FINAL ENVIRONMENTAL IMPACT REPORT APPENDICES

ALTERATION OF NATURAL LAND AND TRANSFORMED LAND (OLD LANDS) FOR AGRICULTURAL USE AND CLEARANCE OF AN AREA OF 80 HA AND THE CONSTRUCTION OF A LOW-LEVEL CROSSING ON THE FARM: KROKODILSPRUIT 248 JT: WHITE RIVER AREA, MPUMALANGA. PROJECT NR.: 1/3/1/16/1E-405.

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ABBREVIATIONS

ASAP	As Soon As Possible
Asl	Above sea level
cm	centimetre
DARDLA	Department of Agriculture: Resource Management: Provincial
DARDLEA Affairs	Department of Agriculture, Rural Development, Land and Environmental
DFFE	Department of Forestry, Fisheries and Environment (Mpumalanga)
DWS	Department of Water and Sanitation
EAP	Environmental Assessment Practitioner
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EIR	Environmental Impact Report
EMPr	Environmental Management Programme
ESKOM	Electricity Supply Commission
GPS	Geographical Positioning System
HIA	Heritage Impact Assessment
HIV	Human Immunodeficiency Virus
I&AP's	Interested and Affected Parties
IEM	Integrated Environmental Management
LFIS	Low Flow Irrigation System
m	metre
mm	millimetre
m/s	metre per second
NA	Not Applicable
NEMA	National Environmental Management Act
MBSP	Mpumalanga Biodiversity Sector Handbook
MTPA	Mpumalanga Tourism and Parks Agency
OMPr	Operational Management Programme
PDI	Previously Disadvantaged Individual
RES	Rhengu Environmental Services
ROW	Right of Way

RTK	Real Time Kinematic
SABS	South African Bureau of Standards
SAHRA	South African Heritage Resources Agency
sqm	square metre

APPENDIX 4.5.2:
TERRESTRIAL ECOLOGY/BIODIVERSITY REPORT

KROKODILSPRUIT FARM: ALTERATION OF LAND FOR AGRICULTURAL USE.

Specialist Study: Ecological Assessment

DR ANDREW DEACON
September 2022

KROKODILSPRUIT FARM: ALTERATION OF LAND FOR AGRICULTURAL USE.

An EIA for the development of 80 ha for orchards and a low-level river crossing on Portion 248 JT of the farm Krokodilspruit in the White River area (Mpumalanga)

Specialist Study: Ecological Assessment.

September 2022

Dr. Andrew Deacon (PhD Zoology)

Registered with the South African Council for Natural Scientific Professions
(Registration number: 116951)

Executive Summary

Rhengu Environmental Services were appointed to undertake an Environmental Impact Assessment on Portion 248 JT of the farm Krokodilspruit in the White River area (Mpumalanga) and this specialist ecological study forms part of the EIA process for the proposed project.

The applicant, DANROC (Pty) Ltd. wishes to implement the alteration of land for agricultural use to establish macadamia and avocado orchards, on 72.5 ha land suitable for these crops. During the proposal period of the project, three different sections of the farm were considered to determine if the land is arable for macadamias and avocado pears.

Project Specifics include:

- Remove indigenous vegetation on approximately 80 ha and establish orchards for agricultural use.
- Development of orchard roads.
- Construction of a low-level river crossing to accommodate equipment and vehicles during harvesting- and general farming operations.

The proposed crossing is situated in the northern part of the Krokodilspruit farm. The advantages of this proposed crossing will enable more sufficient and quicker firefighting activities along the northern boundary of the farm without having to take a long detour. The location found suitable for the proposed low-level crossing consists of large rock formations which will allow for the construction of a stable and reliable crossing.

A total of five units consisting of untransformed habitat types and two units consisting of transformed habitat types that will be associated with the project area.

Vegetation unit and land cover type:

Untransformed vegetation/habitat

1. Untransformed Grassland – North-eastern Mountain Grassland
2. Woodland
3. Perennial rivers
4. Eastern Dry Afrotemperate Forests around drainage lines
5. Rocky outcrops or Granite Inselbergs

Transformed vegetation/habitat

6. Forestry
7. Secondary Grassland: Old and fallow lands

Three sites have been delineated as the preferred sections. See section sizes below:

Section	Area (ha)
1	8.24
2	17.7
3	46.6
Total	72.5

The arable areas were chosen because they are uniform and there are no rocky, steep or wetland areas within the sections. The screening study ensured that buffers were established around the *Aloe simii* colonies, no obvious areas of concern were encountered and there is also sufficient water available to establish orchards.

Biota assemblages of the Krokodilspruit project areas

Seventeen extensive transects (400-3000m) were surveyed for potential habitat, vegetation and associated fauna. Specific habitat features were identified to provide an indication of available habitat for different animals favouring a specific biotope.

A total of 123 indigenous plant species were recorded during fieldwork as well as six exotic species, some declared alien invaders. Twelve Plants of Special Concern that have distribution ranges and habitat preferences, are expected in the study area (Grid: 2530BD).

Aquatic ecosystem

During the aquatic survey, the habitat scores were as follows: IHAS - "Good" 81% score for the healthy diverse habitat; lower HQI - "Fair", mostly due to the alien vegetation on the river banks.

According to the aquatic macroinvertebrate integrity scores, the site is classified as "Good". The SASS score, represented by the number of taxa (140), borders on an "Excellent" condition.

During the fish assessment, the relative FRAI score of this reach of the Sandspruit was placed within the limits of a fish integrity category Class A/B (91.0%), which means this reach is "Unmodified, or approximate natural conditions closely"

It is estimated that 29 frog species, 86 reptile species, 296 bird species and 108 mammal species are expected to occur in the project area, a total of 519 animal species.

Twenty-six Species of Special Concern (SCC) that have a high probability of occurring in the region, are expected to frequent the Krokodilspruit farm. The three project areas, consist mainly of primary grassland. Most of the mammal and bird SCC will be able to move out of the areas during the clearing process. It is only the subterranean species such as golden moles that will be affected if present. Burrowing frogs and reptiles will also be affected by the vegetation clearing and it is suggested that any species caught during the process, should be translocated to the grassland areas in the Nature reserve.

In the event that any threatened or near-threatened animal species are recorded within the study area in future, appropriate conservation measures should be developed in consultation with the relevant conservation authorities.

Mpumalanga Biodiversity Sector Plan (MBSP) and Threatened Ecosystems

According to the Mpumalanga Biodiversity Sector Plan the following Critical Biodiversity Areas and other important aspects of the study area include:

- Legogote Sour Bushveld - **Threatened ecosystem status:** Endangered.
- Northern Escarpment Quartzite Sourveld - **Threatened ecosystem status:** Vulnerable.
- Ecological Support Areas - Top 50% of strategic water resource area; important sub-catchments and the south-eastern corner of farm is a Fish support area.
- Wolkberg Centre of Endemism – North-western corner of farm.

The new areas earmarked for development consist mostly of Untransformed Grassland. The estimated 737 ha of this untransformed biotope will decline from 737.4 ha to 667ha due to clearing (72.5 ha), however, the more than 50 ha of buffers around the *Aloe simii* colonies gains back some of the lost grassland.

Following is a summary of the status that these CBAs will have in the project area:

> **CBA optimal:** All the CBA areas are incorporated either in the buffered Eastern Dry Afrotemperate Forest, the Nature Reserve or the buffered drainage lines and no development will take place in these areas.
> **Other natural areas (ONAs):** All three of the project areas (approximately 71.0 ha) for this EIA will be situated in ONAs.
> **Moderately modified (Old lands):** A portion of Site 1 is located on an old land (approximately 1.51 ha).

It is thus concluded that the delineated "CBA optimal" will be protected in either the Nature Reserve,

or in buffered areas where no development will be allowed.

Corridors for Connectivity

Linkages are used as pathways by animals undertaking a range of movements, including daily or regular movements, seasonal and migratory movements, dispersal movements and range expansion The linkages play an important role as part of the corridor network provided by the proposed buffers on the Krokodilspruit Farm:

- Buffers around rivers;
- Buffers around drainage lines;
- Buffers around wetlands;
- Buffers around inselbergs;
- Forests serve as buffers around valley drainage lines.

These corridors buffer all the CBA areas and connect most of the farm with the proposed Nature Reserve. These buffers protect all of the Sandspruit, Afrotemperate Forests, Floodplain wetlands and Rocky outcrops. All the areas covered by this continuous network make up 2 593 ha of untransformed habitat.

Assessment of impacts

The potential impacts of the project on the biodiversity of the study area are assessed under seven broad impacts, namely:

- Impact 1: River Crossings.
- Impact 2: Clearing of approximately 72 ha of transformed and untransformed land types.
- Impact 3: Erosion and siltation.
- Impact 4: Habitat fragmentation.
- Impact 5: Disturbance to fauna.
- Impact 6: Human interference impacting on biota.
- Impact 7: Linear structures: Impacts of roads and pipelines.
- Impact 8: Alien invasive vegetation.
- Impact 9: Loss of Red listed and protected fauna/flora species.
- Impact 10: Impact of clearing activities on birds.

By making use of “best practice guidelines” during the construction- and operational phases, identify the best practicable environmental options by avoiding loss of biodiversity and disturbance to ecosystems, especially in CBAs, by applying the mitigation hierarchy and the land-use guidelines recommended.

Management actions should be implemented such as:

- the re-establishment of indigenous vegetation wherever possible;
- control of storm water run-off;
- ongoing repair- and stabilisation of any erosion;
- implement an alien plant control programme;
- make use of current roads or tracks as far as possible;
- implement a veld management plan for the conservation area, which emphasises the use of sustainable grazing and controlled fires;
- prevent erosion and sediment-laden water from entering the adjacent watercourses;
- generic buffers should be established around wetlands;
- strict management of potential sources of agrochemical pollution;
- avoid over irrigation;
- Maintaining an intact riparian corridor.

Finally, the original 64% of Untransformed Grassland which was protected on the farm, has been reduced to 62% of Untransformed North-eastern Mountain Grassland. Considering the 2% reduction in protected grassland, against the permanent protection of over 50 ha for all the *Aloe simii* populations on the Krokodilspruit farm, is commendable.

All the expected impacts were assessed and all were confirmed to be “Low” or mitigated which resulted in a “Low” risk level. By implementing all the mitigation measures and managing the system on a continuous basis as prescribed by the Risk Assessment, all the impacts will be addressed to a satisfactory level. It is proposed that the project should be authorised with the provision that the mitigation measures prescribed in this document, where applicable, are included in the EMPr.

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Abbreviations

°C	Degrees Celsius
AQV	Aquatic vegetation
ASPT	Average Score per Taxon
BGIS	Biodiversity Geographic Information System
CARA	Conservation of Agricultural Resources Act
CBA	Critical Biodiversity Areas
cm	Centimetre
DARDLEA	Department of Rural Development, Land and Environmental Affairs
Dr	Doctor
DWA	Department of Water Affairs (post-2010)
DWAF	Department of Water Affairs and Forestry (pre-2010)
DWS	Department of Water and Sanitation (since May 2014))
E	East
e.g.	For example
EA	Environmental Authorisation
EAP	Environmental Assessment Practitioner
EC	Ecological Category
ECO	Environmental Control Officer
EIA	Environmental Impact Assessment
EISC	Ecological Importance and Sensitivity Category
EIS	Ecological Importance and Sensitivity
EMPr	Environmental Management Programme
EI	Ecological Importance
ESA	Ecological Support Area
FEPA	Freshwater Ecosystem Priority Areas
FRAI	Fish Response Assessment Index
FROC	Frequency of Occurrence
GA	General Authorisation
GIS	Geographic Information System
GPS	Global Positioning System
ha	Hectare
HAI	Hydrological Driver Assessment Index
HCR	Habitat Cover Ratings
HQI	Habitat Quality Index
IHAS	Integrated Habitat Assessment System
IHI	Index of Habitat Integrity
IUCN	International Union for Conservation of Nature
km	Kilometre
KNP	Kruger National Park
lt/hr	Litre per hour
LUDS	Land-Use Decision Support Tool
m	Metre
m^2	Square metre
mamsl	Metres above mean sea level
MAP	Mean annual precipitation
MBSP	Mpumalanga Biodiversity Sector Plan
mm	Millimetre
MNCA	Mpumalanga Nature Conservation Act
MTPA	Mpumalanga Tourism and Parks Agency
NEMA	National Environmental Management Act, 1998 (Act No. 107 of 1998)
NEMBA	National Environmental Management & Biodiversity Act
NFEPA	National Freshwater Ecosystem Priority Areas

NP	National Park
NSBA	National Spatial Biodiversity Assessment
NWA	National Water Act
ONA	Other Natural Areas
PES	Present Ecological State
PESEIS	Present Ecological State, Ecological Importance and Ecological Sensitivity
PhD	Doctor of Philosophy
POSA	Plants of Southern Africa
Pr. Sci. Nat	Natural Scientific Professional
Pty (Ltd)	Proprietary limited company
RTK	Real time kinematic
S	South
SA	South Africa
SACNASP	South African Council for Natural Scientific Professions
SANBI	South African National Biodiversity Institute
SANParks	South African National Parks
SARCA	South African Reptile Conservation Assessment
SASS5	South African Scoring System version 5
SCC	Species of Conservation Concern
SHI	Site Fish Habitat Integrity Index
SIC	Stones in Current
SOOC	Stones out of Current
Sqkm	Square kilometre
Sqm	Square metre
TOPS	Threatened or Protected Species
VEGRAI	Riparian Vegetation Response Assessment Index
WMA	Water Management Area

1. Introduction

Rhengu Environmental Services were appointed to undertake an Environmental Impact Assessment on Portion 248 JT of the farm Krokodilspruit (Figure 1) in the White River area (Mpumalanga) and this specialist ecological study forms part of the EIA process for the proposed project.

This project and the report below, is based on the EIA guidelines provided in the Mpumalanga Biodiversity Sector Plan (MBSP, 2014). The Mpumalanga Tourism and Parks Agency (MTPA), as custodian of the environment in Mpumalanga, is the primary implementing agent of the MBSP for the province.

This report addresses the findings of the field surveys as well as a desktop review of the potentially occurring threatened flora and fauna in the proposed development footprint.

Project Specifics include:

- Remove indigenous vegetation on approximately 80 ha and establish orchards for agricultural use.
- Development of orchard roads.
- Construction of a low-level river crossing to accommodate equipment and vehicles during harvesting- and general farming operations.

The purpose of this assessment process is to investigate the impact of implementing such activities at Krokodilspruit 248 JT.

There is an existing Environmental Authorisation (EA) 1/3/1/16/1E-203 which was issued by DARDLEA for the development of the farm in October of 2019. As part the conditions of this EA, an environmental control officer (ECO) must audit the approved EA and ensure that the applicant adheres to the conditions listed in the EA.

During these audit surveys in conjunction with the botanist from the Provincial Conservation Department (MTPA) several rare *Aloe* plants were discovered in certain areas which had been approved for development. Following consultations with DARDLEA, MTPA and the development team it was decided to withdraw permission to develop the areas where the *Aloe* is located. These plants are now protected by a buffer zone. It was also agreed that the applicant may submit a new application to compensate for the loss of over 50ha to protect the aloe plants.

The approximately 716 ha section in the north-western part of the farm was zoned as a Nature Reserve. No development was planned to take place in the Nature Reserve, but due to the buffer zones being added to protect *Aloe simii* populations, resulting in a loss of approved agricultural land, 46.6 ha of the reserve will now be assessed in order to replace the area lost to the ecological buffers.

In terms of the National Water Act (Act 36 of 1998), no Section 21 water uses in terms of the NWA should be triggered, on condition that the alteration of natural land and transformed land (plantations) for agricultural use do not encroach onto the delineated riparian buffer zone.

A General Authorisation (GA) has already been issued for two low-level watercourse crossings on the same property. During the public meeting, the aquatic/riparian specialist indicated that the proposed watercourse crossing must obtain a GN509 LOW Risk Rating. A GA registration process has already been initiated.

Large sections on the property (a total of approximately 1828ha) were cultivated with blue gum plantations as well as with agricultural lands (Van Wyk Rowe, 2018). Most of the existing bluegum plantations have been converted to Macadamia orchards.

1.1 Legislative requirements

The proposed development requires an environmental authorisation for the following listed (or specified) activities:

Notice is given in terms of Regulation 41 of the Environmental Impact Regulations published in Government Notice R 982 in Government Gazette No. 38282 of 4 December 2014, under Section 24(2), 24(5), 24D and 44, read with sections 47A (1) (b) of the National Environmental Management Act, 1998 (Act. 107 of 1998) and Chapter 4, Section 41(4), as amended in 2017, to carry out the following activities:

Property Description and Location: Alteration of Natural Land and Transformed Land (Plantations) for agricultural use and clearance of an area of 80 hectares or more and the construction of a low-level river crossing on the Farm Krokodilspruit 248 JT: White River Area, Mpumalanga.

In terms of Government Notices **R 983, R984** and **R 985** an **Environmental Impact Assessment** is required in terms of the following listed activities that the applicant wishes to implement:

Government Notice: R983 of 4 December 2014 Gazette Number: 38282:
Listing Notice 1:
Activity 12: The development of-
(iii) bridges exceeding 100sqm in size, where such development occurs- (a) within a water course or (c) ……within 32m of a water course.
Activity 19: The infilling or depositing of any material of more than 5 cubic metres into, or the dredging, excavation, removal or moving of soil, sand, shells, shell grit, pebbles or rock, of more than 5 cubic metres from-(i) a watercourse.
Government Notice: R984 of 4 December 2014 Gazette Number: 38282:
Listing Notice 2:
Activity 15: The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for-
(i) the undertaking of a linear activity; or
(ii) maintenance purposes undertaken in accordance with a maintenance management plan.
Government Notice: R985 of 4 December 2014 Gazette Number: 38282:
Listing Notice 3:
Activity 12: The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.
Activity 14: The development of-(iii) bridges exceeding 10sqm in size, where such development occurs-(a) within a water course or (c) ……within 32m of a water course.

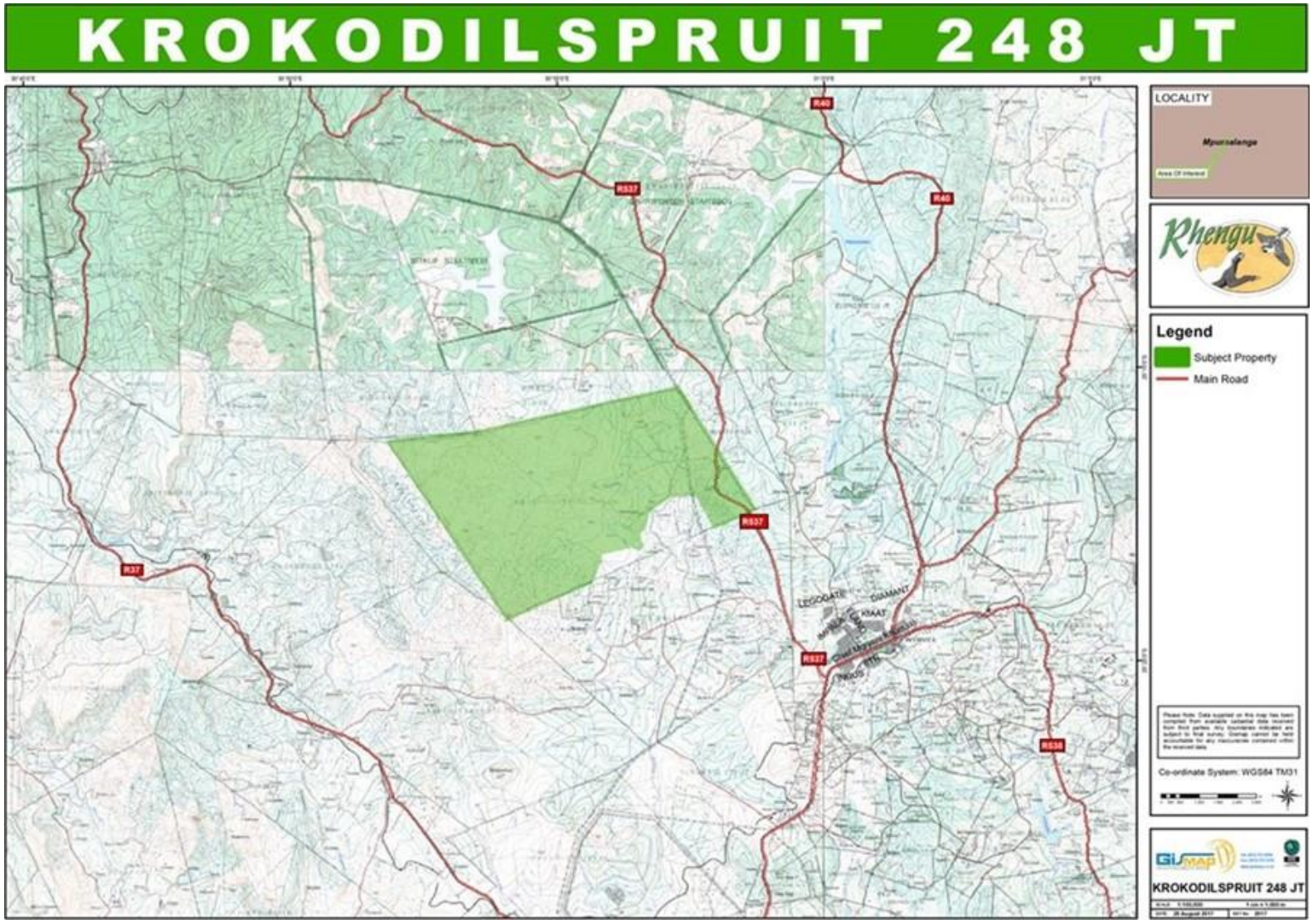


Figure 1: The location of the Krokodilspruit Farm in the White River area.

1.2 Terms of Reference

This project proposal is prepared for a Specialist Study: Environmental Evaluation of the additional 80 ha on the Krokodilspruit farm earmarked for orchards. The following services/specialist components will be addressed:

- This specialist ecological study will form part of the Environmental Impact Assessment process of the proposed de-bushing of the project area.
- Literature review: Applicable documentation will be studied and reviewed, especially the original and existing specialist studies. Extensive background studies regarding species distribution, habitat preference and species status will be updated.
- A site survey will be conducted to determine the current state of the biodiversity environment on site.
- Evaluate the sensitivity of the habitat using the Screening Assessment.
- Evaluate the sensitivity of biota surveyed in both the terrestrial- and wetland habitats, on site.
- Highlight floral and faunal species present on site and determine whether any Threatened or Protected Species (ToPs) or Red Data species are present; this should include species identified on-site as well as those potentially occurring.
- Ground-truth the desktop level findings regarding the provincial C-Plan and provide an opinion regarding the conservation status and actual conditions in situ.
- Provide a general biodiversity sensitivity map for the project area. This should include any proposed buffer zones and “no-go” zones for development.
- Ecosystem services provided by the systems on-site should be addressed.
- Management aspects:
- Identification and quantification of risks to biodiversity.
- The development of management criteria for each risk.
- Indicate in the report any opportunities, constraints and fatal flaws to the study and the project, including gaps in available information and make recommendations going forward.

