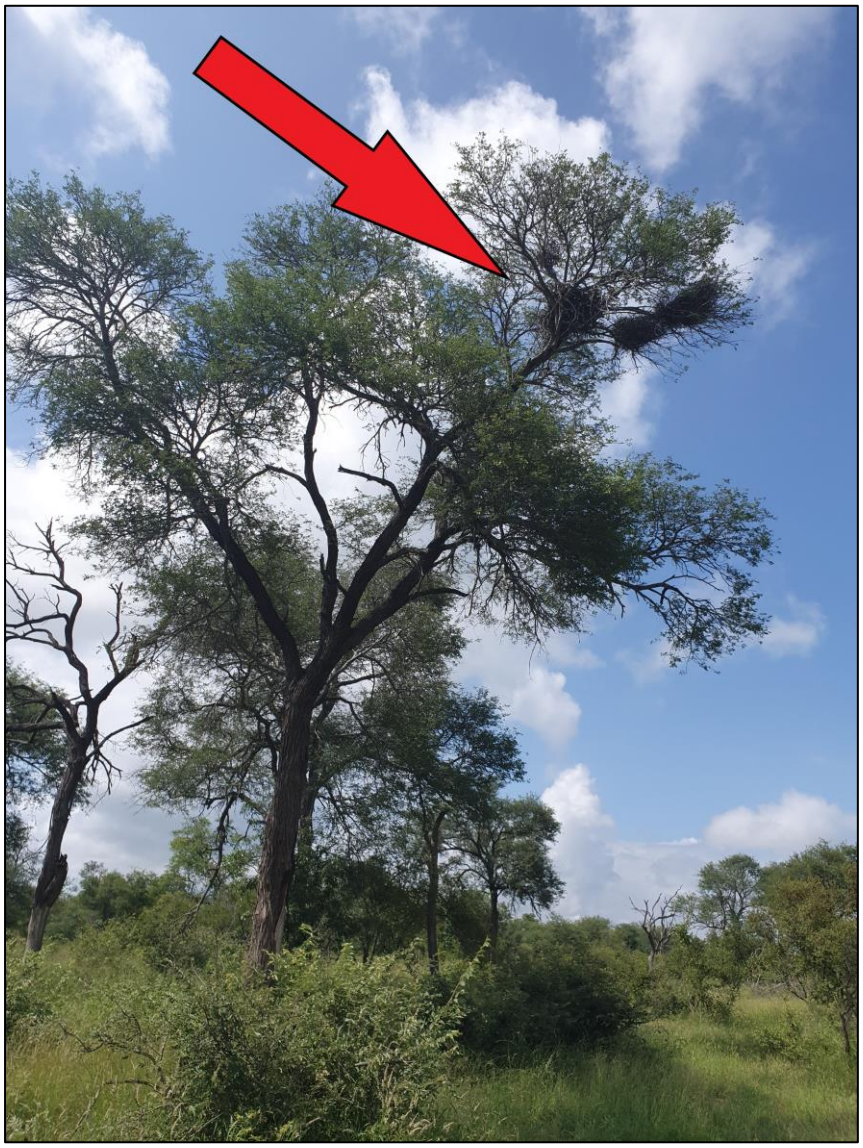


Figure 5. Photograph of a single, inactive raptor nest located within the study area

[23] Taylor *et al*., 2015

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

Six additional threatened species have a moderate or high likelihood of occurring within the study area and are discussed below:

Tawny Eagle *Aquila rapax*

This large eagle is listed as EN due to continuing decline in the local population through habitat transformation, direct persecution, indirect poisoning and drowning in concrete reservoirs[24]. It is largely restricted to conservation areas in South Africa and the GKNP area supports an estimated 500 – 700 pairs (Barnes, 1998). Birds could regularly forage within the study area and a single individual was seen closer to the APNR gate on the day of the survey. Suitable tall breeding trees are present but no active nests were observed.

Southern Ground-Hornbill *Bucorvus leadbeateri*

This large, mostly terrestrial bird is listed as EN due to habitat loss, direct persecution, bush encroachment and collisions with windows[25]. They are mostly restricted to large conservation areas in South Africa and their slow reproduction rate of one chick / 9.3 years per family group means they have a very slow recovery rate if bird mortalities occur[26]. This species is resident in the APNR in low numbers and may occasionally forage within the study area, although no suitable breeding habitat (cavities in large trees) is present.

White-headed Vulture *Trigonoceps occipitalis* (CR), Lappet-faced Vulture *Torgos tracheliotos* (EN) and Cape Vulture *Gyps coprotheres* (EN)

These three vultures are all threatened due to similar anthropogenic impacts as the White-backed Vultures described above such as habitat loss, poisoning, electrocution and collision with powerlines, drowning in concrete farm reservoirs and collection for the medicinal trade[27]. All are either resident or regular visitors to the APNR, and potentially forage within the study area. Suitable breeding trees are present for all except the cliff-nesting Cape Vulture, although no active nests were located.

Martial Eagle *Polemaetus bellicosus*

Africa's largest eagle is listed as EN due to many factors including habitat loss, direct persecution from small-stock farmers and indirect persecution from electrocution and

[24] Taylor *et al*., 2015
[25] Taylor *et al*., 2015
[26] Hockey *et al*., 2005
[27] Taylor *et al*., 2015

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

reservoir drownings[28]. This species occupies very large territories (up to 150 km^2 in the Lowveld[29]) and probably regularly forages over the study area. An estimated 250 birds occur within the GKNP (Hockey *et al*., 2005), and suitable large trees are present in the study area. However, no active nests were located during fieldwork.

Ten bird species potentially occurring within the study area are assessed as NT (Appendix 3). One of these was confirmed during fieldwork, and is discussed below.

European Roller *Coracias garrulous*

This Palaearctic migrant prefers open, grassy areas within savanna. It is listed as NT due to habitat loss over some of its breeding grounds, particularly in Europe[30]. Suitable foraging habitat is present over most of the APNR, and a single bird was recorded within the study area.

One additional NT species has a moderate likelihood of occurring within the study area (Appendix 3) and are discussed below:

Marabou Stork *Leptoptilos crumeniferus*

The largest of all Africa's storks, the Marabou favours a wide diversity of habitats and will readily scavenge around humans. It is listed as NT due to the small regional population, increased threat of poisoning and collision with powerlines[31]. This species is likely to only regularly forage within the study area, particularly on larger ungulate carcasses or during locust outbreaks. This species does not regularly breed in the GKNP but a few pairs breed in central Swaziland and far northern KwaZulu-Natal[32].

The remaining potentially occurring SCC all have a low likelihood of occurring within the study area (Appendix 3). This is primarily due to a lack of suitable habitat or regional scarcity. Ten potentially occurring species are protected under the NEMBA, three of which were confirmed (Appendix 2).

[28] Taylor *et al*., 2015
[29] Hockey *et al*., 2005
[30] Taylor *et al*., 2015
[31] Taylor *et al*., 2015
[32] Taylor *et al*., 2015

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

5.2.3 Reptiles

5.2.3.1 Regional Overview

The northern Lowveld of Mpumalanga supports a high diversity of reptile species with 100 species already recorded from the degree grid 2431[33]. Fifty-eight species of reptiles have been recorded from the QDGS 2431 AC, as listed on the Reptile Atlas of Southern Africa website (http://vmus.adu.org.za/) and in Bates *et al*. (2014), indicating that reptile diversity in the area is high. However, reptile endemicity is low which is to be expected as the area lies in close proximity to Mozambique within the widespread savanna biome (Bates *et al.*, 2014).

5.2.3.2 Confirmed Species

Only one reptile was recorded during dry-season fieldwork (Appendix 3), namely Bushveld Lizard *Heliobolus lugubris*, which is common and widespread species in the Lowveld (Bates *et al*., 2014). Dedicated reptile surveys in the wet season, including trapping, would no doubt 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

Only one of the potentially occurring reptiles is assessed a threatened, namely Nile Crocodile *Crocodylus niloticus*, which is classified as VU. This species has a Very Low likelihood of occurring within the study area due to a lack of permanent open water habitat. Only one protected reptile potentially occurs, namely Southern African Python *Python natalensis,* which is protected under the National Environmental Management: Biodiversity Act (No.10 of 2004) (Appendix 3). This large snake is likely to regularly forage within the study area.

[33] http://vmus.adu.org.za/vm_sp_list.php accessed 26/02/2020

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

5.2.4 Frogs

5.2.4.1 Regional Overview

The Lowveld of Limpopo and Mpumalanga provinces supports one of the richest areas in South Africa for frog diversity (Minter *et al*. 2004). Forty-one species have been recorded in the degree grid 2431, and 27 within the QDGS 2431 AC, as listed on the Frogs of Southern Africa website (http://vmus.adu.org.za/) as well as in the frog atlas project (Minter *et al.*, 2004). However, frog endemicity is very low with no potentially occurring endemic species present in the APNR (Minter *et. al,* 2004).

5.2.4.2 Confirmed Species

No frogs were recorded during fieldwork, primarily due to the lack of surface water. Dedicated frog searches, including nocturnal surveys at the onset of the rains, would have produced some species but are unlikely to have produced data that would change the recommendations in this report.

5.2.4.3 Conservation-Important Species

None of the 41 species of frogs recorded in 2431 have been assessed as threatened, with only one regarded as NT, namely Giant Bullfrog *Pyxicephalus adspersus*. However, it is doubtful that this species ever occurred in the Lowveld and the record is possibly an error, as this species and the African Bullfrog *Pyxicephalus edulis,* which is common in the Lowveld, were formerly conspecific and are very difficult to separate when young[34].

[34] Poynton, 1964

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

5.3 Ecological Sensitivity

5.3.1 Environmental Screening Tool

The EST of the DEA indicates that most of the study area has a Very High Terrestrial Biodiversity theme (Figure 6) due to it being classified as being within the following:

1. Protected Area;
2. Potential occurrence of Wild Dog (EN)
3. Potential occurrence of African Elephant (VU)
4. Potential occurrence of Cheetah (EN)

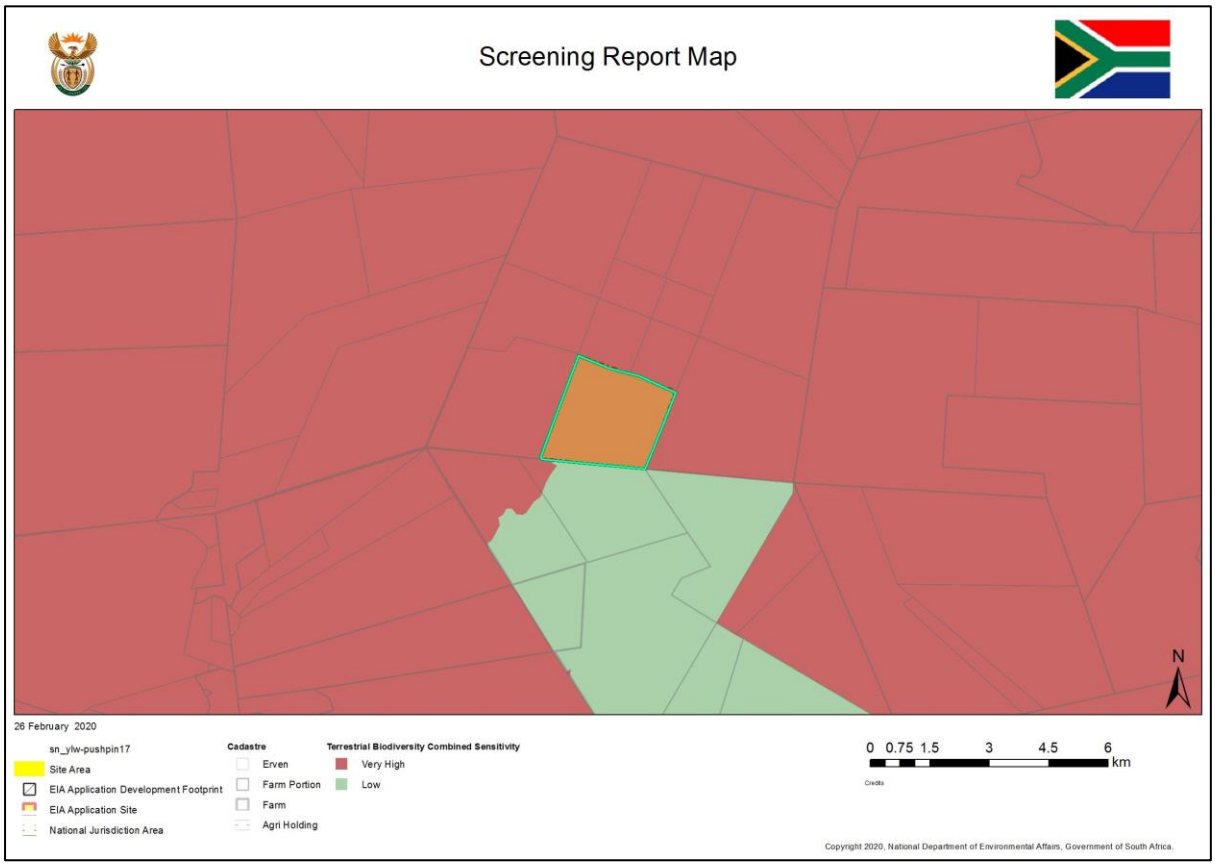


Figure 6. Environmental Screening Tool assessment of Terrestrial Biodiversity Features in the Study Area

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

5.3.2 Mpumalanga Biodiversity Sector Plan

The entire study area is situated within the **Protected Areas National Parks and Nature Reserves** category according to the Mpumalanga Biodiversity Sector Plan (MBSP; Lötter *et al.*, 2014) (Figure 7). The MBSP recommends that protected areas be treated in the same way as "Irreplaceable" Critical Biodiversity Areas, which means that these areas are to be maintained in their natural state. Any development should be carried out under the provisions of the National Environmental Management Act (NEMA, Act 107 of 1998) and the Protected Areas Act (No. 57 of 2003). The recommended permissible land-use is Conservation / Stewardship while Low Impact Tourism (such as a tented safari camp) would be considered a "Land-use that may compromise the biodiversity objective and that is only permissible under certain conditions"[35].

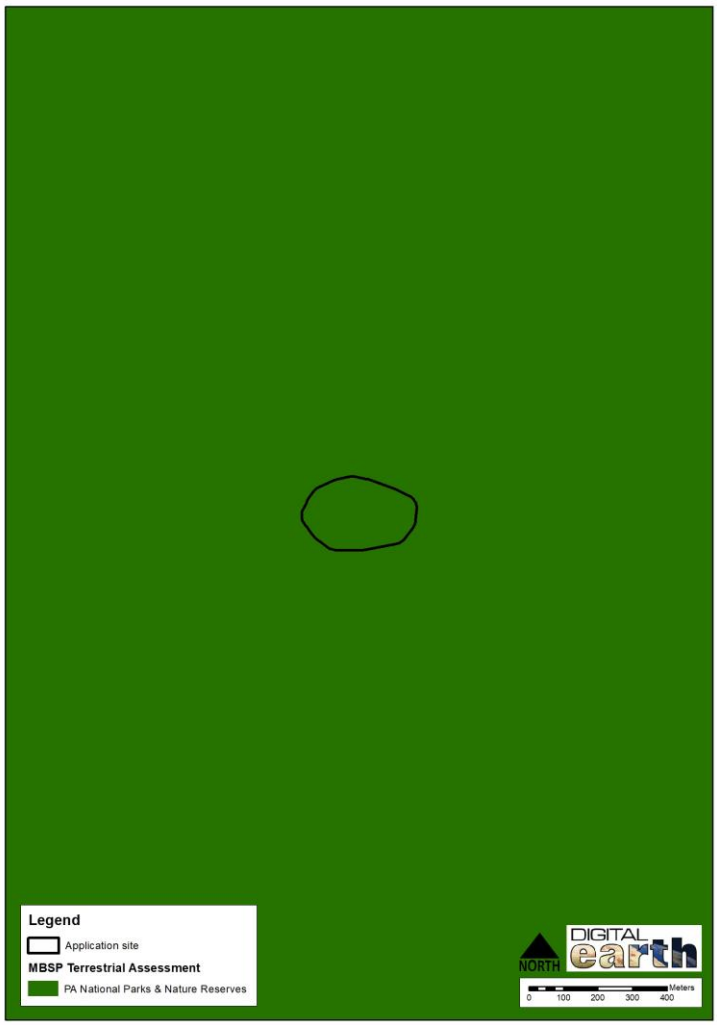


Figure 7. MBSP CBA Map of the Study Area

[35] Lötter *et al.,* 2014

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

5.3.3 Site-specific Ecological Importance Analysis

A SEI analysis of the single vegetation community represented in the study area was undertaken using the methodology described in Section 4.3.

Table 10 shows the calculation of the SEI of the study area, which is displayed in Figure 8 below.

The Closed Woodland vegetation community is classified as being within a Protected Area (KPNR) which supports confirmed populations of CR, EN and VU bird and mammal species. The Conservation Importance (CI) is therefore assessed as Very High which, when combined with a High Functional Integrity (FI) results in a Biodiversity Importance (BI) of **Very High**. Receptor Resilience (RR) is assessed as **Medium** as many savanna species regenerate moderately quickly due to favourable climatic conditions and rate of growth of taxa. When integrated with the High BI the SEI of the vegetation community is assessed as **High**.

The raptor nest site, along with a 100 m conservation buffer surrounding the nest, is assessed as having Very High CI and High FI resulting in a BI of **Very High**. This, when combined with the **Low** RR as this species is potentially prone to disturbance results in a SEI of **Very High**.

Table 10. Ecological Sensitivity of Vegetation Communities in the Study Area

Assessment Criteria	Closed Woodland	Raptor Nest Locality (plus 100m buffer)
Conservation Importance	Very High	Very High
Functional Integrity	**High**	**High**
Biodiversity Importance	Very High	Very High
Receptor Resilience	Medium	Low
SITE ECOLOGICAL IMPORTANCE	**High**	Very High

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

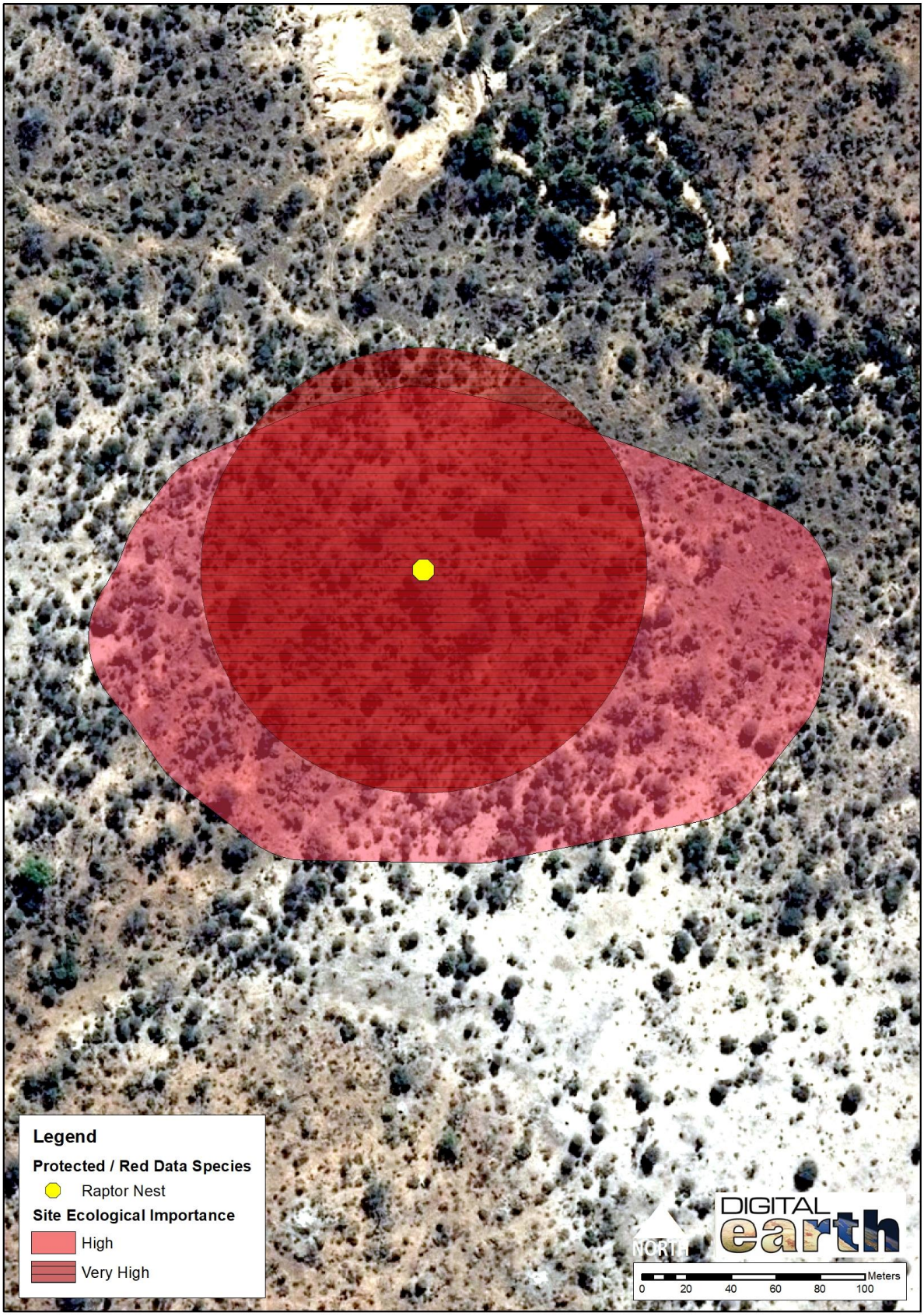


Figure 8. Site Environmental Importance of the vegetation community and raptor nest within the study area

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

6. KEY CURRENT AND POTENTIAL IMPACTS

While a detailed impact assessment was not part of the terms of reference for this report, key general impacts associated with the proposed developments on Ross 55 KU on the ecology of the area are discussed below.

- **Losses of portions of Protected Areas, High Site Ecological Importance and Very High Terrestrial Biodiversity Theme –** The proposed development is situated within an area that has been classified as Protected Areas by the MBSP, has a High SEI and have a Very High Terrestrial Biodiversity Theme by the DEA's EST. However, the total area of the lodge is small in size. In addition, the MBSP recommends that tourism developments are permitted with Protected Areas so the proposed camp is a recommended land-use;

- **Loss of plant species of conservation importance** – One plant SCC could be impacted during the construction phase. The tree *Elaeodendron transvaalense* is listed as NT but only one plant was located. The trees *Elaeodendron transvaalense*, *Sclerocarya birrea, Philenoptera violacea, Combretum imberbe* and *Balanites maughamii* are protected under the NFA;

- **Invasion of natural habitat by alien plants** – although only one alien plant was recorded during fieldwork, potential invasion into natural areas is possible through the introduction of seeds which may establish in adjacent natural areas;

- **Impact on fauna SCC** – The APNR supports healthy populations of a number of VU-listed mammals such as Leopard, Lion and African Elephant, as well as CR-listed White-backed and Hooded Vulture, EN Bateleur and more. These animals are highly mobile and would not be negatively affected by the small proposed lodge. However. the area around the single possible raptor nest is assessed as having Very High SEI as any construction activities around the nest may result in abandonment during the breeding season;

- **Potential loss of topsoil and increased erosion –** A small drainage line is present within the northern section of the study area. Lodge or road construction in this area may cause additional runoff and erosion.

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

7. CONCLUSION AND RECOMMENDATIONS

Approximately 5 ha of untransformed vegetation was surveyed as part of a proposed lodge site on Portion 4 of the farm Ross 55 KU, situated within the KPNR which in turn is situated within the APNR. The reserve is classified as a Protected Area in the MBSP, and a number of threatened and NT species were confirmed to occur or potentially occur, such as African Elephant (VU), Bateleur (EN) and Elaeodendron transvaalense (NT). However, the APNR is situated within the savanna biome adjacent to the *c.* 2 million ha GKNP which formally conserves vast tracts of untransformed vegetation. Consequently, Granite Lowveld is not listed as a Threatened Ecosystem. The APNR is managed as a tourism / conservation enterprise, which is one of the permissible land uses for Protected Areas in the MBSP.

One vegetation community was identified within the study area, namely Closed Woodland, which attained a SEI of **High**. However, the possible raptor nest and a 100m buffer surrounding it are assessed as **Very High** SEI due to the potential presence of nesting threatened species.

Due to the presence of the potential raptor nest within the study area, the following recommendation is applicable.

- No development to be undertaken within 100m around the raptor nest which may prove to belong to SCC such as Bateleur (EN). It is recommended that an experienced avifaunal specialist visit the site in June / July 2020 to establish whether the nest is being utilised, and by which species. If the nest is unused then construction may proceed as the nest site may have been abandoned and is no longer in use. If the nest is occupied by a threatened raptor species, then the 100m buffer recommendation should be applied and the proposed lodge site should be relocated.

If the nest is confirmed to be unused / historically abandoned by the specialist, or belonging to a species that is not listed as a SCC, then the following preliminary recommendations and mitigation measures for the proposed developments are applicable:

- No trees with a diameter of 30 cm or more should be removed by any construction, whether protected or not. Protected trees with a diameter of less than 30 cm should

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

also be avoided. The access roads should be routed around these trees and the proposed lodge should be constructed around all larger trees.

- The small erosion gully in the northern portion of the study area appears to be relatively newly established and actively eroding. It is suggested that erosion control actions be implemented. This may include the construction of a concrete drift, drainage pipes or gabion baskets, as well as packed branches.
- The septic tank and grey-water systems of the proposed lodge should regularly be inspected to ensure that no pollutants are entering the adjacent drainage line.
- All waste and litter generated at the proposed lodge should be removed and recycled.
- Weeds will inevitably establish around bare soil around the construction site and it is important that weed control, if involving herbicides, be managed correctly so as to reduce the impact on the adjacent natural vegetation.

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 and the NEMPAA), 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
(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 26/02/2020.

Barnes, K.N. 2000. *The Eskom Red Data Book of Birds of South Africa, Lesotho & Swaziland.* BirdLife South Africa, Johannesburg.

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.

Bauer, H., Packer, C., Funston, P.F., Henschel, P. & Nowell, K. 2016. *Panthera leo* (errata version published in 2017). *The IUCN Red List of Threatened Species* 2016: e.T15951A115130419. http://dx.doi.org/10.2305/IUCN.UK.2016-3.RLTS.T15951A107265605.en. Downloaded on 26 February 2020.