1.3 Project Description

Orchard development

The applicant, DANROC (Pty) Ltd. wishes to implement the alteration of land for agricultural use to establish macadamia and avocado orchards, on 72.5 ha land suitable for these crops. During the proposal period of the project, three different sections of the farm were considered to determine if land is arable for macadamias and avocado pears (MTC, 2022). Figure 2 shows a merged Google Earth screenshot, illustrating the three sections of the project. The hectare coverage of these sections can be seen in Table 1.

Table 1: The three sections of the project under evaluation.

Section	Area (ha)
1	16.2
2	17.8
3	46.5
Total	80.5

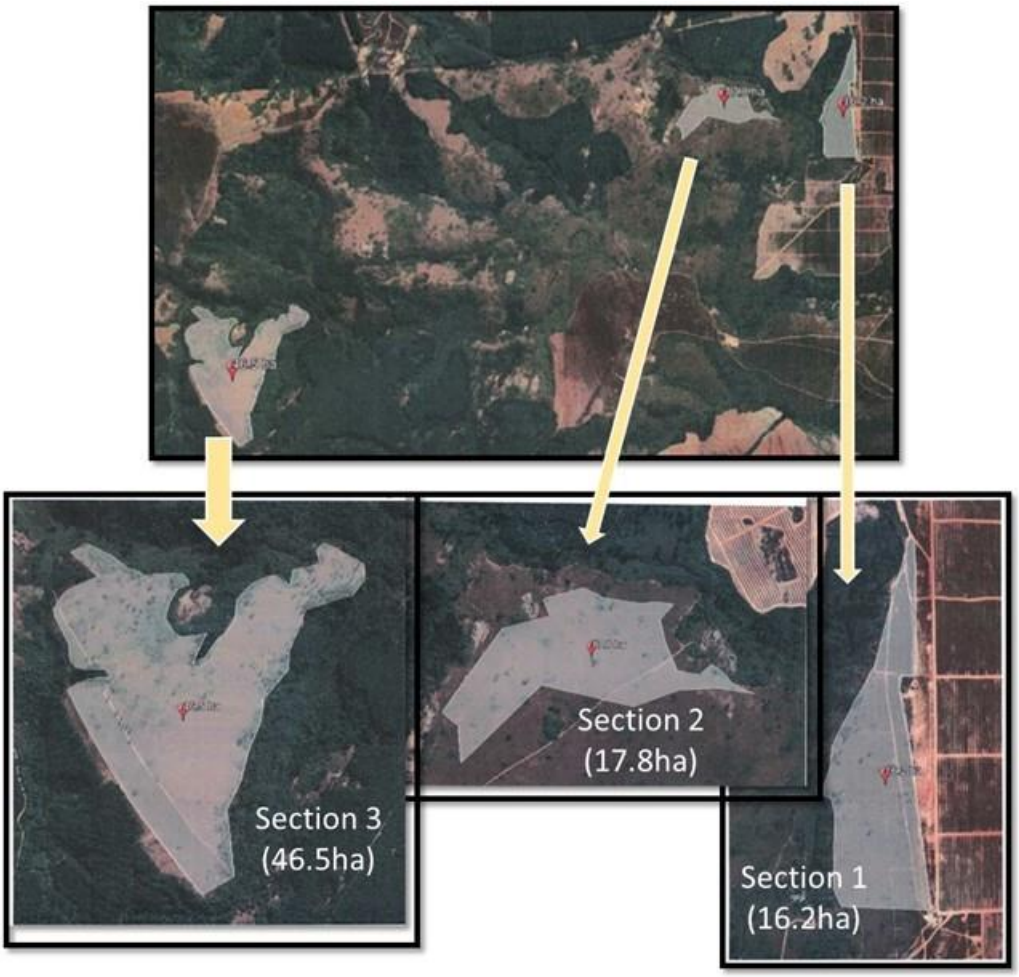


Figure 2: A merged Google Earth screenshot illustrating the three sections for the proposed. orchard development.

The arable areas are uniform and there are no rocky, steep or wetland areas within the arable 80.5 ha assessed for the orchards. There is also sufficient water to establish orchards.

DANROC (Pty) Ltd. has implemented state of the art technology for its new orchard plantings in White River. The technology involves the placement of permeable/breathable agricultural fabric to all but eliminate weed growth and limit the competition for growth. The fabric also retains water by limiting evaporation and maintaining a healthy soil temperature. All rows are marked by using a self-steering RTK system which is accurate to 2cm, thus increasing the yield potential per hectare.

The applicant is following a **Controlled Traffic Farming** principle that reduces compaction in the root zone and promotes a biological ecosystem for the orchard trees. Real-time kinematic (RTK) positioning is a satellite navigation technique used to enhance the precision of positioned data derived from satellite-based positioning systems.

The system of controlled traffic farming is described as a concept that was developed to increase crop yield by reducing soil compaction. Equipment is adapted so all field operations are supported from permanent traffic lanes to allow optimum production from wide, non-trafficked crop beds. In practice it means repeated use of the same wheel tracks for all operations using a precise machinery guidance system.

Advantages and Benefits of low flow irrigation system:

- **Broader water distribution:** Since water enters the ground at a slow pace, it spreads around the sides of the plant rather than seeping downward.
- **Better nutrient utilisation:** Since water remains closer to the area where the roots are most active, more nutrients are available to the plant, and there are fewer ground pollutants.
- **Larger and enhanced yields:** Since the in-ground air-water ratio at any given moment is higher, crop yields are larger and of a better quality.
- **Lower nutrient usage:** Since all fertiliser is distributed at the active root-zone level, the plant receives a high percentage of the amount distributed, leading to lower quantities of applied fertiliser.
- **Water saving:** Irrigation is placed underneath the agricultural fabric; the low flow drip ensures no over irrigation. Drip emitters have an ultra-low flow of 0.7 lt/hr each, spaced 1m apart.

Fertiliser used:

Water soluble fertilisers are mixed on the farm and dosed into the irrigation lines. The same principles above apply, fertiliser is only injected in targeted areas therefore there will be no negative impact on indigenous trees or shrubs.

Typical fertilisers used are as follows: Ammonium sulphate, Potassium chloride, Calcium nitrate, Zink nitrate, Boron, Monoammonium phosphate. These fertilisers are not detrimental to indigenous plants.

Bee Stations: Pollinating hives are distributed approximately 2 hives per hectare. Hives can be placed in the natural bush. It is often ideal to locate them near trees or tall grass to minimise drifting of the colonies. These landmarks allow them to find their hives and not enter different hives.

Sandspruit crossing

Figure 3 shows a close-up Google Earth screenshot of the proposed low-level crossing. The location found suitable for the proposed low-level crossing consists out of large rock formations which will allow for the construction of a stable and reliable crossing (Danroc, 2022). The dimensions and the location of the proposed low-level crossing can be seen in the table below.

Table 2: Details of the proposed low-level crossing.

Width	Length	Height	Coordinates
8m	70m	1m	S 25.266023 E 30.919792

The proposed crossing is situated in the northern part of the Krokodilspruit farm. The advantages of this proposed crossing will enable more sufficient and quicker firefighting activities along the northern boundary of the farm without having to take a long detour. The closest Sandspruit crossing currently on the Krokodilspruit farm can also be seen in Figure 3. This crossing will also allow access for farming activities (harvesting, etc.) from the north-western side of the farm to the north-eastern side and vice versa and eliminate travel times in case of emergency.

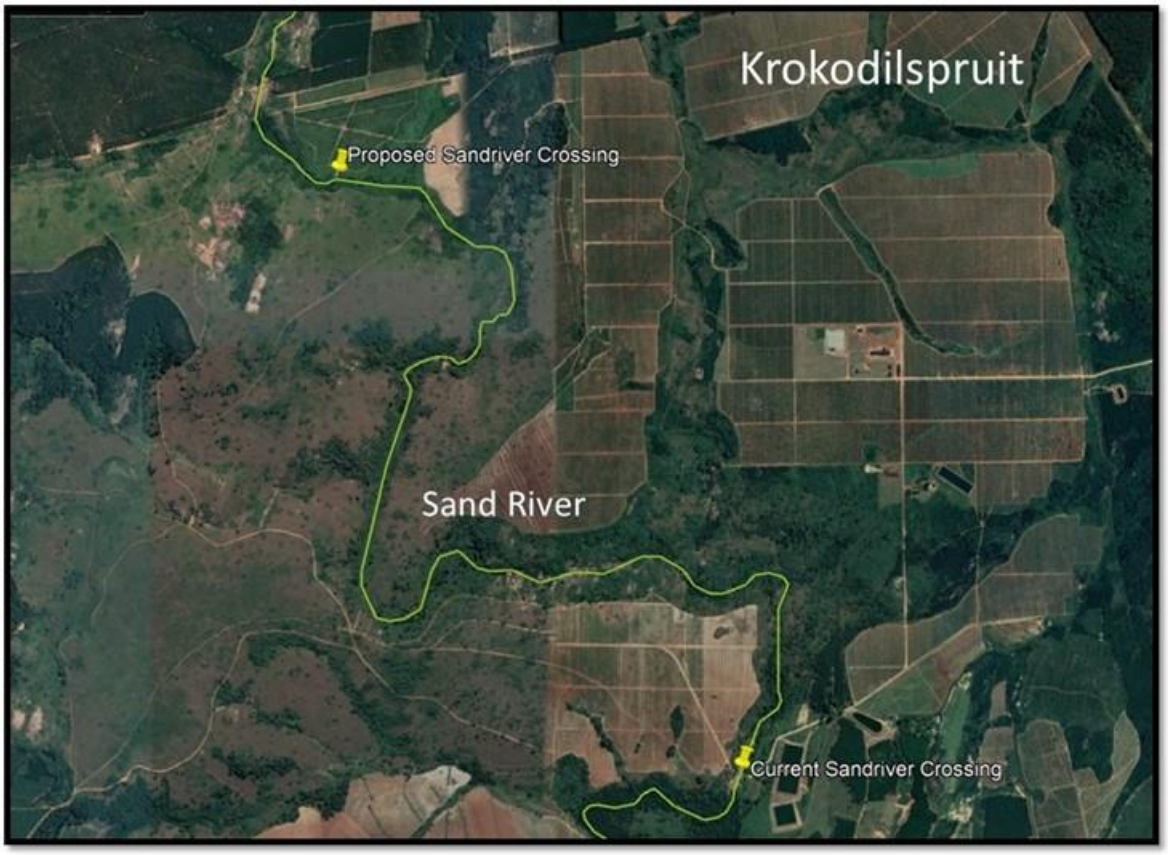


Figure 3: The Sandspruit crossings: Current and proposed.

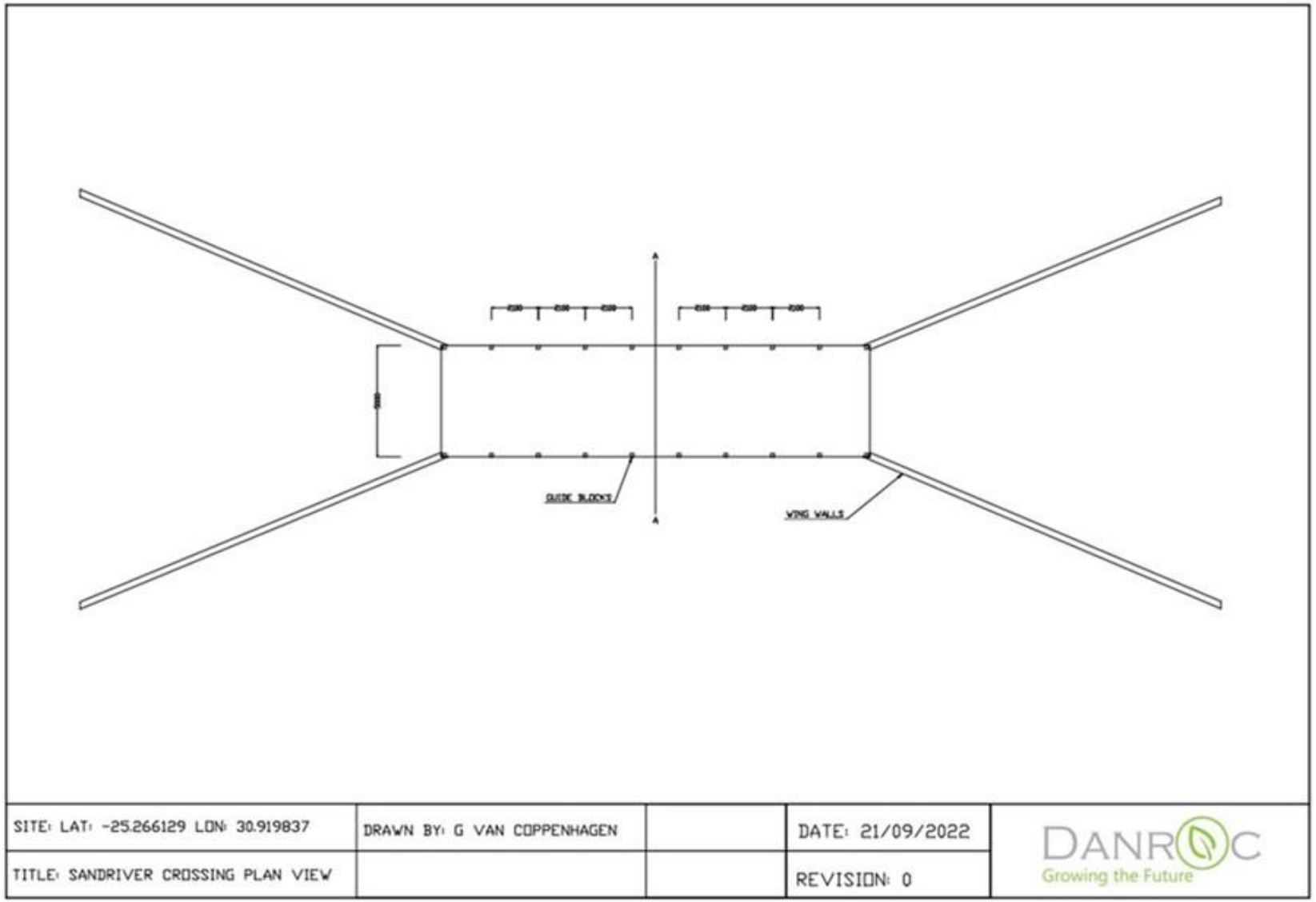


Figure 4: The Sandspruit 2 Crossing: Plan of the low-level crossing.

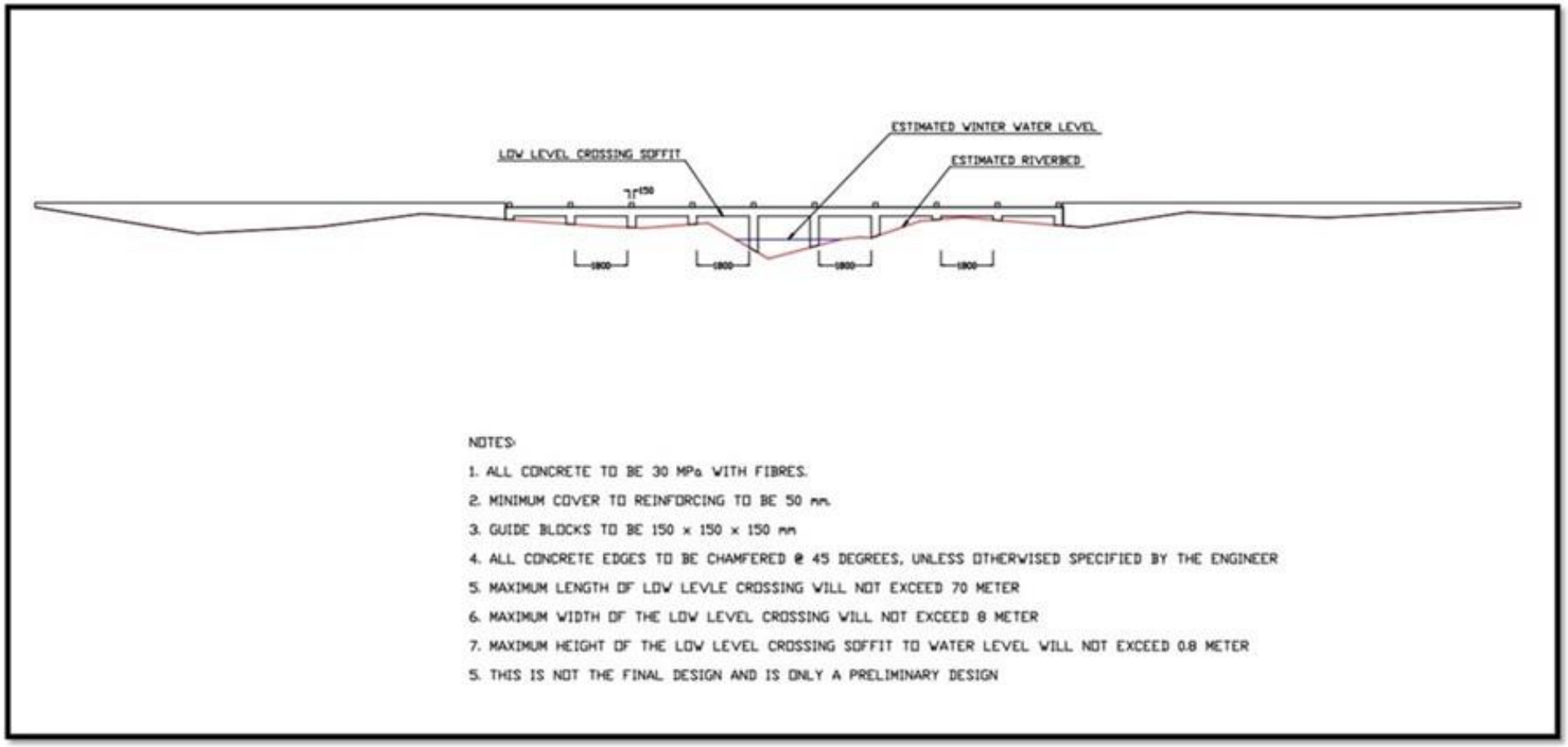


Figure 5: The Sandspruit 2 Crossing: Side view of the low-level crossing.

1.4 Assumptions, Limitations and Knowledge gaps

Assumptions, Limitations and Knowledge gaps associated with this study include the following: The assumption has been made that:

- This study is completed with the assumption that the evaluation of the effects of bush-clearing and its associated impacts (influence on sensitive areas and biota) is the principal aspect of concern.
- Spatial GIS shape files received from the client that demarcate the proposed infrastructure development footprints are accurate.
- Project proponents will always strive to avoid and mitigate potentially negative project related impacts on the environment, with impact avoidance being considered the most successful approach, followed by mitigation. It further assumes that the project proponents will seek to enhance potential positive impacts on the environment.
- Wetland areas within transformed landscapes, are often affected by disturbances that restrict the use of available wetland indicators, such as hydrophytic vegetation or soil indicators (e.g., as a result of the dominance of alien vegetation and canalisation). This might influence the delineation process; however expert knowledge will generally overcome most of these discrepancies.
- Due to the relatively brief duration of the field surveys (seven days in total) conducted during a single growing season, the species list provided for the area cannot be regarded as comprehensive. Only species of plants visible and/or flowering at that time were detected. It is possible that plants which flower at other times of the year are under-represented.
- Red List species are, by their nature, usually very rare and difficult to locate. Compiling the list of species that could potentially occur in an area is limited by the paucity of collection records that make it difficult to predict whether a species may occur in an area or not. The methodology used in this assessment is designed to reduce the risks of omitting any species, but it is always possible that a species that does not occur on a list may be located in an area where it was not formerly known to exist.
- The lists of fauna for the site are based on those observed at the site as well as those likely to occur in the area based on their distribution and habitat preferences. Due to the nature and habits of most faunal taxa it is unlikely that all species would have been observed during a site assessment of limited duration. Therefore, site observations are compared with literature studies where necessary.
- Animal species, especially birds, are mostly highly mobile and often migrate seasonally. Any field assessment of relatively short duration is therefore unlikely to record anything more than the most common species that happen to be on site at the time of the survey. Such field surveys are generally a poor reflection of the overall diversity of species that could potentially occur on site.
- Due to added corridors and small patches of land unaccounted for, the total hectares do not add up, thus the area sizes in hectares are just approximate values of area covered.

1.5 Details of the Author

Dr Andrew Deacon (PhD Zoology) worked as a researcher at Scientific Services, South African National Parks (SANParks, 1989 - 2012). He was initially employed as an Aquatic ecologist to coordinate the multidisciplinary KNP Rivers Research Programme, but later was tasked to manage the monitoring and research programmes for small vertebrate ecology in 15 South African National Parks (including Addo-, Kalahari- and Kruger NP).

As a recognised scientist in the fields of Ichthyology and Terrestrial Ecology, he is currently engaged as a specialist consultant for ecological studies. He was involved in numerous research programmes and projects and produced EIA specialist reports (aquatic or terrestrial ecology) for 82 projects.

Additionally, he also participated in Aquatic ecosystem projects, Environmental Water Requirement Studies and Faunal and ecosystems monitoring projects.

Apart from multiple environmental projects in South Africa, he has worked on assignments in the Democratic Republic of the Congo, Zambia, Mozambique, Zimbabwe, Namibia and Swaziland. He completed: Wetland Introduction and Delineation Course – Centre for Environmental Management: University of the Free State. He is a registered Professional Natural Scientist (Pr. Sci. Nat.) in the fields of Ecological Science (Reg. no. 116951).

2. Methodology

Methods and approach

This project, and this report, is based on the guidelines provided in the Mpumalanga Biodiversity Sector Plan Handbook (MTPA, 2014). According to the MBSP, "it is important to note that all decisions regarding land-use applications in Mpumalanga are going to be evaluated by the authorities using the CBA maps and data, so it makes sense to consider these proactively, either prior to, or during, the EIA process."
The methods used in this report were undertaken in accordance with to the MTPA Minimum Criteria Guideline with special emphasis on Protected Species.

2.1 Riparian delineation

It is important to differentiate between wetlands and riparian habitats. Riparian zones are not wetlands, however, depending on the ecosystem structure, wetlands can be also be classified as riparian zones if they are located in this zone (e.g., valley bottom wetlands). Although these distinct ecosystems will be interactive where they occur in close proximity it is important not to confuse their hydrology and eco-functions.

Riparian delineations are performed according to *"A practical field procedure for identification and delineation of wetlands and riparian areas"* as amended and published by the Department of Water Affairs and Forestry (2005); (Henceforth referred to as DWAF Guidelines (2005).

Aerial photographs and land surveys were used to determine the different features and riparian areas of the study area. Vegetation diversity and assemblages were determined by completing survey transects along all the different vegetation communities identified in the riparian areas.

Riparian areas are protected by the National Water Act (Act 36 of 1998), which defines a riparian habitat as follows:

> *"Riparian habitat includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas."*

Riparian areas include plant communities adjacent to and affected by surface and subsurface hydrologic features, such as rivers, streams, lakes, or drainage ways. Due to water availability and rich alluvial soils, riparian areas are usually very productive.
Tree growth rate is high and the vegetation is lush and includes a diverse assemblage of species. The delineation process requires that the following be taken into account:

- Topography associated with the watercourse;
- Vegetation;
- Alluvial soils and deposited material.

A typical riparian area according to the DWA&F Guidelines (2005) is illustrated in Figure 6.
In addition to the DWA&F Guidelines (2005) and DWAF updated manual (2008), the unpublished notes: *Draft riparian delineation methods prepared for the Department of Water Affairs and Forestry, Version 1* (Mackenzie & Rountree, 2007) were used for classifying riparian zones encountered on the property according to the occurrence of nominated riparian vegetation species.

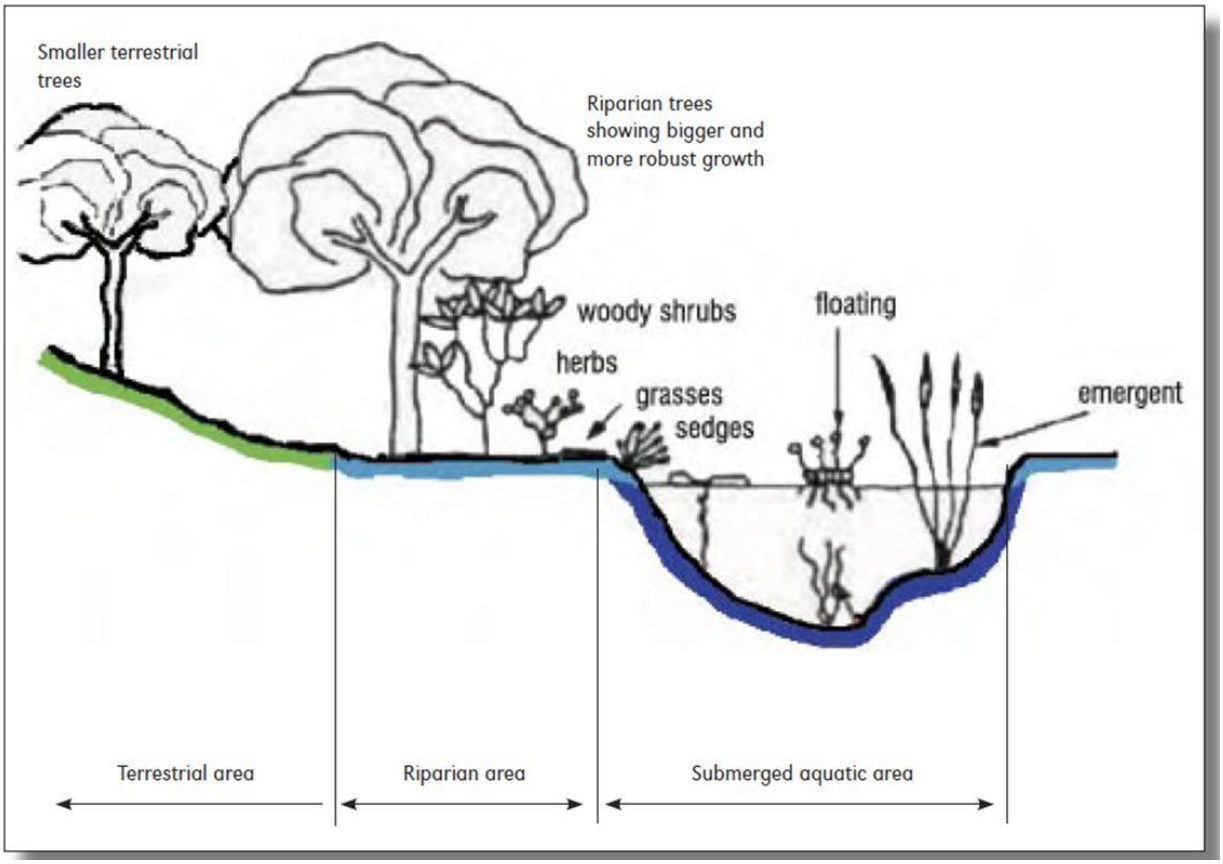


Figure 6: A cross section through a typical riparian area (DWA&F Manual, 2008).

2.2 Buffers

Aquatic buffer zones are typically designed to act as a barrier between human activities and sensitive water resources thereby protecting them from adverse negative impacts. Buffer zones associated with water resources have been shown to perform a wide range of functions, and on this basis, have been proposed as a standard measure to protect water resources and associated biodiversity (Macfarlane et al, 2015). These functions include:

- Maintaining basic aquatic processes;
- Reducing impacts on water resources from upstream activities and adjoining land uses;
- Providing habitat for aquatic- and semi-aquatic species;
- Providing habitat for terrestrial species; and
- A range of ancillary societal benefits.

Due to their positioning adjacent to water bodies, buffer zones associated with streams and rivers will typically incorporate riparian habitat. Riparian habitat, as defined by the NWA, includes the physical structure and associated vegetation of the areas associated with a watercourse. These areas are commonly characterised by alluvial soils (deposited by the current river system) and are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas (Macfarlane et al, 2015).

However, the riparian zone is not the only vegetation type that lies in the buffer zone as the zone may also incorporate stream banks and terrestrial habitats depending on the width of the aquatic impact buffer zone applied. A diagram indicating how riparian habitat typically relates to aquatic buffer zones defined in this guideline is provided in Figure 7.

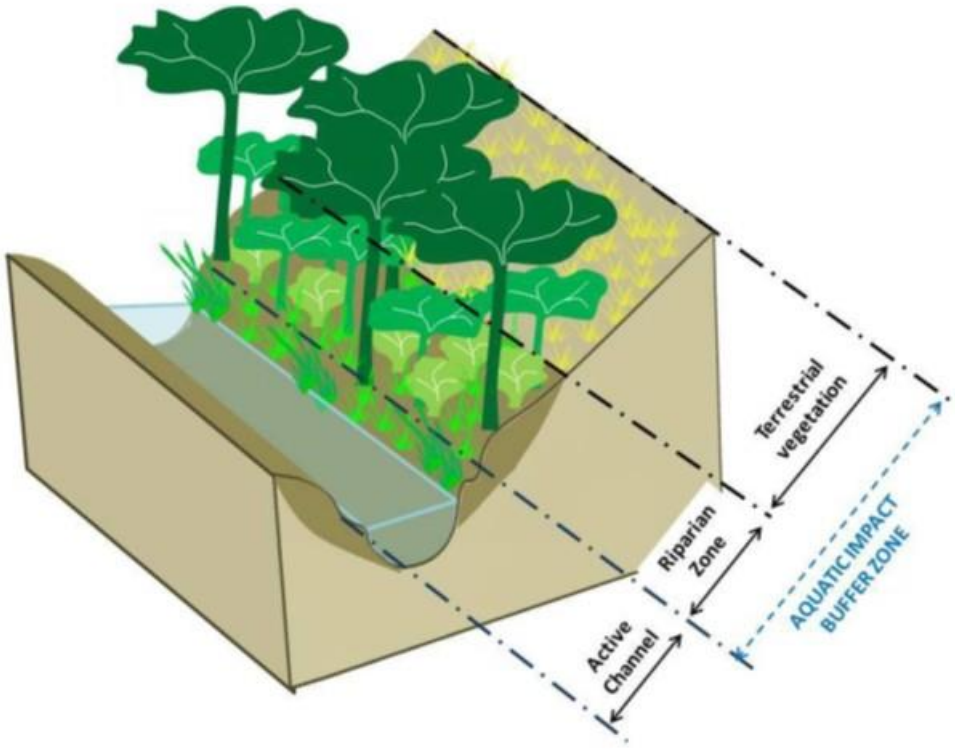


Figure 7: Schematic diagram indicating the boundary of the active channel and riparian habitat, and the areas potentially included in an aquatic impact buffer zone (Macfarlane et al, 2015).

Once an aquatic impact buffer zone has been determined, management measures need to be tailored to ensure buffer zone functions are maintained for effective mitigation of relevant threat/s. Management measures must therefore be tailored to ensure that buffer zone functions are not undermined. Aspects to consider include:

- Aquatic impact buffer zone management requirements;
- Management objectives for the aquatic impact buffer zone; and
- Management actions required to maintain or enhance the aquatic impact buffer zone in line with the management objectives. Activities that should not be permitted in the aquatic impact buffer zone should also be stipulated.

2.3 Specialist assessment: Aquatic Studies

Aquatic biota surveys

Macro-invertebrates and fish are good indicators of river health. By making use of established and accepted survey methods (SASS5 for invertebrates and FRAI-based surveys for fish) and incorporating the habitat aspects, a proper basis for biological diversity can be obtained.

The different components of the proposed development and its impact on the aquatic environment will be assessed for the river in the project area. The following recognised bio-parameters and methods will be used:

- Aquatic invertebrates: South African Scoring System version 5 (SASS5).
- Fish communities: Fish Response Assessment Index (FRAI). Applicable fish habitat assessments such as the Habitat Cover Ratings (HCR) and Site Fish Habitat Integrity Index (SHI) will be used to assess the habitat potential and condition for fish assemblages.

Aquatic invertebrate assessment

Benthic macro-invertebrate communities of the selected sites were investigated according to the South African Scoring System, version 5 (SASS5) approach. An invertebrate net (30cm x 30cm square with 0.5mm mesh netting) was used for the collection of the organisms. The available biotopes at each site will be identified on arrival. Each of the biotopes was then sampled separately and by different methods. Sampling of the biotopes was done as follows:

- **Stones in current (SIC):** Movable stones of at least cobble size (3 cm diameter) to approximately 20 cm in diameter, within the fast and slow flowing sections of the river. Kick-sampling is used to collect organisms in this biotope. This is done by placing the net on the bottom of the river, just downstream of the stones to be kicked, in a position where the current will carry the dislodged organisms into the net. The stones are then kicked over and against each other to dislodge the invertebrates (kick-sampling) for ± 2 minutes.
- **Stones out of current (SOOC):** Where the river is calm, such as behind a sandbank or ridge of stones or in backwaters. Collection is again undertaken using the kick-sampling method, except in this case the net is swept across the area sampled to catch the dislodged biota. Approximately 1 m^2 is sampled in this way.
- **Sand:** These include sandbanks within the river, small patches of sand in hollows at the side of the river or sand between the stones at the side of the river where flow was slow or no flow was recorded. This biotope is sampled by stirring the substrate, shuffling or scraping of the feet is done for half a minute, whilst the net is continuously swept over the disturbed area.
- **Gravel:** Gravel typically consists of smaller stones (2-3 mm up to 3 cm). Sampling similar to that of sand.
- **Mud:** It consists of very fine particles, usually as dark-coloured sediment. Mud usually settles to the bottom in still or slow flowing areas of the river. Sampling similar to that of sand.
- **Marginal vegetation (MV):** This represents the overhanging grasses, bushes, twigs and reeds from the riverbank. Sampling is undertaken by holding the net perpendicular to the vegetation (half in and half out of the water) and sweeping back and forth in the vegetation (± 2m of vegetation).

- **Aquatic vegetation (AQV):** Rooted, submerged or floating waterweeds such as *Potamogeton, Aponogeton and Nymphaea.* Sampled by pushing the net (under the water) against and amongst the vegetation in an area of approximately one square metre.

The organisms sampled in each biotope were identified and their relative abundance is also noted on the SASS5 datasheet. Habitat assessments, according to the habitat sampled, were performed due to the fact that changes in habitat can be responsible for changes in SASS5 scores. This was achieved by applying the SASS orientated habitat assessment indices. The indices used are the Integrated Habitat Assessment System (IHAS) score sheet and the Habitat Quality Index (HQI).

The SASS5 method was used to establish the macro-invertebrate integrity in all three of the main habitat assemblages: stones, vegetation and sand/mud/gravel. The associated habitat types were determined with the Invertebrate Habitat Assessment System (IHAS) and the Habitat Quality Index (HQI).

Although the SASS5 method was used as prescribed by DWS, it must be kept in mind that this method was designed for water quality purposes. Therefore, the macro-invertebrate integrity scores may vary throughout the year as water quality changes, due to flow variation, as should be the case in the pre- and post-construction phases of the project.

Fish communities - Fish Response Assessment Index (FRAI)

The biotic assessment method uses a series of fish community attributes related to species composition and ecological structure to evaluate the quality of an aquatic biota. Data on distribution, richness, length frequency and abundance will be collected. The sampling methods include fish traps, seine nets, mosquito nets and electro-fishing.

Fish segment identification, species tolerance ratings, abundance ratings, frequency of occurrence and health status techniques are applied during this survey to determine the integrity of the fish communities.

On arrival at the site a basic on-site visual appraisal is made of the habitat types available on that particular day at that particular flow. A site diagram is compiled indicating the different habitat types and the various components thereof. Sampling takes place in each of the different habitat types. These different habitat types are sampled separately using different methods.

a) Electro-shocking

Electro-shocking commences in the downstream component of the habitat. One person uses a backpack electro-shocker for shocking, using a scoop net to catch the stunned fish. The researcher progresses upstream, keeping the fish caught in a bucket until that particular habitat is surveyed. Each habitat shocked is timed. It is necessary to take care (as far as possible) when shocking so as not to disturb the remainder of the habitat still to be surveyed. As each habitat is completed the fish species caught, are identified, recorded and released back into their respective habitat types.

Any fish species that cannot be identified at the time is preserved in 10% formalin (in a sample bottle with label inside) for later identification by experts. The data sheet is completed for that particular habitat – recording every fish, its age class (adult, sub-adult, juvenile) and whether any fish is diseased (e.g., visible ecto-parasites). Each habitat type is recorded (e.g., shoot, riffle or pool etc.), as well as the width, depth, substrate, the extent sampled, the percentage of algae on substrate, whether there was any vegetation and the turbidity. The flow of that particular habitat is classified into one of five flow classes (no flow, slow flow, medium flow, fast and very fast flow).

The electro shocking device is used to sample certain habitat types: shoots, riffles, rapids, shallow- medium depth pools in stream and off stream, runs and back waters.

b) Cast net

A cast net (a weighted circular net that is thrown into the water) is used in pool type or slower flow and deeper habitat types. As with method (a) all aspects of the habitat type are recorded including the fish species, numbers, age class and health. The number of throws efforts per habitat is also recorded.

2.4 Specialist assessment of terrestrial vegetation for the Krokodilspruit bush clearing project

In accordance with the accepted proposal for this study, the botanical specialist study presented in the current report was to assess the footprint of the Krokodilspruit development. The scope of work will include the Terrestrial- and Riparian Components as per the MTPA Minimum Criteria Guideline with special emphasis on Protected Species, including GPS coordinates for encountered species to facilitate obtaining the necessary permits.

Minimum requirements guidelines from the Mpumalanga Tourism and Parks Agency:

1. A map indicating the total area (ha) of disturbance/transformation on the property, including the proposed development.
2. A map indicating vegetation communities and sensitive areas on the property. The map should include the delineation of a 30m buffer zone around any sensitive areas.
3. A map indicating all surrounding land use on adjacent properties.
4. A list of threatened plants species (Red Data Listed) that may potentially occur in the area should be submitted.
5. A floristic survey should be conducted during the growing season with at least two visits undertaken (± November and ± February). Visits during other seasons will be determined by the flowering and fruiting times of species that do not occur during the summer season.
6. The MTPA should be supplied with a list of all plant taxa encountered during the surveys. The following should be investigated: threatened species (Red Data Listed), important medicinal species, protected species (Mpumalanga Conservation Act, 1989) as well as endemic taxa.
7. Plants that have been surveyed and which may be of conservation importance should be identified down to species level.
8. The MTPA should be supplied with a detailed list of all threatened species, including their locality information as well as details regarding date, GPS location and spatial resolution.
9. A list of threatened species that could potentially occur but were not found during site visits should be provided separately. In respect of each such species an opinion on the likelihood of that species occurring on the site and the reason for that opinion should be provided.
10. A list of alien plant species occurring on the property should be provided.
11. The invasion extent of category 1 & 2 plants (CARA: Act 43 of 1983, Regulation 15) should be investigated.
12. Any existing or planned eradication programs of alien vegetation should be indicated in the report.
13. Relocation plans of plants of conservation importance should be included and this relocation should be undertaken by specialists that have expertise in the area of environmental concern (EIA Guideline Document).

Desktop

Vegetation communities and general land use patterns were identified prior to fieldwork using satellite imagery on Google Earth. Conservation-important plant species listed for the quarter-degree grid 2530BD in the Mpumalanga Tourism & Parks Agency's (MTPA) threatened species database, as well as the Plants of South Africa (POSA) data from the South African National Biodiversity Institute (SANBI), were used to produce a list of the most likely occurring species, which were searched for during fieldwork. Conservation-important plants include those listed as species of conservation concern by the SANBI Red List of South Africa or protected species as listed under the Mpumalanga Nature Conservation Act (MNCA) (No. 10 of 1998), or the National Environmental Management: Biodiversity Act Threatened or Protected Species (NEMBA ToPS) (No. 10 of 2004).

Fieldwork

Vegetation communities identified in the desktop phase were ground-truthed during a field visit on 24-28 September 2018, and during 2022: 7-9 February, 22-25 March and 5-8 July. The project area as well as the surrounding environment was surveyed on foot and dominant plant species were listed according to each of the vegetation communities.
The study area was broadly stratified into major classes on the basis of gradient, aspect, terrain units (e.g., crest, mid-slope and foot slope), rock cover, soils, land-use and vegetation physiognomy.

A total of 17 sites were surveyed and floristic data is summarised in Table 23. Environmental parameters recorded at each stand included the following:

- locality coordinates using a Global Positioning System (GPS) receiver;
- terrain unit (midslope, foot slope, etc.);
- estimated percentage surface rock cover; and
- any visible disturbances (e.g., grazing, fire, old lands).

This floristic classification was used only to guide the identification of the robust ‘vegetation units’ described in this report, which are based on qualitative and semi-quantitative floristic and habitat data gathered at the sites surveyed during the study.

Parameters such as geology, topography, etc. were also obtained from the relevant topographical-, geological- and soils maps.

For the purposes of this study, the most recent version of the Mpumalanga Biodiversity Conservation Plan (MBCP) map of ecological sensitivity was obtained from the Mpumalanga Tourism and Parks Agency, and the boundaries of the study area were superimposed on this map. The MBCP divides the entire province into the following categories of importance in terms of biodiversity conservation value: ‘Irreplaceable’, ‘Highly Significant’, ‘Important and

Necessary’, ‘Least Concern’ and ‘No Natural Habitat Remaining’. **No ‘Irreplaceable’ or ‘Important and Necessary’ areas occur within the study area.**

The study site borders on the Wolkberg Centre of Endemism and the proposed Nature Reserve might extend into this Centre of Plant Endemism (Van Wyk & Smith, 2001).

2.5 Specialist assessment of terrestrial fauna for the Krokodilspruit bush clearing project

Minimum requirements guidelines from the Mpumalanga Tourism and Parks Agency:

Mammals/Birds

1. The Mpumalanga Biobase Report should be consulted for obtaining background on the conservation value of land and areas of sensitivity within the Mpumalanga Province. This report is obtainable from the Mpumalanga Tourism and Parks Agency (MTPA).
2. A list of all potential species should be submitted. The following should be highlighted for threatened (Red Data) species.
    i. International Red Data status (Latest version of IUCN Red Data List)
    ii. National Red Data status (Latest version)
    iii. Endemic status of each species
    iv. Protection status of each species (Mpumalanga Nature Conservation Act 10 of 1998)
3. A full survey to determine species richness should be undertaken. The time of year to conduct surveys should depend on the activity pattern of the species. The survey area should not be restricted to the proposed site of development but should include all habitat types over the entire property as well as adjacent areas. These surveys should be performed by specialists with expertise in the area of environmental concern (EIA Guideline document).
4. A list of all species recorded during the survey should be supplied to the MTPA. Species data (GPS point locality, species name and date) should be forwarded to the MTPA.
5. Where total destruction is going to take place:
    i. Specified faunal species must be captured and relocated to suitable habitat in the area.
    ii. The operations must be handled by specialists with expertise in the area of environmental concern (GIS Guideline document).
    iii. Species data (GIS point locality, species name and date) must be forwarded to the MTPA.
6. Maps indicating
    i. Areas of sensitivity
    ii. Areas already disturbed/transformed and size (ha)
    iii. Proposed development and size
    iv. Land-use on surrounding properties.
    v. Location of important species as well as roosting and hibernation sites e.g., caves of ecological importance, in relation to the proposed development.
7. Recommendations on buffer zones will only be made once comprehensive species lists have been received and reviewed in the EMPr/Scoping Reports.
8. A list of threatened species that can potentially occur but were not found during site visits or surveys should be provided. In respect of each such species an opinion on the likelihood of that species, occurring on the site and the reason for that opinion should be provided.
9. A list of exotic/introduced vertebrate species occurring on the property should be provided.
10. An ethically accepted plan for the eradication or removal of any exotic/introduced species posing a threat to indigenous species should be included in the report.
11. Any existing and/or planned actions to prevent free movement/roaming of domestic animals such as dogs, cats, goats and pigs should be provided.

Desktop studies and literature review:

A detailed desktop study on all faunal species recorded in the past was completed and includes a description of red data and protected status according to the IUCN red data list and the National Environmental Management Biodiversity Act (TOPS List). All applicable literature was reviewed and extensive background studies regarding species distributions, habitat preferences and species status were updated accordingly (Appendices 3-6). The potential occurrence of threatened species was also evaluated from historical records, available literature, habitat availability and personal experience. The fauna species lists thus represent the majority of species occurring in the study area and provides a solid basis from which the project can continue to develop a comprehensive species list. The following detailed desktop studies and baseline animal assessment were conducted:

- Identification of all animal species expected to be present according to desktop studies of all relevant animal groups, namely birds; herpetofauna (amphibians and reptiles); and mammals. Potential occurrence of fauna in the study area was predicted based on knowledge of known habitat requirements of local fauna species.
- Lists of conservation-important mammals, birds, reptiles and frogs potentially occurring within the proposed agricultural development were prepared using data from the MTPA's threatened species database and applicable literature. The above data was captured mostly at a quarter-degree spatial resolution, but was refined by excluding species unlikely to occur within the study area, due to unsuitable habitat characteristics (e.g., altitude and land-use).
- Identification of all red data-, protected and conservation important species per animal group and the compilation of distribution maps and GPS coordinates where recorded.
- Design management and monitoring programs to successfully monitor and manage all red data and protected and/or conservation important species.
- The assessment includes a review of all relevant literature, completion of field surveys, production of specialist reports and development of management recommendations.