Blanc, J. 2008. *Loxodonta africana*. *The IUCN Red List of Threatened Species* 2008: e.T12392A3339343. http://dx.doi.org/10.2305/IUCN.UK.2008.RLTS.T12392A3339343.en. Downloaded on 26 February 2020.

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.

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

DEA. 2014. National Environmental Management: Biodiversity Act 2004 (Act 10 of 2004) Alien and Invasive Species Lists. Government Gazette.

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

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.

Ferreira, S.M., Greaver, C., Simms, C. 2017. *Elephant population growth in Kruger National Park, South Africa, under a landscape management approach*. Koedoe (59)1, a1427.

Hockey, P.A.R., Dean, W.R.J., Ryan, P.G. (eds) 2005. *Roberts Birds of Southern Africa, VIIth ed.* The Trustees of the John Voelcker Bird Book Fund, Cape Town.

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

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.

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

Poynton, J.C. 1964. *The Amphibia of Southern Africa: a Faunal Study*. Annals of the Natal Museum 17: 1-334.

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.

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

South African National Parks. 2011. Census results displayed on https://www.sanparks.org/parks/kruger/conservation/scientific/ff/biodiversity_statistics.php

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.

Williams, V.L., Raimondo, D., Crouch, N.R., Cunningham, A.B., Scott-Shaw, C.R., Lötter, M. & Ngwenya, A.M. 2008a. *Elaeodendron transvaalense* (Burtt Davy) R.H.Archer. National Assessment: Red List of South African Plants version 2017.1. Accessed on 2020/02/26

Williams, V.L., Raimondo, D., Crouch, N.R., Brueton, V.J., Cunningham, A.B., Scott-Shaw, C.R., Lötter, M. & Ngwenya, A.M. 2008b. *Drimia sanguinea* (Schinz) Jessop. National Assessment: Red List of South African Plants version 2017.1. Accessed on 2020/02/26

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

9. APPENDICES

Appendix 1. Checklist of Flora recorded during fieldwork

Taxa	Growth Form	Red Data	Protected	MPU Endemic	Closed Woodland
Family Acanthaceae					
Justicia flava (Vahl) Vahl	herb				r
Ruellia cordata Thunb.	herb				u
Ruellia patula Jacq.	herb				r
Family Amaranthaceae					
Kyphocarpa angustifolia (Moq.) Lopr.	herb				u
Family Anacardiaceae					
Lannea schweinfurthii (Engl.) Engl. var. *stuhlmannii* (Engl.) Kokwaro	tree				u
Sclerocarya birrea (A.Rich.) Hochst. subsp. *caffra* (Sond.) Kokwaro	tree		NFA		r
Family Asparagaceae					
Chlorophytum galpinii (Baker) Kativu	geophyte				r
Family Asteraceae					
Dicoma tomentosa Cass.	herb				f
Family Balanitaceae					
Balanites maughamii Sprague subsp. *maughamii*	tree		NFA		r
Family Boraginaceae					
Ehretia amoena Klotzsch	tree				r
Heliotropium ciliatum Kaplan	herb				u
Family Capparaceae					
Maerua parvifolia Pax	shrub				u
Family Celastraceae					
Elaeodendron transvaalense (Burtt Davy) R.H.Archer	tree	NT	NFA		r
Gymnosporia maranguensis (Loes.) Loes.	shrub				r

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

Family Combretaceae					
Combretum apiculatum Sond. subsp. *apiculatum*	tree				u
Combretum hereroense Schinz	tree				f
Combretum imberbe Wawra	tree		NFA		r
Terminalia prunioides M.A.Lawson	tree				d
Terminalia sericea Burch. ex DC.	tree				r
Family Commelinaceae					
Commelina africana L.	herb				r
Commelina erecta L.	herb				r
Family Convolvulaceae					
Evolvulus alsinoides (L.) L.	herb				r
Ipomoea magnusiana Schinz	climber				r
Ipomoea obscura (L.) Ker Gawl. var. *obscura*	climber				r
Merremia kentrocaulos Rendle	climber				r
Family Cucurbitaceae					
Cucumis hirsutus Sond.	climber				r
Momordica balsamina L.	climber				r
Family Ebenaceae					
Euclea divinorum Hiern	tree				u
Family Fabaceae					
Acacia exuvialis I.Verd.	shrub				r
Acacia nigrescens Oliv.	tree				d
Bolusanthus speciosus (Bolus) Harms	tree				r
Colophospermum mopane (J.Kirk ex Benth.) J.Kirk ex J.Leonard	tree				r
Crotalaria sp.	herb				r
Dichrostachys cinerea (L.) Wight & Arn. subsp. *africana* Brenan & Brummitt	tree				u
Indigofera sp. (no flowers)	herb				r
Indigofera rhytidocarpa Benth. ex Harv. subsp. *rhytidocarpa*	herb				u
Indigofera sp. White flowers	herb				r
Peltophorum africanum Sond.	tree				r
Philenoptera violacea (Klotzsch) Schrire	tree		NFA		r
Rhynchosia minima (L.) DC.	climber				r
Tephrosia cf. *purpurea*	herb				r
Family Gisekiaceae					
Gisekia africana (Lour.) Kuntze	herb				u
Family Geraniaceae					

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

Monsonia angustifolia E.Mey. ex A.Rich.	herb				r
Family Lamiaceae					
Endostemon tereticaulis (Poir.) M.R.Ashby	herb				r
Leucas sexdentata Skan	herb				r
Ocimum americanum L. var. *americanum*	herb				u
Family Lophiocarpaceae					
Corbichonia decumbens (Forssk.) Exell	herb				r
Family Malvaceae					
Abutilon angulatum (Guill. & Perr.) Mast. var. *angulatum*	dwarf shrub				r
Abutilon austro-africanum Hochr.	dwarf shrub				u
Cienfuegosia hildebrandtii Garcke	dwarf shrub				u
Corchorus asplenifolius Burch.	herb				u
Gossypium herbaceum L.	dwarf shrub				r
Grewia bicolor Juss. var. *bicolor*	shrub				d
Grewia villosa Willd. var. *villosa*	shrub				u
Hermannia glanduligera K.Schum. ex Schinz	herb				u
Hermannia modesta (Ehrenb.) Mast.	herb				r
Hibiscus micranthus L.f. var. *micranthus*	dwarf shrub				r
Hibiscus sidiformis Baill.	herb				u
Melhania prostrata DC.	herb				u
Pavonia burchellii (DC.) R.A.Dyer	dwarf shrub				r
Sida cordifolia L. subsp. *cordifolia*	dwarf shrub				r
Waltheria indica L.	herb				r
Family Molluginaceae					
* *Mollugo nudicaulis* Lam.	herb				r
Family Olacaceae					
Ximenia americana var. *microphylla* Welw.	shrub				r
Family Pedaliaceae					
Ceratotheca triloba (Bernh.) Hook.f.	herb				r
Sesamum alatum Thonn.	herb				r
Family Phyllanthaceae					
Flueggea virosa (Roxb. ex Willd.) Voigt subsp. *virosa*	shrub				u
Phyllanthus maderaspatensis L.	dwarf shrub				r
Family Poaceae					
Aristida adscensionis L.	grass				u
Aristida congesta Roem. & Schult. subsp. *barbicollis* (Trin. & Rupr.) De Winter	grass				u

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

Aristida stipitata subsp. *graciliflora* (Pilg.) Melderis	grass				r
Bothriochloa radicans (Lehm.) A.Camus	grass				r
Brachiaria serrata (Thunb.) Stapf	grass				d
Cenchrus ciliaris L.	grass				u
Chloris virgata Sw.	grass				u
Digitaria eriantha Steud.	grass				f
Eragrostis heteromera Stapf	grass				r
Eragrostis lehmanniana Nees var. *lehmanniana*	grass				r
Eragrostis rigidior Pilg.	grass				u
Eragrostis sp.	grass				r
Eragrostis superba Peyr.	grass				r
Panicum maximum Jacq.	grass				f
Perotis patens Gand.	grass				r
Schmidtia pappophoroides Steud.	grass				r
Tragus berteronianus Schult.	grass				f
Urochloa mosambicensis (Hack.) Dandy	grass				r
Family Polygonaceae					
Oxygonum dregeanum Meisn.	herb				r
Family Portulacaceae					
Talinum caffrum (Thunb.) Eckl. & Zeyh.	herb				r
Family Rubiaceae					
Agathisanthemum bojeri Klotzsch subsp. *bojeri*	herb				u
Family Sapindaceae					
Pappea capensis Eckl. & Zeyh.	tree				r
Family Scrophulariaceae					
Aptosimum lineare Marloth & Engl. var. *lineare*	herb				r
Family Solanaceae					
Solanum campylacanthum A. Rich.subsp. *panduriforme*	dwarf shrub				r
Family Turneraceae					
Tricliceras glanduliferum (Klotzsch) R.Fern.	herb				r
Family Verbenaceae					
Lantana rugosa Thunb.	dwarf shrub				r
Family Vitaceae					
Cissus cornifolia (Baker) Planch.	climber				u
Rhoicissus tridentata (L.f.) Wild & R.B.Drumm. subsp. *tridentata*	climber				r
Family Zygophyllaceae					

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

Tribulus terrestris L.	herb				u
TOTAL	**97**	**1**	**5**	**0**	**97**

NFA - National Forests Act NT - Near Threatened * - exotic species	d = dominant f = frequent u = uncommon r = rare

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

Appendix 2. Checklist of fauna recorded during fieldwork

Common Name	Scientific Name	Red Data	Endemic	Protected	Woodland
Mammals					
ORDER: PRIMATES					
Family Cercopithecidae (Old World monkeys)					
Chacma Baboon	*Papio ursinus*				x
ORDER: RODENTIA					
Family Sciuridae (squirrels)					
Tree Squirrel	*Paraxerus cepapi*				x
ORDER: PROBOSCIDEA					
Family Elephantidae (elephants)					
African Elephant	*Loxodonta africana*	VU‡		NEMBA (PR)	x
ORDER: PERRISODACTYLA					
Family Equidae (horses)					
Plains (Burchell's) Zebra	*Equus quagga burchellii*			NEMBA (PR)	x
ORDER: CETARTIODACTYLA					
Family Giraffidae (giraffes)					
South African Giraffe	*Giraffa camelopardalis giraffa*			MNCA	x
Family Bovidae (antelope, cattle)					
African Buffalo	*Syncerus caffer*			MNCA	x
Impala	*Aepyceros melampus*				x
Greater Kudu	*Tragelaphus strepsiceros*				x
Subtotal	7	2	1	4	7
Birds					
ORDER: GALLIFORMES					
Family Phasianidae (pheasants, fowl and allies)					
Crested Francolion	*Dendroperdix sephaena*				x
Swainson's Spurfowl	*Pternistis swainsonii*				x
Natal Spurfowl	*Pternistis natalensis*				x
ORDER: ACCIPITRIFORMES					

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

Family Accipitridae (kites, hawks and eagles)					
White-backed Vulture	*Gyps africanus*	CR		NEMBA (EN)	over
Hooded Vulture	*Necrosyrtes monachus*	CR		NEMBA (EN)	over
Bateleur	*Terathopius ecaudatus*	EN		NEMBA (EN)	over
ORDER: OTIDIFORMES					
Family Otididae (bustards)					
Red-crested Korhaan	*Lophotis ruficrista*				x
ORDER: COLUMBIFORMES					
Family Columbidae (pigeons and doves)					
Cape Turtle Dove	*Streptopelia capicola*				x
Laughing Dove	*Spilopelia senegalensis*				x
Emerald-spotted Wood Dove	*Turtur chalcospilos*				x
ORDER: MUSOPHAGIFORMES					
Family Musophagidae (turacos)					
Grey Go-away-bird	*Corythaixoides concolor*				x
ORDER: CUCULIFORMES					
Family Cuculidae (cuckoos)					
Jacobin Cuckoo	*Clamator jacobinus*				x
ORDER: APODIFORMES					
Family Apodidae (swifts)					
Little Swift	*Apus affinis*				over
ORDER: COLIIFORMES					
Family Coliidae (mousebirds)					
Red-faced Mousebird	*Urocolius indicus*				x
ORDER: CORACIIFORMES					
Family Coraciidae (rollers)					
Lilac-breasted Roller	*Coracias caudatus*				x
European Roller	*Coracias garrulus*	NT			x
Purple Roller	*Coracias naevius*				x
Family Alcedinidae (kingfishers)					
Woodland Kingfisher	*Halcyon senegalensis*				x
Brown-hooded Kingfisher	*Halcyon albiventris*				x
Family Meropidae (bee-eaters)					
European Bee-eater	*Merops apiaster*				x
ORDER: BUCEROTIFORMES					
Family Phoeniculidae (wood-hoopoes)					

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

Green Wood-hoopoe	*Phoeniculus purpureus*				x
Family Bucerotidae (hornbills)					
African Grey Hornbill	*Lophoceros nasutus*				x
Southern Red-billed Hornbill	*Tockus rufirostris*				x
Southern Yellow-billed Hornbill	*Tockus leucomelas*				x
ORDER: PICIFORMES					
Family Lybiidae (African barbets)					
Acacia Pied Barbet	*Tricholaema leucomelas*				x
Crested Barbet	*Trachyphonus vaillantii*				x
Family Picidae (woodpeckers)					
Bearded Woodpecker	*Dendropicos namaquus*				x
ORDER: PSITTACIFORMES					
Family Psittacidae (parrots)					
Brown-headed Parrot	*Poicephalus cryptoxanthus*				x
ORDER: PASSERIFORMES					
Family Platysteiridae (wattle-eyes and batises)					
Chinspot Batis	*Batis molitor*				x
Family Malaconotidae (bushshrikes)					
Brown-crowned Tchagra	*Tchagra australis*				x
Black-backed Puffback	*Dryoscopus cubla*				x
Brubru	*Nilaus afer*				x
Grey-headed Bushshrike	*Malaconotus blanchoti*				x
Black-backed Puffback	*Dryoscopus cubla*				x
Orange-breasted Bushshrike	*Chlorophoneus sulfureopectus*				x
Family Laniidae (shrikes)					
Magpie Shrike	*Urolestes melanoleucus*				x
Red-backed Shrike	*Lanius collurio*				x
Southern White-crowned Shrike	*Eurocephalus anguitimens*				x
Family Oriolidae (figbirds and orioles)					
Black-headed Oriole	*Oriolus larvatus*				x
Family Dicruridae (drongos)					
Fork-tailed Drongo	*Dicrurus adsimilis*				x
Family Paridae (tits and chickadees)					
Southern Black Tit	*Melaniparus niger*				x
Family Alaudidae (larks)					
Sabota Lark	*Calendulauda sabota*				x

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

Family Pycnonotidae (bulbuls)					
Dark-capped Bulbul	*Pycnonotus tricolor*				x
Family Hirundinidae (swallows and martins)					
Barn Swallow	*Hirundo rustica*				x
Lesser Striped Swallow	*Cecropis abyssinica*				x
Red-breasted Swallow	*Cecropis semirufa*				x
Family Macrosphenidae (crombecs and African warblers)					
Long-billed Crombec	*Sylvietta rufescens*				x
Family Phylloscopidae (leaf warblers and allies)					
Willow Warbler	*Phylloscopus trochilus*				x
Family Cisticolidae (cisticolas and allies)					
Rattling Cisticola	*Cisticola chiniana*				x
Burnt-necked Eremomela	*Eremomela usticollis*				x
Stierling's Wren-Warbler	*Calamonastes stierlingi*				x
Tawny-flanked Prinia	*Prinia subflava*				x
Yellow-breasted Apalis	*Apalis flavida*				x
Family Leiothrichidae (laughingthrushes)					
Arrow-marked Babbler	*Turdoides jardineii*				x
Family Sturnidae (starlings)					
Cape Glossy Starling	*Lamprotornis nitens*				x
Burchell's Starling	*Lamprotornis australis*				x
Violet-backed Starling	*Cinnyricinclus leucogaster*				x
Wattled Starling	*Creatophora cinerea*				x
Family Buphagidae (oxpeckers)					
Red-billed Oxpecker	*Buphagus erythrorhynchus*				x
Family Muscicapidae (chats and Old World flycatchers)					
White-browed Scrub Robin	*Erythropygia leucophrys*				x
Spotted Flycatcher	*Muscicapa striata*				x
Family Nectariniidae (sunbirds)					
Marico Sunbird	*Cinnyris mariquensis*				x
White-bellied Sunbird	*Cinnyris talatala*				x
Family Passeridae (Old World sparrows)					
Southern Grey-headed Sparrow	*Passer diffusus*				x
Family Ploceidae (weavers and widowbirds)					
Red-headed Weaver	*Anaplectes rubriceps*				x
Red-billed Buffalo Weaver	*Bubalornis niger*				x

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

Red-billed Quelea	*Quelea quelea*				x
White-winged Widowbird	*Euplectes albonotatus*				x
Family Estrildidae (waxbills, munias and allies)					
Blue Waxbill	*Uraeginthus angolensis*				x
Green-winged Pytilia	*Pytilia melba*				x
Family Viduidae					
Village Indigobird	*Vidua chalybeata*				x
Family Fringillidae (finches and canaries)					
Yellow-fronted Canary	*Crithagra mozambica*				x
Family Emberizidae (buntings and New World sparrows)					
Cinnamon-breasted Bunting	*Emberiza tahapisi*				x
Golden-breasted Bunting	*Emberiza flaviventris*				x
Subtotal	74	4	0	3	74
Reptiles					
ORDER: SQUAMATA					
Family Lacertidae (true lizards)					
Bushveld Lizard	*Heliobolus lugubris*				x
Subtotal	1	0	0	0	1
TOTAL	**82**	**6**	**1**	**7**	**82**

PR - Protected
NT - Near Threatened
VU - Vulnerable
EN - Endangered
CR - Critically Endangered
NEMBA - National Environmental Management: Biodiversity Act
MNCA - Mpumalanga Nature Conservation Act
‡ - IUCN assessment

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

Appendix 3. Potentially occurring fauna of conservation concern

Common Name	Scientific Name	Red Data	Protected	Habitat	SABAP2 Reporting Rate for 2431 AC	Likelihood	Reason
Mammals							
Cheetah	*Acinonyx jubatus*	VU	NEMBA (VU)	Savanna, semi desert		Low	Could rarely pass through the study area, rare in the area
African Clawless Otter	*Aonyx capensis*	NT	MNCA	Rivers and streams		Very Low	No suitable habitat present
White Rhinoceros	*Ceratotherium simum*	NT	NEMBA (PR)	Savanna, semi desert		Moderate	Could occasionally pass through the study area but would not remain for long due to the small size
Blue Wildebeest	*Connochaetes taurinus*		NEMBA (PR)	Savanna, grassland		High	Suitable habitat present
Swamp Musk Shrew	*Crocidura mariquensis*	NT		Wetlands in savanna		Very Low	No suitable habitat present
Spotted Hyaena	*Crocuta crocuta*	NT	NEMBA (PR)	Wide variety of habitats		High	Suitable habitat present, fairly common species in the GKNP
African Marsh Rat	*Dasymys incomtus*	NT		Wetlands		Very Low	No suitable habitat present
Black Rhinoceros	*Diceros bicornis minor*	EN	NEMBA (VU)	Thickets, dense woodland		Low	Very rare in the area
Burchell's Zebra	*Equus quagga burchelli*		NEMBA (PR)	Savanna, grassland		Confirmed	
Southern Lesser Galago	*Galago moholi*		MNCA	Savanna		High	Suitable habitat present
Giraffe	*Giraffa camelopardalis*		MNCA	Savanna		Confirmed	
Hippopotamus	*Hippopotamus amphibius*	VU‡	MNCA	Wetlands		Low	No aquatic environments are situated near the study area
Sable	*Hippotragus niger*	VU	NEMBA (VU)			Low	Rare in the area
Waterbuck	*Kobus ellipsiprymnus*		MNCA	Savanna, grasslands, wetlands		Moderate	Suitable habitat present

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

Serval	*Leptailurus serval*	NT	NEMBA (PR)	Grassland, wetlands		Low	Limited suitable habitat present, rae in the area
African Elephant	*Loxodonta africana*	VU‡	NEMBA (PR)	Wide variety of habitats		Confirmed	
African Wild Dog	*Lycaon pictus*	EN	NEMBA (EN)	Wide variety of habitats		Moderate	Could occasionally pass through the study area but would not remain for long due to the small size
Honey Badger	*Mellivora capensis*		MNCA	Wide variety of habitats		Moderate	Could occasionally pass through the study area but would not remain for long due to the small size
Aardvark	*Orycteropus afer*		NEMBA (PR)	Wide variety of habitats		Low	Rare in the Lowveld, may occasionally pass through
Thick-tailed Greater Galago	*Otolemur crassicaudatus*		MNCA	Moist woodland and forest		Low	No suitable habitat present
Lion	*Panthera leo*	VU‡	NEMBA (VU)	Wide variety of habitats		Moderate	Could occasionally pass through the study area but would not remain for long due to the small size
Leopard	*Panthera pardus*	VU	NEMBA (VU)	Wide variety of habitats		Moderate	Could occasionally pass through the study area but would not remain for long due to the small size
African Weasel	*Poecilogale albinucha*	DD		Wide variety of habitats		Very Low	Very rare in E Mpumalanga
Aardwolf	*Proteles cristatus*		MNCA	Wide variety of habitats		Low	Rare in the Lowveld, may occasionally pass through
Steenbok	*Raphicerus campestris*		MNCA	Wide variety of habitats		High	Suitable habitat present
Sharpe's Grysbok	*Raphicerus sharpei*		MNCA	Dry woodland		Moderate	Suitable habitat present
Ground Pangolin	*Smutsia temminckii*	VU	NEMBA (VU)	Wide variety of habitats		Low	Could rarely pass through the study area, rare in the APNR
African Buffalo	*Syncerus caffer*		MNCA	Wide variety of habitats		Confirmed	
Nyala	*Tragelaphus angasi*		MNCA	Woodland, thicket		Low	No suitable habitat present
Subtotal	29	16	26				
Birds							

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

Half-collared Kingfisher	*Alcedo semitorquata*	NT		Streams with overhanging vegetation	-	Very Low	No suitable habitat present
Steppe Eagle	*Aquila nipalensis*	EN‡		Savanna	0,9%	Low	Very rare in the APNR
Tawny Eagle	*Aquila rapax*	EN	NEMBA (EN)	Savanna	30,7%	Moderate	Suitable habitat present
Verreaux's Eagle	*Aquila verreauxii*	VU		Arid, mountainous areas	-	Low	No suitable habitat present
Kori Bustard	*Ardeotis kori*	NT	NEMBA (PR)	Open savanna	-	Low	No suitable habitat present
Southern Ground-Hornbill	*Bucorvus leadbeateri*	EN	NEMBA (EN)	Savanna	18,0%	Moderate	Suitable habitat present
Curlew Sandpiper	*Calidris ferruginea*	NT‡		Mudflats, tidal wetlands	-	Very Low	Rare in the Lowveld, no suitable habitat present
Abdim's Stork	*Ciconia abdimii*	NT		Wide variety of habitats	0,5%	Low	Occasional influxes possible but rare in the APNR
Black Stork	*Ciconia nigra*	VU		Forages in wetlands and breeds on cliffs	2.8%	Very Low	No suitable habitat present
Pallid Harrier	*Circus macrourus*	NT		Open grassland and semi-desert	-	Low	No suitable habitat present, unrecorded from the QDGS
African Marsh Harrier	*Circus ranivorus*	EN		Moist grassland and wetland	-	Very Low	No suitable habitat present, unrecorded from the QDGS
European Roller	*Coracias garrulus*	NT		Savanna	21,0%	Confirmed	
Saddle-billed Stork	*Ephippiorhynchus senegalensis*	EN		Large rivers, dams and pans	5,3%	Very Low	No suitable habitat present
Lanner Falcon	*Falco biarmicus*	VU		Wide variety of habitats but nests on cliffs	0,7%	Low	Very rare in the APNR
White-backed Night-Heron	*Gorsachius leuconotus*	VU		Streams with overhanging vegetation	0,2%	Very Low	No suitable habitat present
White-backed Vulture	*Gyps africanus*	CR	NEMBA (EN)	Savanna	73,3%	Confirmed	
Cape Vulture	*Gyps coprotheres*	EN	NEMBA (EN)	Wide variety of habitats	9,5%	Moderate	May occasionally forage within study area
Marabou Stork	*Leptoptilos crumeniferus*	NT		Wide variety of habitats	18,0%	Moderate	Suitable foraging habitat present
Bat Hawk	*Macheiramphus alcinus*	EN		Tall woodland along rivers	-	Low	No suitable habitat present, unrecorded from the QDGS

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

Lesser Jacana	*Microparra capensis*	VU		Floating vegetation on tropical wetlands	-	Very Low	No suitable habitat present, unrecorded from the QDGS
Yellow-billed Stork	*Mycteria ibis*	EN		Wide variety of wetlands	3.3%	Very Low	No suitable habitat present
Hooded Vulture	*Necrosyrtes monachus*	CR	NEMBA (EN)	Wide variety of wetlands	23,9%	Confirmed	
African Pygmy Goose	*Nettapus auritus*	VU		Tropical wetlands with floating vegetation	-	Very Low	No suitable habitat present, unrecorded from the QDGS
Great White Pelican	*Pelecanus onocrotalus*	VU		Large pools, rivers and lakes	-	Very Low	No suitable habitat present, unrecorded from the QDGS
Pink-backed Pelican	*Pelecanus rufescens*	VU		Large pools, rivers and lakes	-	Very Low	No suitable habitat present, unrecorded from the QDGS
Greater Flamingo	*Phoenicopterus roseus*	NT		Saline wetlands	0,2%	Very Low	No suitable habitat present
African Finfoot	*Podica senegalensis*	VU		Rivers and streams with overhanging vegetation	0,2%	Very Low	No suitable habitat present
Martial Eagle	*Polemaetus bellicosus*	EN	NEMBA (EN)	Wide variety of habitats	17,3%	Moderate	May occasionally forage within study area
Greater Painted-snipe	*Rostratula benghalensis*	NT		Wetlands	0,5%	Low	No suitable habitat present
African Skimmer	*Rynchops flavirostris*	NT‡		Open water; rivers and dams	-	Very Low	Although recently confirmed breeding within the APNR no open water habitats are present within the study area
Secretarybird	*Sagittarius serpentarius*	VU		Open savanna and grassland	0,5%	Low	No suitable habitat present
Pel's Fishing Owl	*Scotopelia peli*	EN		Rivers and streams with overhanging vegetation	-	Very Low	No suitable habitat present, unrecorded from the QDGS
Crowned Eagle	*Stephanoaetus coronatus*	VU		Forest	-	Low	No suitable habitat present, unrecorded from the QDGS
Bateleur	*Terathopius ecaudatus*	EN	NEMBA (EN)	Savanna	53,9%	Confirmed	
Lappet-faced Vulture	*Torgos tracheliotos*	EN	NEMBA (EN)	Savanna	9,9%	Moderate	May occasionally forage within study area
White-headed Vulture	*Trigonoceps occipitalis*	CR	NEMBA (EN)	Savanna	6,6%	Moderate	May occasionally forage within study area
Subtotal	36	36	10				
Reptiles							

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

Nile Crocodile	*Crocodylus niloticus*	VU	NEMBA (VU)	Wetlands		Very 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
Subtotal	2	1	2				
TOTAL	**67**	**53**	**38**				

CR - Critically Endangered EN - Endangered
VU - Vulnerable NT - Near Threatened
DD - Data Deficient PR - Protected
NEMBA - National Environmental Management: Biodiversity Act
MNCA - Mpumalanga Nature Conservation Act
‡ - IUCN assessment

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

Appendix 4. 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, Lesotho, Tanzania, Guinea, 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

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

Appendix 5. 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 (as amended in 2017);
- 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

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

ANNEXURE B: Flood Line Delineation.