2.6 Field surveys and habitat evaluation.

The current status of the faunal environment and an evaluation of the extent of site-related effects were determined using selected ecological indicators. At the same time all rare and endangered species, protected species, sensitive species and endemic species (conservation important faunal species) were identified and used to update and supplement existing studies. Ideally faunal surveys should cover the summer season, stretching from October to February. Surveys were conducted during 7-9 February, 22-25 March and 5-8 July 2022. These surveys included the following faunal groups:

Terrestrial vertebrate surveys

Amphibians, reptiles, birds and mammals were surveyed in pre-selected units. Emphasis was placed on fauna with high conservation value and their probability of occurrence in the unit. These include meticulous searches on fixed transects in all the representative biotopes to assess the presence/absence of amphibians, reptiles, birds and mammal species. Where necessary, special methods were implemented to augment the chances of finding species, including traps, nocturnal spotlight searches and identifying tracks and scats. Special emphasis is placed on finding threatened species.

- **Amphibian surveys**

Visual encounter surveys and audio monitoring are appropriate techniques for both inventory and monitoring of amphibian species. Both visual and auditory surveys were conducted along all transects, in plots, along streams and around ponds. Most amphibians are detectable in this manner. To ensure a comprehensive inventory, all possible microhabitats were also searched, namely: soil, water, tree trunks and beneath rocks, during both the day and at night.

- **Reptile surveys**

The most practical way to monitor reptiles, over large areas, is to sample along transects and systematically search encountered refuge areas. Transects were surveyed in different habitat types and all “cover” objects within a specified distance of the line turned over and checked. One particular strength of such transect monitoring is that it can be used to relate reptile abundance to habitat variables, such as vegetation and cover. The main objective of the survey is not to find as many reptiles as possible, but to get a reliable estimate of available habitat and quality of shelter and to compare these with expected reptiles and their required suite of habitat types.

- **Bird surveys**

Transects are probably the most widely used method of estimating the number of bird species in terrestrial habitats. Traditionally, observers will move along a fixed route undertaking surveys and recording the birds they see on either side of the route. For small birds, which are usually relatively numerous, a transect width of 10m on either side of the route (or 20-30m in open habitats) was found to be suitable for this study.

Transects were placed in such a way that all dominant soil and associated habitat types were adequately covered. Birds outside the transect band or those flying over were noted. Surveys always commenced at first light when avian activity was at its peak. Bird calls are equally important in bird surveys and especially important during point counts in rugged terrain and dense bush where visual observations are limited. Point surveys can also be used within wide open areas where birds can be spotted from a distance, for example pans and grassland flats.

- **Mammal surveys**

The same line-transects were surveyed on foot to monitor diurnal mammal species. Each sighting as well as the related vegetation features was recorded to establish habitat preferences. All major habitat types were assessed.

Visual sightings, as well as all signs of mammal presence (tracks and scats) were used as indicators of presence for some species.

- **Habitat surveys**

Representative habitat transects within the study area were surveyed. Macro- and micro-habitat surveys were executed to assess the quality of habitat and its potential to support various faunal species.

In assessing the habitat profiles in conjunction with the distribution data per species, accurate information on the probability of the species occurring in the relevant biotopes was obtained. Thus, a list of expected species for the different biotopes in the survey area was compiled and compared with the fauna observed during monitoring surveys.

The information obtained from the micro-habitat surveys was used to enhance the prediction abilities of the process. To this end, quality and quantity of habitat aspects provide an indication of species abundance, while presence or absence of habitat aspects indicates the probability of species occurrence. Habitat quality classifications could be a useful indication of resource utilisation (especially in adjacent areas).

2.7 Impact Assessment

2.7.1 Mpumalanga Biodiversity Sector Plan (MBSP) and Threatened Ecosystems

It is important to note that all decisions regarding land-use applications in Mpumalanga are going to be evaluated by the authorities using the CBA maps and data (Figure 8 and 9), so it makes sense to consider these proactively, either prior to, or during, the EIA process (MBSP Handbook, 2014).

The following are extracts from the MBSP Handbook (2014) provided as background to our approach: “Environmental assessment is used to determine the broad ‘environmental fit’, and ecological sustainability of proposed land-use changes. It also establishes the biodiversity context within which a change in land-use is being contemplated and against which its likely impacts (both site-based and cumulative) must be assessed. CBA maps and their associated land-use guidelines provide a proactive and scientific basis for assessing the potential impacts of proposed land-uses and play an important role in providing a biodiversity-sensitive perspective in this process.”

Preliminary systematic biodiversity plans will help ascertain whether any habitat modification will contribute to cumulative impacts and compromise biodiversity targets for specific ecosystems or species, or by contributing to habitat fragmentation and degradation of ecological processes.

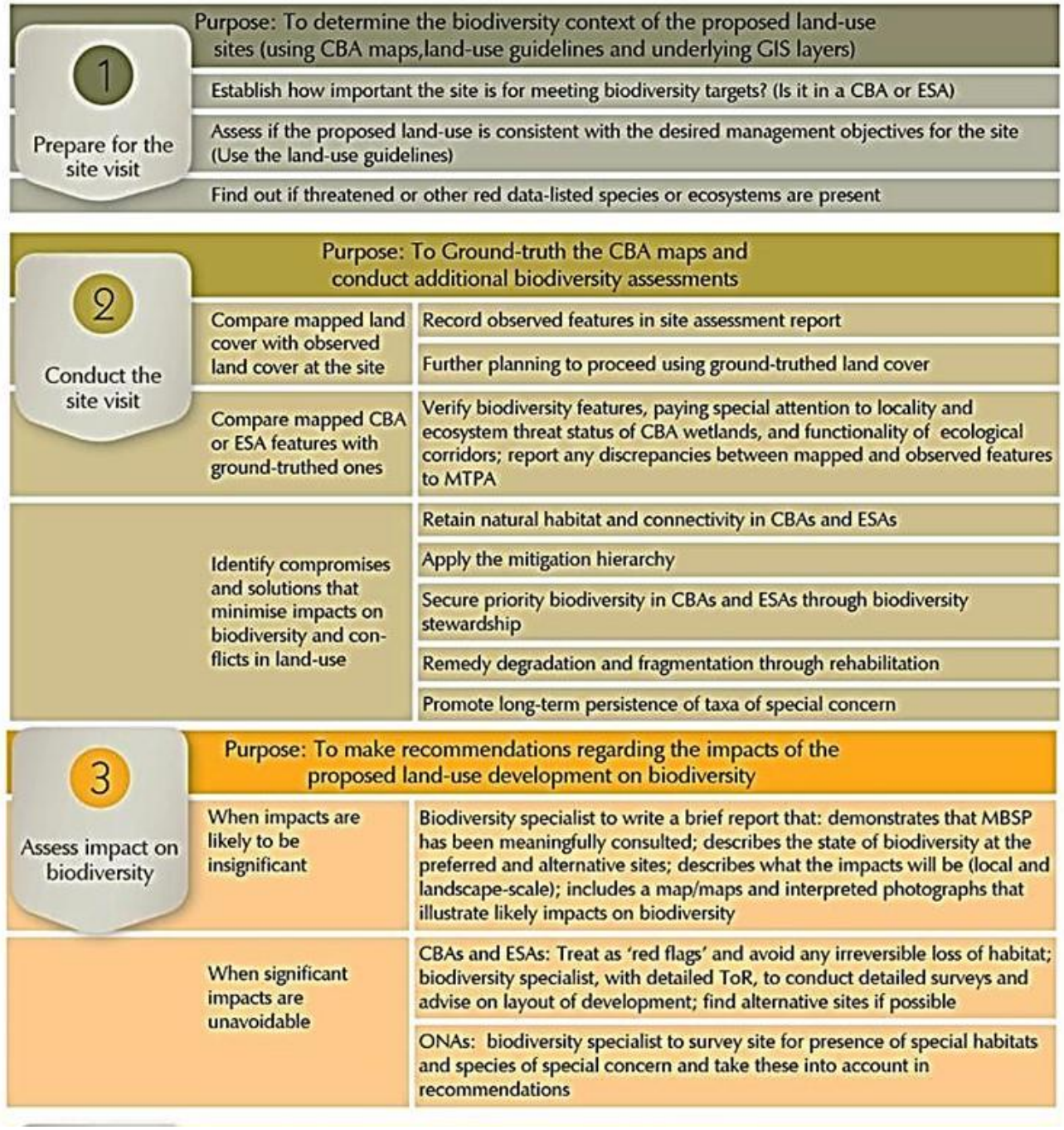


Figure 8: A summary of the first three steps to be followed in using the CBA maps proactively in environmental impact assessment.

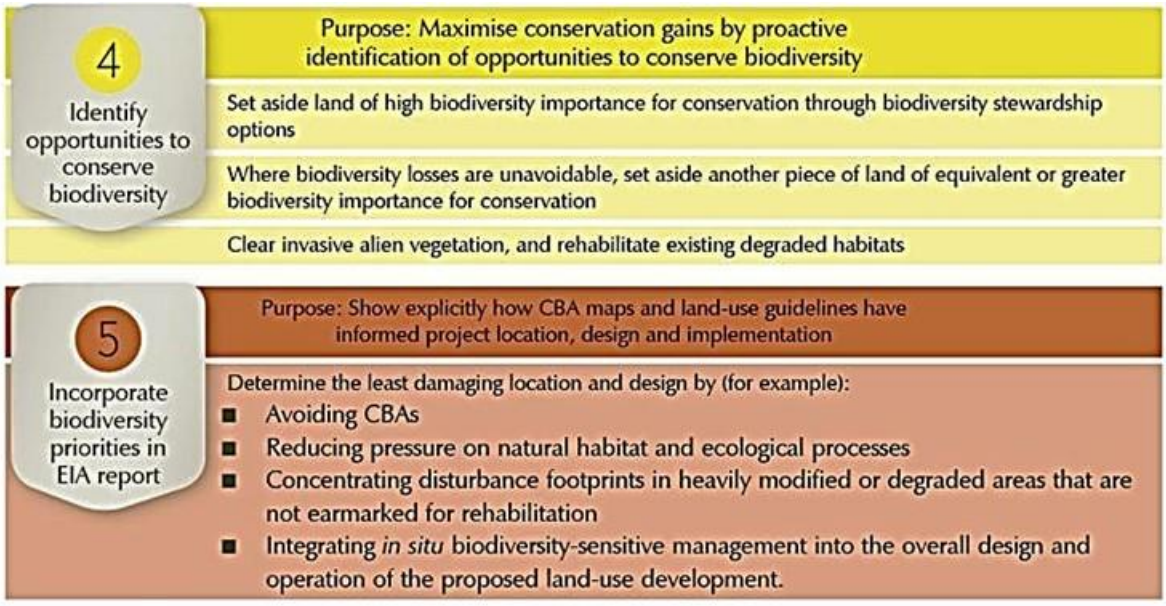


Figure 9: A summary of steps 4 and 5 to be followed in using the CBA maps proactively in environmental impact assessment.

Impact Rating Methodology

It is the goal of the impact assessment process to determine the significance of potential environmental impacts associated with the proposed development. The significance of an impact is defined as a combination of the consequence of the impact occurring and the probability that the impact will occur. Each impact was evaluated individually, however the possibility of a cumulative impact was also considered and evaluated accordingly.

The potential impacts or risks associated with the proposed development were assessed based on the following criteria:

- **Applicable phase: Construction, Operational, (Decommissioning)**
- **Nature of impact:** Provides a description of the expected impacts (Negative, neutral or positive)

The criteria used to determine impact consequence are presented in the tables below.

Table 3: Criteria used to determine the consequence of the impact

Rating	Definition of Rating	Score
A. Extent - the area over which the impact will be experienced		
Site	Confined to the site, or part thereof	1
Local	Effect limited to 3 to 5km of the site	2
Regional	Effect will have an impact on a regional scale.	3
B. Intensity - the magnitude of the impact in relation to the sensitivity of the receiving environment, taking into account the degree to which the impact may cause irreplaceable loss of resources		
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. Duration - the timeframe over which the impact will be experienced and its reversibility		
Short-term	Up to 2 years	1
Medium-term	2 - 15 years	2
Long-term	>15 years	3

The scores are then combined (A+B+C) to determine the Consequence Rating (Table 4).

Table 4: Calculation of the consequence score.

Combined Score (A+B+C)	3-4	5	6	7	8-9
Consequence Rating	Very low	Low	Medium	High	Very high

The probability of the impact occurring needs to be considered in order for the final significance rating to be informed by the specific context.

Table 5: Probability Classification.

Probability - the likelihood of the impact occurring	
Improbable	<40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	>70%- 90% chance of occurring
Definite	>90% chance of occurring

The significance of the impact is attained by cross-referencing probability against consequence, as is listed below.

- **Significance:**
    - Low: Where the impact will have a relatively small effect on the environment and will not have an influence on the decision
    - Medium: Where the impact can have an influence on the environment and the decision and should be mitigated
    - High: Where the impact definitely has an impact on the environment and decision regardless of any possible mitigation

Table 6: Status and Confidence classification.

Status of Impact	
Indication whether the impact is adverse (negative) or beneficial (positive)	+ ve
	- ve
Confidence of Assessment	
The degree of confidence in predictions based on available information, the EAP's judgement and/or specialist knowledge.	Low
	Medium
	High

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **INSIGNIFICANT**: the potential impact is negligible and **will not** have an influence on the decision regarding the proposed activity/development.
- **VERY LOW**: the potential impact is very small and **should not** have any meaningful influence on the decision regarding the proposed activity/development.
- **LOW**: the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.
- **MEDIUM**: the potential impact **should** influence the decision regarding the proposed activity/development.
- **HIGH**: the potential impact **will** affect the decision regarding the proposed activity / development.
- **VERY HIGH**: the proposed activity should only be approved under special circumstances.

Significance post mitigation: Describes the significance after mitigation.

Mitigation: Provides recommendations for mitigation measures

Spatial data sets that indicate Critical Biodiversity Areas

To establish how important the site is for meeting biodiversity targets, a number of resources and tools are used as prescribed by the Mpumalanga Biodiversity Sector Plan (MBSP) (Mpumalanga Biodiversity Sector Plan, 2014). Specifically, the Land-Use Decision Support Tool (LUDS) and the MBCP are extensively used to compile the LUDS Report (BGIS, 2016). LUDS was developed to facilitate and support biodiversity planning and land-use decision-making at a national and provincial level. Its primary objective is to serve as a guideline for biodiversity planning but should not replace specialist ecological assessments.

Critical Biodiversity Areas (CBAs) are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. If these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.

Land-Use Decision Support Tool (LUDS)

To establish how important the site is for meeting biodiversity targets, it is necessary to answer the following three simple but fundamentally important questions:

- How important is the site for meeting biodiversity objectives (e.g., is it in a **Critical Biodiversity Area** (CBA) or Ecological Support Area (ESA)?
- Is the proposed land-use consistent with these objectives or not (to be checked against the land-use guidelines)?
- Does the sensitivity of this area trigger the requirements for assessing and mitigating environmental impacts of developments, or in terms of the listed activities in the EIA regulations?

2.7.2 Habitat sensitivity assessment

The purpose of producing a habitat sensitivity map is to provide information on the location of potentially sensitive biodiversity features in the study area, including areas of natural vegetation, habitat types supporting important biodiversity features or high diversity, areas supporting important ecological processes and habitat suitable for any species of conservation concern.

An explanation of the different sensitivity classes is given in Table 7. Areas containing untransformed natural vegetation of conservation concern, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered potentially sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to potentially have low sensitivity.

Table 7: Explanation of sensitivity ratings.

Sensitivity	**Factors contributing to sensitivity**	**Example of qualifying features**
VERY HIGH	Indigenous natural areas that are highly positive for any of the following: • Presence of threatened species (Critically Endangered, Endangered, Vulnerable) and/or habitat critical for the survival of populations of threatened species. • High conservation status (low proportion remaining intact, highly fragmented, habitat for species that are at risk). • Protected habitats (areas protected according to national/provincial legislation, e.g., National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act) And may also be positive for the following: • High intrinsic biodiversity value (high species richness and/or turnover, unique	• CBA areas. • Remaining areas of vegetation type listed in Draft Ecosystem List of NEM:BA as Critically Endangered, Endangered or Vulnerable. • Protected forest patches. • Confirmed presence of populations of threatened species.

	ecosystems) • High value, ecological goods & services (e.g., water supply, erosion control, soil formation, • carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value) • Low ability to respond to disturbance (low resilience, dominant species very old).	
HIGH	Indigenous natural areas that are positive for any of the following: • High intrinsic biodiversity value (moderate/high species richness and/or turnover). Presence of habitat highly suitable for threatened species (Critically Endangered, Endangered, Vulnerable species). • Moderate ability to respond to disturbance (moderate resilience, dominant species of intermediate age). • Moderate conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk). • Moderate to high value ecological goods & services (e.g., water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value). And may also be positive for the following: Protected habitats (areas protected according to national / provincial legislation, e.g., National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act).	• Habitat where a threatened species could potentially occur (habitat is suitable, but no confirmed records). • Confirmed habitat for species of lower threat status (near threatened, rare). • Habitat containing individuals of extreme age. • Habitat with low ability to recover from disturbance. • Habitat with exceptionally high diversity (richness or turnover). • Habitat with unique species composition and narrow distribution. • Ecosystem providing high value ecosystem goods and services.
MEDIUM-HIGH	Indigenous natural areas that are positive for one or two of the factors listed above, but not a combination of factors.	• Corridor areas. • Habitat with high diversity (richness or turnover). • Habitat where a species of lower threat status (e.g. (near threatened, rare) could potentially occur (habitat is suitable, but no

		confirmed records).
MEDIUM	Other indigenous natural areas in which factors listed above are of no particular concern. May also include natural buffers around ecologically sensitive areas and natural links or corridors in which natural habitat is still ecologically functional.	
MEDIUM-LOW	Degraded, secondary or disturbed indigenous natural vegetation.	
LOW	No natural habitat remaining.	

Table 8: The use of CBA maps in Environmental Impact Assessment and the reference to relevant sections present in the report.

Land-use planning and Decision-making	Reference
Step 1: Prepare for the site visit: Purpose: To determine the biodiversity context of the proposed land-use sites (using CBA maps, land-use guidelines and underlying GIS layers)	
Step 1.1 Establish how important the site is for meeting biodiversity targets? (Is it in a CBA or ESA?)	Critical Biodiversity Areas (under 5.4)
○ Step 1.1.1 Proposed land use	Project description (under 1.3)
○ Step 1.1.2 Environmental Impact Assessments (EIA) and Freshwater Ecosystem Priority Areas (FEPA)	Freshwater Ecosystem Priority Areas (FEPAs) (under 5.4)
○ Step 1.1.3 Description of the biophysical environment	3.2 Physiography of the study area
○ Step 1.1.4 Present Ecological State of the Krokodilspruit	3.1 Present Ecological State of the study area
○ Step 1.1.5 Critical Biodiversity Areas	Critical Biodiversity Areas (under 5.4)
• Step 1.2 Assess if the proposed land-use is consistent with the desired management objectives for the site (Use the land-use guidelines)	Critical Biodiversity Areas (under 5.4)
○ Step 1.2.1 Critical Biodiversity Area in the Krokodilspruit project area	Critical Biodiversity Areas (under 5.4)
• Step 1.3 Find out if threatened or other red data-listed species or ecosystems are present ○ Vegetation ○ Fish ○ Frogs ○ Reptiles ○ Birds ○ Mammals	4.3 Biota assemblages of the Krokodilspruit project areas

Step 2: Conduct the site visit: Purpose: To Ground-truth the CBA maps and conduct additional biodiversity assessments in the study area	4.2 Ecological survey transects in the Krokodilspruit project area.
Step 2.1 Compare mapped land cover with observed land cover at the site	4.1 Vegetation units and land cover types within the study area
○ Step 2.1.1 Record observed features in site assessment report ▪ Ecological surveys - methods ▪ Aquatic habitat assessments ▪ Vegetation ▪ Aquatic biota ▪ Aquatic invertebrate assessment ▪ Fish communities ▪ Terrestrial fauna studies ▪ Amphibian surveys ▪ Reptile surveys ▪ Bird surveys ▪ Mammal surveys	2. Methodology 4.3 Biota assemblages of the Krokodilspruit project areas
○ Step 2.1.2 Results of Ecological Surveys	4. Results
Vegetation	4.1 Vegetation units and land cover types within the study area
▪ Observed vegetation	4.3.1 Vegetation communities
▪ Riparian delineation	Perennial rivers – Sandspruit River **-** (under 4.1.3)
○ Fauna surveys	
▪ Aquatic habitats and fauna	Surveys of Aquatic biota **-** (under 4.3.2)
▪ Aquatic habitat assessment	4.3.2.1 Aquatic ecosystem types
▪ Aquatic invertebrate assessment	4.3.2.2 Aquatic invertebrate assessment
▪ Fish Response Assessment Index	4.3.2.3 Fish communities - Fish Response Assessment Index

	(FRAI)
▪ Terrestrial fauna	4.3.3 Surveys of Terrestrial biota
○ Frogs	4.3.3.1 Frogs
○ Reptiles	4.3.3.2 Reptiles
○ Birds	4.3.3.3 Birds
○ Mammals	4.3.3.4 Mammals
○ Step 2.1.3 Further planning to proceed using ground-truthed land cover	5.5 Land-use planning and Decision-making
Step 2.2 Compare mapped CBA or ESA features with ground-truthed ones	4.1 Vegetation units and land cover types within the study area
Step 2.3 Identify compromises and solutions that minimise impacts on biodiversity and conflicts in land-use	Critical Biodiversity Areas (under 5.4)
○ Step 2.3.1 Retain natural habitat and connectivity in CBAs and ESAs	Critical Biodiversity Areas (under 5.4) - Corridors for Connectivity
○ Step 2.3.2 Apply the mitigation hierarchy	5.7 Assessment of impacts
○ Step 2.3.3 Secure priority biodiversity in CBAs and ESAs through biodiversity stewardship	5.8 Conditions for inclusion in the environmental authorisation
○ Step 2.3.4 Remedy degradation and fragmentation through rehabilitation	5.8 Conditions for inclusion in the environmental authorisation
○ Step 2.3.5 Promote long-term persistence of taxa of special concern	5.8 Conditions for inclusion in the environmental authorisation
Step 3: Assess impact on biodiversity: Purpose: To make recommendations regarding the impacts of the proposed land-use development on biodiversity	5.7 Assessment of impacts
Step 3.1 When impacts are likely to be insignificant	5.7 Assessment of impacts
○ Step 3.2 When significant impacts are unavoidable	5.10.1 Reasoned opinion
○ Step 3.2.1 CBAs and ESAs	5.10.1 Reasoned opinion
○ Step 3.2.2 ONAs	5.10.1 Reasoned opinion

Step 4: Identify opportunities to conserve biodiversity: Purpose: Maximise conservation gains by proactive identification of opportunities to conserve biodiversity	Critical Biodiversity Areas (under 5.4)
○ Step 4.1 Set aside land of high biodiversity importance for conservation through biodiversity stewardship options	Critical Biodiversity Areas (under 5.4)
○ Step 4.2 Where biodiversity losses are unavoidable, set aside another piece of land of equivalent or greater biodiversity importance for conservation	Critical Biodiversity Areas (under 5.4)
○ Step 4.3 Clear invasive alien vegetation and rehabilitate existing degraded habitats	5.7 Assessment of impacts
Step 5: Incorporate biodiversity priorities in EIA report: Purpose: Show explicitly how CBA maps and land-use guidelines have informed project location, design and implementation	Critical Biodiversity Areas (under 5.4)
○ Step 5.1 Determine the least damaging location and design	Critical Biodiversity Areas (under 5.4)
○ Step 5.1.1 Avoiding CBAs	Critical Biodiversity Areas (under 5.4)
○ Step 5.1.2 Reducing pressure on natural habitat and ecological processes.	5.7 Assessment of impacts
○ Step 5.1.3 Concentrating disturbance footprints in heavily modified or degraded areas that are not earmarked for rehabilitation	5.7 Assessment of impacts
○ Step 5.1.4 Integrating *in situ* biodiversity-sensitive management into the overall design and operation of the proposed land-use development	5.7 Assessment of impacts

2.7.3 Risk assessment

Due to the fact that the construction of a low-level river crossing is planned to accommodate equipment and vehicles during harvesting- and general farming operations, it was decided to conduct a DWS Risk assessment protocol for these activities.