R19-084-00

Henwood Environmental Solutions (Pty) Ltd
P. O. Box 12340
Steiltes
NELSPRUIT
1213

Att: Mr. S. Henwood

11 March 2020

e-mailed to: shenwood@mweb.co.za

FLOODLINE DELINEATION FOR PROPOSED NEW COMMERCIAL AND PRIVATE CAMP ON PORTION 4 OF THE FARM ROSS 55

1. Find attached with this letter plan R19-084-00-L01 depicting the 1:100 year floodline for the river in question located adjacent to the proposed new commercial and private Camp.

2. **Design methodology**

   A detailed survey of the natural ground level for the proposed site was received from Van Staden Surveyors.

   Aerial photography and 5m contours of the catchment area were obtained from WGS Aerial Surveys and include map area 2431AD_01, 2431AC_05, 2431AD_06 & 2431AC_10.

   Rainfall data of three (3) surrounding weather stations (Hoedspruit, Satara and Phalaborwa) were used to determine the average Mean Annual Precipitation (520mm MAP) for design rainfall depths. The Alternative Rational Method was used to determine the design flood peaks. Cross sections of the river were taken at Fourty (40) meter intervals. The Hec-Ras program was used to determine the flood height levels for the 1:100 year flood.

   - 1:100 Year design flow : 24.558 m^3/s

3. Find attached with this letter the dxf, dwg and Google Earth KML file of the 1:100 year floodline. It remains the responsibility of the client to set-out the floodline as per the information provided prior to commencement with the project.

4. Should you have any queries, feel free to contact me.

Yours faithfully

D. J. STEENKAMP (Pr Tech Eng)
Technologist
Richards Bay Office

Richards Bay Office: 21 Kingfish Creek, Richards Bay, Meerensee • PO Box 10812, Meerensee, 3901 • Tel: +27 35 753 1083 • Fax: +27 35 753 1094 • rbay@ilifa.biz

Reg No: 1989/005925/07 **Directors:** P Krikke; A Kriel; JD Tembe; MM Masoeu
Offices: Pretoria +27 12 941 1616 • Harrismith +27 58 622 1297 • Vanderbijlpark +27 16 981 0591 • Richards Bay +27 35 753 1083 • Krugersdorp +27 11 955 5334 • Secunda +27 17 634 8895 • Newcastle +27 34 312 6464 • Dundee +27 34 212 1205 • Mtubatuba +27 35 550 2881 • Finance / HR +27 12 362 0166 • Associate office: Nelspruit

No.	Date	By	Description
0	11/03/2020	N.N	FOR INFORMATION

REVISIONS

AS BUILT DRAWINGS

TECHNICAL CO-ORDINATOR	ENGINEER
DATE:.....	DATE:.....

CLIENT

Henwood Environmental Solutions (Pty) Ltd

P.O.Box 12340
Steltes
Nelspruit
1213

e-mail: shenwood@mweb.co.za

CLIENT APPROVAL

Project leader:		Signature :
Date:		

CLIENT DRAWING NUMBER:

ilifa
AFRICA ENGINEERS

PRETORIA	012- 362 1473	RICHARDS BAY OFFICE,
HARRISMITH	058- 622 1297	21 Kingfish Creek,
SASOLBURG	016- 976 0850	MEERENSEE,
VANDERBIJLPARK	016- 981 0591	PO Box 10812,
KRUGERSDORP	011- 955 5334	Meerensee, 3901.
RICHARDSBAY	035- 753 1083	
SECUNDA	017- 634 8895	email: rbay@ilifa.biz
NEWCASTLE	034- 312 6464	Web: www.ilifa.biz

ASSOCIATED OFFICES:
BRITS ; MTUBATUBA ; NELSPRUIT; DUNDEE.

Designed :	N.Naumann	Date:	11/03/2020	Signature :
Drawn :	N.Naumann	Date:	11/03/2020	Signature :
Checked :	D.Steenkamp	Date:	11/03/2020	Signature :
Approved: D.Steenkamp Reg No.: 201270171		Date:	11/03/2020	Signature

PROJECT TITLE

NEW COMMERCIAL AND PRIVATE CAMP ON PORTION 4 OF THE FARM ROSS 55

PROJECT DESCRIPTION

FLOODLINE DELINEATION

DRAWING TITLE

100 Year Floodline Layout Plan

DATE:	SCALE:		SHEET NO:
MARCH 2020	1 : 1400	A1	1 OF 1

PLAN No.

CONSULTING ENG. DRAWING NO:	Rev
R19-084-00-L01	0

DRIVE:\ ENGINEERING MANAGEMENT\ Projects\2019 Projects\R19-084-00 Farm Ross 55\00 Design Development\50 Drawings

ANNEXURE C: Palaeontological Impact Assessment.

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

EVOLUTIONARY STUDIES INSTITUTE

Palaeosciences Centre, East Campus, 1 Jan Smuts Avenue, Braamfontein, Johannesburg
Private Bag 3, WITS 2050, Johannesburg, SOUTH AFRICA Tel: 011 717 6682

Marion.bamford@wits.ac.za
23 March 2020

Dr Ragna Redelstorff
Heritage Officer Archaeology, Palaeontology & Meteorites Unit
South African Heritage Resources Agency
111 Harrington Street
Cape Town 8001

Dear Dr Redelstorff

RE: Request for Exemption of any Palaeontological Impact Assessment for the proposed camp and commercial development on Farm Ross 55, Klaserie Private Nature Reserve, Mpumalanga Province

In my capacity as a professional palaeontologist, I am requesting exemption for palaeontological impact assessment in terms of the National Heritage Resources Act (Act 25 of 1999) and the National Environmental Management Act (Act 107 of 1998) which requires that the proposed development must be preceded by the relevant impact assessment, in this case for palaeontology.

The entire are of Farm Ross 55 lies on the basement rock of the Makhutswi Gneiss (Fig. 1). This is composed of trondhjemite and tonalite gneiss and is Palaeo-archaean in age, ca 3228 million years old (Robb et al., 2006). These are extremely old volcanic rocks that have also been metamorphosed so do not preserve any fossils at all. The area has been indicated as being of zero palaeontological sensitivity on the SAHRIS map (Fig. 2), therefore we request no further palaeontological impact assessment, and that the proposed project can proceed.

Yours faithfully

MKBamford

Prof Marion Bamford PhD
Palaeobotanist; PhD (Wits, 1990)

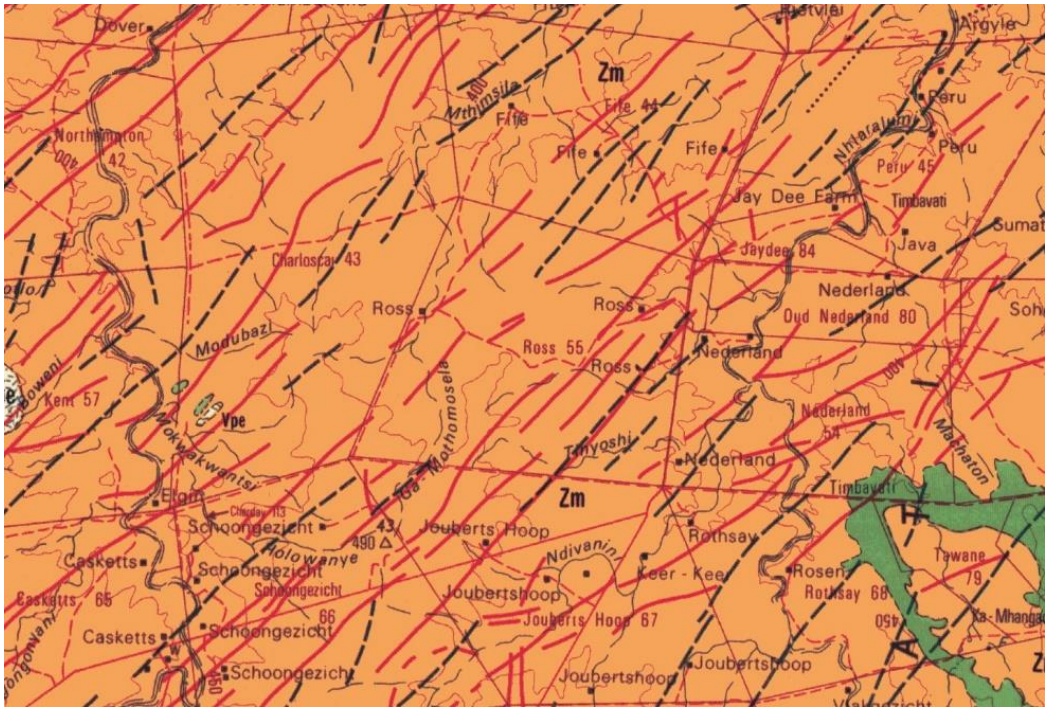


Figure 1: Geological map of Farm Ross 55 in the Klaserie Private Nature Reserve, Mpumalanga. Map symbol Zm = Makhutwsi Gneiss. Map enlarged from the Geological Survey 1:250 000 map 2430 Pilgrims Rest.

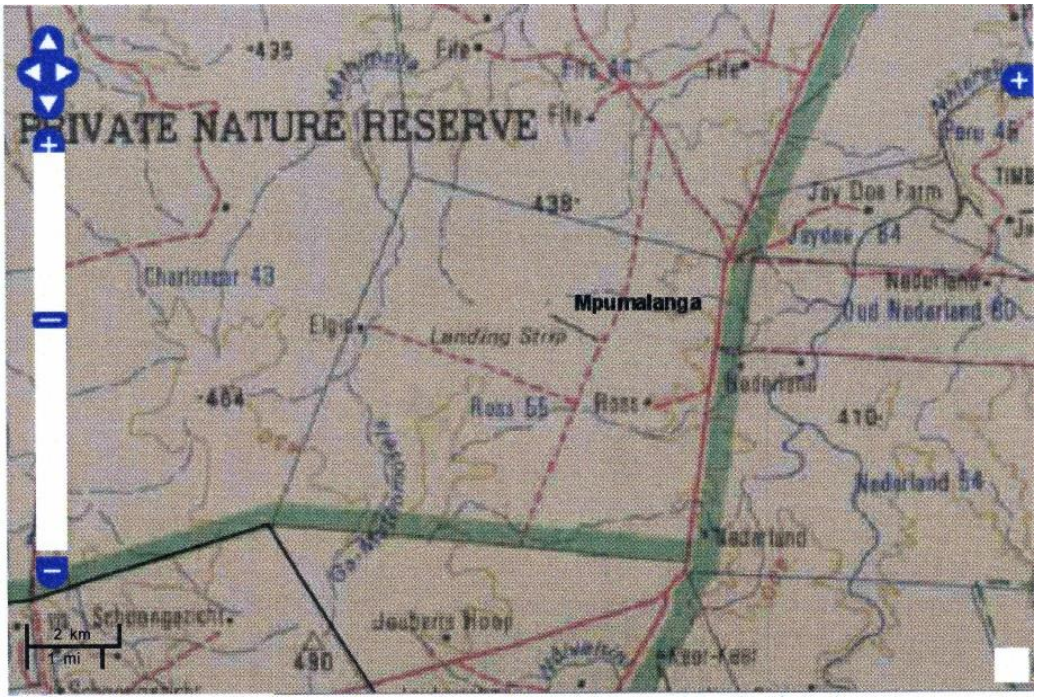


Figure 3: SAHRIS palaeosensitivity map for Farm Ross 55. They grey background indicates insignificant/zero sensitivity.

Reference cited:

Robb, L.J., Brandl, G., Anhaeusser, C.R., Poujol, M., 2006. Archaean Granitoid Intrusions. 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 57-94.

ANNEXURE D: Phase 1 Archaeological Survey

Phase 1 Archaeological and Heritage Impact Assessment on Portion 1 the farm Ross 55 KU in respect of the proposed construction of a camp in Klaserie, Mpumalanga Province.

Compiled by:

For **Henwood Environmental Solutions**

Surveyor: Mr JP Celliers

2 March, 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: An area of approximately 2 ha on Portion 1 of the farm Ross 55 KU in respect of the establishment of a safari camp.
Purpose of the study: An archaeological and heritage study in order to identify cultural heritage resources in respect of the establishment of a camp for tourism purposes.

Topographical Maps: 1:50 000 2431 AC (1970, 1986).

EIA Consultant: Henwood Environmental Solutions

Client:

Heritage Consultant: Kudzala Antiquity CC.
Contact person: JP Celliers Tel: +27 72 583 1622
E-mail: kudzala@lantic.net

Report date: 2 March 2020

Description and findings:

An Archaeological and Heritage Impact Assessment was undertaken by Kudzala Antiquity CC in respect of the proposed establishment of a camp and associated facilities on an area of approximately 2 hectares of Portion 1 of the farm Ross 55 KU in the Klaserie Private Reserve near Hoedspruit, 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. Archival information including scrutiny of previous heritage surveys of the area formed the baseline information against which the survey was conducted. A single location, site RK 1, with a small number of poorly defined stone tools was documented although it has no archaeological context and of low significance.
A total of seven survey orientation locations were documented, sites SO 1-7 which includes a GPS location and photographs of the landscape at that particular location.
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, some stone tools were found in a natural drainage/ erosion furrow but it is considered to be of low significance. Monitoring during construction of the proposed camp is recommended.
In terms of section 36 of the NHRA, no graves or gravesites and burial grounds were located.
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 the proposed construction of a safari camp on an area of approximately 2 hectares on Portion 1 of the farm Ross 55 KU located within the Klaserie Private Nature and Game Reserve in 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 establish a safari camp. Suitable areas within this identified area are earmarked for this activity pending environmental authorization.

1.1.2. Constraints and limitations

The archaeological survey consisted of non-intrusive methods which exclusively rely on surface observations. Most of the project footprint area was relatively easy of access but certain areas were difficult to access due to dense vegetation growth which resulted in archaeological visibility being low.

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.

1.2.1. Heritage in Protected areas

In February 2016 Government Gazette no. 40593 the Department of Environmental Affairs published Cultural Heritage Survey Guidelines and Assessment tools for protected areas in South Africa, under the National Environmental Management: Protected Areas Act, 2003 (Act 57, 2003).

In protected areas a basic inventory of the property facilitates confirmation of national heritage resources; conducting of heritage audits; site condition monitoring; prioritising sites by ranking their significance; evaluation of a protected area's heritage; assistance in planning for heritage resources and allocating resources.

Process in compiling the cultural resources inventory for the Klaserie Private Nature Reserve entails significance assessment of the heritage resources, condition assessment and evaluation for grading of the resources. This has not yet been done for the Klaserie and may be a valuable future consideration. A concise history of the establishment and history of the Klaserie Rivate Nature Reserve is discussed in section 4.1.5. of this report.

1.3. Approach and statutory requirements

The SAHRA Minimum standards of 2007 guideline document, 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 Klaserie Private Nature Reserve, Mpumalanga Province.
The survey was carried out on a project footprint consisting of approximately 2 hectares of Granite Lowveld vegetation.

Landscape: Natural and wetland vegetation previously Granite Lowveld vegetation and soils.

Visibility: Good-Poor in certain areas due to dense vegetation cover.

Veld type: The vegetation is classed as Granite Lowveld comprising tall shrubland with few trees to moderately dense woodland on the deep sandy uplands with *Terminala sericea, Combretum zeyheri and C. Tricholaena Eragrostis rigidior*. Dense thicket to open savanna in the bottomlands.

The dense herbacius layer contains the dominant *Digitaria eriantha, Panicum maximum* and *Astrida congesta* on fine-textured soils. The brackish bottomlands support *Sporobolus nitens, Urochloa mosambicensus* and *Chloris virgata* (Mucina and Rutherford, 2009).

Geology and soils: Swazian Goudplaats Gneiss, Makhutswi Gneiss and Nelspruit Suite occur from north to south. Further south, the younger Mpuluzi Granite form the major base geology of the area. Archaian gneiss and granite weather into sandy soils in the uplands and clayey soils with high sodium content in the lowlands.

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 2002 Mr FP Coetzee conducted an Archaeological Investigation on Antwerpen Game Farm in the Hoedspruit District. He did find some Middle Stone Age and early Iron Age remains in an erosion donga on the farm which is approximately 6000 hectares in extent.

In 2003 Mr F Roodt compiled a report in respect of a lodge development on the farm Avoca 88 for R&R Cultural Resources Consultants. He found some pottery fragments which were eroded from a nearby anthill. He did not ascribe any significance to the fragments.

In 2005 Dr Udo Kűsel conducted a "*Cultural Heritage Resources Impact Assessment of a Portion of Kapama Hoedspruit (Guernsey 81 KU Portions 6, 34, 98, 109, 56, 204 and 210)".* He stated that "except for a few isolated Stone Age flakes no important cultural heritage resources could be found".

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 project area was conducted on 25 February 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.
- No archaeologically of heritage significant sites were located. 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. Field guide Mr Beer Roux, 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 **(*AIso 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 Nguni 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 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).

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).

4.1.4. Railway history in the Eastern Lowveld

By June 1892, the new railway constructed from Lourenco Marques to Pretoria, reached Nelspruit. In November 1891 the Hall family opened a new hotel, mainly to accommodate railway construction workers. This hotel was moved to the centre of the town in June 1892 and was named the Fig Tree Hotel.

Railway expansion continued up until the Anglo-Boer War (1899-1902) and thereafter (Bergh, 1999). After the establishment of the Union of South Africa on 31 May 1910 the Transvaal had the most railway track in terms of distance. Some 2 730km of railway connected the economic centres of this province. Railways made a huge contribution towards economic development especially in the Witwatersrand area where it served as important platform for mining and industrial development (Bergh, 1999).

Figure 4.1. Railway development in the Transvaal, 1889-1980 (Bergh, 1999: 79)

The decade after establishment of the Union is characterised by a sharp increase in railway development especially between 1911 – 1916, after which a period of inactivity followed due to the First World War (Bergh, 1999). Most of the development took place in the Eastern Transvaal and five railway lines were constructed in order to promote the growing agricultural industry.

Ermelo was linked with Piet Retief and further to the south with Commondale and Vryheid in Natal (Fig. 4.1.). The Komatipoort – Newington line was extended and passed over Acornhoek, Hoedspruit, Letsitele, Tzaneen and Soekmekaar where it connects with the northern line from Pietersburg towards Louis Trichardt and Schoemansdal (Bergh, 1999).

4.1.5. 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, the property under investigation formed part of the Lydenburg district. By 1902 the farm was under the jurisdiction of the Ohrigstad ward of the Lydenburg district. As of 1924, the property formed part of the Pilgrims Rest district, and this was still the case by 1994, when the new Mpumalanga province was proclaimed. (Bergh, 1999: 17, 20-27)

From the 1860s to 1870, the study area formed part of the farm Ross 917, Lydenburg District. From 1871 to 1950 the farm was known as Ross 119 Pilgrims Rest District, ward Origstadsrivier. From 1950, the farm has been known as Ross 55 KU.

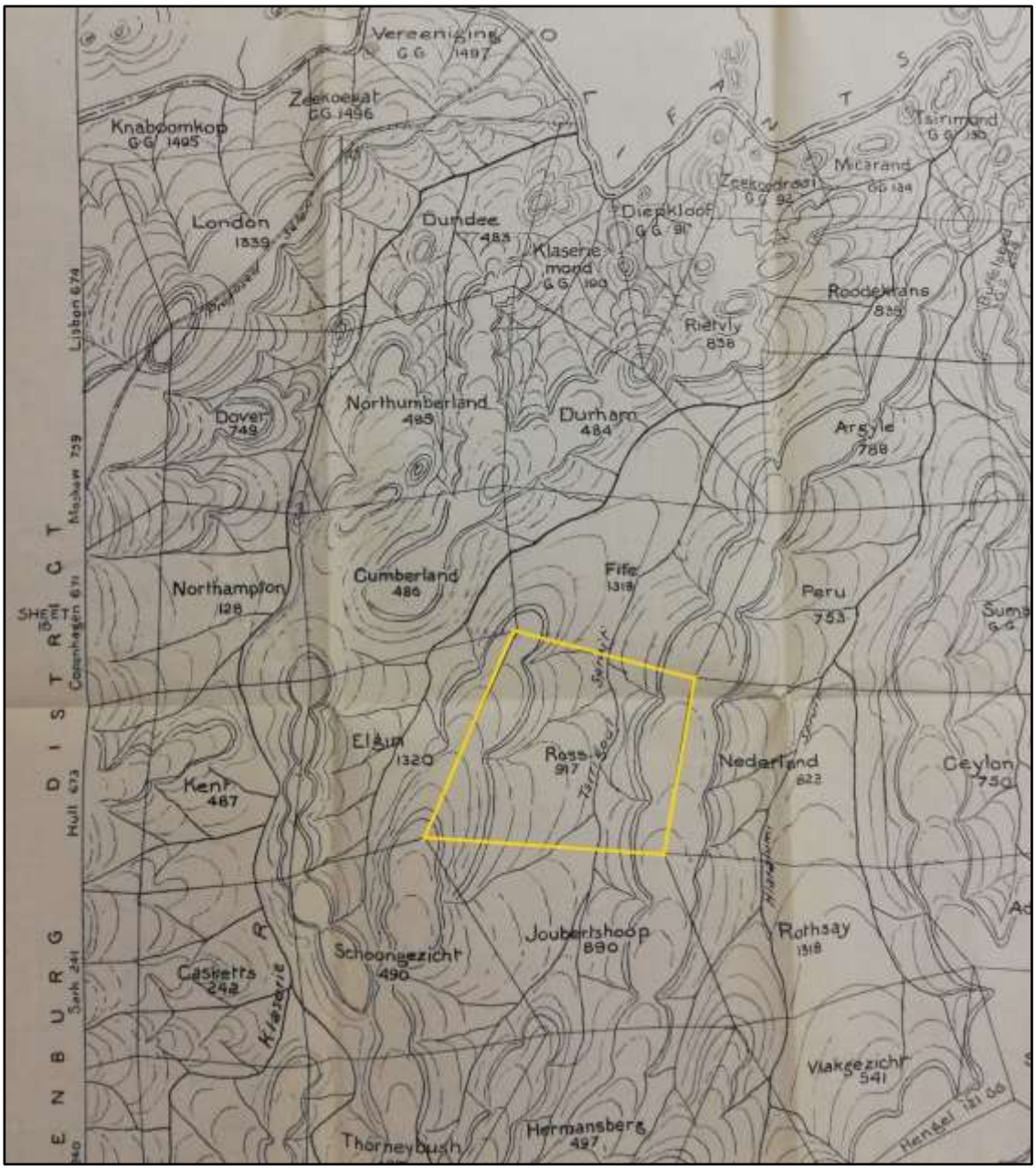


Figure 4.2. Map of the Lebombo Flats between the Olifants and Crocodile Rivers in 1891. The farm Ross 917 is indicated with a yellow border (NARSSA, *Maps: 1/148*).

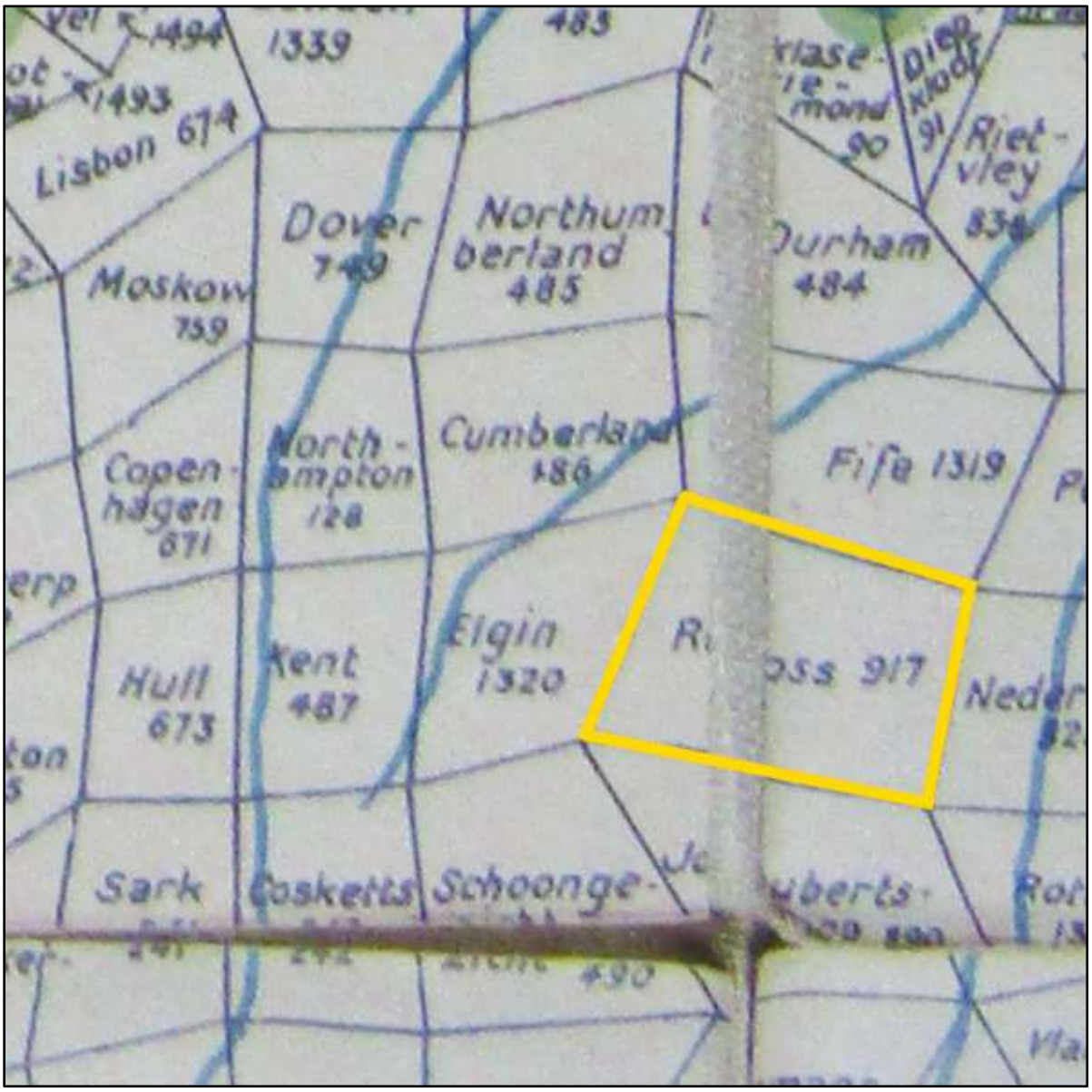


Figure 4.3. A map of the Transvaal compiled in the 1920's. The farm under investigation was still known as Ross 917, (Anon 1920s).