The DWS Risk assessment protocol that was used was obtained from GN 509. Risk posed to "resource quality", as defined in the NWA, must be scored according to the Risk Rating Table for Severity (Table 16). A Severity score is then generated. Consequence, Likelihood and finally Significance scores are automatically calculated with the rest of parameters according to respective Risk Rating Tables (Tables 9 -15).

Risk is determined after considering all listed control/mitigation measures. Borderline LOW /MODERATE risk scores can be manually adapted downwards up to a maximum of 25 points (from a score of 80) subject to a listing of additional mitigation measures considered and listed in **RED** font. ONLY LOW RISK ACTIVITIES located within the regulated area of the watercourse will qualify for a General Authorisation (GA) according to GN 509 (Table 16). Medium and High-risk activities will require a Section 21 (c) and (i) water use license. The risk rating is determined by combined scores from the following matrix components (Tables 9 -15):

Consequence= Severity + Spatial Scale + Duration
Likelihood = Frequency of the Activity+ Frequency of the Impact + Legal Issues + Detection
Risk = Consequence x Likelihood

Table 9: Severity - How severe do the aspects impact on the resource quality (flow regime, water quality, geomorphology, biota, and habitat)? Derived from the DWS Risk Matrix Impact Assessment method (GN 509).

Insignificant / non-harmful	1
Small / potentially harmful	2
Significant / slightly harmful	3
Great / harmful	4
Disastrous / extremely harmful and/or wetland(s) involved	5
Where "or wetland(s) are involved" it means that the activity is located within the delineated boundary of any wetland. The score of 5 is only compulsory for the significance rating.	

Table 10: Spatial scale - How large is the area that the aspect is impacting on? Derived from the DWS Risk Matrix Impact Assessment method (GN 509).

Area specific (at impact site)	1
Whole site (entire surface right)	2
Regional/neighbouring areas (downstream within quaternary catchment)	3
National (impacting beyond secondary catchment or provinces)	4
Global (impacting beyond SA boundary)	5

Table 11: Duration -How long does the aspect impact on the resource quality? Derived from the DWS Risk Matrix Impact Assessment method (GN 509).

One day to one month, PES, EIS and/or REC not impacted	1
One month to one year, PES, EIS and/or REC impacted but no change in status	2
One year to 10 years, PES, EIS and/or REC impacted to a lower status but can be improved over this period through mitigation	3
Life of the activity, PES, EIS and/or REC permanently lowered	4
More than life of the organisation/facility, PES and EIS scores, a E or F	5
PES and EIS (sensitivity) must be considered.	

Table 12: Frequency of the activity - How often do you do the specific activity? Derived from the DWS Risk Matrix Impact Assessment method (GN 509).

Annually or less	1
6 monthly	2
Monthly	3
Weekly	4
Daily	5

Table 13: Frequency of the incident/impact - How often does the activity impact on the resource quality? Derived from the DWS Risk Matrix Impact Assessment method (GN 509).

Almost never / almost impossible / >20%	1
Very seldom / highly unlikely / >40%	2
Infrequent / unlikely / seldom / >60%	3
Often / regularly / likely / possible / >80%	4
Daily / highly likely / definitely / >100%	5

Table 14: Legal issues - How is the activity governed by legislation? Derived from the DWS Risk Matrix Impact Assessment method (GN 509).

No legislation	1
Fully covered by legislation (wetlands are legally governed)	5
This is a constant, will always be regulated in terms of a Section 21 water use, if not then the affected activity should not be subject to the Risk Matrix. **Located within the regulated areas refers to a location within the 1 in 100-year flood line or delineated riparian area as measured from the middle of the watercourse measured on both banks, or within a 500 m radius of the boundary of any wetland.**	

Table 15: Detections – How quickly/easily can the impacts/risks of the activity be observed on the resource quality, people and property? Derived from the DWS Risk Matrix Impact Assessment method (GN 509).

Immediately	1
Without much effort	2
Need some effort	3
Remote and difficult to observe	4
Covered	5

Table 16: Significance rating score and risk classes based on the DWS Risk Matrix Impact Assessment method (GN 509).

RATING	CLASS	MANAGEMENT DESCRIPTION
1 – 55	**(L) Low Risk**	**Acceptable as is or consider requirement for mitigation. Impact to watercourses and resource quality small and easily mitigated.**
56 – 169	**(M) Moderate Risk**	**Risk and impact on watercourses are significant and require mitigation measures on a higher level, which costs more and requires specialist input. License required.**
170 – 300	**(H) High Risk**	**Watercourse(s) impacts by the activity are such that they impose a long-term threat on a large scale and lowering of the Reserve. License required.**

3. Description of the study area

3.1 Present Ecological State of the study area

This report covers an area on Portion 248 JT of the farm Krokodilspruit in the White River area Mpumalanga. The entire study area is located within the quarter degree grid 2530BD. The site is located within the Ehlanzeni District Municipality, Mpumalanga Province.

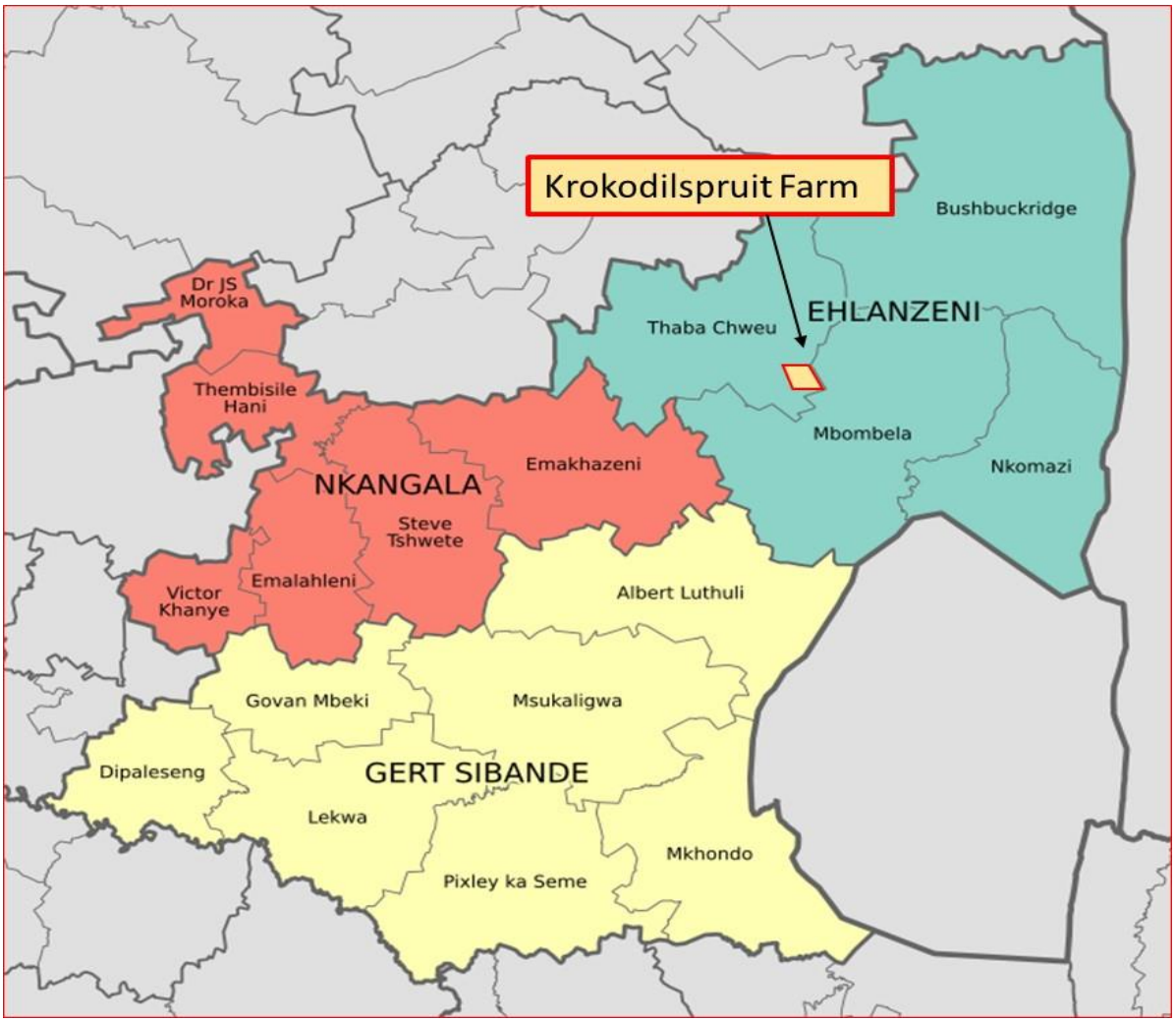


Figure 10: Location of the Krokodilspruit farm.

The Ehlanzeni District Municipality is a Category C municipality situated in the north-east of the Mpumalanga Province. It makes up just over a third of the province's geographical area. The district includes of four local municipalities: Bushbuckridge, City of Mbombela, Nkomazi and Thaba Chweu.

Commercial farming began in White River after the 1904 Transvaal Land Department survey of the valley and with the construction of a weir over the river and the construction of a canal. One hundred plots of land were offered for sale and citrus trees by the thousand, were planted.

Citrus, tobacco, vegetables and plantations were farmed well into the 20th century although the environment took a harsh toll on the crops. By the end of the century, citrus and tobacco had disappeared, replaced by eucalyptus plantations interspersed with macadamia and avocado orchards.

The new generation of farmers have branched into designer fruit and vegetables, plantations are giving way to more macadamias whilst avocados remain a key crop. The farms are relatively small however the agriculture is intensive with tropical and citrus fruits in abundance, and vegetables and cut flowers readily available.

Before 1942 the Krokodilspruit farm was utilised to farm with maize and cattle extensively. The plantations were only established in 1977. Aerial maps from 1936 were studied and showed the sections which were cultivated at the time. These are situated roughly in the middle of the farm and have been fallow for many years. Many drainage lines slope from low hills towards the Sand- and Krokodilspruit streams which flow through the farm. Several earthen water furrows were constructed to channel water to the cultivated areas in earlier years. The water furrows were lined with concrete in 1960 (Van Wyk Rowe, 2018).

Large sections on the property were covered in blue gum plantations (see Figure 29), which are currently being converted into agricultural lands (macadamias).

Figure 11 illustrates the land cover for the Krokodilspruit project obtained from the Mpumalanga LUDS maps (BGIS, 2022), showing areas discussed in this section.

Agriculture, plantation forestry, mining and ecotourism based on wildlife and nature-based adventure sports, form the backbone of Mpumalanga's economy. The agricultural sector is the single biggest land-user in Mpumalanga, with 19% of the province's land surface under cultivation, followed by plantation forestry, which covers 9% of the land surface area. In addition, a notable proportion (7%) of the province's landscape is made up of 'old lands', or secondary grasslands which are no longer cultivated (Lötter et al, 2014).

The high-altitude grassland areas of the province are well-suited to cultivation of commercial softwood timber (such as pine), whilst the warmer savanna regions are favoured for the cultivation of fruit, sugarcane and hardwood timber (such as blue gum). In addition, both the grassland and savanna regions are used extensively as rangelands for livestock by both commercial and subsistence farmers, and a growing number of farmers are converting to farming with game, or mixed game/domestic livestock operations (Lötter et al, 2014).

Following a boom in the South African and global macadamia industry, South Africa is now the largest producer of macadamia nuts in the world. The South African market is largely driven by exports and as demand increases, we have seen hectares under macadamias trees increasing rapidly in South Africa's macadamia growing areas (https://www.bizcommunity.com/Article/196/358/175342.html).

It is estimated that, just over the past year, roughly 650 ha of forestry plantations were converted to more lucrative crops such as macadamia and avocado in the White River, Hazyview and Sabie area alone and significant areas are still in the process of being converted. Timber as young as two to three years is being clear-felled and areas de-stumped to make way for the new orchards. The economic benefits that these new crops bring to the landowners and to the region far outweigh the returns from forestry. Roughly 95% of the South African macadamia crops are exported and the weak Rand ensures very good returns to macadamia growers (http://saforestryonline.co.za/news/changing-face-forestry-lowveld/).

Macadamias, adapted to the fringes of subtropical rainforests of coastal, eastern Australia, are resilient to mild water stress. Even after a prolonged drought, it is difficult to detect stress in commercial trees. Despite this, macadamia orchards in newer irrigated regions produce more consistent crops than those from traditional, rain-fed regions. Crop fluctuations in the latter tend to follow rainfall patterns. The benefit of irrigation in lower rainfall areas is undisputed, but there are many unanswered questions about the most efficient use of irrigation water. Water is used more efficiently when it is less readily available, causing partial stomatal closure that restricts transpiration more than it restricts photosynthesis.

Limited research suggests that macadamias can withstand mild stress. In fact, water use efficiency can be increased by strategic deficit irrigation. However, macadamias are susceptible to stress during oil accumulation. There may be benefits of applying more water at critical times, less at others, and this may vary with each cultivar. Currently, it is common for macadamia growers to apply about 20-40 L $tree^{-1}$ day^{-1} of water to their orchards in winter and 70-90 L $tree^{-1}$ day^{-1} in summer.

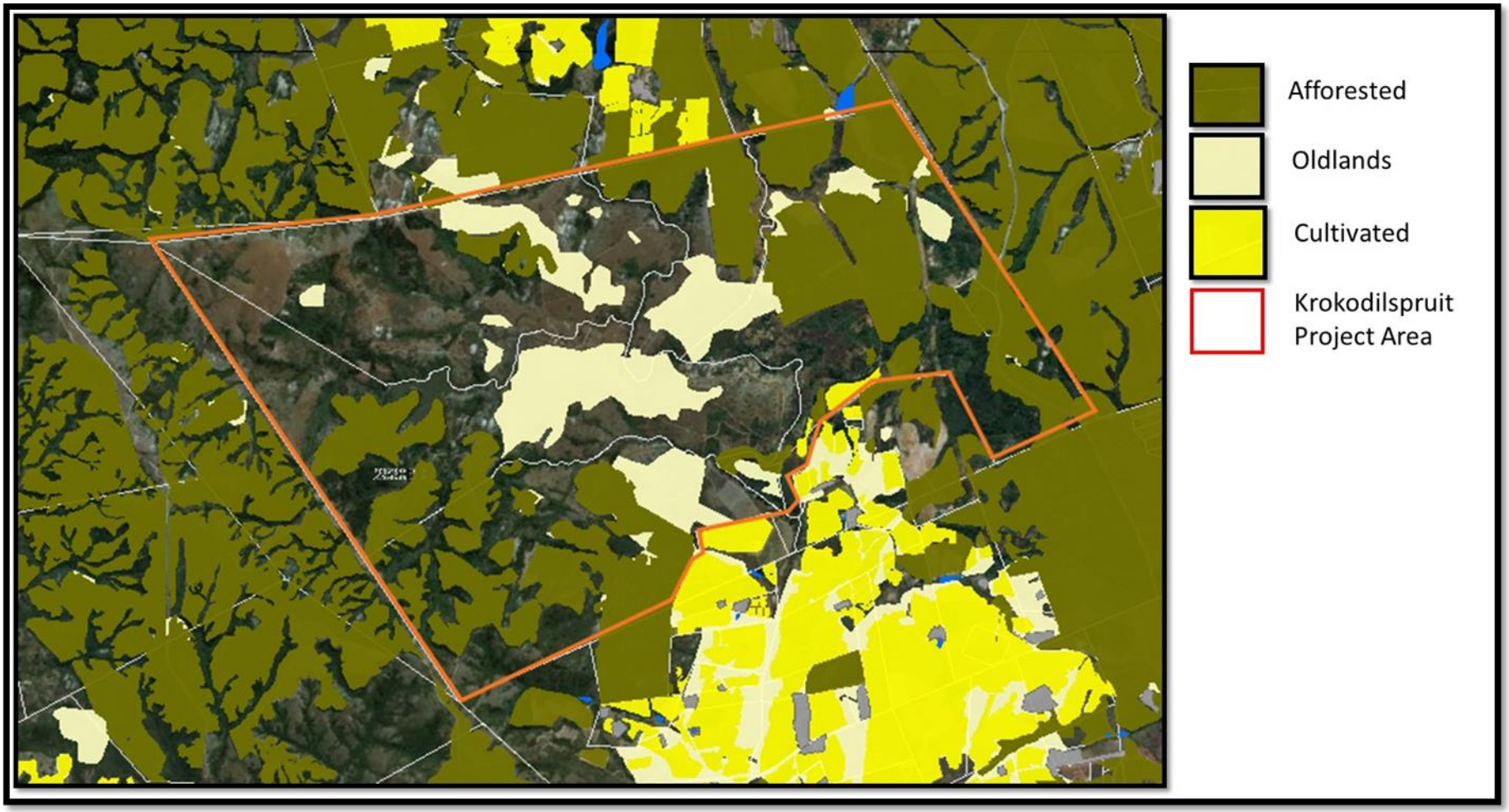


Figure 11: The land cover for the Krokodilspruit project obtained from the Mpumalanga LUDS maps (BGIS, 2022).

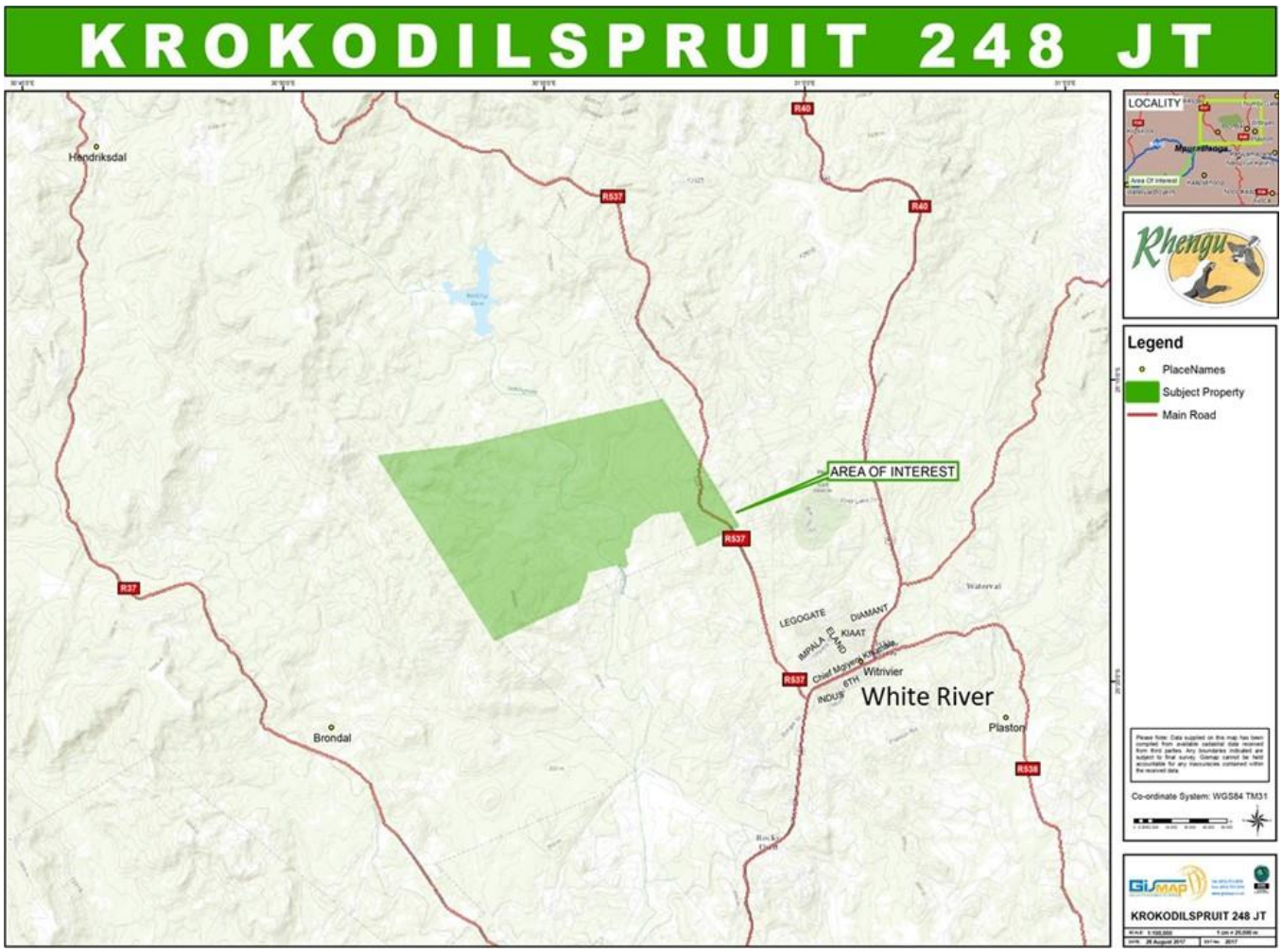


Figure 12: The locality of the project area indicated with the green polygon, illustrating the surrounding roads and towns.

3.2 Physiography of the study area

The most recent vegetation map for South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2006), maps the vegetation of the vast majority of the study area as **Legogote Sour Bushveld**. The north-western corner of the farm penetrates the Northern Escarpment Quartzite Sourveld.

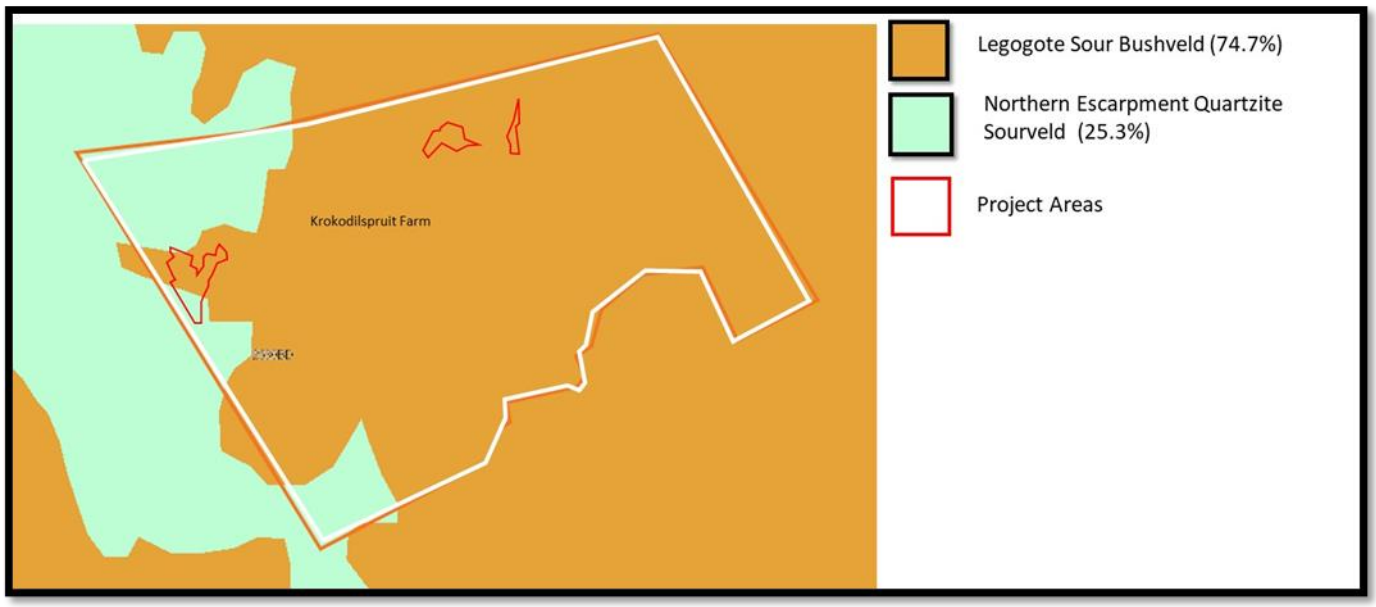


Figure 13: A broad-scale overview of the vegetation types in and around the Krokodilspruit Project area and the area being covered by the vegetation types (BGIS, 2018; Mucina & Rutherford, 2006).

Table 17: SVI 9 Legogote Sour Bushveld – status.

Name of vegetation type	Legogote Sour Bushveld
Code as used in the Book - contains space	SVl9
Conservation Target (percent of area) from NSBA	19%
Protected (percent of area) from NSBA	1.6% (+2.3%)
Remaining (percent of area) from NSBA	50.4%
Description of conservation status from NSBA	Endangered
Description of the Protection Status from NSBA	Poorly protected
Area (sqkm) of the full extent of the Vegetation Type	3538.14 (354 000 ha)
Name of the Biome	Savanna Biome
Name of Group (only differs from Bioregion in Fynbos)	Lowveld Bioregion
Name of Bioregion (only differs from Group in Fynbos)	Lowveld Bioregion

Distribution: Mpumalanga and Limpopo Provinces: Lower eastern slopes and hills of the north-eastern escarpment from Mariepskop in the north through White River to the Nelspruit area extending westwards up the valleys of the Crocodile, Elands and Houtbosloop Rivers and terminating in the south in the Barberton area. Altitude 600–1 000 m and higher in places.

Vegetation & Landscape Features: Gently to moderate. Sloping upper pediment slopes with dense woodland including many medium to large shrubs often dominated by *Parinari curatellifolia* and *Bauhinia galpinii* with *Hyperthelia dissoluta* and *Panicum maximum* in the undergrowth. Short thicket dominated by *Vachellia ataxacantha* occurs on less rocky sites. Exposed granite outcrops have low vegetation cover.

Geology & Soils: Most of the area is underlain by gneiss and migmatite of the Nelspruit Suite, but the southern part occurs on the potassium-poor rocks of the Kaap Valley Tonalite (both Swazian Erathem). The western parts of the distribution are found in Pretoria Group shale and quartzite (Vaalian). Archaean granite plains with granite inselbergs and large granite boulders also occur. Soils are of Mispah, Glenrosa and Hutton forms, shallow to deep, sandy or gravelly and well drained. Diabase intrusions are common, giving rise to Hutton soils.

Climate: Summer rainfall with dry winters. MAP from about 700 mm on the footslopes of the escarpment in the east to about 1 150 mm where it borders on grassland at higher altitude to the west. Frost infrequent to occasional at higher altitudes. Mean monthly maximum and minimum temperatures for Nelspruit 35.7°C and 1.6°C for October and July, respectively. Corresponding values for Barberton: 36.0°C and 0.8°C for October and June, respectively. Both weather stations lie at the eastern edge of the unit at lower altitude.

Conservation: Endangered. Target 19%. About 2% statutorily conserved mainly in the Bosbokrand and Barberton Nature Reserves; at least a further 2% is conserved in private reserves including the Mbesan and Kaapsehoop Reserves and Mondi Cycad Reserve. It has been greatly transformed (50%), mainly by plantations and also by cultivated areas and urban development. Scattered alien plants include *Lantana camara, Psidium guajava* and *Solarium mauritianum.* Erosion is very low to moderate.

Remark: At places on the footslopes this vegetation becomes very dense and is transitional to forest in kloofs on the eastern slopes of the escarpment.

The study site borders on the Wolkberg Centre of Endemism and the proposed Nature Reserve might extend into this Centre of Plant Endemism (Van Wyk & Smith, 2001) The Wolkberg Centre of endemism extends from Kaapsehoop in the south, along the Black Reef and Chuniespoort formations of the Mpumalanga Escarpment and northward into Limpopo Province. Its geology consists mainly quartzites and dolomites and many of the plant endemics in this centre are directly associated with soils. Occurring as it does in areas that are ideal for afforestation, the Wolkberg Centre has undergone extensive habitat modification, with just under half of the original extent already lost (MBSP).

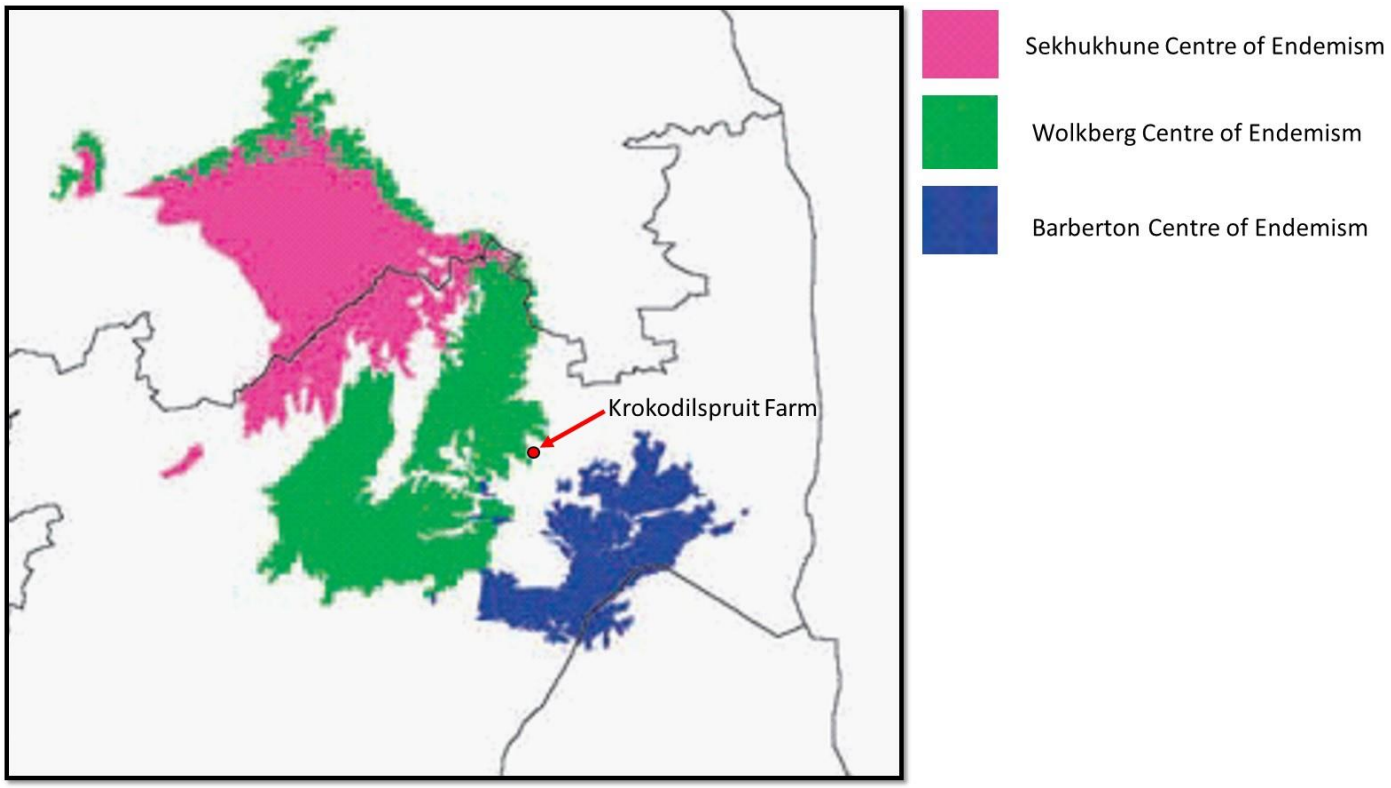


Figure 14: The study site is situated close to the edge of the Wolkberg Centre of Endemism and the proposed Nature Reserve might extend into this Centre of Endemism (Van Wyk & Smith, 2001).

Table 18: Dominant and common plant taxa of the **Legogote Sour Bushveld** (Mucina & Rutherford, 2006).

Plant group	Species
Tall Trees:	*Pterocarpus angolensis (d), Sclerocarya birrea subsp. caffra (d).*
Small Trees:	*Vachellia davyi (d), A. sieberiana var. woodii (d), Combretum zeyheri (d), Erythrina latissima (d), Parinari curatellifolia, Terminalia sericea (d), Trichilia emetica (d), Vernonia amygdalina (d), Vachellia caffra, Antidesma venosum, Erythroxylum emarginatum, Faurea rochetiana, F. saligna, Ficus burkei, F. glumosa, F. ingens. F. petersii, Heteropyxis natalensis, Peltophorum africanum, Piliostigma thonningii, Pterocarpus rotundifolius, Schotia brachypetala.*
Succulent Tree:	*Euphorbia ingens.*
Tall Shrubs:	*Diospyros lycioides subsp. sericea, Erythroxylum delagoense, Olea europaea subsp. africana, Pachystigma macrocalyx, Pseudarthria hookeri var. hookeri, Rhus pentheri.*
Low Shrubs:	*Diospyros galpinii (d). Flemingia grahamiana (d), Agathisanthemum bojeri, Eriosema psoraleoides, Gymnosporia heterophylla, Hemizygia punctata, Indigofera filipes, Myrothamnus flabellifolius, Rhus rogersii.*
Succulent Shrubs:	*Aloe petricola, Euphorbia vandermerwei, Huernia kirkii.*
Woody Climbers:	*Vachellia ataxacantha (d), Bauhinia galpinii (d), Helinus integrifolius,*

	Sphedamnocarpus pruriens subsp. pruriens.
Graminoids:	*Bothriochloa bladhii (d), Cymbopogon caesius (d), C. nardus (d), Hyparrhenia cymbaria (d), H. poecilotricha (d), Hyperthelia dissoluta (d), Panicum maximum (d), Andropogon schirensis, Paspalum scrobiculatum, Schizachyrium sanguineum.*
Herbs:	*Gerbera ambigua, G. viridifolia, Hemizygia persimilis, Hibiscus sidiformis, Ocimum gratissimum, Waltheria indica.*
Geophytic Herbs:	*Gladiolus hollandii, Hypoxis rigidula.*
Succulent Herbs:	*Orbea carnosa subsp. carnosa, Stapelia gigantea.*
Endemic Taxon Succulent Herb:	*Aloe simii.*

Table 19: Gm 23 Northern Escarpment Quartzite Sourveld – status.

Name of vegetation type	Northern Escarpment Quartzite Sourveld
Code as used in the Book - contains space	Gm23
Conservation Target (percent of area) from NSBA	27%
Protected (percent of area) from NSBA	15.3% (+9.2%)
Remaining (percent of area) from NSBA	61.6%
Description of conservation status from NSBA	Vulnerable
Description of the Protection Status from NSBA	Moderately protected
Area (sqkm) of the full extent of the Vegetation Type	1365.28
Name of the Biome	Grassland Biome
Name of Group (only differs from Bioregion in Fynbos)	Mesic Highveld Grassland Bioregion
Name of Bioregion (only differs from Group in Fynbos)	Mesic Highveld Grassland Bioregion

Distribution: Limpopo and Mpumalanga Provinces: Occurring along the high-altitude crests of the Northern Escarpment, from Haenertsburg in the north, south-eastwards, then bending southwards past Blyde River Canyon, Graskop and as far south as the vicinity of Kaapsehoop. Altitude 1000–1740 m.

Conservation: Vulnerable. The conservation target is 27% and 15% is protected within the Lekgalameetse and Blyde River Canyon National Park. As much as 38% of this unit has been transformed mainly by plantations (37%), with limited cultivated areas. Estimated erosion potential levels very low (39%), low (47%) and moderate (14%).

Vegetation & Landscape Features The landscape is characteristically very rugged, with steep east-facing cliffs. This escarpment is intersected in some areas with large east-flowing rivers. Short, closed grassland rich in forb species with scattered trees and shrubs. This unit is very rocky and occurs on weather-resistant quartzite. The nutrient-poor soils lead to a lower biomass which, together with the rocky landscape, results in a reduced frequency and intensity of fires. It therefore has slightly more woody elements than the adjacent units.

Geology and Soils: Black Reef Group and Wolkberg Group quartzite (formed 2.5 billion years ago and occurring at the base of the Transvaal Supergroup), covered with shallow rocky soils of the Mispah form.

Climate: Summer rainfall, but orographic effects enhance precipitation (overall regional MAP 1 176 mm). Mist common along the highest areas. Warm-temperate climate (MAT 16.6°C), with infrequent frost.

Remark 1: This vegetation type closely coincides with the Wolkberg Centre of Endemism and is rich in endemic plants. Although this centre does incorporate the dolomites of Gm 22 Northern Escarpment Dolomite Grassland and SVcb 25 Poung Dolomite Mountain Bushveld, it is also includes two subcentres, namely the Serala and Blyde Subcentres. The Serala Subcentre is found to the north of the Olifants River along the Northern Escarpment, with approximately 36 endemics and near-endemics. The Blyde Subcentre is found to the south of the Olifants River along the Northern Escarpment, with approximately 15 endemic or near-endemic species.

Table 20: Dominant and common plant taxa of the Northern Escarpment Quartzite Sourveld (Mucina & Rutherford, 2006).

Plant group	Species
Tall Trees:	
Small Trees:	*Protea roupelliae* subsp. *Roupelliae* (d), *Faurea galpinii*, *F. rochetiana*, *Syzygium cordatum* var. *cordatum*.
Tree Fern:	*Cyathea dregei*.
Succulent Tree:	
Tall Shrubs:	*Vernonia myriantha*.
Low Shrubs:	*Athrixia phylicoides*, *Clutia monticola*, *Crotalaria doidgeae*, *Erica woodii*, *Euryops pedunculatus*, *Helichrysum kraussii*, *H. obductum*, *H. wilmsii*, *Phymaspermum acerosum*, *P. bolusii*, *Rhus tumulicola* var. *meeuseana*.
Succulent Shrubs:	*Lopholaena coriifolia* (d), *Aloe arborescens*, *Crassula sarcocaulis*.
Woody Climbers:	
Graminoids:	*Aristida junciformis* subsp. *galpinii* (d), *Loudetia simplex* (d), *Melinis nerviglumis* (d), *Monocymbium ceresiiforme* (d), *Panicum ecklonii* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *Alloteropsis semialata* subsp. *eckloniana*, *Andropogon appendiculatus*, *Cymbopogon nardus*, *Digitaria maitlandii*, *Diheteropogon filifolius*, *Elionurus muticus*, *Festuca costata*, *Hyparrhenia poecilotricha*, *Ischyrolepis schoenoides*, *Juncus lomatophyllus*, *Koeleria capensis*, *Merxmuellera drakensbergensis*, *Microchloa caffra*, *Pentaschistis natalensis*, *Rendlia altera*, *Schizachyrium sanguineum*, *Sporobolus pectinatus*, *Stiburus alopecuroides*, *Themeda triandra*, *Trichopteryx dregeana*.
Herbs:	*Rhynchosia woodii* (d), *Acalypha glandulifolia*, *Anisopappus smutsii*, *Aster harveyanus*, *Berkheya echinacea*, *Craterocapsa tarsodes*, *Dicoma anomala*, *Eriosema angustifolium*, *Geigeria burkei* subsp. *burkei*, *Gerbera ambigua*, *Helichrysum acutatum*, *H. appendiculatum*, *H. cephaloideum*, *H. nudifolium* var. *pilosellum*, *H. oreophilum*, *H. umbraculigerum*, *Indigofera sanguinea*, *Kohautia amatymbica*, *Lobelia flaccida*, *Monsonia attenuata*, *Pearsonia sessilifolia* subsp. *marginata*, *Rabdosiella calycina*, *Selago hyssopifolia*, *Senecio panduriformis*, *S. scitus*, *Vernonia centaureoides*, *V. natalensis*, *V. poskeana*, *Wahlenbergia squamifolia*.
Herbaceous Climber:	*Rhynchosia caribaea*.
Geophytic Herbs:	*Asplenium aethiopicum*, *Cheilanthes hirta*, *Pteridium aquilinum*, *Schizocarphus nervosus*.

Succulent Herbs:	*Crassula alba*, *C. vaginata*, *Craterostigma wilmsii*.
Biogeographically Important Taxa Northern Escarpment Quartzite Sourveld	Northern sourveld endemics: Small Trees: *Protea rubropilosa* (d), *Encephalartos paucidentatus*. Tall Shrub: *Tricalysia capensis* var. *galpinii*. Low Shrubs: *Berkheya carlinopsis* subsp. *magalismontana*, *Helichrysum mimetes*, *H. reflexum*, *H. rudolfii*, *H. uninervium*, *Hemizygia parvickerdtii*. Herbs: *Cineraria hederifolia*, *Inezia speciosa*, *Monopsis kowynensis*, *Monsonia lanuginosa*, *Schistostephium artemisiifolium*, *Streptocarpus decipiens*. Geophytic Herbs: *Brachystelma pachypodium*, *Crocosmia mathewsiana*, *Cyrtanthus huttonii*, *C. junodii*, *Dierama adelphicum*, *Disa aristata*, *Drimiopsis davidsonae*, *Ledebouria* sp. nov. (‘*rupestris*’), *L. galpinii*, *L. petiolata*, *Schizochilus crenulatus*, *Tulbaghia coddii*, *T. simmleri*, *Watsonia strubeniae*. Succulent Herb: *Aloe nubigena*.

Catchment and Wetland Setting

The Portion 248 JT of the farm Krokodilspruit is situated in the Crocodile River Sub-Water Management Area which form part of the Komati River drainage system. The project site is located in quaternary catchment X22F and two prominent streams: the Sandspruit (X22F-00886) and the Krokodilspruit (not DWS labelled) flow through the area (Figure 15).

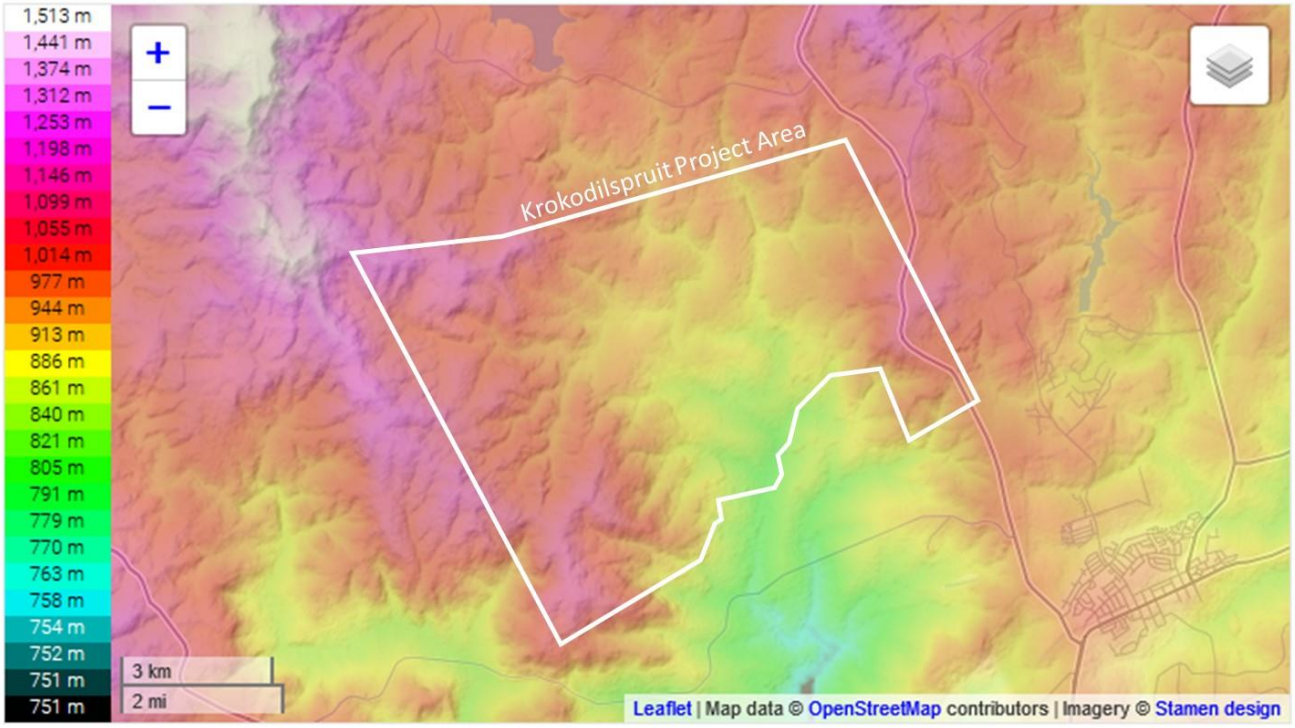


Figure 15: Altitude across the project area varies from *c*. 770 to 1441 mamsl and consists of hilly areas to the west of the farm, draining down the slope to the valleys in the south of the farm.