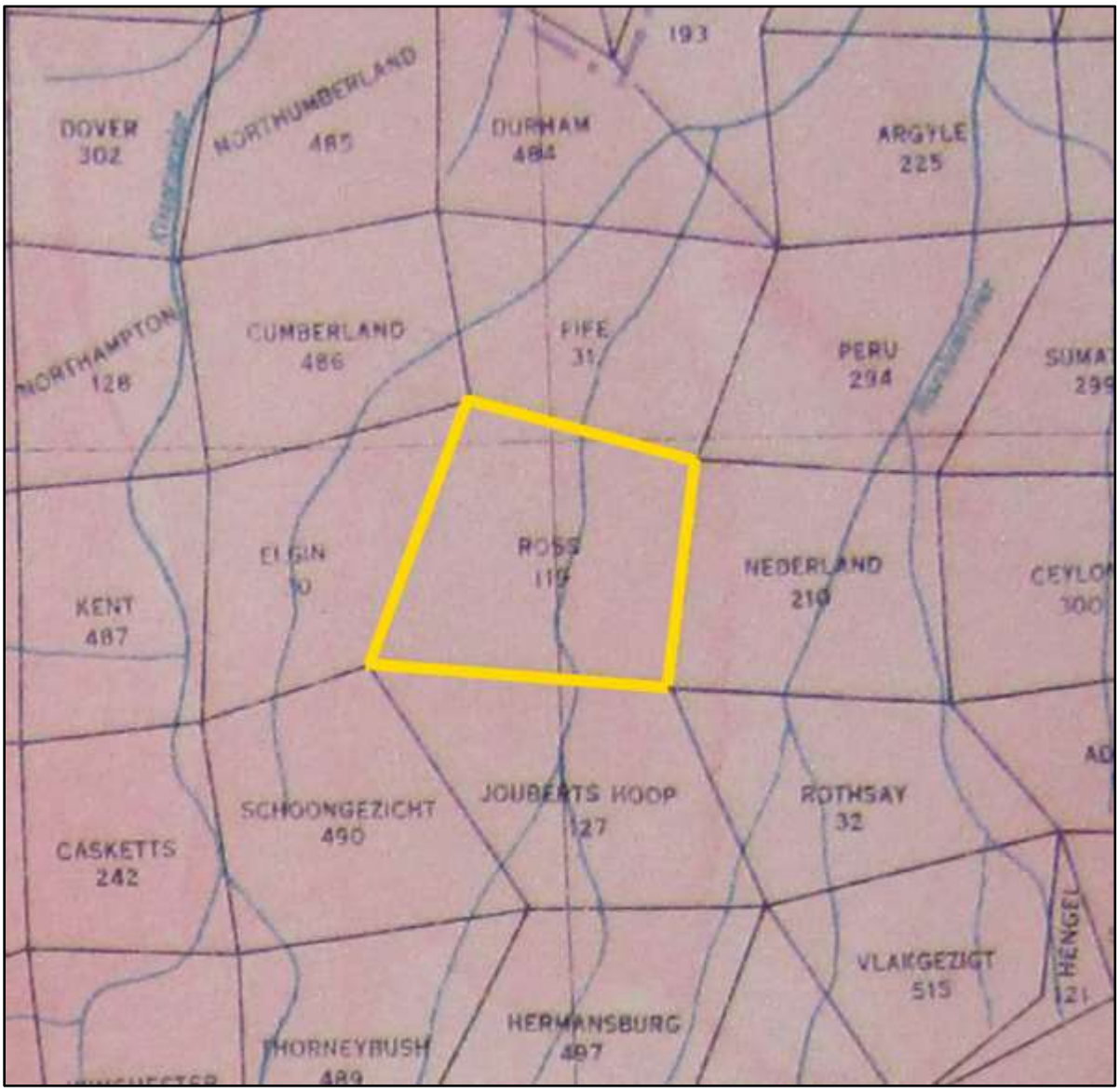


Figure 4.4. Map of the Kruger National Park and surrounds, dated approximately 1930. The farm under investigation was known as Ross 119. A river can be seen flowing through the centre of the farm, (NARSSA Maps: 3/1254).

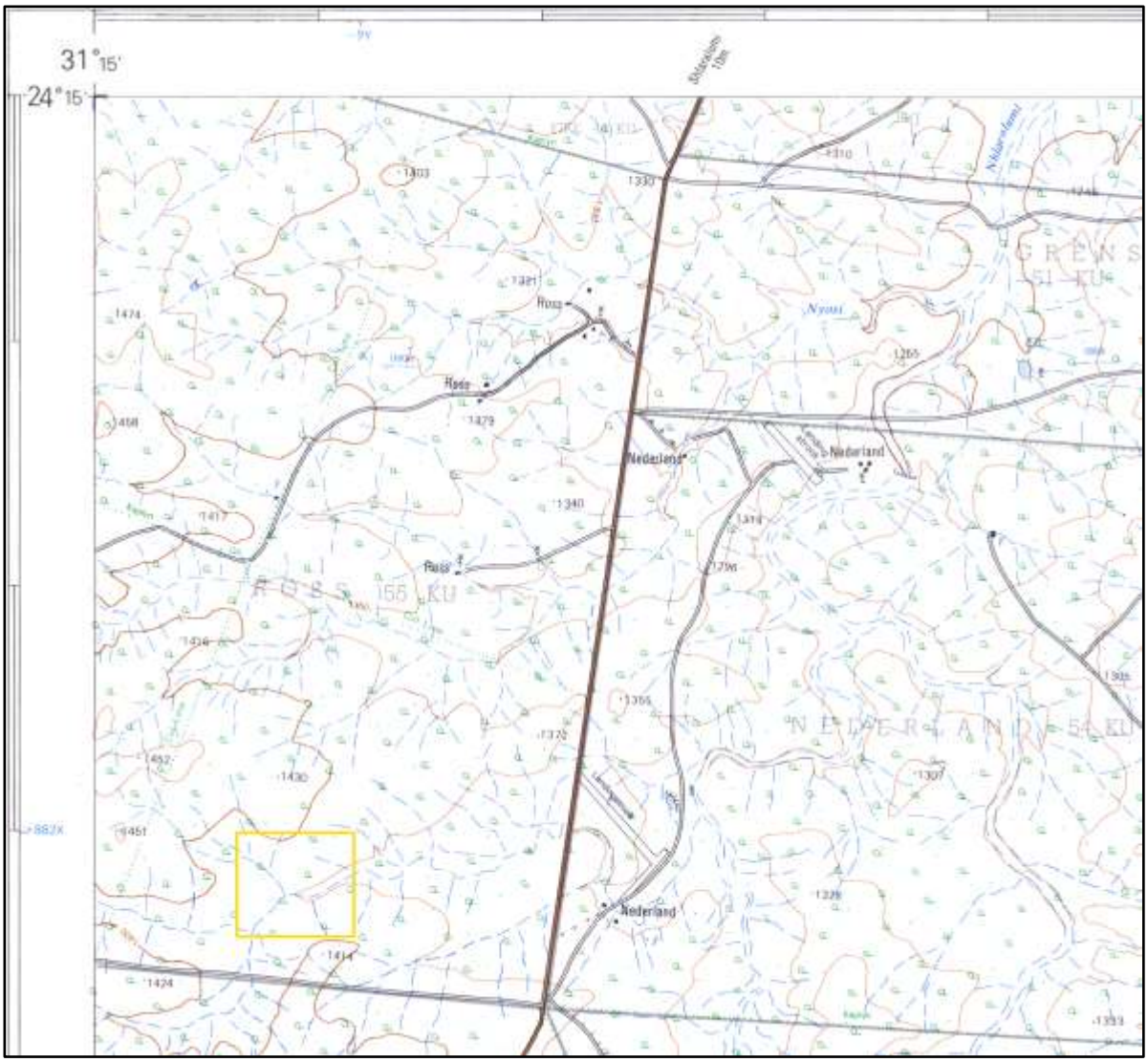


Figure 4.5. Topographical map of the project area in 1970. By this time the farm was known as Ross 55 KU. A yellow border shows the approximate location of the study area. The tributaries of a stream went through the property and Argyle Road and be seen on the eastern border of the farm. No buildings or other developments can be seen in the study area, (Topographical Map, 2431 AC, 1970).

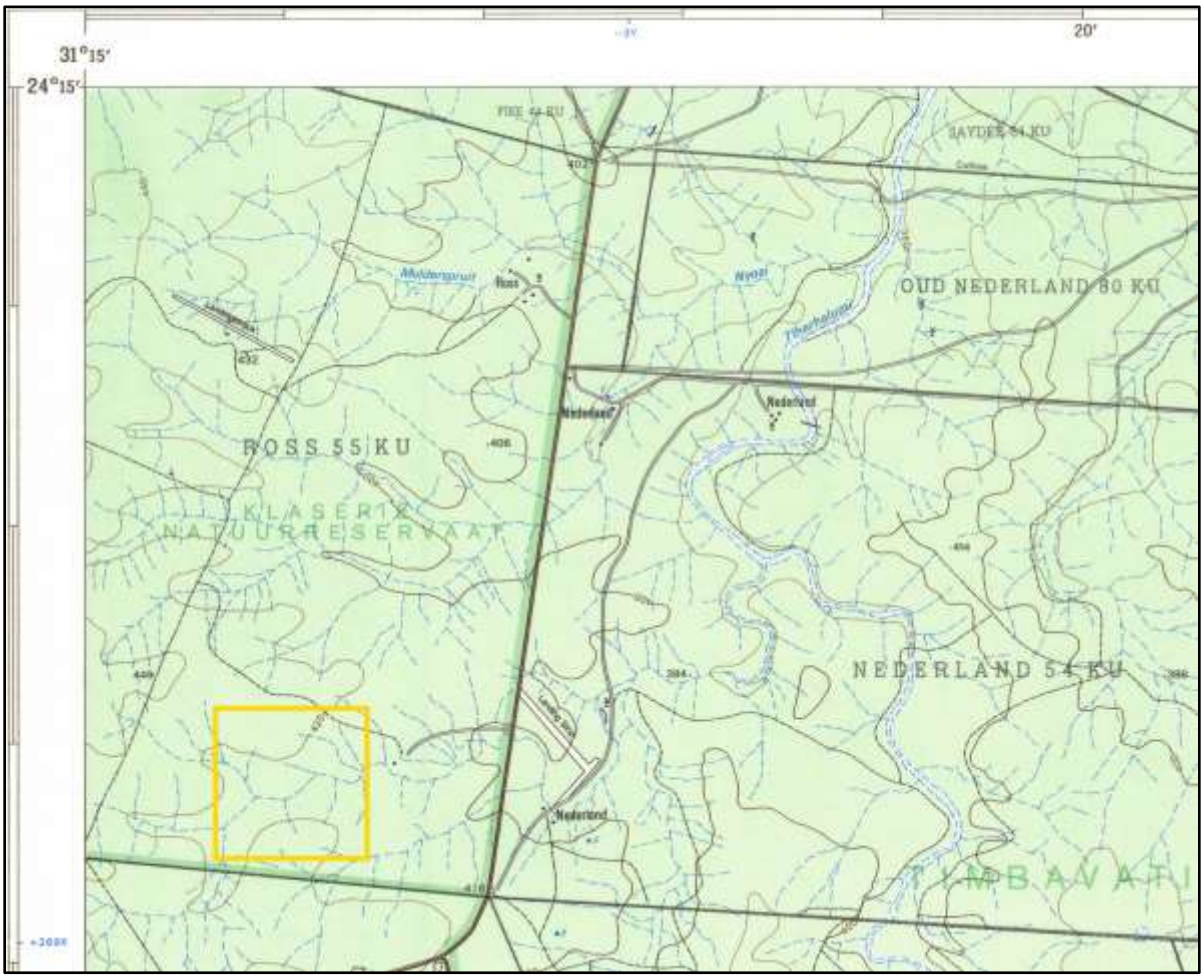


Figure 4.6. Topographical map of the project area in 1986. A yellow border shows the approximate location of the study area. The tributaries of a stream went through the property, and one can see several track / hiking trails going through the farm. Two landing strips can be seen, one north east of the study area and another on the adjoining farm to the east, called Nederland 54 KU. No buildings or other developments can be seen in the study area (Topographical Map, 2431 AC, 1986).

4.1.5. Historical overview, ownership and development of the farm Ross 55 KU

Online sources and information found at the National Archives Repository of South Africa were used to compile an overview of historical ownership and development of the farm Ross 55. Firstly, a record of historical landowners will be provided. Thereafter follows a discussion of how the study area and surrounds was historically used and developed.

Record of historical landowners

Ross 119, ward Ohrigstadrivier, was first inspected by P. D. de Villiers on 23 December 1869 and again by P. B. Swart between July and October 1897. According to P. D. de Villiers, the property measured 6064 morgen 262 square roods and P. B. Swart measured the property at 4000 morgen. The title deed to Ross 119 was first granted to Robert Hutchinson on 22 February 1871. The following details could be found regarding subsequent landowners:

Entry number	Date of transfer	Portion	Transported from	Transported to
2	31/1/76	Farm	R. Hutchinson	Thomas Sylvester Hutchinson
3	28/4/93	Farm	T.S. Hutchinson	Frits Krug
4	3/8/93	Farm	F. Krug	Edmund Francis Bourke
5	26/11/03	Farm	E.F. Bourke	The Transvaal Land Syndicate
6	18/5/08	Farm	Transvaal Land Syndicate	(Verulam) Transvaal Land Syndicate Ltd
7	24/10/38	Farm	(Verulam) Transvaal Land Syndicate Ltd	George Dugmore Hulley William Abraham Kriel
8	24/10/38	Farm	G.D. Hulley W.A. Kriel	Paul Michael Bester Robert Nicolaas Aling
9	28/2/41	½ Share	Certificate of Registered Title	Robert Nicolaas Aling
10	21/5/41	Farm	R.N. Aling	Herman Peter Jacob Verseput Jacob Izak Bosman
11	4/3/44	¼ Share from Entry 10	Est. J.I. Bosman	Anna Elizabeth de Villiers
12		¼ Share from Entry 10	Est J.I. Bosman	Jacob Izak Bosman
13	4/4/44	¼ Share from Entry 11	Certificate of Registered Title	Anna Elizabeth de Villiers
14	25/5/44	¼ Share from Entry 12	Certificate of Registered Title	Jacob Izak Bosman
15	16/5/47	Farm	H.P.J. Verseput + two others	Christiaan Frederick van der Merwe
16	31/7/48	Farm of Izak	C.F. van der Merwe	Andries Cornelis Strydom
17	1/7/50	Portion 1	Certificate of Registered Title	Andries Cornelis Strydom
18	1/7/50	Portion 2	Certificate of Registered Title	Andries Cornelis Strydom
19	1/7/50	Portion 3	Certificate of Registered Title	Andries Cornelis Strydom
20	1/7/50	Portion 4	Certificate of Registered Title	Andries Cornelis Strydom
21	1/7/50	Portion 5	Certificate of Registered Title	Andries Cornelis Strydom
22	28/9/50	Portion 3	A.C. Strydom	Ignatius Michael Prinsloo Lambertus Philippus van den Berg
23	28/9/50	Portion 4	A.C. Strydom	Ignatius Michael Prinsloo
24	28/9/50	Remaining Portion	A.C. Strydom	Ignatius Michael Prinsloo Johannes Lodewicus du Preez Marthinus Johannes Prinsloo

				Hermanus Nicolaas Fourie Lukas Johannes van der Merwe Joachina Petrus Prinsloo Barend Jacobus Prinsloo Daniel Jacobus Elardus Nel Ignatius Michael Prinsloo van Niekerk
25	28/9/50	3/5 Interest in Portion 3	Certificate of Registered Title	Lambertus Philippus van den Berg
26	28/9/50	3/10 Interest in Portion 3	L.P. van den Berg	Robert Philip Ueckerman
27	28/9/50	16/45 Interest in Portion 3	I.M. Prinsloo	Johannes Lodewicus du Preez Marthinus Johannes Prinsloo Hermanus Nicolaas Fourie Lukas Johannes van der Merwe Joachina Petrus Prinsloo Barend Jacobus Prinsloo Daniel Jacobus Elardus Nel Ignatius Michael Prinsloo van Niekerk
28	28/9/50	8/9 Interest in Portion 4	I.M. Prinsloo	Johannes Lodewicus du Preez Marthinus Johannes Prinsloo Hermanus Nicolaas Fourie Lukas Johannes van der Merwe Joachina Petrus Prinsloo Barend Jacobus Prinsloo Daniel Jacobus Elardus Nel Ignatius Michael Prinsloo van Niekerk

(NARSSA *TAB, RAK: 2937*)

An enquiry on the Windeed Search Engine provided the following details regarding the more recent land owners of Portion 1 of Ross 55 JU:

Owner	**Title Deed**	**Registration Date**
P.Y. Jansen van Vuuren 1/2	T47408/1974	
Mentz Johannes George 1/2	T10171/1987	
Ross Trust	T109071/1995	
Nicolasina Susanna Aletta van Staden	T15047/1982	
Daledra Pty Ltd	T113618/1999	
Plaas Ross se Bos Pty Ltd	T113618/1999	
Nicolasina Susanna Aletta van Staden - Trustees	T15047/1982	1982/05/05
Nicolasina Susanna Aletta van Staden - Trustees	T21573/2000	
118 Witkoppen Pty Ltd	T26140/2007	2007/02/27

(Windeed Search Engine, 2020)

History of land use

Little information could be found in the National Archives that specifically deals with the settlement and development of the farm Ross 55 KU. Given its location, the history of this farm is closely linked with the history of the Kruger National Park and the later Klaserie Private Nature Reserve, of which it currently forms part.

The Kruger National Park was proclaimed in 1926, and brought with it greater conservation awareness in South Africa. A section of land lying to the west of the Park, between the Sabie River in the south and the Olifants River in the north, was the area where the concept of private nature reserves in South Africa was born. Charles Boyed Varty and Frank A. Unger, both fervent wildlife lovers, purchased the farm Sparta, in the present Sabi Sand Wildtuin, and proceeded to pioneer the "game farm" idea in this area (Klaserie Reserve, 2018).

In 1934, some landowners who desired the establishment of a scheme of co-operative game protection, applied to the Transvaal Land Owners Association for help. This organisation administrated unoccupied agricultural and game farms for individuals and groups, among other things. The "Game Ordinance" was consequently founded in 1935. By the mid-1940s this ordinance had however become obsolete, as modern methods of transport and hunting increased the risk of over hunting. In 1947, the Division of Nature Conservation was established to assist with the protection of wildlife resources in the country (Klaserie Reserve, 2018).

In 1950, the Klaserie River Irrigation District was proclaimed, and it included all the farms along the Klaserie River south of the Klaserie Private Nature Reserve, (NASA *SAB, BAO: 10984 H124/1080/12*).

Figure 4.7. A Map of the Klaserie River Irrigation District drawn in 1963. The study area can be found just northeast of the farm Schoongezight (NASA SAB, BAO: 10984 H124/1080/12).

In 1954 the Transvaal Game Ordinance (No 23 of 1949) was amended, and people were allowed to form private reserves under certain conditions. The first reserve that was established was the Umbabat Private Nature Reserve, named after the Umbabat River. This reserve's name was

changed in 1956 to Timbavati – the Xitsonga name for the river. In 1961 the Kruger National Park started to fence their western boundary, and the Timbavati Private Nature Reserve was also fenced (Klaserie Reserve, 2018).

In 1962, Paul Mouton and Daan du Preez each bought portions of the farm Fife and influenced their friend Jan de Necker to purchase a portion of the farm Charloscar. Cattle farmers were very active on Charloscar and Moscow at the time. Mouton and Du Preez got their mutual friends, Stoffel Botha, who became Administrator of Natal and later Minister of Internal Affairs and of Post and Telegraphs, and Wynand Lindeque, to buy out these farmers. This was done with the intention of establishing a private nature reserve (Klaserie Reserve, 2018).

By the late 1960s a group of landowners, including De Necker, Mouton, Du Preez and others started lobbying more seriously for the establishment of the Klaserie Private Nature Reserve. Individual landowners had to be approached in the area, among others the Crookes family, who owned four farms along the Klaserie River. The first meeting of 14 landowners was held in Randburg on 28 January 1969, to discuss the formation of the game reserve. On 8 October 1969, at a crucial meeting in Pretoria attended by 36 landowners, each landowner verbally confirmed that he / she wanted to become a member of the reserve and accepted the constitution. The largest private game reserve in South Africa was thus established (Klaserie Reserve, 2018).

A report submitted to the Minister of Agriculture in about 1968, dealt with the agriculture situation in the Hoedspruit and Klaserie areas (NASA *SAB, LPE: 29 NA2/9/2*).

The Hoedspruit irrigation area was said to have developed after World War II with the erection of two canals and there were 80 farmers within this area. Originally, the predominant crop in the area was rice, but with low cost imported rice, this farming stopped in 1958. Instead, tomatoes, tobacco, sugar, pumpkins and to a lesser extent citrus, was then cultivated (NASA *SAB, LPE: 29 NA2/9/2*).

The area was said to be excellent for winter production and that water was cheap and abundant. Transportation from the area was said to be good, however, there were some problems with irrigation and the existing canals needed to be replaced with cement canals (NASA *SAB, LPE: 29 NA2/9/2*).

The Klaserie area was described as an area where agronomy plays an important part. The water supply was said to be stable due to the Klaserie dam further upstream. According to the report, the water was primarily used in the cultivation of vegetables such as tomatoes, pumpkins and onions, however it was also used in the production of tobacco and maize. Beef farming was said to play a rather insignificant role, but that the area offered ideal conditions for this type of farming. However,

the close proximity to the Kruger National Park means that foot and mouth as well as lions pose a risk to cattle (NASA *SAB, LPE: 29 NA2/9/2*).

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 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 32odelling 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

A single location, site RK 1, with a small number of poorly defined stone tools was documented although it has no archaeological context and of low significance.

A total of seven survey orientation locations were documented, sites SO 1-7 which includes a GPS location and photographs of the landscape at that particular location.

The survey orientation sites 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	RK 1	Low

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 RK 1

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

Description: Survey orientation location.

Impact of the proposed development/ activity: N/A

Recommendation: N/A


Photo view north-west

Survey orientations:

5.1.2. Site SO 1.

Location: See Appendix B and D (fig. 3, 4)

Description: Survey orientation location.

Impact of the proposed development/ activity: N/A

Recommendation: N/A


Photo view east

5.1.3. Site SO 2.

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 view north

5.1.4. Site SO 3.

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 view south

5.1.5. Site SO 4.

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 view east

5.1.6. Site SO 5.

Location: See Appendix B and D (fig. 11, 12)

Description: Survey orientation location.

Impact of the proposed development/ activity: N/A

Recommendation: N/A


Photo view south

5.1.7. Site SO 6.

Location: See Appendix B and D (fig. 13, 14)

Description: Survey orientation location.

Impact of the proposed development/ activity: N/A

Recommendation: N/A


Photo view west

5.1.6. Site SO 7.

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

Description: Survey orientation location.

Impact of the proposed development/ activity: N/A

Recommendation: N/A

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

Site No.	Description	Type of significance	Degree of significance	NHRA heritage resource & rating
RK 1	Stone tools	Archaeological	Archaeological: Poor Historic: N/A	Section 35. GP C. Low significance
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
SO7	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
RK 1	Archaeological	Poor	Poor	Ross 55 KU	Poor	1	Monitoring during construction
SO 1	N/A	N/A	N/A	Ross 55 KU	Archaeology: N/A Historically: N/A	-	N/A
SO 2	N/A	N/A	N/A	Ross 55 KU	Archaeology: N/A Historically: N/A	-	N/A
SO 3	N/A	N/A	N/A	Ross 55 KU	Archaeology: N/A Historically: N/A	-	N/A
SO 4	N/A	N/A	N/A	Ross 55 KU	Archaeology: N/A Historically: N/A	-	N/A
SO 5	N/A	N/A	N/A	Ross 55 KU	Archaeology: N/A Historically: N/A	-	N/A
SO 6	N/A	N/A	N/A	Ross 55 KU	Archaeology: N/A Historically: N/A	-	N/A
SO 7	N/A	N/A	N/A	Ross 55 KU	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
RK 1	Camp construction	Stone tool scatter	Site	Short term	Low (1)	Possible (2)	3
SO 1	Camp construction	N/A	N/A	Short term	Low	Improbable	2
SO 2	Camp construction	N/A	N/A	Short term	Low	Improbable	2
SO 3	Camp construction	N/A	N/A	Short term	Low	Improbable	2
SO 4	Camp construction	N/A	N/A	Short term	Low	Improbable	2
SO 5	Camp construction	N/A	N/A	Short term	Low	Improbable	2
SO 6	Camp construction	N/A	N/A	Short term	Low	Improbable	2
SO 7	Camp construction	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
RK 1	Neutral	5	-	-	-	5
SO 1	Neutral	-	-	-	-	-
SO 2	Neutral	-	-	-	-	-
SO 3	Neutral	-	-	-	-	-
SO 4	Neutral	-	-	-	-	-
SO 5	Neutral	-	-	-	-	-
SO 5	Neutral	-	-	-	-	-
SO 5	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. Construction of the proposed camp can possibly impact on the identified site RK 1 although it is located within a drainage line/ erosion furrow which makes it unsuitable for camp construction. Monitoring of the immediate area, by a qualified archaeologist, during construction activities is recommended in order to identify and manage any significant cultural material should it be uncovered. Also see section 6.1. Recommended management measures.

6. Summary of findings and recommendations

A single location, site RK 1, with a small number of poorly defined stone tools was documented although it has no archaeological context and of low significance. Monitoring of the immediate area, by a qualified archaeologist, during construction activities is recommended in order to identify and manage any significant cultural material should it be uncovered.

A total of seven survey orientation locations were documented, sites SO 1-7 which includes a GPS location and photographs of the landscape at that particular location.

In terms of the archaeological component of the Act (25 of 1999, section 35) some stone tools were found in a natural drainage/ erosion furrow but it is considered to be of low significance. Monitoring during construction of the proposed camp is recommended.

In terms of the built environment in the project area (section 34 of the Act) no sites were identified in the study area.

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. Cartwright, A. P. 1961. Valley of gold. 1872-1961. Cape Town.

7. Coetzee, F.P. 2002. *An Archaeological Investigation Antwerpen Game Farm, Hoedspruit District, Northern Province.* An unpublished report by the Archaeology Contracts Unit (UNISA) on file at SAHRA as: 2002-SAHRA-0087.

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. Giliomee, H. 2003. ***The Afrikaners, a biography of a people*****.** Tafelberg: Cape Town & Charlottesville.

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

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

14. Huyser, J. D. ***Die Naturelle-Politiek van die Suid-Afrikaanse Republiek.*** D. LITT. Verhandeling, Universiteit van Pretoria.

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

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

17. Küsel, U. 2005. *Cultural Heritage Resources Impact Assessment of a Portion of Kapama Hoedspruit (Guernsey 81 KU Portions 6, 34, 98, 109, 56, 204 and 210).* An unpublished report by

African Heritage Consultants CC on file at SAHRA as: 2005-SAHRA-0264.

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

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

20. 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.

21. Raper, P. E. 2014. A dictionary of Southern African place names. Johannesburg: Jonathan Ball Publishers.

22. Roodt, F. 2003. *Lodge Development-Timbavati Nature Reserve Farm: Avoca 88 (Acornhoek).* An unpublished report by R & R Cultural Resource Consultants on file at SAHRA as: 2003-SAHRA-0032.

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

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

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

ELECTRONIC SOURCES:

1. Google Earth. 2019. 24°18'20.71" S 31°*14'52.75" E elev 437 m.* [Online]. [Cited 5 February 2020].

2. Google Earth. 2019. 24°18'13.00" S 31°*14'58.18" E elev 435 m.* [Online]. [Cited 5 February 2020].

3. Google Earth. 2019. 24°10'09.61" S 31°*11'30.70" E elev 368 m.* [Online]. [Cited 5 February 2020].

4. Hoedspruit. N/d. *History of Hoedspruit.* [Online]. Available: http://www.hoedspruit.co.za/history.html. [Cited 30 October 2018]

5. Klaserie Reserve. 2018. Klaserie Private Nature Reserve. History. [Online]. Available: http://www.klaseriereserve.co.za/about.html. [Cited 30 October 2018]

6. Pistorius, C. C. 2008. *A Phase I Heritage Impact Assessment (HIA) study for the proposed Wonderfontein Colliery near Belfast in the Mpumalanga Province of South Africa. Prepared by: Dr Julius C. C. Pistorius, Archaeologist and Heritage Management Consultant.* . [Online]. Available: http://www.sahra.org.za/sahris/sites/default/files/heritagereports/Wonderfontein%20Colliery_0.pdf. [Cited 26 June 2018]

7. University of the Witwatersrand. 2017. *Rock Art Research Institute, University of the Witwatersrand. Rock Art of Southern Africa*. [Online]. Available: https://www.wits.ac.za/rockart/about-rock-art/rock-art-of-southern-africa/. [Cited 25 June 2018]

8. Windeed Search Engine. 2020. *Deeds Office Property. Ross, 55, 1 (Mpumalanga).* [Accessed: 31 January 2020]

ARCHIVAL SOURCES(National Archive Pretoria)

1. National Archives and Records Service of South Africa. 1904-1950. *TAB, RAK: 2937. Pelgrimsrus.*

2. National Archives of South Africa. N/d. *Maps: 3/1254. Kruger National Park.*

3. National Archives and Records Service of South Africa. 1963-1972. S*AB, BAO: 10984 H124/1080/12. Besproeiing. Klaserie Rivierbesproeiingsdistrik. Suid-Afrikaanse Naturelle Trust. Plaas Brooklyn. Bosbokrand.*

4. National Archives and Records Service of South Africa. 1968-1969. SAB, *LPE: 29 NA2/9/2. Landboubeleid en Aktuele Landbouaangeleendhede. Ad hoc en spesiale ondersoeke Klaserie – Hoedspruit omgewing en finansiele probleme. Sondagsrivier.*

MAPS

1. Anon. 1920s. *The standard map of the Transvaal. Compiled from registered diagrams and information supplied by the various land owner and from other authentic sources. Johannesburg: The Map Office.*

2. Surveyor General. 1904. *Transvaal (Jackson's First Series). Sheet No. 58. Olifant's River*. Pretoria: Government Printing Works.

3. Topographical Map. 1970. *South Africa. 1:50 000 Sheet. 2431AA Grietjie. First Edition.* Pretoria: Government Printer.

4. Topographical Map. 1986. *South Africa. 1:50 000 Sheet. 2431AA Grietjie. Second Edition.* Pretoria: Government Printer.

5. Topographical Map. 1986. *South Africa. 1:50 000 Sheet. 2431AC Casketts. Second Edition.* Pretoria: Government Printer.
6. Topographical Map. 1998. *South Africa. 1:250 000 Sheet. 2430 Pilgrim's Rest. Fourth Edition.* Pretoria: Government Printer.

7. Topographical Map. 2008. *South Africa. 1:50 000 Sheet. 2431AA Grietjie. Third Edition.* Pretoria: Government Printer.

8. Topographical Map. 2008. *South Africa. 1:50 000 Sheet. 2431AC Casketts. 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

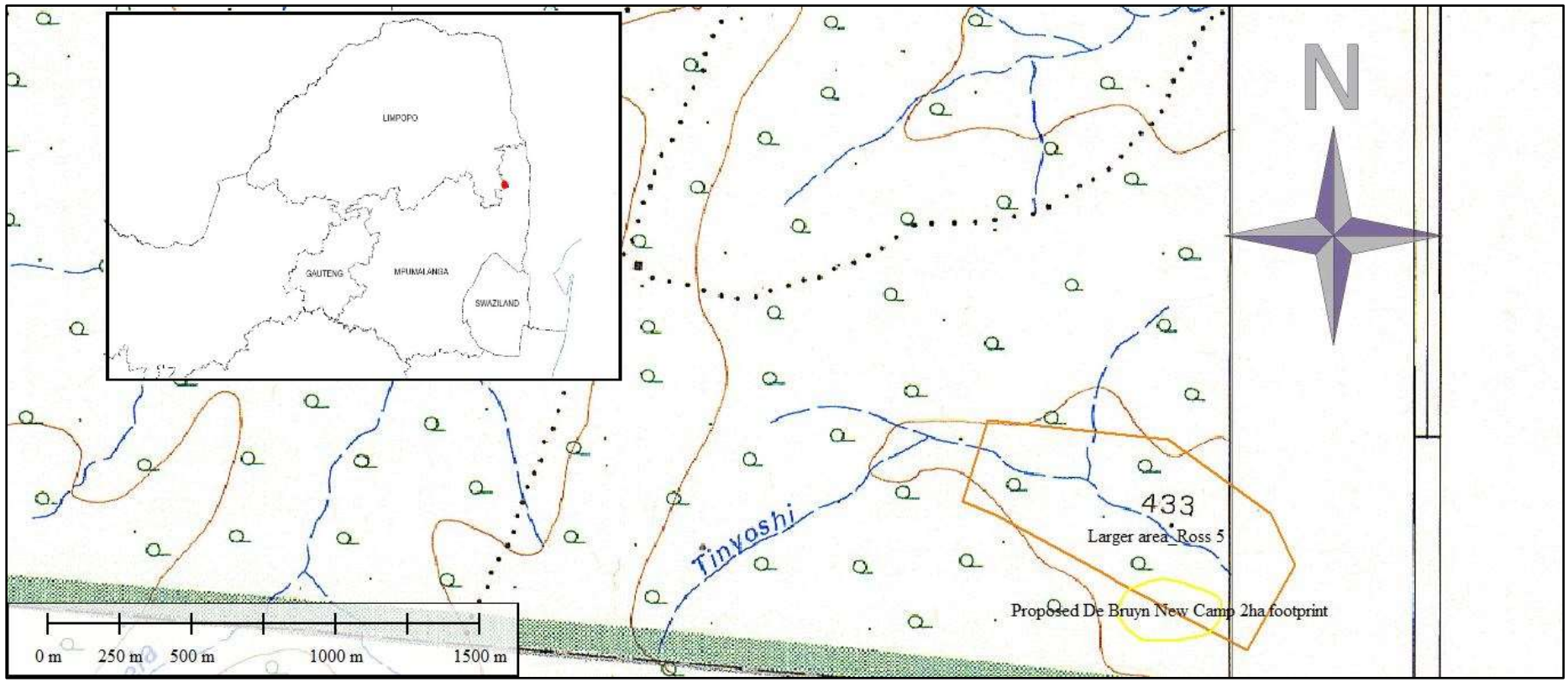
List of sites

One site was recorded and numbered RK 1. A total of seven survey orientation sites were recorded. The sites were named SO 1-7.

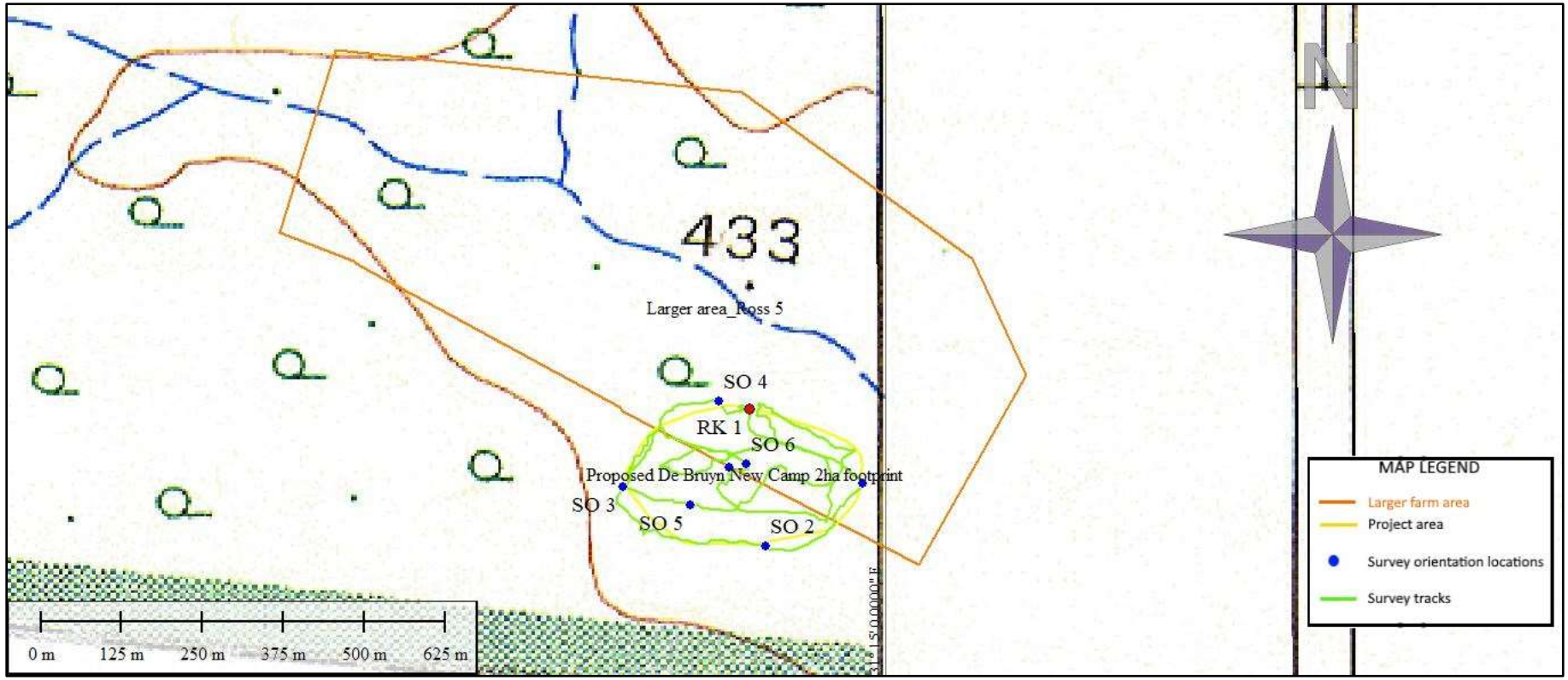
Table A. Site and Survey Orientation Locations.

Site Name	Date of compilation	GPS Coordinates		Photo figure No.
RK 1	25/02/2020	S24°18'18,410"	E031°14'53,228"	1, 2
SO 1	25/02/2020	S24°18'22,161"	E031°14'58,877"	3, 4
SO 2	25/02/2020	S24°18'25,294"	E031°14'54,024"	5, 6
SO 3	25/02/2020	S24°18'22,345"	E031°14'46,878"	7, 8
SO 4	25/02/2020	S24°18'18,032"	E031°14'51,648"	9, 10
SO 5	25/02/2020	S24°18'23,234"	E031°14'50,219"	11, 12
SO 6	25/02/2020	S24°18'21,154"	E031°14'53,059"	13, 14
SO 7	25/02/2020	S24°18'21,355"	E031°14'52,184"	15

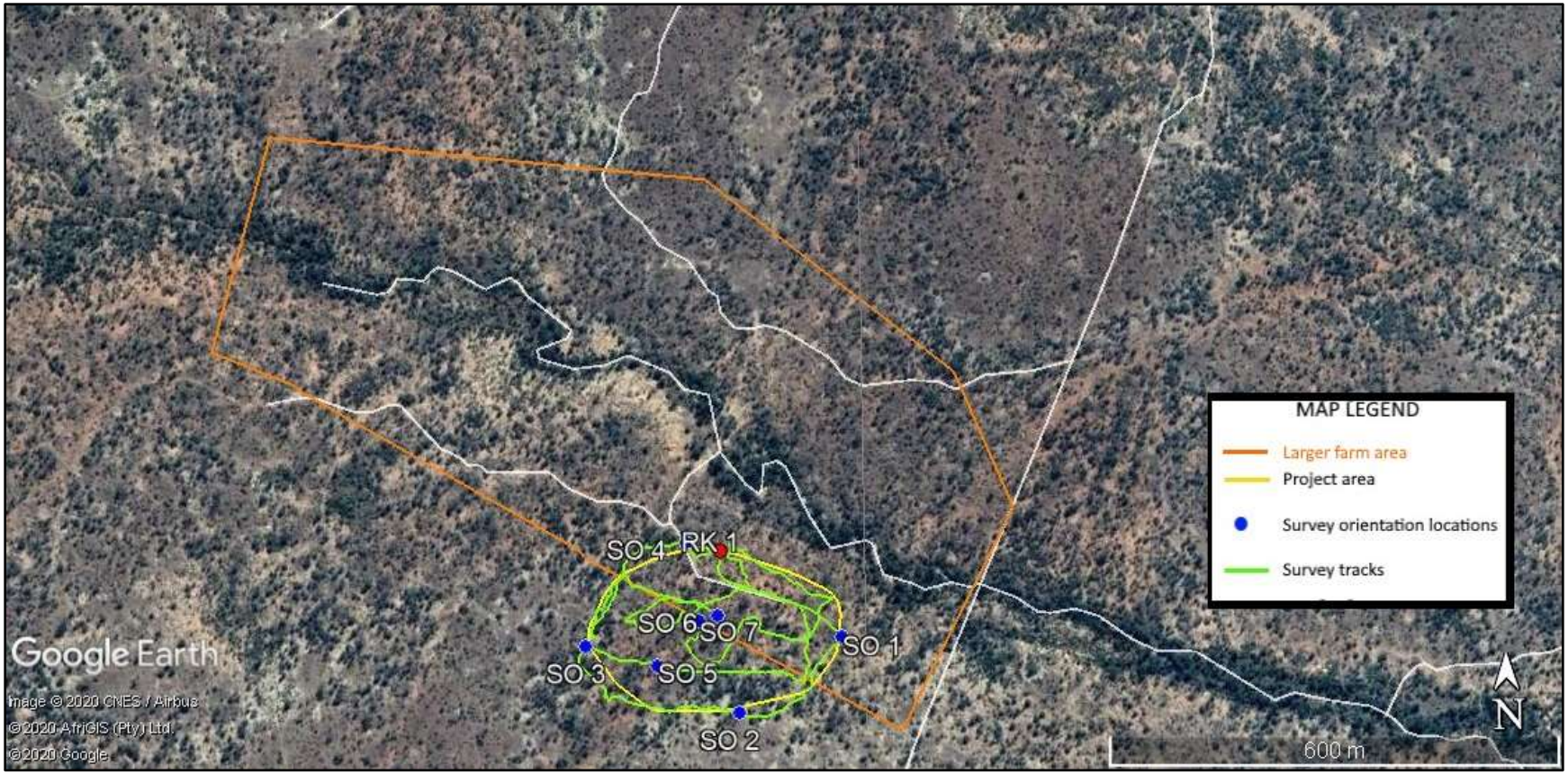
Appendix C



Regional Map 1:50 000 Topographical Map 2431 AC (1986)



Topographical Map 1:50 000 2431 AC (1986)



Aerial view: Google Earth 2020.

Appendix D

Site Photos

Fig. 1. Site RK 1. Photo taken north-west. Notice the erosion furrow where the stone tools were found.

Fig. 2. Site RK 1. The stone tools found near the erosion furrow.

Survey Orientation Photos

Fig. 3. Site SO1. Photo taken in a northern direction.

Fig. 4. Site SO1. Photo taken in a southern direction.

Fig. 5. Site SO2. Photo taken in an eastern direction.

Fig. 6. Site SO 2. Photo taken in a western direction.

Fig. 7. Site SO 3. Photo taken in an eastern direction.

Fig. 8. Site SO 3. Photo taken in a western direction.

Fig. 9. Site SO 4. Photo taken in a northern direction.

Fig. 10. Site SO 4. Photo taken in a southern direction.

Fig. 11. Site SO 5. Photo taken in an eastern direction.

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

Fig. 13. Site SO 6. Photo taken in a northern direction.

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

Fig. 15. Site SO 7. Photo of an existing borehole.

Annexure E: Aquatic

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

Email: shenwood@mweb.co.za

P O Box 4349
WHITE RIVER, 1240
South Africa

Tel: +27 (0) 13 - 751 1533
Fax: 08668 28220
Cell: 082 574 4486
E-mail: rob@nepid.co.za
Webpage: www.nepid.co.za

Date: 9th March 2020

STATEMENT ON AQUATIC ECOSYSTEMS AT PROPOSED CAMP: PORTION 4 OF ROSS 5

Background
Nepid Consultants CC was appointed by Henwood Environmental Solutions (Pty) Ltd to assess the potential ecological risks of a proposed commercial and private camp on Portion 4 of Ross 5 on aquatic ecosystems.

Field Survey
The proposed camp area was visited on the 14th February 2020.

Survey Findings
The survey found the following:

- there are no aquatic ecosystems within the proposed camp area so there was no justification for a detailed specialist report on aquatic ecosystems;
- aquatic ecosystems within 500 m of the proposed camp comprised an episodic drainage line with a coarse mobile sand bed and with a gradient equivalent to an Upper Foothill Stream (Photos P3 and P4). The proposed camp is further than 32 m from the edge of the riparian zone of this watercourse and therefore the proposed development is unregulated in terms of 2017 NEMA regulations (GNR 327 Activity 12); and
- an episodic drainage line runs through the proposed camp area (Figure A; Photos P1 & P2). This drainage line appears to have been formed by stormwater runoff from a 4x4 track that runs east-west some 300 m south of the proposed camp, and therefore appears to be artificial. The drainage line has no riparian zone and does not constitute an aquatic ecosystem or watercourse.

Recommendations
Authorisation of the proposed development in relation to potential impacts on aquatic ecosystems is recommended on the grounds that the potential risks to aquatic ecosystems are zero. However, a buffer zone of no development that could impede flows within 2 m on either side of the drainage line is recommended to minimize the potential impacts of erosion caused by stormwater runoff (Figure A).

Yours sincerely

Rob Palmer SANASCP Reg No 400108/95
Director: Nepid Consultants CC

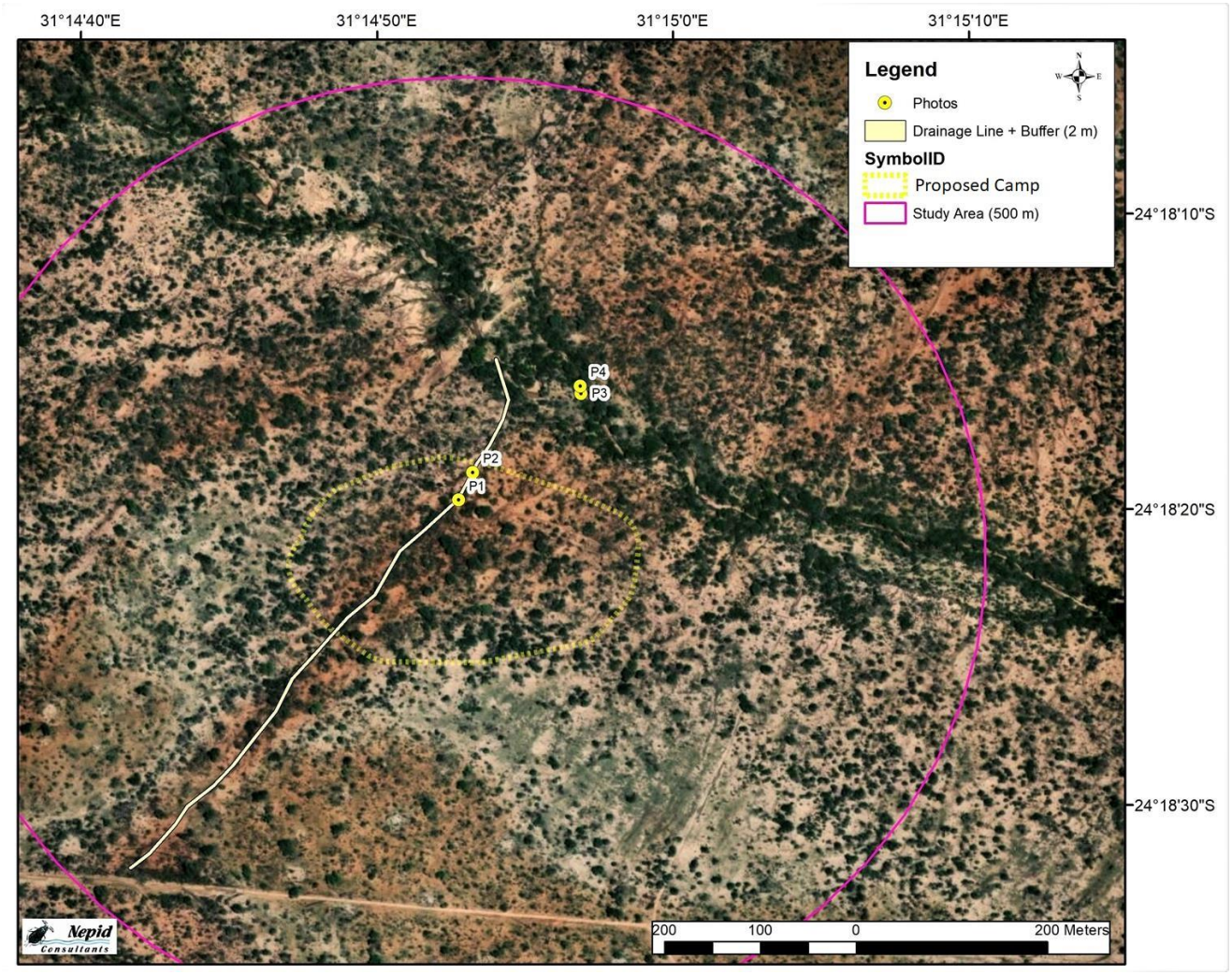
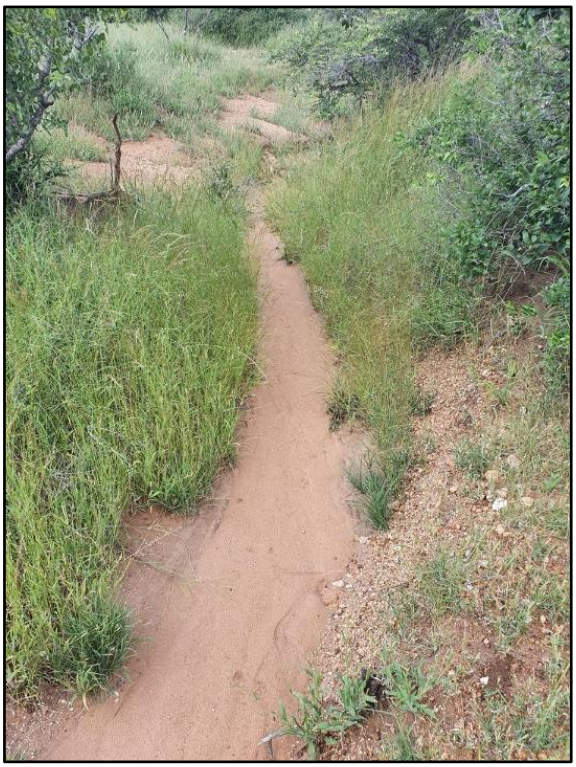


Figure A. Artificial drainage line that runs through the proposed camp on Portion 4 of the farm Ross 5.

Drainage Line

P1: Drainage Line at -24.305470; 31.247990; 8th March 2020. (Photo by Duncan McKenzie).



P2: Drainage Line at -24.305210; 31.248120; 8th March 2020. (Photo by Duncan McKenzie).