Ecoregion and River Characteristics

Ecoregions are groups of rivers within South Africa, which share similar physiography, climate, geology, soils and potential natural vegetation. For the purposes of this study, the ecoregional classification presented by Department of Water Affairs and Forestry in 1999 (DWAF, 1999), which divides the country's rivers into ecoregions, was used. The project site is located in quaternary catchment X22F with the development taken place within the catchments of the Sandspruit and Krokodilspruit draining from the North-Eastern Highlands (4.04) and Lowveld (3.07) Ecoregions.

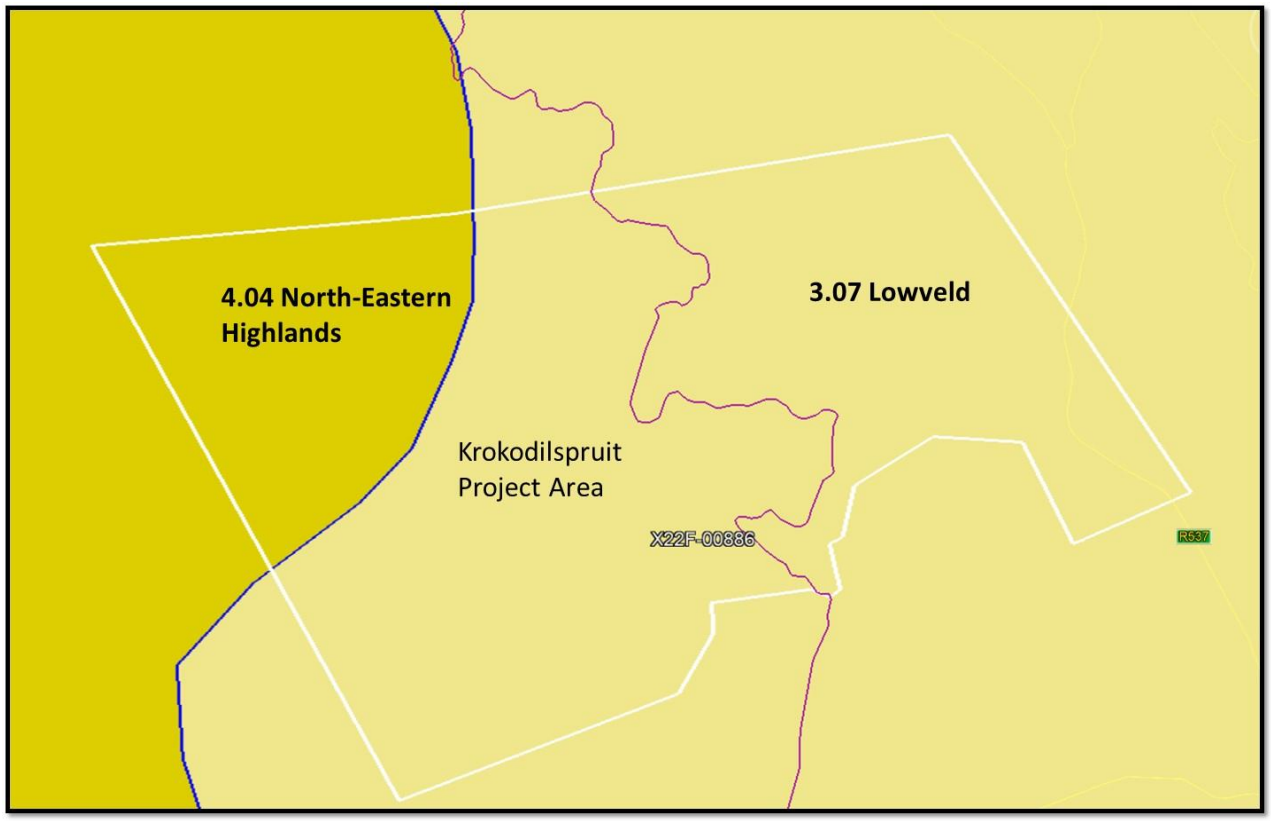


Figure 16: The Project Area straddles two ecoregions: North-Eastern Highlands (4.04) and Lowveld (3.07) Ecoregions according to the Water Resource Classification System (DWS, 2014).

3.07 Lowveld Ecoregion

Although several large perennial streams traverse this region, e.g., Komati, Crocodile, Sabie, Olifants, Letaba and Luvuvhu, few perennial streams originate here.

- Mean annual precipitation: Tends to be moderate towards the west, but low over most of the region.
- Coefficient of variation of annual precipitation: Mostly moderate.
- Drainage density: Mostly low, but high in some of the central areas.
- Stream frequency: Mostly low to medium but high in some of the central areas.
- Slopes <5%: >80% of the area.
- Median annual simulated runoff: Mostly low/moderate, but moderate in areas.
- Mean annual temperature: High to very high.

Table 21: Characteristics of the Lowveld Ecoregion (**Project Area attributes In Bold**).

Main Attributes	**Description**
Terrain Morphology: Broad division	Plains; Low Relief; **Plains; Moderate Relief**; Lowlands, Hills and Mountains; Moderate and High Relief (limited) Open Hills, Lowlands; Mountains; Moderate to High Relief; (limited) Closed Hills; Mountains; Moderate and High Relief (Limited)
Vegetation types	Mopane Bushveld**;** Mopane Shrubveld; **Mixed Lowveld Bushveld;** Sour Lowveld Bushveld; Sweet Lowveld Bushveld; Natal Lowveld Bushveld; Lebombo Arid Mountain Bushveld; Mixed Bushveld North Eastern Mountain Grassland;
Altitude (m a.m.s.l)	0-700; 700-1300 limited
MAP (mm)	200 to 1000
Rainfall seasonality	Early to late summer
Mean annual temp. (°C)	16 to >22
Median annual simulated runoff (mm) for quaternary catchment	10 to >250

4.04 North-Eastern Highlands Ecoregion

This is a mountainous area characterised by closed hills and mountains with moderate to high relief and vegetation including North-Eastern Highveld Grassland and Lowveld Bushveld types. Patches with Afromontane Forest are scattered throughout the region.
Generally, this ecoregion can be regarded as transitional between the Lowveld and the Northern Escarpment. Perennial tributaries commonly contribute to the flow of larger rivers along the length of the region.

- Mean annual precipitation: Moderate to high.
- Coefficient of variation of annual precipitation: Moderate to very low.
- Drainage density: Generally medium.
- Stream frequency: Low/medium to medium high.
- Slopes <5%: Varies from <20% to 25 – 50%.
- Median annual simulated runoff: Moderate/high to high.
- Mean annual temperature: Cool to moderate.

Table 22: Characteristics of the North-Eastern Highlands Ecoregion (**Project Area attributes In Bold**).

Main Attributes	**Description**
Terrain Morphology: Broad division	**Plains; Moderate Relief** Open Hills, Lowlands, Mountains; Moderate to High Relief Closed Hills, Mountains; Moderate and High Relief
Vegetation types	Mixed Bushveld; Mixed Lowveld Bushveld; **Sour Lowveld Bushveld;** Natal Lowveld Bushveld (limited) **North-eastern Mountain Grassland;** Patches Afromontane Forest
Altitude (m a.m.s.l)	300-1300 (1300-1500 limited)
MAP (mm)	400 to 1000
Rainfall seasonality	Early to mid-summer
Mean annual temp. (°C)	16 to 22
Median annual simulated runoff (mm) for quaternary catchment	20 to >250

According to the initial Present Ecological State, Ecological Importance and Ecological Sensitivity (PESEIS) data (unpublished reports: Louw, 2011), the following aspects have been recorded for the Sandspruit (X22F-00886): **Instream metrics** – PES category D; **Riparian metrics** - PES category C; **Overall PES** category C.

The following impacts/activities were identified: CRITICAL: None. SERIOUS: Large dams (Witklip Dam at start of SQ). LARGE: Bed and Channel disturbance, Alien vegetation, Forestry. MODERATE: Abstraction, Algal growth, Low water crossings, Erosion, Irrigation, Roads, Runoff/effluent: Irrigation, Sedimentation, Grazing (land-use), Vegetation removal.

Habitat diversity: Incised channel, surface water, grassy edges, riparian trees, pools, riffles and rapids.

Habitat depicting sensitivity: Incised channel, surface water, pools, riffles and rapids.

Impacting on fauna: Agriculture, instream dams, abstraction for irrigation, alien trees, riparian tree removal, roads and forestry.

4. Results

4.1 Vegetation units and land cover types within the study area

The most recent vegetation map for South Africa, Lesotho and Swaziland (Mucina & Rutherford, 2007), places the entire study area (Figure 16) within 3207 ha of Legogote Sour Bushveld (74.7%) and 1089 ha **of** Northern Escarpment Quartzite Sourveld (25.3%).

Vegetation/habitat types are mapped on the basis of available information (aerial photography, soil types, geology) and will consist of structurally distinct vegetation units (wetland, grasslands, woodland) as well as transformed areas (cultivated land, areas of alien vegetation). Vegetation/habitat units will be graded according to biodiversity value and conservation status.

The following broad-scale vegetation units are simply practical units that combine various plant communities which share structural and functional characteristics and have common management requirements.

A total of five units consisting of untransformed vegetation/habitat and two units consisting of transformed vegetation/habitat that will be associated with the new EIA project were identified. These seven units are listed below, and each unit is later described in more detail.

Vegetation unit and land cover type:

Untransformed vegetation/habitat

1. Untransformed Grassland – North-eastern Mountain Grassland
2. Woodland
3. Perennial rivers
4. Eastern Dry Afrotemperate Forests around drainage lines
5. Rocky outcrops or Granite Inselbergs

Transformed vegetation/habitat

6. Forestry
7. Secondary Grassland: Old and fallow lands

The vegetation types within the eastern higher-rainfall regions of the grassland biome are most vulnerable to transformation, particularly the North-eastern Mountain Grassland. Afforestation is the primary threat within these areas.

Afforestation is the most important (in terms of area occupied) transforming land-use in Short Mistbelt Grassland and North-eastern Mountain Grassland. In all other vegetation types, cultivation has been the dominant transforming land-use, particularly in Afro Mountain Grassland.

The dominant predicted threats of land-use transformation within the local vegetation types, such as the North-eastern Mountain and Short Mistbelt Grassland, are highlighted as being most threatened, based on the number of land-uses for which they are suitable. All are favourable for afforestation and agriculture, which are likely to result in large-scale transformation.

4.1.1 Untransformed grassland – North-eastern Mountain Grassland

The untransformed (primary) grasslands in the project area are mostly concentrated in patches to the north-western part of the farm (Figure 17). The north-western corner of the farm penetrates the Northern Escarpment Quartzite Sourveld (Figure 13) of the proposed Nature Reserve and into the Wolkberg Centre of Endemism. The untransformed grassland has many attributes in common with the North-eastern Mountain Grassland which is the typical grassland of the escarpment mountains and plateau.

Soils are usually shallow and acidic, overlying a variety of rock types in the North-eastern Mountain Grassland. Altitudes varies from 1 400 – 2 100 masml; the grassland in the project area varies between 800 masml in the valleys to 1278 masml at the highest point in the north-west portion of the farm. Long-term protection from fire allows a scrubby form of Afromontane Forest to develop and rocky outcrops usually have forest- like thickets.

The Untransformed Grassland is found on undulating plains, including rock sheet habitats and bush clumps. These bush clumps are dominated by *Vachellia sieberiana var. woodii* and *Pterocarpus angolensis*. Approximately 737.9 ha of this biotope is still present on the Krokodilspruit Farm, covering 17.9% of the total area.

Untransformed Grassland covers approximately 10% of Site 1, 80% of Site 2 and 90% of Site 3 (Figure 17). Primary Grassland includes fragmented portions of untransformed grassland which only occurs in areas where elevated soil moisture or rockiness and shallow soils preclude successful cultivation. This grassland is the most widespread natural vegetation type remaining in the study area, as most of the remaining grasslands occur either on shallow soil or in rocky localities that are/were difficult to plough.

A large number of rare or endemic plant species occur in North-eastern Mountain Grassland, mostly restricted to either quartzite or dolomite, and these grasslands must be considered a conservation priority (Schmidt, et al. 2002).

Although the grassland seems rather homogenous, it also consists of dense grass swards which provide favourable habitat for local fauna. Additional aspects of habitat, such as stones, rocks, forbs, shrubs and termite mounds, are attractive for the certain fauna. Smaller species tunnel and move beneath the overhead grassy cover and the grass also provides food for a number of herbivorous animal species (rodents, small antelopes and hares) as well as seed-eating birds.

Apart from drainage lines, there are no proper wetlands that will be impacted upon by the current project sites.

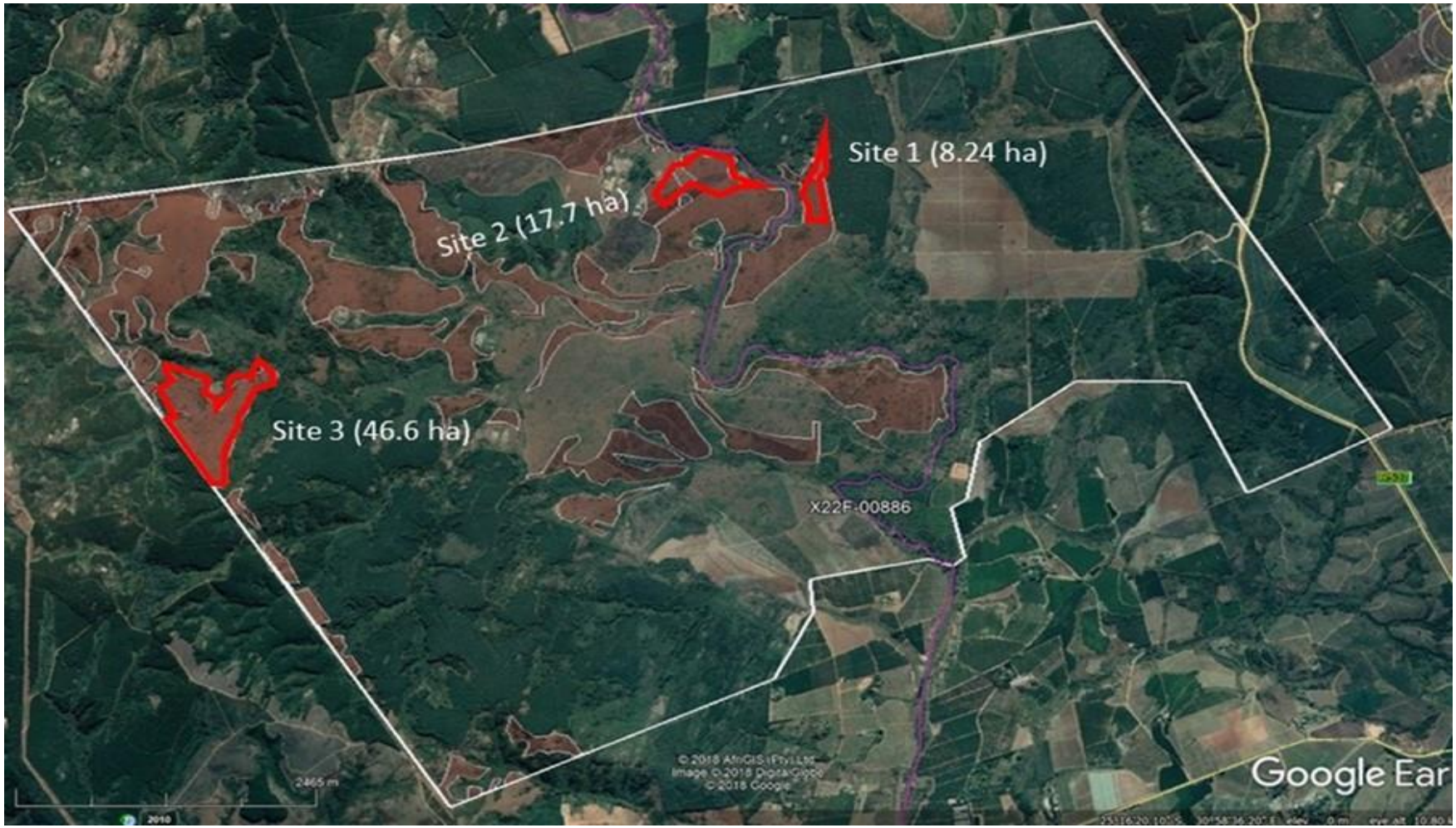


Figure 17: Untransformed or primary grassland (737.9 ha) still present on the Krokodilspruit Farm (Wine red polygons).

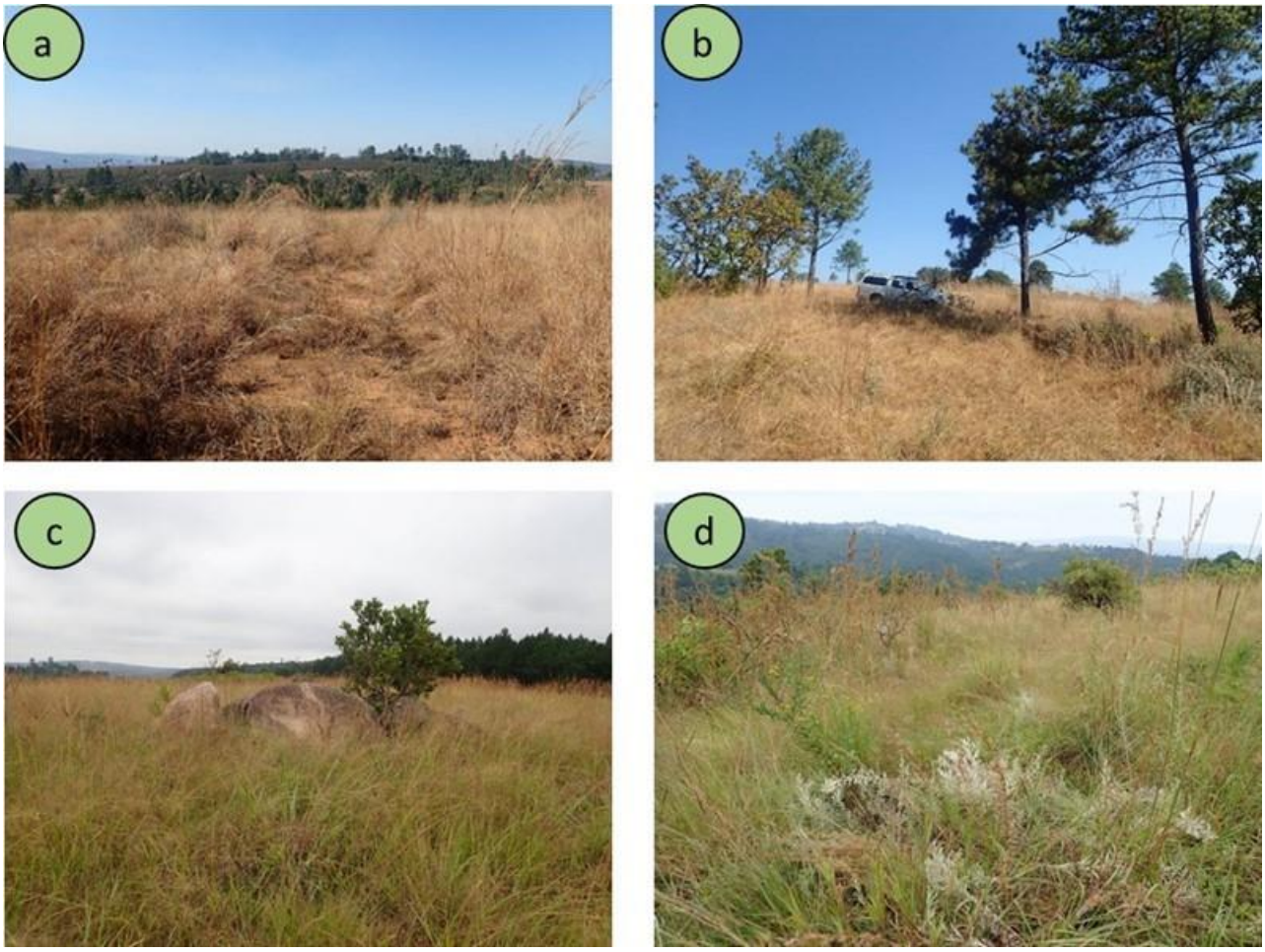


Figure 18: Untransformed North-eastern Mountain Grassland.
18a. Untransformed North-eastern Mountain Grassland with forestry and wooded areas on the background.
18b. Alien trees are dispersed on the grassland in places.
18c. A small rock outcrop in the grassland.
18d. Herbaceous cover in the primary grassland.

4.1.2 Woodland

Mpumalanga's savannas include tall, dense woodland in the warmer, wetter areas as well as more open woodland in the drier and cooler areas; it incorporates wooded, shrubby hill slopes, dense thickets and grassy plains with scattered trees or bush-clumps (Lötter et al, 2014). Areas of woodland are present on the periphery of the arable sections, but none will be directly impacted by vegetation clearing. The woody layer varies from an open to closed canopy thereby providing a variety of habitat types for the different faunal species.

Figure 19a and b: Areas of woodland are present on the periphery of the arable sections.

4.1.3 Perennial rivers

The Portion 248 JT of the farm Krokodilspruit is situated in the Crocodile River Sub-Water Management Area which forms part of the Komati River drainage system. The project site is located in quaternary catchment X22F and one perennial stream, the Sandspruit (X22F-00886), flows through the area (Figure 21).