Watercourse

P3: Episodic Sand Bed Upper Foothill Stream at -24.304470; 31.249140; 14th February 2020.

P4: Episodic Sand Bed Upper Foothill at -24.304400; 31.249130; 14th February 2020.

ANNEXURE E: Geohydrological Assessment

GEO3 CC
Consulting Engineering, Hydro & Environmental Geologists
CK 1994/010338/23 VAT Reg. No. 4170162442
www.geo3cc.co.za
PO Box 6559 Nelspruit 1200 / 17 Jan Street Rocky Drift
Tel: (013) 758 1226; email: henry@geo3.co.za

03 September 2020
GC/1347/1/hjs

Henwood Environmental Solutions (Pty) Ltd
Per e-mail
Attention: Mr S Henwood

Dear Sir,

ENGINEERING GEOLOGICAL AND HYDROGEOLOGICAL INVESTIGATIONS UNDERTAKEN ON PTN 4 OF THE FARM ROSS 55-KU IN THE KLASERIE PRIVATE NATURE RESERVE

1. Terms of Reference

Geo3cc was appointed to evaluate the use of on-site sanitation for a new lodge on the abovementioned farm. We were also asked to evaluate the likelihood of a recently drilled borehole on said farm (Ross), influencing the yield from a borehole at Gomo Gomo (GG) Lodge on the adjacent farm to the south, i.e. on Portion 16 of the farm Jouberts Hoop 67-KU.

Our appointment follows the submission of a proposal and costing dated 26 July 2020 (Our reference: GQ/2051/a/hjs), submitted in response to a request for a quotation.

2. General/Background Information

The site is in the Klaserie Nature Reserve, some 30-kilometres due east of Hoedspruit (**Figure 1**).

The provided provisional layout, indicates the lodge is downslope from the recently drilled borehole, with the envisaged soakaway(s) positioned between the lodge and the non-perennial stream further downslope.

3. Reference Sources

The following information was used during our investigation:

- Geological data provided by the Council for Geosciences (2014) – used in the compilation of **Figure 1**.
- Layout of proposed lodge provided by Henwood Environmental Solutions (Pty) Ltd (HES) included in **Figures 2**.
- 1:20 000 Scale aerial Photographs: 2354 - 2355 (Strip 14), 2392 – 2394 (Strip 15), Date: 1944, Job: 056. Chief Directorate of Survey and Mapping – used to assess variability of the soils (**Figure 2**) and hydrogeological/lineament analysis (**Figure 3**).

3. Fieldwork

The fieldwork was undertaken on 20 August 2020 and comprised the excavation of two pits in areas downslope from the proposed development, but well away from water courses. The stereoscopic analysis of historic aerial photographs also suggested the two areas would have different soil profiles. The position of the pits are indicated on **Figure 2**. These were profiled according to standard procedures [1], together with an exposures of the gneiss bedrock (TP 2) in a shallow stream. The resultant soil logs are attached.

To classify the soils, representative samples of the regolith, recovered from the holes excavated for the percolation tests, with a sample of the surficial transported soil, were submitted to Messrs EngeoLab in Nelspruit for testing according to our instructions. The test results, in the format they were received, are attached.

Following on from the inspection of the pits, percolation tests [4] were undertaken in the base of Pit 1 and 3, the results of which are attached.

4. Results of the investigation

4.1 Geology

The results from the fieldwork reveal the farms are underlain by gneiss. In terms of published geological maps for the area, the gneiss is homogeneous, light grey (leucocratic) medium-grained, and belongs to the Makhutswi Gneiss Formation (**Figure 1**). The geology map also indicates the presence of north-east / south-west trending lineaments, with these beyond the area of interest.

4.2 Soakaway assessment

i) The pits excavated were dry, consistent with what would have been anticipated towards the end of the drier winter season. However, the present of dense residua at shallow depth in Pit 1, and sub-outcropping gneiss in the shallow stream between Pits 1 and 3 (**Figure 2**), suggest that competent residua and/or bedrock is likely at shallow depth, limiting the thickness of available regolith for a soakaway.

ii) The results from grading and Atterberg Limits tests undertaken on samples from the pits are included on the relevant soil profiles. With reference to Pit 1, the percolation test was undertaken in dense, gravelly residua - grading modulus of 2,25 - moderate Atterberg Limits and an overall Unified Soil Classification (USC) of *SM*.

The surficial transported soils in Pit 3 Classify as *CL* (USC) with elevated Atterberg Limits, low grading moduli, i.e. fine-grained, confirming these soils are unlikely to prove suitable for effluent disposal/soakaways. The underlying reworked residua, while not as coarse-grained as that of Pit 1 - grading modulus of 1,65 - has slightly elevated Atterberg Limits and a USC of *SC*, suggesting the soils are also not ideal for a soakaway.

iii) To assess the suitability of the soils for on-site sanitation, percolation tests [5] were undertaken in the base of the Pits 1 and 3. (The shallower horizons were deemed unsuitable in view of their cohesiveness). The results from these tests are summarized in **Table 1**.

Table 1: Percolation results

Material	Position (see **Figure 1**)	Unified Soil Classification	Percolation Rate [min/25mm]
r/r granite	*TP 1*	*SM*	26
r/r granite	*TP 3*	*SC*	26

Notes: * = weakly ferruginous cemented.

The recorded percolation rates are only just below the maximum recommended percolation rate of 30minutes/25mm [6]. As such, and taking cognisance that the surficial soils are unsuitable, bedrock and/or dense residua is anticipated at shallow depth, with both constraints limiting the aerobic horizon available to absorb percolating waste water, we recommend that alternate sewage disposal options be pursued, e.g. Lilliput / Biorock Systems etc.

If soakaways are to be pursued, these must be designed for a maximum application of 33litres/m^2/day for the wall area below the surficial transported soils, i.e. exclude fine colluvium and gullywash, and excluding the base of the trench. Further considerations for soakaways are attached to the end of this report.

4.3 Preliminary hydrogeological assessment

i) In general, groundwater occurrences in the gneiss are mostly associated with secondary aquifers, confined to fractures, zones of deeper weathering, and contact zones with

intrusive dykes, pegmatites etc. Typically, these aquifers are characterised by *low* yielding boreholes [4]. A desktop assessment of the site and environs, using available maps [8], can be summarized as follows:

- aquifer classification: major aquifer region – with the potential for high yielding boreholes, i.e. intergranular and fractured with the potential for yields of greater than 5,0 l/s
- overall groundwater quality: electrical conductivities typically fall in the range 300 to 1000mS/m, with the potential for a noticeable salty taste, i.e. the water will not slake a thirst

In terms of Vegter's Hydrogeological Maps [9], the probability of drilling a successful borehole (~0.1 l/s) in the area is greater than 50%, while the probability of drilling a successful borehole with a yield of greater than 2l/s is less than 40%.

ii) The topography of the area of interests is characterized by post African Erosion Surface which is partially planed [6] and as such, gently undulating. The annual evaporation of 2 000 – 2 200mm, far exceeds annual precipitation of 400 - 600mm [1], and as such, the area constitutes a water-deficit region.

iii) Stereoscopic analysis of available aerial photographs at a scale of 1:20 000 did not reveal lineaments, which may provide preferential aquifers traversing the areas of interest. As such, there is no visible lineament/secondary aquifer that would indicate a conduit between the two boreholes (**Figure 3**) that are approximately 630m apart.

iv) Information gleaned for the recently drilled borehole on Ross, and the borehole in use for the GG Lodge on the farm to the south (**Figure 3**), are summarized in **Table 2**.

Table 2: Borehole information

Position [**Figure 3**]	Estimated Elev. [mamsl]		Depth	SWL	Rep. yield	Est. max. abstraction*	Comments
	ground level	phreatic surface	[m]	[m]	[l/s]	[m³/day]	
Ross	431	407,3	84	23,7	1,8	58,3	Above lodge
GG	440	413,4	n/i	26,6	2,1	68,0	Next to drainage line

Notes: SWL = static water level; "n/i" = no information; mamsl = metres above mean sea level (SG 1:50 Topographical contour data); * = assumed 12-hour pumping period; no chemical data available.

From **Table 2** it is evident that:

- the reported yields for both boreholes Classify as *medium* [4], i.e. 1 – 5l/s
- using contours in the public domain (1:50 000 scale topographical maps), the phreatic surface for GG is six metres higher than that of the Ross borehole, i.e. suggesting flow away from GG. (This observation is deemed a worst-case scenario since the GG borehole is in production while the Ross borehole has yet to be commissioned).

v) Reported recharge for Klaserie and environs varies from 10 to 50mm [8], which implies that the Farm Ross has 51 800m^3 available per annum, using the lower recharge, i.e. being conservative. Using the current reported yields for the Ross borehole and an assumed pumping period of 9-hours per day, suggests that at the anticipated maximum available abstraction, the farm requires only 5mm recharge per annum to ensure the groundwater is not "mined", which could affect groundwater resources in the area. As such, we content that for the assumptions presented, the farm Ross is "entitled" to the groundwater from its borehole, and conservatively, will use less than 50% of what should be available from accumulated recharge. Speculation that groundwater use by Ross will adversely affect GG are disingenuous and are dismissed.

vi) Salient findings from our desktop assessment include:

- the stereoscopic analysis of available aerial photographs (**Figure 3**), did not identify lineaments that could indicate a conduit between the GG and Ross boreholes
- groundwater levels are relatively deep, suggesting that groundwater in the area is unlikely to be encountered in the surficial weathered bedrock, but confined to fractures in the bedrock
- the hydrostatic head difference between the Ross and GG boreholes at the time of our fieldwork, suggests groundwater flow, if possible, would be from away from GG;
- there is no merit to the assertion that the GG borehole will be adversely affected by the recently drilled borehole on Ross. If objections persist, it is recommended that GG Lodge undertake costly long-term test pumping of the Ross borehole, while having independent monitoring of their borehole water level
- if the Ross borehole is to be pursued as a potable source of water, detailed chemical testing must be undertaken to assess its suitability, bearing in mind the elevated conductivities that are typical of the area

6. Report provisions

While every effort is made during the fieldwork to identify the different soil and rock horizons and determine their distribution, guaranteeing that isolated zones of either lower permeability or shallow bedrock has not been identified is impossible under the constraints of an investigation of this nature. The investigation has therefore sought to highlight potential geotechnical constraints for soakaways and provide warning to the design engineers/environmentalists. The hydrogeological assessment, which included the stereoscopic analysis of available aerial photographs, for the most part constitutes a desktop study.

We trust the above comments suffice in your requirements of us at this project. However, should you have any queries, please do not hesitate to contact us.

Yours faithfully,

HJ Schurink, Pr.Sci.Nat.
for Geo3cc

Attached

- Figures 1 to 3
- Soil profiles and percolation test results
- Laboratory test results
- Additional considerations for soakaways

7. References

[1] South African Institute for Engineering Geologists - Association of Engineering Geologists - South African Institute of Civil Engineers (Geotechnical Division), "Guildelines for Soil and Rock Logging - Geotecchnology Workshop," SAIEG, Johannesburg, 1990.

[2] D. C. De Villiers, "Evaluation of sites for on-site sanitation systems," *The Civil Engineer in South Africa,* pp. 313-315, 1987.

[3] Government Gazette, "In situ percolation tests for soils," Government Gazette, Pretoria, 1985.

[4] South African Department of Water Affairs and Forestry, "Waste Management Series: Vol. 1 - 3 - Minimum Requirements for Waste Disposal by Landfill," CTP Book Printers, Cape Town, 1998 (2nd Edition).

[5] South African Department of Water Affairs and Forestry / Directorate Hydrogeological Services / Sub-Directorate Groundwater Information, "Aquifer Classification, Groundwater Quality, Vulnerability and Susceptibility Maps with explanatory notes. (Original Maps compiled by CSIR 1999).," Government Printers, Pretoria, August 2012.

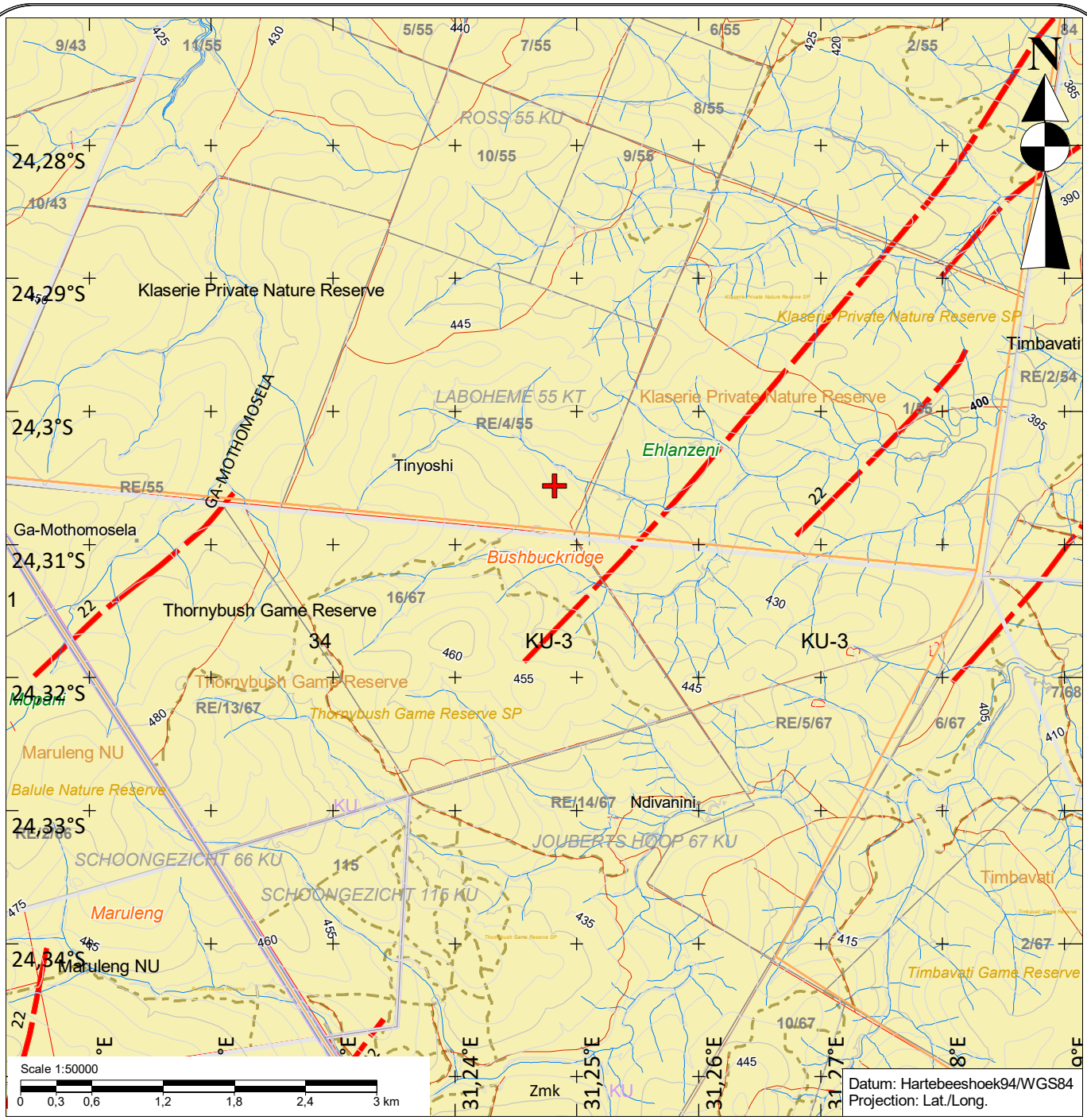
[6] J. R. Vegter, "Groundwater Resources of South Africa - An expalanation of a set of National Groundwater Maps," Water Research Commision, Pretoria, August 1995.

[7] T. C. Partridge and R. Maud, "Map showing the principal cyclic land surfaces of Southern Africa at 1:2 500 000.," *South African Journal of Geology,* vol. 90, no. (2), 1987.

[8] C. Musekiwa and K. Maola, "Groundwater vulnerability map for South Africa," Council for Geosicen Report Number: 2011-0063, Western Cape, 2011.

[9] R. J. Drews, "A guide to the use of septic tank systems in South Africa," CSIR Technical Guide, Pretoria, 1986.

[10] E. Wright, "The hydrogeology of crystalline basement aquifers in Africa," Geological Society Special Publication No 66, pp 1 - 27, Oxon, United Kingdom, 1992.



Legend

Geology (Council for Geosciences, 2014)

General

- M1/Jd - Diabase dyke
- Structural lineament

Swazian Era (c >3100)

- Zmk (Makhutswi Gneiss) - Homogeneous, light grey (leucocratic) medium-grained granodioritic/tonalitic biotite gneiss
- Zmk1 (Makhutswi Gneiss) - Recrystalized

PROJECT INFORMATION FOR:

#1347

General

- Site

Figure 1: Geology and Locality Map

PROJECT: **Engineering & Hydrogeological Investigations for Ptn 4 of Ross 55-KU**

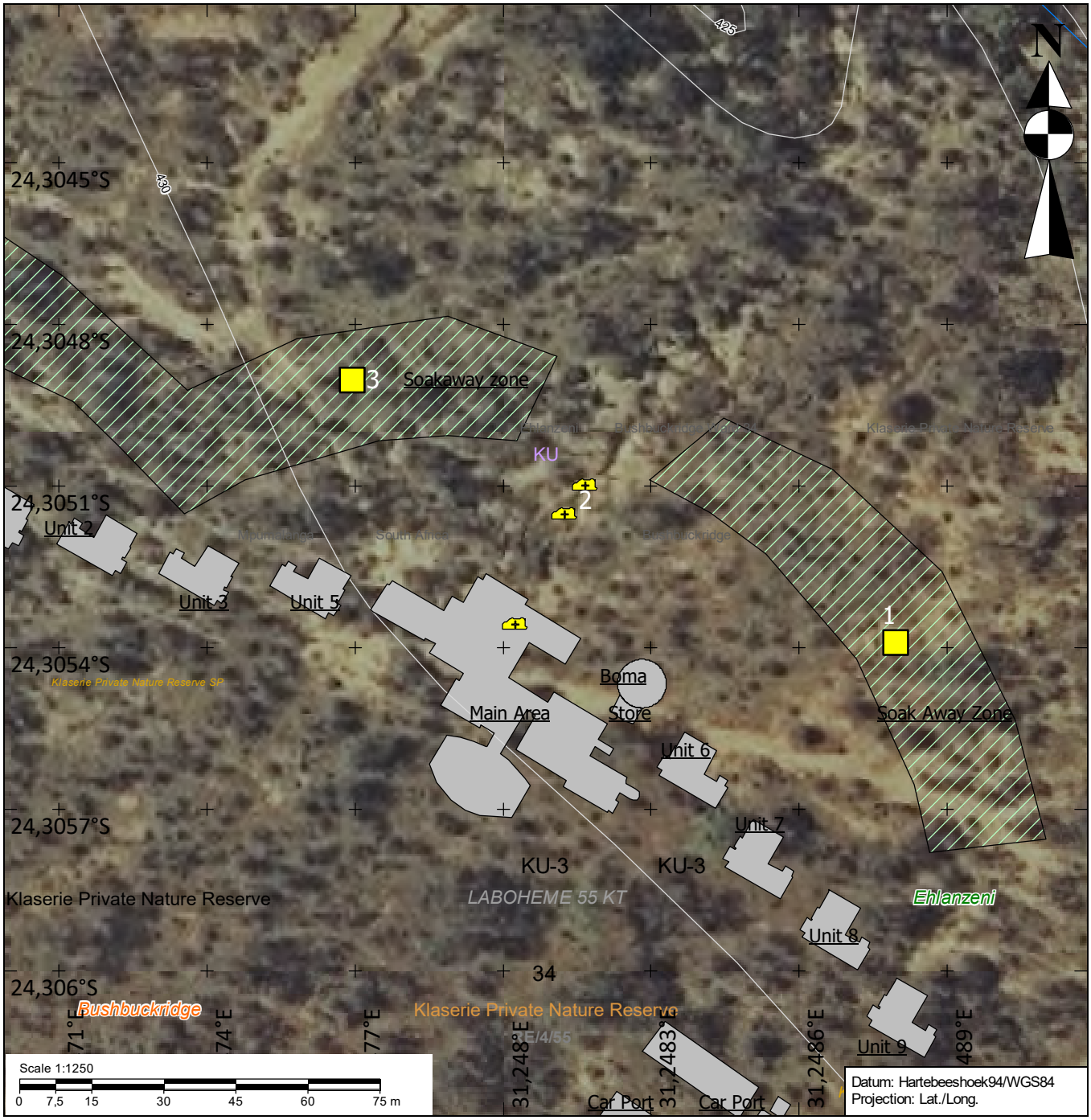
CLIENT: **Henwood Environmental Solutions (Pty) Ltd**

OUR REF.: **GD1347.01**

DATE: **August 2020**

GEO3 CC

Consulting Engineering, Hydro and Environmental Geologists
PO Box 6559, Nelspruit, 1200; Tel: 013 758 1226; www.geo3cc.co.za



Legend

PROJECT INFORMATION FOR:

#1347

General

- Gomo Gomo Lodge
- Possible soakaway areas (HS)

(imported KML) Proposed Camp

- Area Features

Fieldwork

- Pits terminating in granitic residua
- Granite outcrops noted during the fieldwork

Figure 2: Soakaway Map

PROJECT: **Engineering & Hydrogeological Investigations for Ptn 4 of Ross 55-KU**

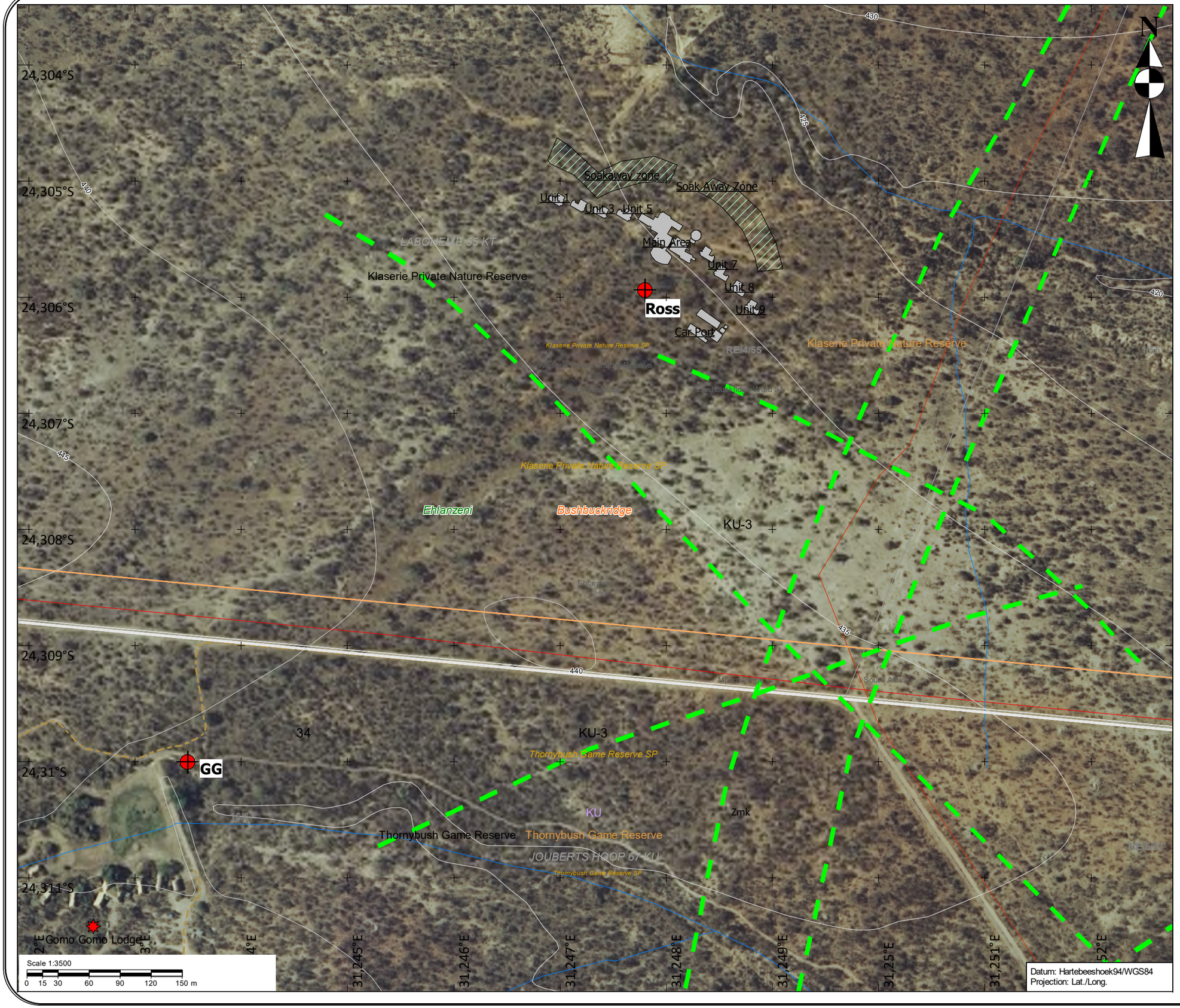
CLIENT: **Henwood Environmental Solutions (Pty) Ltd**

OUR REF.: **GD1347.02**

DATE: **August 2020**

GEO3 CC

Consulting Engineering, Hydro and Environmental Geologists
PO Box 6559, Nelspruit, 1200; Tel: 013 758 1226; www.geo3cc.co.za



Legend

Geology (Council for Geosciences, 2014)

General

- M1/Jd - Diabase dyke
- Structural lineament

PROJECT INFORMATION FOR:

#1347

General

- Gomo Gomo Lodge
- Possible soakaway areas (HS)

(imported KML) Proposed Camp

- Area Features

Groundwater

- Boreholes in question
- Airphoto lineaments

Notes:

1) Basemap compises annotated rectified aerial photograph.
2) Borehole positions have not been surveyed.

PROJECT: **Ptn 4 of Ross 55-KU**

CLIENT: **Henwood Environmental Solutions (Pty) Ltd**

OUR REF.: **GD1347.02**

DATE: **August 2020**

Figure 3: Hydrogeological Map

GEO3 CC
Consulting Engineering, Hydro and Environmental Geologists
PO Box 6559, Nelspruit, 1200; Tel: 013 758 1226; www.geo3cc.co.za.

SOIL DESCRIPTIVE TERMS

Descriptive Order - **1**. Moisture. **2**. Colour. **3**. Consistency. **4**. Soil Structure. **5**. Soil Type. **6**. Origin

1. MOISTURE CONDITION - assessment of insitu conditions.	
Dry	No water detectable; sample cannot be moulded.
Slightly Moist	Water just discernable; sample can be moulded.
Moist	Water easily discernable.
Very Moist	Water can be squeezed out.
Wet	Generally below the water table.

2. COLOUR - described in profile, at natural moisture content unless otherwise specified.	
Speckled	Very small patches of colour < 2mm
Mottled	Irregular patches of colour 2 - 6mm
Blotched	Large irregular patches 6-20mm
Banded	Approximately parallel bands of varying colour
Streaked	Randomly orientated streaks of colour
Stained	Local colour variations; associated with discontinuity surfaces

3(a) CONSISTENCY: GRANULAR SOILS - measure of the hardness or denseness of a soil

SPT "N"	GRAVELS & clean SANDS Generally free draining soils		Typical Dry Density(kg/m^3)
< 4	Very Loose	Crumbles very easily when scraped with geological pick.	< 1450
4 - 10	Loose	Small resistance to penetration by sharp geological pick.	1451 - 1600
>10 - 30	Medium dense	Considerable resistance to penetration by sharp end of geological point.	1601 - 1750
>30 - 50	Dense	Very high resistance to penetration by sharp end of geological pick; requires many blows of pick for excavation.	1751 - 1925
> 50	Very Dense	High resistance to repeated blows of geological pick; requires power tools for excavation.	> 1925

3(b) CONSISTENCY: COHESIVE SOILS - measure of the hardness or denseness of a soil

SPT "N"	SILTS and CLAYS and combinations thereof with SANDS. Generally slow draining soils (φ = 0 material).		UCS (kPa)
<2	Very soft	Pick point can easily be pushed in to shaft of handle; easily moulded by fingers.	< 50
2 - 4	Soft	Pick point can easily be pushed in 30 - 40 mm; moulded by fingers with some pressure; easily penetrated by thumb.	50 - 125
5 - 8	Firm	Pick point penetrates up to 10mm; very difficult to mould with fingers; indented by thumb with effort; can just be penetrated with an ordinary hand spade.	126 - 250
9 - 15	Stiff	Slight indentation produced by pushing pick point into soil; cannot be moulded by fingers; penetrated by thumb nail; requires hand pick for excavation.	251 - 500
16 - 20	Very Stiff	Slight indentation produced by blow of pick point; requires power tools for excavation; indented by thumb nail with difficulty.	501 -1000

4. **SOIL STRUCTURE** - presence or absence of fissures or other planes of weakness.	
Intact	Structureless, no discontinuities identified.
Fissured	Soil contains discontinuities which may be open or closed, stained or unstained and of variable origin.
Slickensided	Contains highly polished shear surfaces, glossy and often striated.
Shattered	Very closely to extremely closely spaced continuities resulting in gravel size soil fragments which are usually stiff to very stiff and difficult to break down.
Micro-shattered	As above, but sand-sized fragments.
Controlled / uncontrolled	Descriptive term for fill material; relates to whether the material has been engineered, i.e. controlled, or not, i.e. uncontrolled.
Open textured	Contains small voids between individual grains-visible to the naked eye. Alt pinholed.
Stratified	Parallel bedding planes. Laminated if layers are less than 20mm thick.
Varved	Alternating silty and clayey layers.
Foliated	Residual metamorphic texture.

5. SOIL TYPE - soil texture described on the basis of the grain size of particles.

SOIL TYPE	PARTICLE SIZE [mm]	REMARKS
CLAY	< 0.002	Feels sticky; soils hands; shiny when wet.
SILT	0.002 - 0.06	Dilatant; dusts off once dry; chalky feel on teeth.
SAND fine medium coarse	0.06 -0.2 0.2 - 0.6 0.6 - 2.0	Gritty on teeth. Visible to naked eye. Visible to naked eye.
GRAVEL fine medium coarse	2 - 6 6 - 20 20 - 60	Observed with the naked eye. **Matrix-supported** - clasts supported by matrix **Clast-supported** - clasts touching (matrix may or may not be present).
COBBLES	60 - 200	
BOULDERS	>200	

Fine grained soils: slightly <5%; clayey/silty 5-15%; very silty/clayey 15-35%.
Gravels / cobbles and boulders: occasional <5%, scattered 5-20%, numerous 20-45%; abundant >45%.

6. ORIGIN - origination of particular soil horizon.	
Transported	Alluvium, hillwash, talus, colluvium etc.
Residual	Weathered from parent rock.
Pedocretes	Ferricrete, calcrete, laterite, silcrete, dorbank etc.

DEGREE OF CEMENTATION OF PEDOCRETES		UCS (MPa)
Very weakly cemented	Some material can be crumbled between finger and thumb; disintegrates under knife blade to a friable state.	0.1 - 0.5
Weakly cemented	Cannot be crumbled with fingers; some material can be crumbled by strong pressure between thumb and hard surface; under light hammer blows disintegrates to a friable state.	0.5 - 2.0
Cemented	Material crumbles under firm blows of sharp pick point; grains can be dislodges with some difficulty by a knife blade.	2 - 5
Strongly cemented	Firm blows of sharp pick point on hand held specimen show 1 - 3 mm indentations; grains cannot be dislodged by knife blade.	5 - 10
Hardpan	Hand held specimen can be broken by single firm blow of hammer head; similar appearance to concrete.	10 - 25

Reference: *Guide to soil profiling for Civil Engineering Purposes* - Geoterminology Workshop (1990) SAIEG - AEG - SAICE (Geotechnical Division).

ROCK DESCRIPTIVE TERMS

Description for rocks masses: A - description of rock B - description of discontinueties C - description of fracture filling

A. ROCK DESCRIPTION	Descriptive Order for rock description: **1**. Colour **2**. Weathering **3**. Texture **4**. Fracture and microtexture **5**.Rock hardness **6**. Rock type.
1. Colour	Described wet.

2. Weathering

Degree of Weathering	Extent of Discolouration	Fracture Condition	Surface Characteristics	Original Fabric	Grain Boundary Condition
Unweathered	No visible alteration.	Closed or stained	Unchanged	Preserved	Tight
Slightly weathered	Fractures stained or discoloured < 20% of fracture spacing on both sides of fracture.	Discoloured, may contain thin filling	Partial discolouration. Often unweathered rock colour.	Preserved	Tight
Moderately weathered	Staining or discolouration extends >20% of fracture spacing on both sides of fracture.	Discoloured, may contain thick filling.	Partial to complete discolouration. Not friable except poorly cemented rocks.	Preserved	Partial opening
Highly weathered	Extends throughout the rock.	------	Friable and usually pitted	Mainly preserved	Partial separated.
Completely weathered	Totally discoloured.	------	Resembles a soil	Partially preserved	Complete separation of grains.

3. Texture / **4. Microstructure and fracture spacing**

Classification	Size	Recognition	Separation	Spacing (foliation, cleavage, bedding, etc.)	Spacing (fractures, joints, etc.)	Fracture spacings/metre
Very fine grained	< 0,2	Individual grains cannot be seen with a hand lens.	< 6	very intensely	Very highly	> 50
Fine grained	0,2 - 0,6	Just visible as individual grains under hand lens	6 - 20	intensely		
Medium grained	0,6 - 2,0	Grains clearly visible under hand lens, just visible to the naked eye.	20 - 60	very thinly	Highly	5 - 50
Coarse grained	2 - 6	Grains clearly visible to the naked eye.	60 - 200	thinly		
Very coarse grained	> 6	Grains measurable	200 - 600	medium	Moderately	~1 - 5
			600 - 2 000	thickly	Slightly	~ 1
			> 2 000	very thickly	Very Slightly	< 1

5. Rock Hardness

Hardness	Description	UCS (MPa)	Hardness	Description	UCS (MPa)
Very soft rock	Material crumbles under firm blow with geological pick point; can be peeled with a knife; too hard to cut undisturbed sample by hand.	1 - 3	Hard rock	Breaks with difficulty, rings when struck. Point load or laboratory test results necessary to distinguish between categories.	25 - 70
Soft rock	Can just be scraped and peeled with a knife; 1-3mm indents with firm blow of geological pick.	3 - 10	Very hard rock		70 - 200
Medium hard rock	Firm blows of pick head will break hand held specimen. Cannot be scraped or peeled with a knife.	10 - 25	Extremely hard rock		> 200

6. Rock Type	According to accepted lithographic terminology.
B. DISCONTINUITY SURFACE DESCRIPTION:	Descriptive Order for joint description: **1**.Type **2**. Separation **3**.Fill material **4**. Roughness **5**. Orientation
1. Type	Bedding planes, flow banding, foliation, joints, shears, faults, fractures.

2. Seperation / **3. Fracture filling** / **4. Roughness of discountinuity planes**

Description	Separation	Description	Definition	Classification	Description
Closed	0	Clean	No fracture filling material	Smooth	Appears smooth and is essentially smooth to the touch. May be slickensided.
Very narrow	0 - 0,6	Stained	Colouration of rock only. No recognisable filling.	Slightly rough	Aspiraties on the fracture surface are visible and can be distinctly felt.
Narrow	0,6 - 2,0	Filled	Recognisable filling material.	Medium rough	Asperities are clearly visible and fracture surface feels abrasive.
Wide	2,0 - 6,0			Rough	Large angular asperities can be seen. Some ridge and high side angle steps are evident.
Very wide	6,0 - 20			Very rough	Near vertical steps and ridges occur on the fracture surface.

5. Discontinuity orientation	Discontinuity inclinations (i.e. of joints, bedding, faults,etc.) are measured with respect to the horizontal i.e. a vertical joint dips at 90° in orientated core the fracture inclinations are w.r.t. the core axis.
C. FRACTURE FILLING DESCRIPTION	Fracture filling should be described in terms of the MCCSSO Soil Classification

Note: All dimensions in mm unless otherwise stated. REFERENCE: **South African Institute of Engineering Geologists**, 1990. *Guidelines for soil and rock logging - Geotechnology Workshop.*

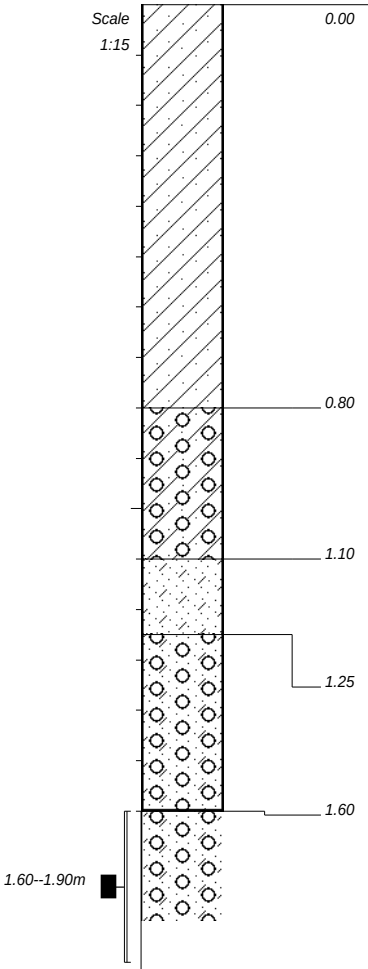
GEO3 CC
PO Box 6559
Helenmut
1200
Tel: (013) 758 1226

Henwood Environmental Solutions (Pty) Ltd

Ptn 4 of the farm Ross 55-KU

HOLE No: TP01
Sheet 1 of 1

JOB NUMBER: 1347



0.00 – Dry, reddish brown (in profile reddish brown), **stiff**, pinholed, sandy CLAY with occasional fine gravels; fine colluvium.

0.80 – Abundant predominantly medium and fine GRAVELS, loosely packed in a matrix as above; overall consistency **firm - stiff**; pebble marker - intermittent and thins.

1.10 – Dry, yellowish brown (in profile yellowish brown blotched various shades of brown and buff locally), **firm**, pinholed, clayey SAND with occasional gravels; reworked residual gneiss.

1.25 – Dry, yellowish brown (in profile yellowish brown speckled white), **dense**, intact, clayey SAND with numerous GRAVELS that become more numerous with depth; partially reworked residual gneiss.

1.60 – (LL = 39, PI = 11, LS = 4,8%, GM = 2,25; **SM**, activity = low; percolation = 26min/25mm).

NOTES

1) Pit excavated without refusal.

2) No groundwater seepage encountered.

3) Percolation test undertaken at 1.60--1.90m, together with sample recovered for indicator tests over the same depth.

CONTRACTOR :
MACHINE : Kubota BT1000
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 August 2020
DATE : 03/09/2020 08:16
TEXT : ..ts\1347\1347testpits.txt

DATUM : WGS84/Lo31
S / X-COORD : 31.24880
E / Y-COORD : -24.30539

HOLE No: TP01

PERCOLATION TEST

Site:	Ptn 4 of the farm Ross 55-KU	Position number:	TP 1
Client:	Henwood Environmental Solutions (Pty) Ltd	Date:	26-Aug-20
Test depth:	1,60 m	Start of test:	10:50 am
Remarks:	undertaken in base of pit	End of test:	3:35 pm

PERCOLATION RATE [min / 25mm]: **25,6**

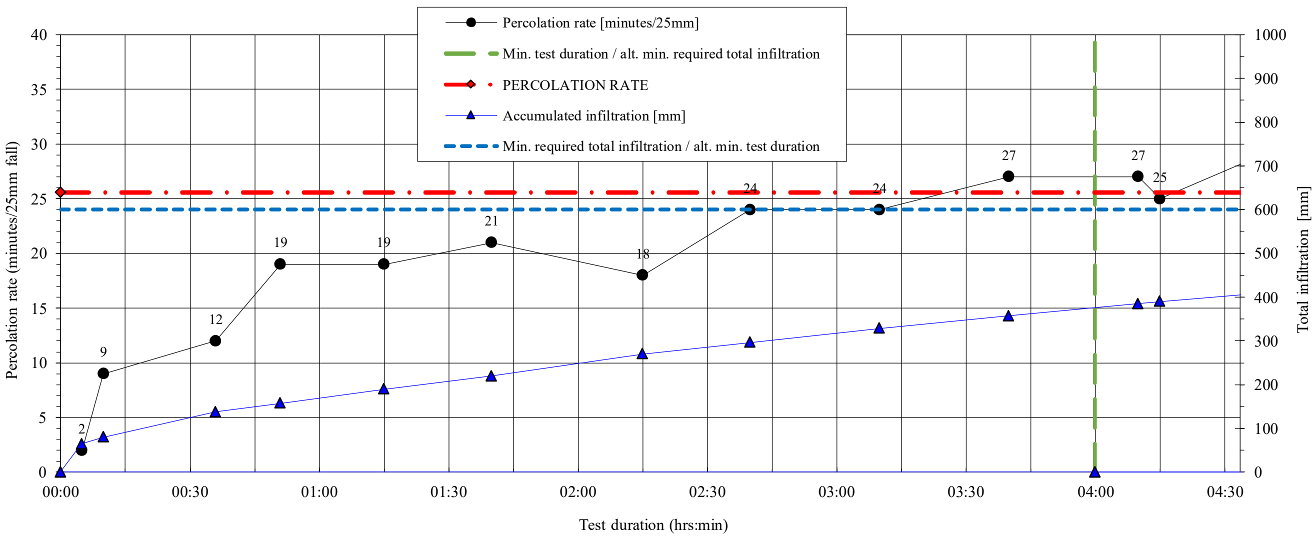
sites may not be suitable for septic tanks, especially if they are small*.

Recommended maximum rate of septic tank effluent application to subsoil infiltration areas: 33 **litres/m^2/day****

Time (hrs:min)	Water level start [mm]	Water level final [mm]	Change in level [mm]	Total infiltration [mm]	Percolation rate [mm/hour]	Percolation rate [min/25 mm]	Remarks
10:50		270					
10:55	270	205	65	65	780	1,9	
11:00	205	190	15	80	180	8,3	
11:26	250	192	58	138	134	11,2	
11:41	192	172	20	158	80	18,8	
12:05	252	220	32	190	80	18,8	
12:30	220	190	30	220	72	20,8	
13:05	255	205	50	270	86	17,5	
13:30	205	178	27	297	65	23,2	
14:00	250	218	32	329	64	23,4	
14:30	218	190	28	357	56	26,8	
15:00	248	220	28	385	56	26,8	
15:05	220	215	5	390	60	25,0	
15:35	255	230	25	415	50	30,0	
				415		30,0	
				415		30,0	
				415		30,0	
				415		30,0	
				415		30,0	
				415		30,0	
				415		30,0	
				415		30,0	
				415		30,0	
				415		30,0	
				415		30,0	
				415		30,0	
				415		30,0	
				415		30,0	
				415		30,0	
				415		30,0	
				415		30,0	
				415		30,0	

* de Villiers (1987); ** Government Gazette (1985).

tp01 @ 1,60m (percolation rate v2.1).xlsx



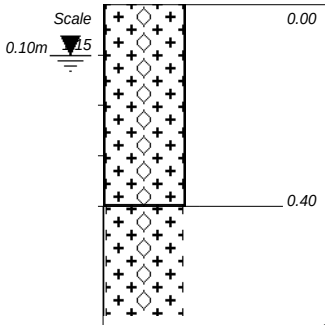
GEO3 CC
PO Box 6559
Helenmut
1300
Tel: (013) 758 1226

Henwood Environmental Solutions (Pty) Ltd

Ptn 4 of the farm Ross 55-KU

HOLE No: TP02
Sheet 1 of 1

JOB NUMBER: 1347



Buff, highly weathered, coarse grained, fractured, **soft rock**; GNEISS.

NOTES

1) Profile recorded in a shallow river cutting - sub-outcropping gneiss along the length of the stream.

2) Susceptible to surface flow.

3) No samples taken.

CONTRACTOR :
MACHINE : none
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 August 2020
DATE : 03/09/2020 08:16
TEXT : ..ts\1347\1347testpits.txt

DATUM : WGS84/Lo31
S / X-COORD : 31.24812
E / Y-COORD : -24.30515

HOLE No: TP02
outcrop

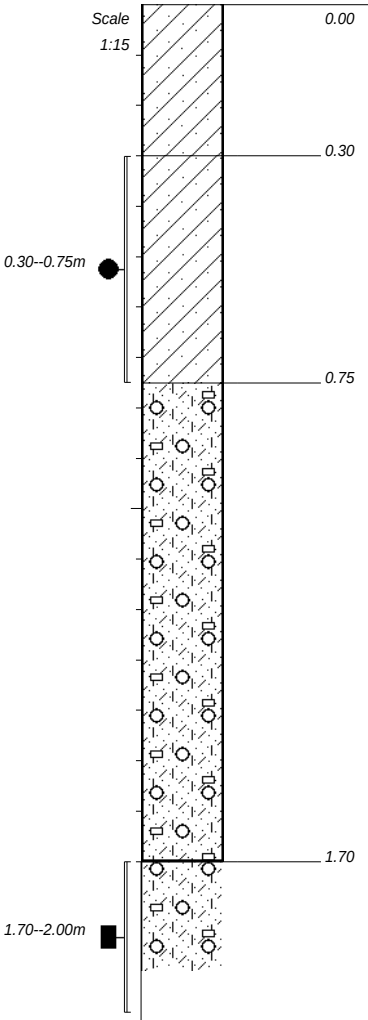
GEO3 CC
PO Box 6559
Helenmut
1300
Tel: (013) 758 1226

Henwood Environmental Solutions (Pty) Ltd

Ptn 4 of the farm Ross 55-KU

HOLE No: TP03
Sheet 1 of 1

JOB NUMBER: 1347



Dry, dark brown (in profile dark brown), **stiff**, weakly shattered, sandy CLAY; large roots; topsoil.

Dry, black (in profile dark brown), **stiff**, shattered, sandy CLAY; gullywash.

(LL = 37, PI = 15, LS = 6,7%, GM = 0,65; **CL**, activity = low).

Dry, yellowish brown (in profile yellowish brown), **firm**, intact, clayey silty SAND with scattered gravels and friable calcrete nodules; reworked residual gneiss.

(LL = 38, PI = 16, LS = 7,2%, GM = 1,68; **SC**; activity = low; percolation = 26min/25mm).

NOTES

1) Pit excavated without refusal.
2) No groundwater seepage encountered.
3) Indicator samples taken at 0.30--0.75m.
4) Percolation test undertaken at 1.70--2.00m, together with sample recovered for indicator tests over the same depth.

CONTRACTOR :
MACHINE : Kubota BT1000
DRILLED BY :
PROFILED BY : H. Schurink, Pr.Sci.Nat.
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE : 20 August 2020
DATE : 03/09/2020 08:16
TEXT : ..ts\1347\1347testpits.txt

DATUM : WGS84/Lo31
S / X-COORD : 31.24769
E / Y-COORD : -24.30490

HOLE No: TP03

PERCOLATION TEST

Site:	Ptn 4 of the farm Ross 55-KU	Position number:	**TP 3**
Client:	Henwood Environmental Solutions (Pty) Ltd	Date:	26-Aug-20
Test depth:	1,70 m	Start of test:	11:55 am
Remarks:	undertaken in base of pit	End of test:	4:25 pm

PERCOLATION RATE [min / 25mm]: **26,4**

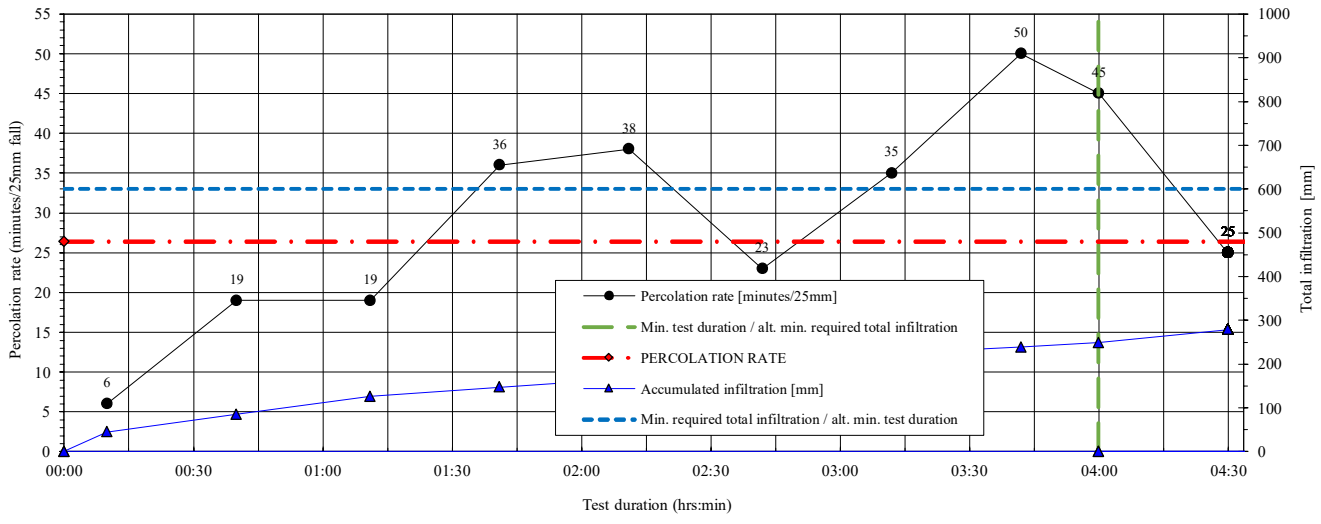
sites may not be suitable for septic tanks, especially if they are small*.

Recommended maximum rate of septic tank effluent application to subsoil infiltration areas: 33 **litres/m²/day****

Time	Water level		Change in level	Total infiltration	Percolation rate		Remarks
	start	final					
(hrs:min)	[mm]	[mm]	[mm]	[mm]	[mm/hour]	[min/25 mm]	
11:55		280					
12:05	280	235	45	45	270	5,6	
12:35	235	195	40	85	80	18,8	
13:06	280	239	41	126	79	18,9	
13:36	239	218	21	147	42	35,7	
14:06	218	198	20	167	40	37,5	
14:37	280	245	35	202	68	22,1	
15:07	245	223	22	224	44	34,1	
15:37	223	208	15	239	30	50,0	
15:55	208	198	10	249	33	45,0	
16:25	280	250	30	279	60	25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	
				279		25,0	

* de Villiers (1987); ** Government Gazette (1985).

tp03 @ 1,70m (percolation rate v2.1).xlsx



GEO3 CC
PO Box 6559
Helspruit
1200
Tel: (013) 758 1226

Henwood Environmental Solutions (Pty) Ltd

Ptn 4 of the farm Ross 55-KU

LEGEND

Sheet 1 of 1

JOB NUMBER: 1347

	GRAVELS	{SA02}
	GRAVELLY	{SA03}
	SAND	{SA04}
	SANDY	{SA05}
	SILTY	{SA07}
	CLAY	{SA08}
	CLAYEY	{SA09}
	PLUTONIC/norite/syenite	{SA17}
	FREE QUARTZ/visible quartz	{SA44}
	GNEISS	{SA17}{SA44}
	SCATTERED CALCRETE NODULES	{SA28}
11.5	WATER TABLE/permanent water table	{SA35}
Name	UNDISTURBED SAMPLE	{SA37}
Name	DISTURBED SAMPLE	{SA38}

CONTRACTOR :
MACHINE :
DRILLED BY :
PROFILED BY :
TYPE SET BY :
SETUP FILE : STANDARD.SET

INCLINATION :
DIAM :
DATE :
DATE :
DATE : 03/09/2020 08:16
TEXT : ..ts\1347\1347testpits.txt

DATUM :
S / X-COORD :
E / Y-COORD :

LEGEND

SUMMARY OF SYMBOLS

EngeoLab (Pty) Ltd
Civil Engineering Materials Laboratory

FOUNDATION INDICATOR TEST RESULT

Tests undertaken in terms of TMH 1 Methods: A1a, A2, A3, A4, A5

CLIENT:	Geo3cc		PROJECT :	1347		Date	Job No.	2107
Position :	TP01	Depth [m] :	1,60-1,90	Source :	insitu	28-Aug-20	Sample No.	0394

SIEVE ANALYSIS (% PASSING)

53.0mm	37.5mm	26.5mm	19.0mm	13.2mm	9.5mm	4.75mm	2.0mm	0.425mm	0.250mm	0.150mm	0.075mm	0.060mm	0.050mm	0.020mm	0.006mm	0.005mm	0.002mm	0.0018mm
100	100	100	84	75	66	52	37	23	19	17	15	13	11	7	4	4	4	3

ATTERBERG LIMITS

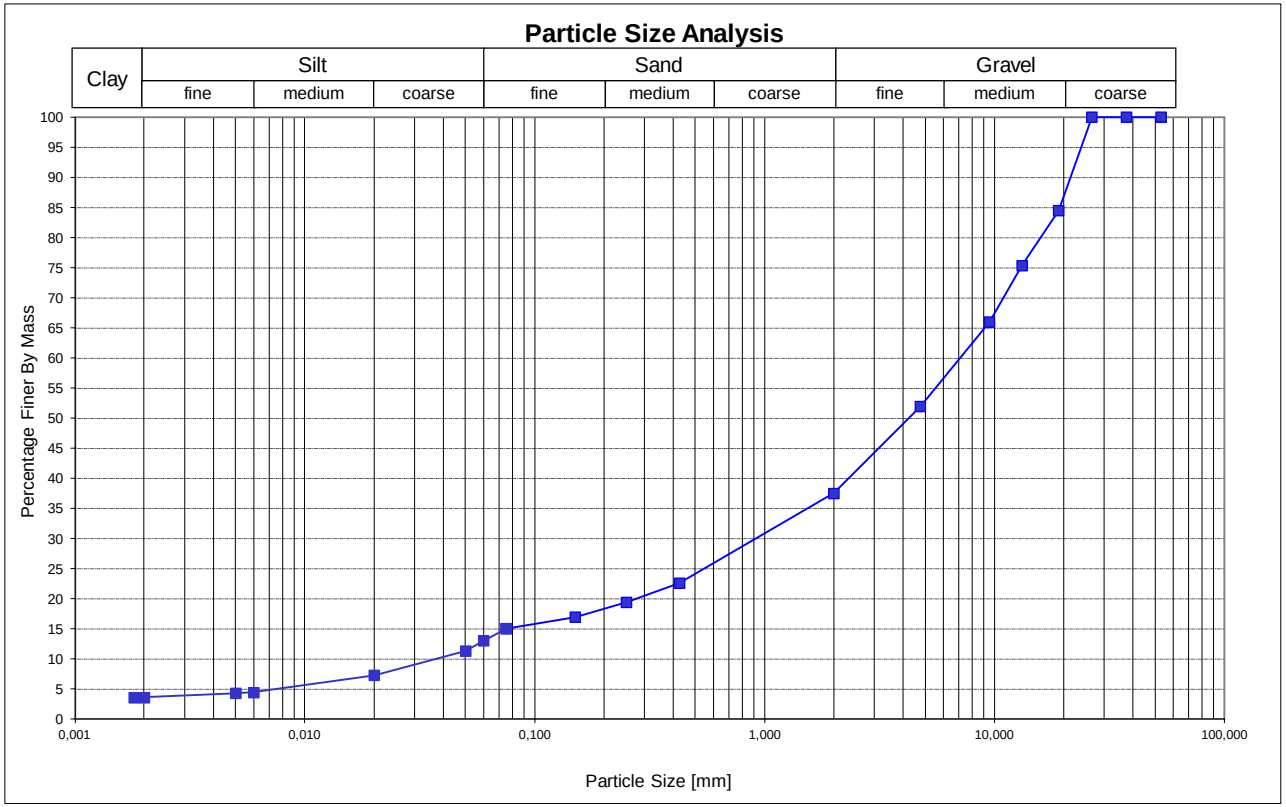
Liquid Limit	Plasticity Index	PI (weighted)	Linear Shrinkage	Grading modulus
39	11	2	4,8	2,25

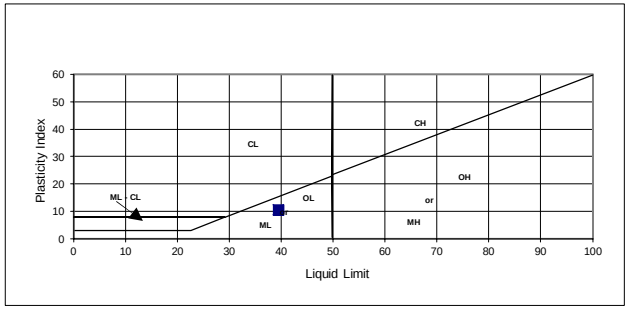
CLASSIFICATION

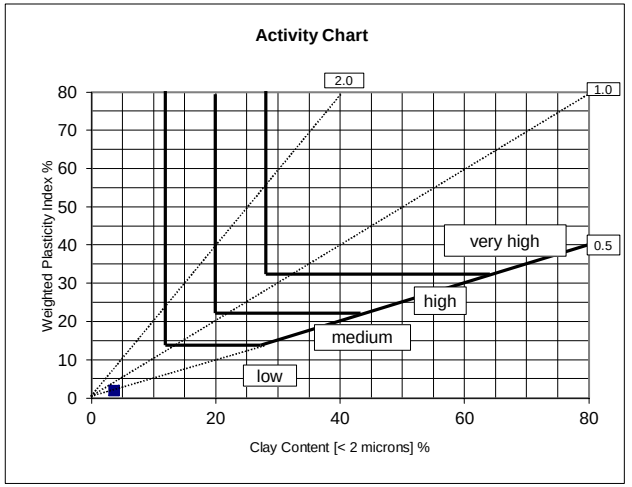
UNIFIED	PRA	TRH
SM	A.2.6 (0)	

Soil constituents % :	Clay :	4	Silt :	9	Sand :	25	Gravel :	63	Fines :	23	Soil description :	light brown

D_{10} :	0,038	D_{30} :	0,920	D_{60} :	7,088	Uniformity coefficient :	189	Curvature coefficient :	3	Active program :	YES







REMARKS: **none**

CHECKED BY : H Schurink

EngeoLab (Pty) Ltd
Civil Engineering Materials Laboratory

FOUNDATION INDICATOR TEST RESULT

Tests undertaken in terms of TMH 1 Methods: A1a, A2, A3, A4, A5

CLIENT:	Geo3cc		PROJECT :	1347		Date	Job No.	2107
Position :	TP03	Depth [m] :	0,30-0,75	Source :	insitu	28-Aug-20	Sample No.	0395

SIEVE ANALYSIS (% PASSING)

53.0mm	37.5mm	26.5mm	19.0mm	13.2mm	9.5mm	4.75mm	2.0mm	0.425mm	0.250mm	0.150mm	0.075mm	0.060mm	0.050mm	0.020mm	0.006mm	0.005mm	0.002mm	0.0018mm
100	100	100	100	100	100	100	98	77	71	65	60	59	58	44	34	33	29	29

ATTERBERG LIMITS

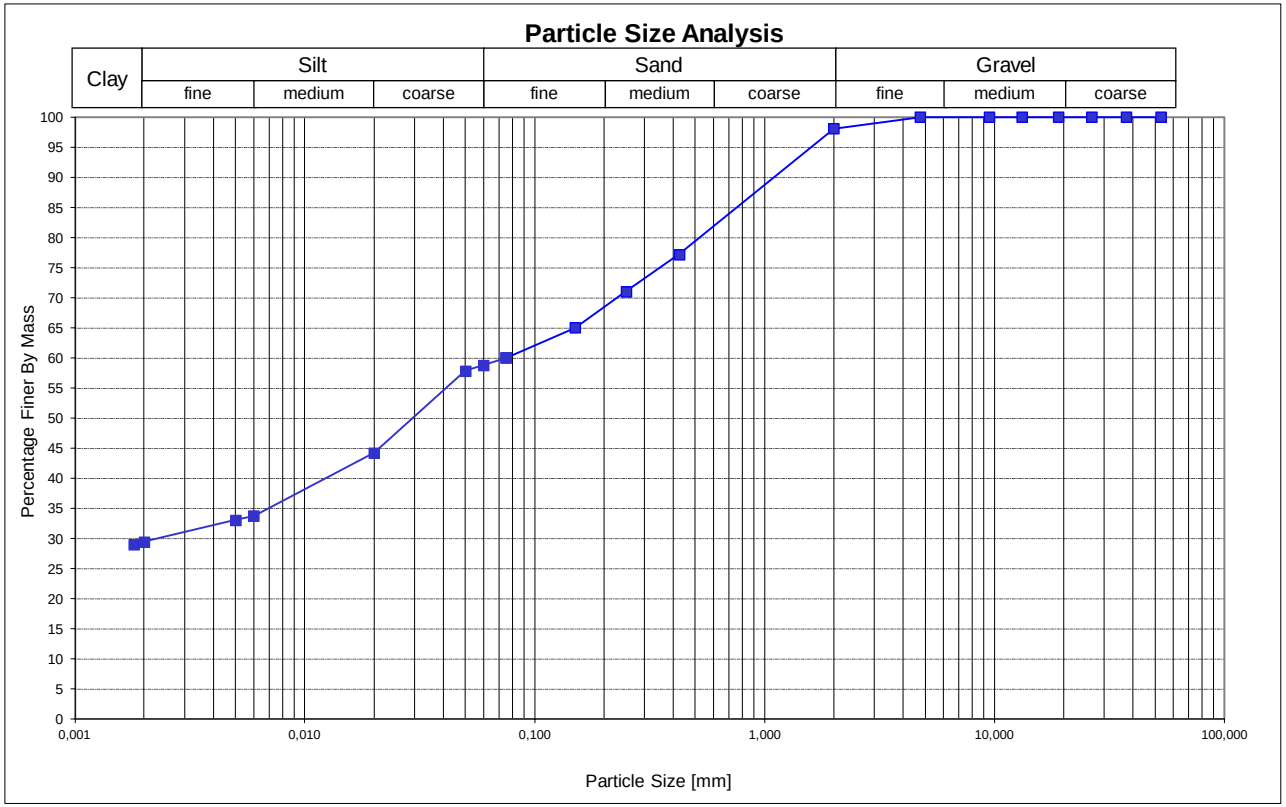
Liquid Limit	Plasticity Index	PI (weighted)	Linear Shrinkage	Grading modulus
37	15	11	6,7	0,65

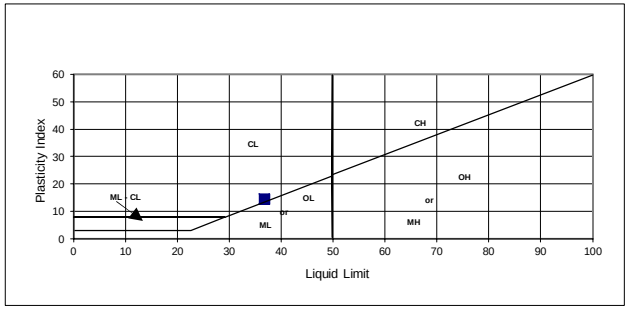
CLASSIFICATION

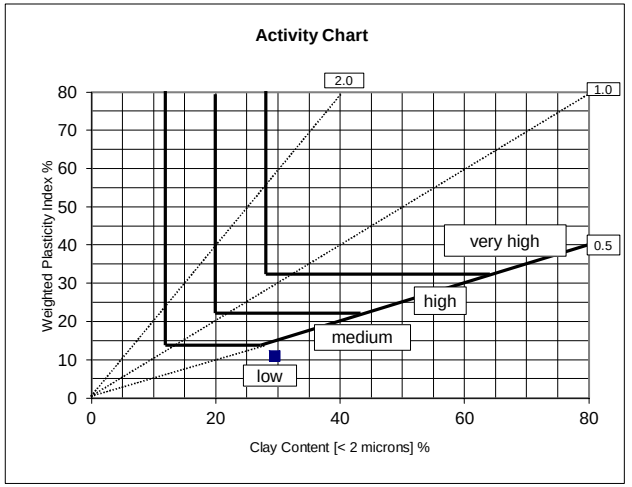
UNIFIED	PRA	TRH
CL	A.6 (7)	

Soil constituents % :	Clay :	29	Silt :	29	Sand :	39	Gravel :	2	Fines :	77	Soil description :	dark grey

D_{10} :		D_{30} :	0,002	D_{60} :	0,075	Uniformity coefficient :	not available	Curvature coefficient :	not available	Active program :	YES







REMARKS: **none**

CHECKED BY : H Schurink

EngeoLab (Pty) Ltd
Civil Engineering Materials Laboratory

FOUNDATION INDICATOR TEST RESULT

Tests undertaken in terms of TMH 1 Methods: A1a, A2, A3, A4, A5

CLIENT:	Geo3cc	**PROJECT :**	1347		
Position :	TP03	**Depth [m] :**	1,70-2,00	**Source :**	insitu

Date	**Job No.**	2107
28-Aug-20	**Sample No.**	0396

SIEVE ANALYSIS (% PASSING)

53.0mm	37.5mm	26.5mm	19.0mm	13.2mm	9.5mm	4.75mm	2.0mm	0.425mm	0.250mm	0.150mm	0.075mm	0.060mm	0.050mm	0.020mm	0.006mm	0.005mm	0.002mm	0.0018mm
100	100	100	100	98	94	81	62	44	39	35	26	23	20	12	6	6	6	5

ATTERBERG LIMITS

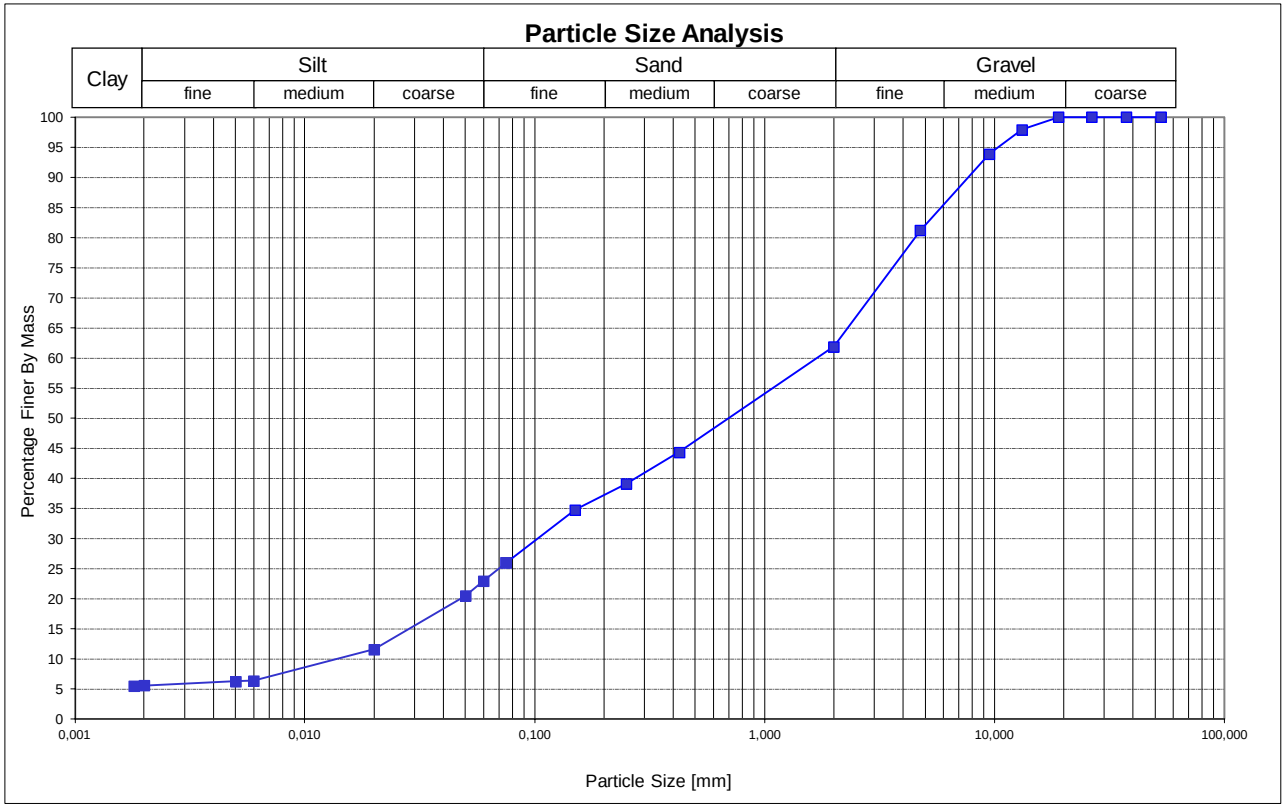
Liquid Limit	Plasticity Index	PI (weighted)	Linear Shrinkage	Grading modulus
38	16	7	7,2	1,68

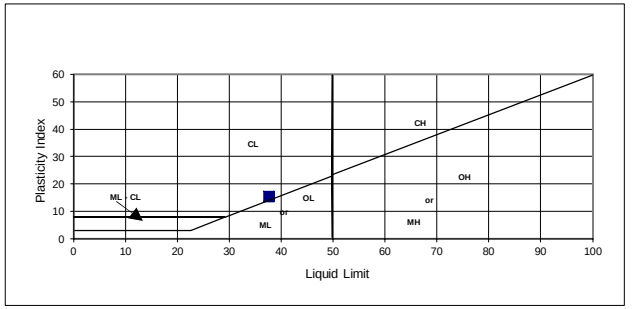
CLASSIFICATION

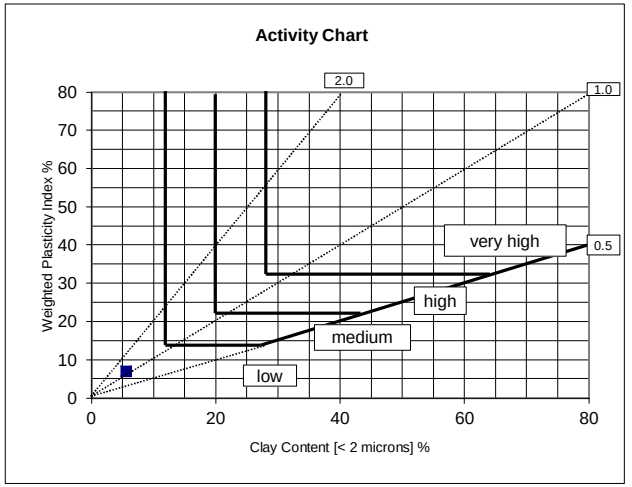
UNIFIED	PRA	TRH
SC	A.2.6 (0)	

Soil constituents % :	**Clay :**	6	**Silt :**	17	**Sand :**	39	**Gravel :**	38	**Fines :**	44	**Soil description :**	light brown

D_{10} :	0,014	**D_{30} :**	0,103	**D_{60} :**	1,699	**Uniformity coefficient :**	121	**Curvature coefficient :**	0	Active program :	YES







REMARKS: **original sample**

CHECKED BY : H Schurink

EngeoLab (Pty) Ltd
Civil Engineering Materials Laboratory

FOUNDATION INDICATOR TEST RESULT

Tests undertaken in terms of TMH 1 Methods: A1a, A2, A3, A4, A5

CLIENT:	Geo3cc		PROJECT :	1347		Date	Job No.	2107
Position :	TP03	Depth [m] :	1,70-2,00	Source :	insitu	28-Aug-20	Sample No.	0396

SIEVE ANALYSIS (% PASSING)

53.0mm	37.5mm	26.5mm	19.0mm	13.2mm	9.5mm	4.75mm	2.0mm	0.425mm	0.250mm	0.150mm	0.075mm	0.060mm	0.050mm	0.020mm	0.006mm	0.005mm	0.002mm	0.0018mm
100	100	100	100	98	94	81	65	44	39	35	26	23	20	12	6	6	6	5

ATTERBERG LIMITS

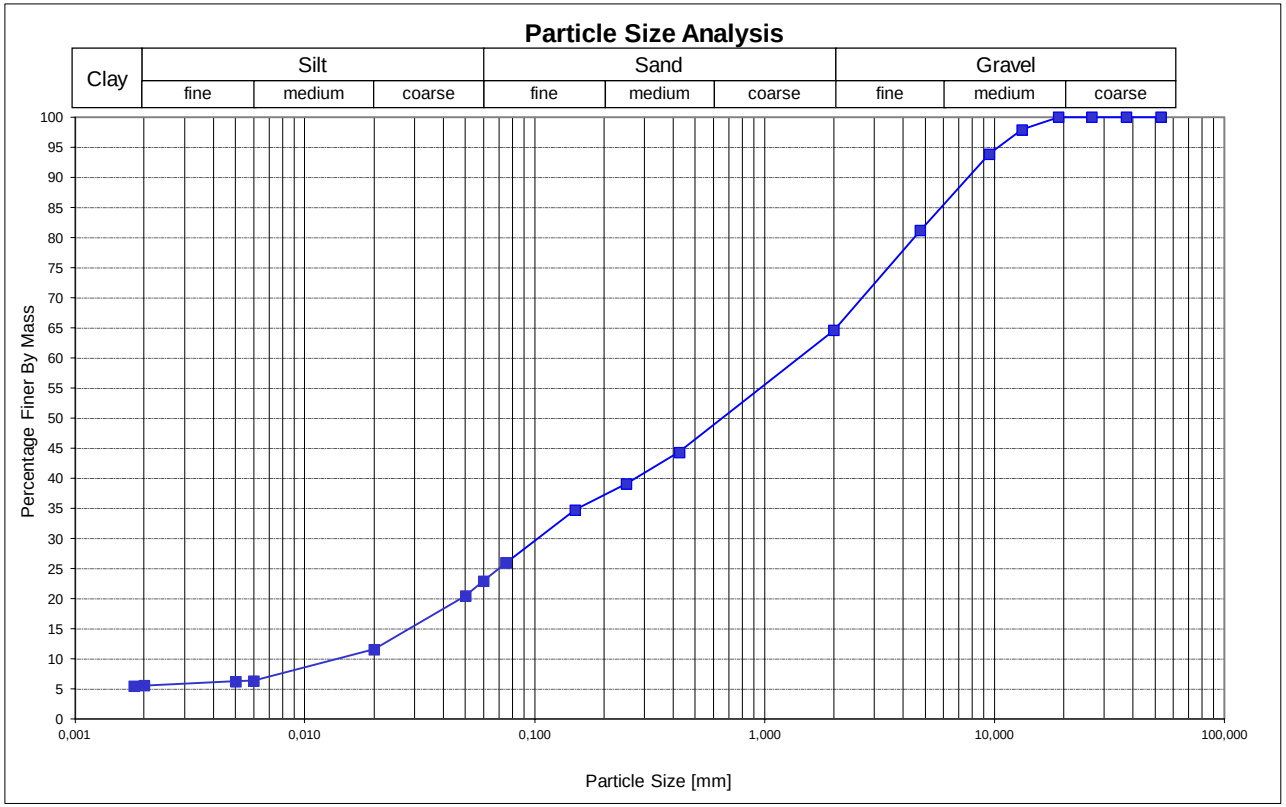
Liquid Limit	Plasticity Index	PI (weighted)	Linear Shrinkage	Grading modulus
37	14	6	6,3	1,65

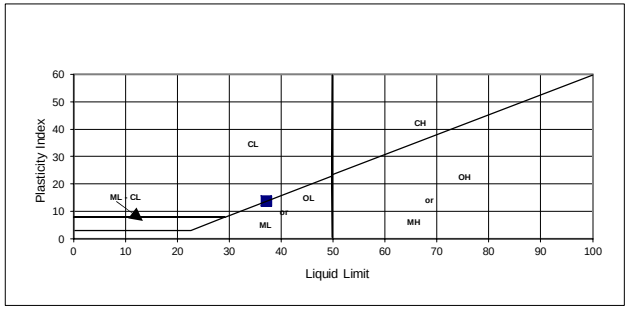
CLASSIFICATION

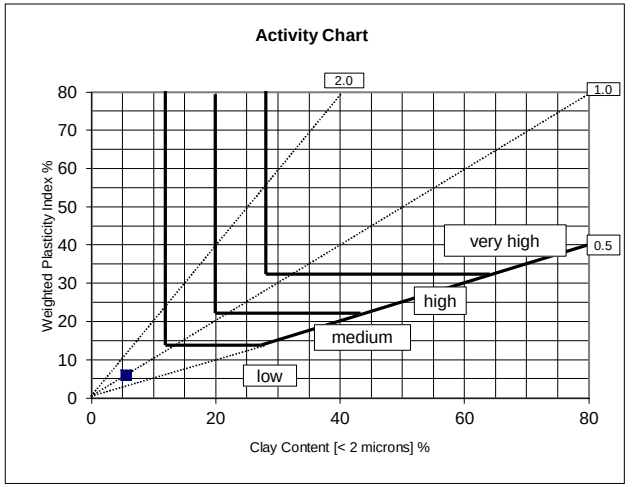
UNIFIED	PRA	TRH
SC	A.2.6 (0)	

Soil constituents % :	Clay :	6	Silt :	17	Sand :	42	Gravel :	35	Fines :	44	Soil description :	light brown

D_{10} :	0,014	D_{30} :	0,103	D_{60} :	1,414	Uniformity coefficient :	100	Curvature coefficient :	1	Active program :	YES







REMARKS: **after wash**

CHECKED BY : H Schurink

Additional considerations for soakaways

In the event a soakaway is to be pursued:

- Since the bottom of the trench will clog more rapidly than the sidewalls, the infiltration area should be calculated from the sidewalls of the trench only, from at least 0,5m below ground level to the base of the trench, but also exclude the surficial fine-grained transported soils. Consequently, deep narrow trenches are preferred to shallow, broad trenches.
- The end user must be educated as to the limitations of the system to prevent clogging, i.e. what may and may not be disposed in the system.
- Grease traps must be installed at points of egress from outlets containing fatty wastewater, e.g. kitchens etc., failing which the drain's life will be considerably reduced.
- The use of dual drains is recommended, allowing a "rest period" for each trench, which should extend the overall life span of the system. A further advantage is that in the event of one soakaway failing, the discharge can be switched to the next while the clogged one is replaced/rehabilitated.
- Drains should be designed to run parallel to the contours.
- Since the trench is likely to be excavated using a backhoe or similar, the sides of the more clayey sections of the trench, must be roughened to restore a natural infiltration surface.
- The size of the filling material is not critical, but the material should be clean and dust free; builders' rubble is not acceptable. The size of gravel may be anything from 2cm to 10cm or larger [7], with any distribution pipe placed directly on top of the gravel, below PVC sheeting or similar cover.
- For trenches longer than 6m, a distribution pipe must be used to encourage effluent flow over the full length of the trench.
- Owing to the heterogeneous nature inherent of soils and the fact that the percolation test is an empirical assessment with many technical weaknesses [7], the trenches should be designed to allow them to be extended if needed.

Since the area in general is prone to the development of a perched groundwater, water-loving vegetation should ideally be planted along or immediately downslope of the soakaway to facilitate the uptake of moisture. Surface water from around the proposed lodge should be diverted away from the area(s) earmarked for the soakaway.