According to desktop information (DWS, 2013), the activities in the Sandspruit catchment and local land uses have impacted upon the aquatic system, which have rendered the system as moderately modified. The Ecological Importance (EI) and species richness of the reach is rated as high. Habitat diversity and integrity is classed as moderate. Adverse conditions within the reach are due to bed and channel disturbances, erosion, large dams, abstraction, low water crossings, and irrigation.

The riparian zone associated with the Sandspruit is characterised by the prominence of various hydrophilic plant species such as *Phragmites mauritianus, Schoenoplectus corymbosus, Paspalum dilatatum, Cyperus textilis*, while the woody species include *Vachellia sieberiana*, and *Vachellia ataxacantha*. Unfortunately, the category 1 declared alien invader shrub *Lantana camara* has infested large areas thereby displacing large numbers of the indigenous vegetation and associated animal life.

Figure 20: Untransformed woodland (303.9 ha) still present on the Krokodilspruit Farm (Yellow-green polygons).

Figure 21: The Sandspruit (purple line) with its delineated riparian zone (126.8 ha) buffered with a 50m buffer zone (blue area).

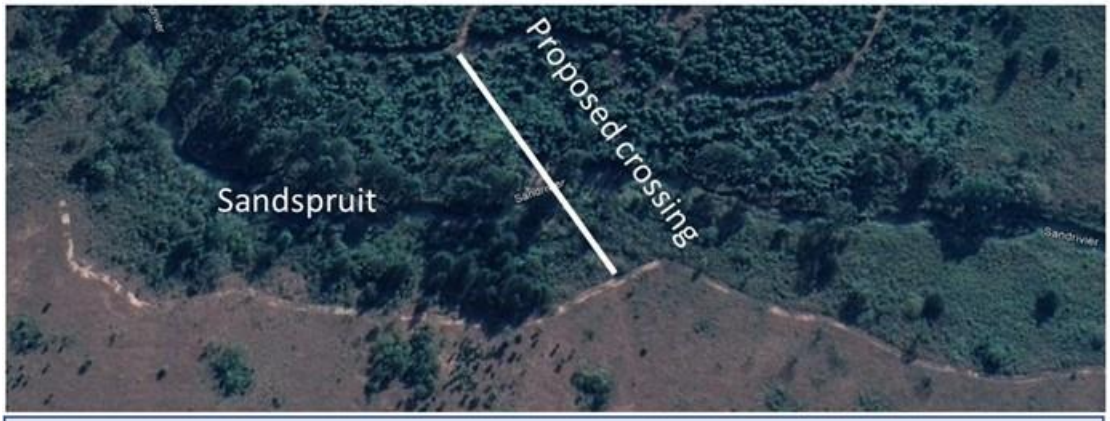
The only arable section near a perennial river is Site 2 that borders the 50m buffer of the Sandspruit. The vegetation clearing of the section will not impact the buffer directly, thus the core zone will be protected from the agricultural activities.

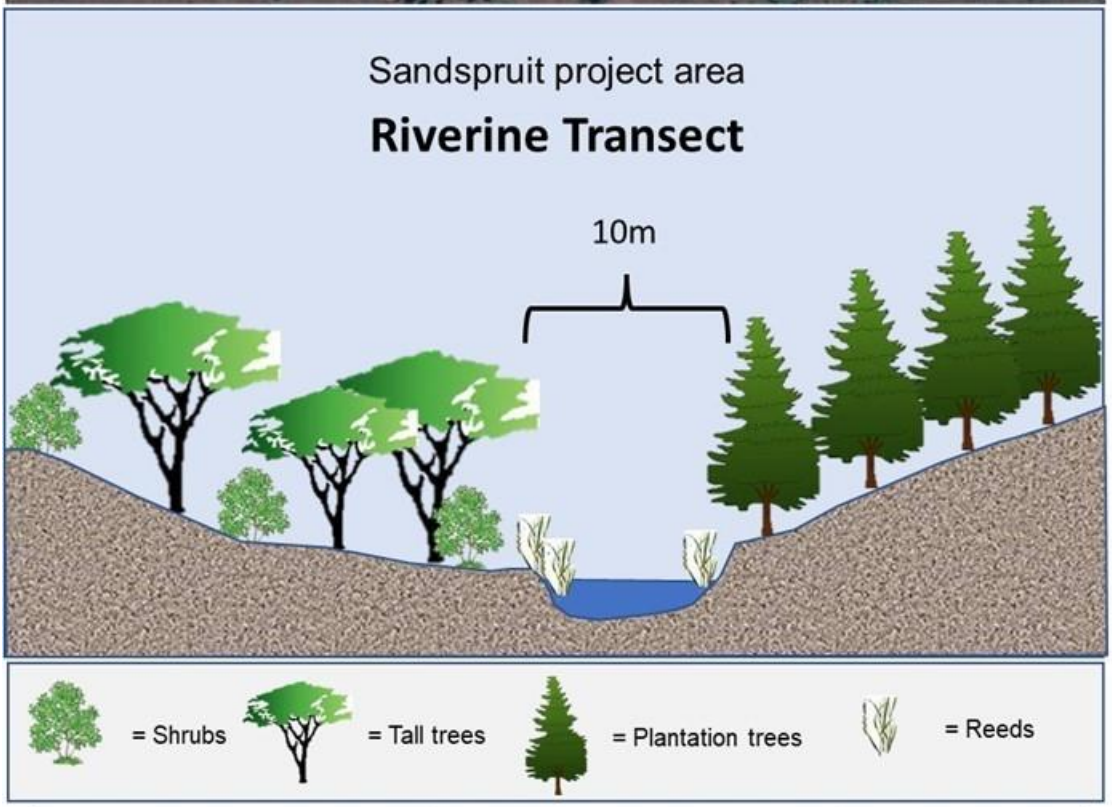
The river crossing will be at a specific point on the river and the clearing and construction of the crossing structure will have an impact on the riparian zone and aquatic ecology of the crossing point (Figure 23). Measures to mitigate will ensure minimal impact on the crossing site.

Figure 22: The perennial Sandspruit.

22a – b. The perennial Sandspruit with associated riparian zone, flowing through the Krokodilspruit project area.

During the survey of the Sandspruit river crossing, the riparian delineation was completed by surveying a transect through the drainage line (Figure 23), as well as inspecting the riparian corridor on both banks.





Terrestrial	Riparian	Opposite bank
Paperbark thorn *(Vachellia sieberana)*	Paperbark thorn *(Vachellia sieberana)*	Commercial plantation
Velvet bushwillow (*Combretum molle*)	Velvet bushwillow (*Combretum molle*)	
Common hook thorn *(Senegalia caffra)*	Velvet wild-medlar (*Vangueria infausta*)	
Camphor bush (*Tarchonanthus camphoratus*)	Common wild currant (*Searsia pyroides)*	
Common wild currant (*Searsia pyroides)*	River bushwillow (*Combretum erythrophyllum)*	
Ferns	Bluegum *(Eucalyptes)*	
Bramble	Bugweed (*Solanum mauritianum*)	

Figure 23: This figure illustrates the basic components of the riverine layout evaluated during the survey. Riparian Transect - Sandspruit (25°15'57.71"S; 30°55'11.23"E).

4.1.4 Eastern Dry Afrotemperate Forests around drainage lines

A number of smaller seasonal tributaries to the Sandspruit, enter the farm from the northern- and eastern boundaries. Most of these drainage lines have been affected by forestry, roads and agriculture, but there are still some pockets of unaltered riverine woodland associated with these systems.

Drainage lines emanating from the north-western sloping hillsides of the Krokodilspruit Farm, are associated with scattered patches of forests which occur on steep and often fire-free slopes. In addition, these sensitive soils are not suited for cultivation.

These forest areas receive high rainfall during the wet season, which drains into the deeply incised river valleys. The groundwater from associated streams and precipitation in the form of mist forests supports the forests through the dry season. Due to this close association between the drainage line functions and the presence of the forests, this biotope will be considered as one entity and covers an area of 717.5 ha.

Figure 24: Drainage lines

24a and b. The drainage line alongside Site 1 is eroded and invaded by alien *Eucalyptus* trees.
24c. The drainage line alongside Site 3 is invaded by alien pine trees.
24d. The Afrotemperate Forest around Site 3 contains extensive closed canopy forest.

The remainder of the drainage lines that are not associated with the Eastern Dry Afrotemperate Forest, will be buffered with a 30m buffer and the total area covered by these buffered drainage lines, will cover 251.3 ha.

The areas that border drainage lines delineated for this project, are Sites 1 and 3 (Figure 26). These drainage lines adjacent to the sites, are buffered by Eastern Dry Afrotemperate Forest. The area around Site 3 contains extensive close canopy forest (Figure 24d), while the forest area around Site 1 is invaded by many large alien *Eucalyptus* trees (Figure 24c).

4.1.5 Rocky outcrops or Granite Inselbergs.

Landscapes in the eastern lowveld of Mpumalanga are characterised by the presence of boulder-strewn granite inselbergs that rise up out of the surrounding savanna-covered plains (Lötter et al, 2014). These inselbergs, such as those that characterise the north-western corner of the farm, provide a great number and variety of ecological niches and thus support a host of plant communities and animal species. They are characterised by a number of endemic plant species.

Forest margins and nearby rocky outcrops generally support a different plant community to the forest proper. Short thickets dominated by *Vachellia ataxacantha* occurs on rocky sites in the study area. Exposed granite outcrops have a low vegetation cover, typically with *Englerophytum magaliesmontanum*, *Aloe petricola* and *Myrothamnus falbellifolia* (Mucina & Rutherford 2006).

The large granite outcrops do not have much vegetation cover though smaller forb species do grow in the crevices where soil and litter have collected. This woodland around rocky outcrops occurs on rocky terrain that varies from level to mildly steep. The soil is shallow on the higher-lying rocky areas and varies from shallow to moderately deep in the lower-lying more level areas. Soil texture is sandy to loam with some clay present.

Sites 2 and 3 are associated with large inselbergs to the north-east of the sites (Figure 27). These outcrops are allocated a buffer of 30m (Figures 25a and b) which will buffer the outcrop and associated vegetation on the rim of the bedrock from the agricultural activities at the sites.

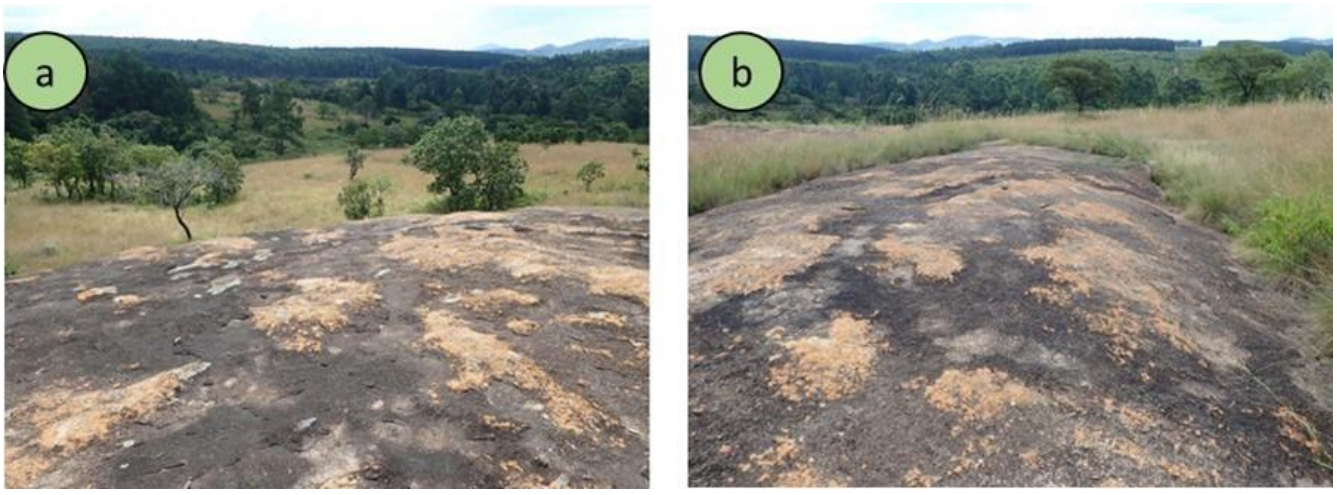


Figure 25: Rocky outcrops or Granite Inselbergs.
25a and b. The inselberg on the northern edge of Site 2 will be protected by a 30m buffer.

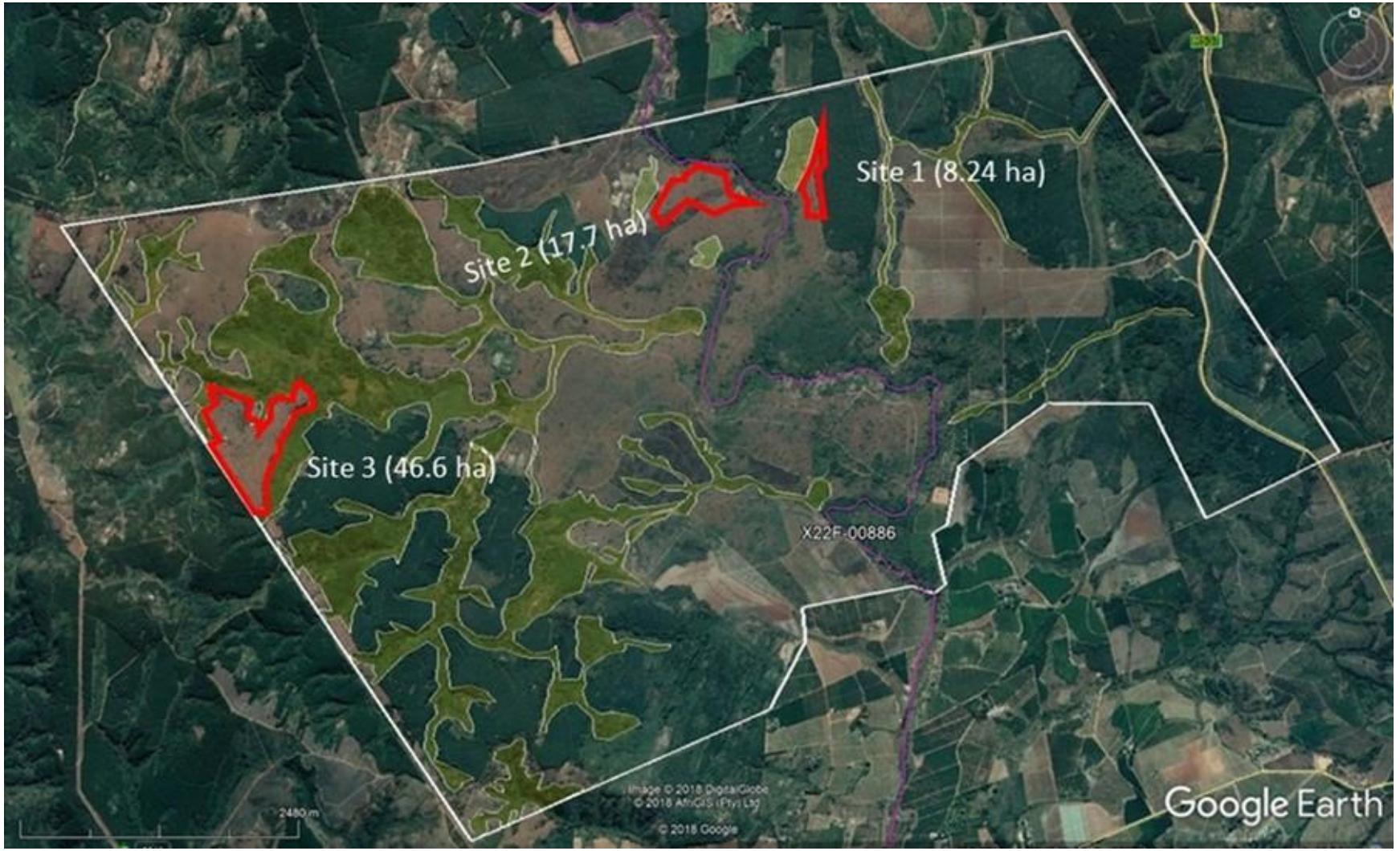


Figure 26: Seasonal and ephemeral drainage lines with its associated vegetation cover (green areas).

Figure 27: Rocky outcrops or Granite Inselbergs (light grey areas: 65.0 ha) on the Krokodilspruit Farm.

Transformed vegetation/habitat

Transformation refers to the removal or radical disturbance of natural vegetation, for example by crop agriculture, plantation forestry, mining or urban development. Transformation mostly results in a permanent loss of biodiversity and fragmentation of ecosystems, which in turn leads to the failure of ecological processes. Remnants of biodiversity may survive in transformed landscapes (Ferrar and Lötter, 2007).

The most widespread cause for terrestrial biodiversity loss in Mpumalanga is crop- and timber cultivation. All forms of production agriculture will benefit from applying codes of best practice, such as have been developed in the timber growing industry (Ferrar and Lötter, 2007). Half of Mpumalanga's natural habitat has already been irreversibly modified, mostly through large-scale agriculture, plantation forestry and mining (Lötter et al, 2014).

By using the Google Earth facility, the landcover of the project area was delineated with the assistance of the BGIS maps (Figure 28) and information supplied by the landowners. The following transformed habitat types are present on the Krokodilspruit farm (Figure 28), but none of them will be affected by the current project:

- Current cultivation
- Infrastructure
- Transformed woodland

4.1.6 Forestry

Large-scale commercial afforestation in South Africa and elsewhere in the world, can potentially have a profound impact on the biota inhabiting the regions afforested, in addition to having far-reaching water-budget-, economic- and sociological implications. This is not surprising, considering the radical extent of the habitat changes brought about by timber cultivation, especially when open and largely treeless ecosystems are transformed to monocultures of closed-canopy forests consisting of alien tree species. This issue is currently intensely relevant to efforts to conserve biodiversity.

The Mpumalanga Province covers an area of 8.3 million ha. Approximately 7% is afforested (roughly 580,000 ha). Commercial afforestation is not evenly distributed throughout Mpumalanga Province but is concentrated in a north-south strip, largely corresponding with the escarpment between the coastal lowlands and the interior plateau. Most plantations occur at elevations between 1000 and 2000 m in the areas receiving more than 850 mm of rainfall annually.

The Google Earth photo (Figure 28) illustrates the total area of forestry (1085.7 ha) in the project area. A number of forestry patches have been deforested and transformed into orchards. Site 1 is situated next to a forestry block that has been cleared and in the process, is being transformed into a macadamia orchard.

4.1.7 Secondary Grassland: Old and fallow lands.

Historically cultivated areas consist of secondary vegetation of transformed habitat types and are dominated by indigenous pioneer grasses. The fallow lands originate from previously ploughed soils. The pioneer plant communities currently present have a low species richness and are dominated by pioneer forbs or weeds that are indicative of disturbance.

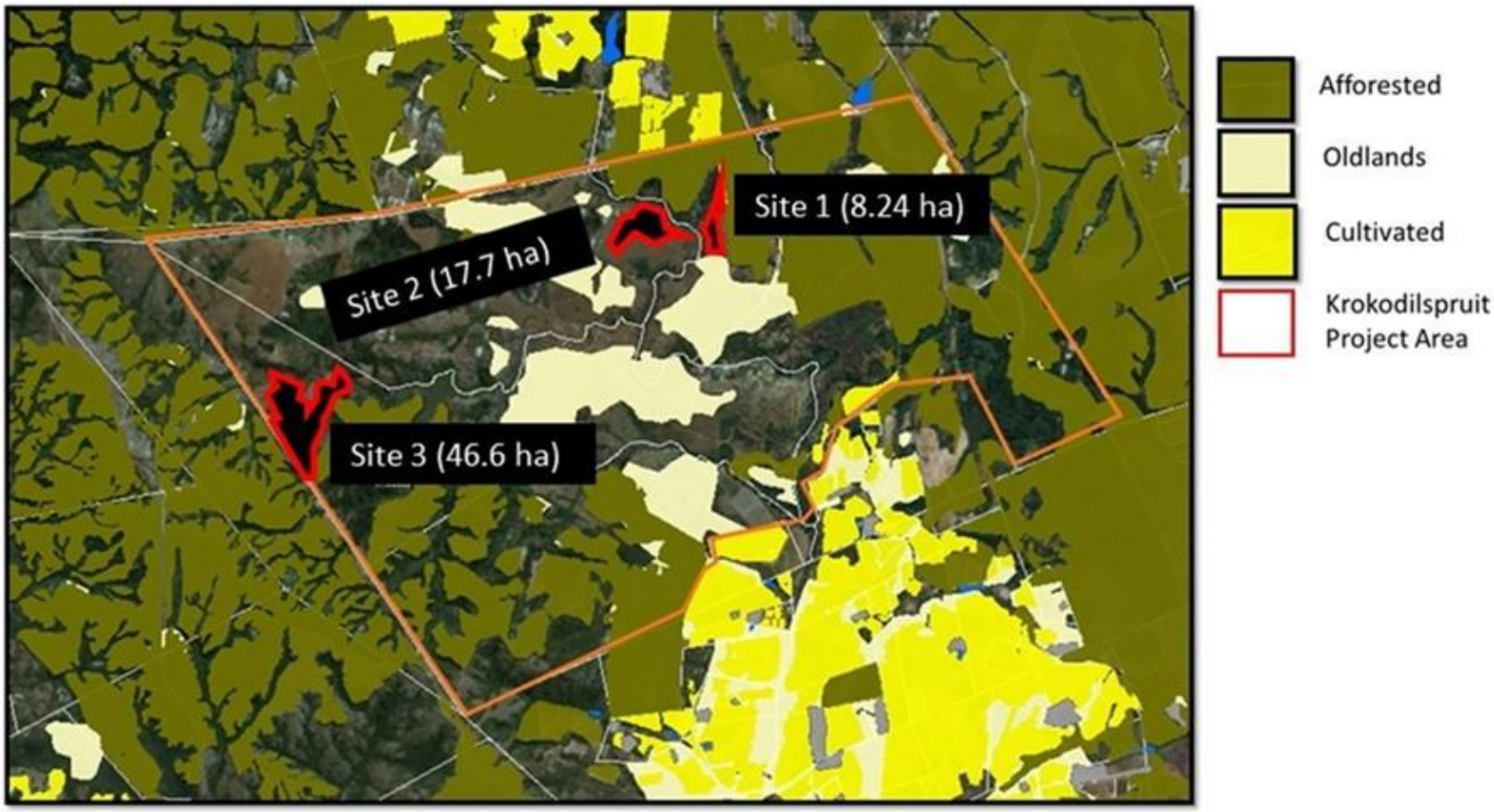


Figure 28: A Google Earth map indicating the total area of current disturbance/transformation on the Krokodilspruit property according to the LUDS maps.

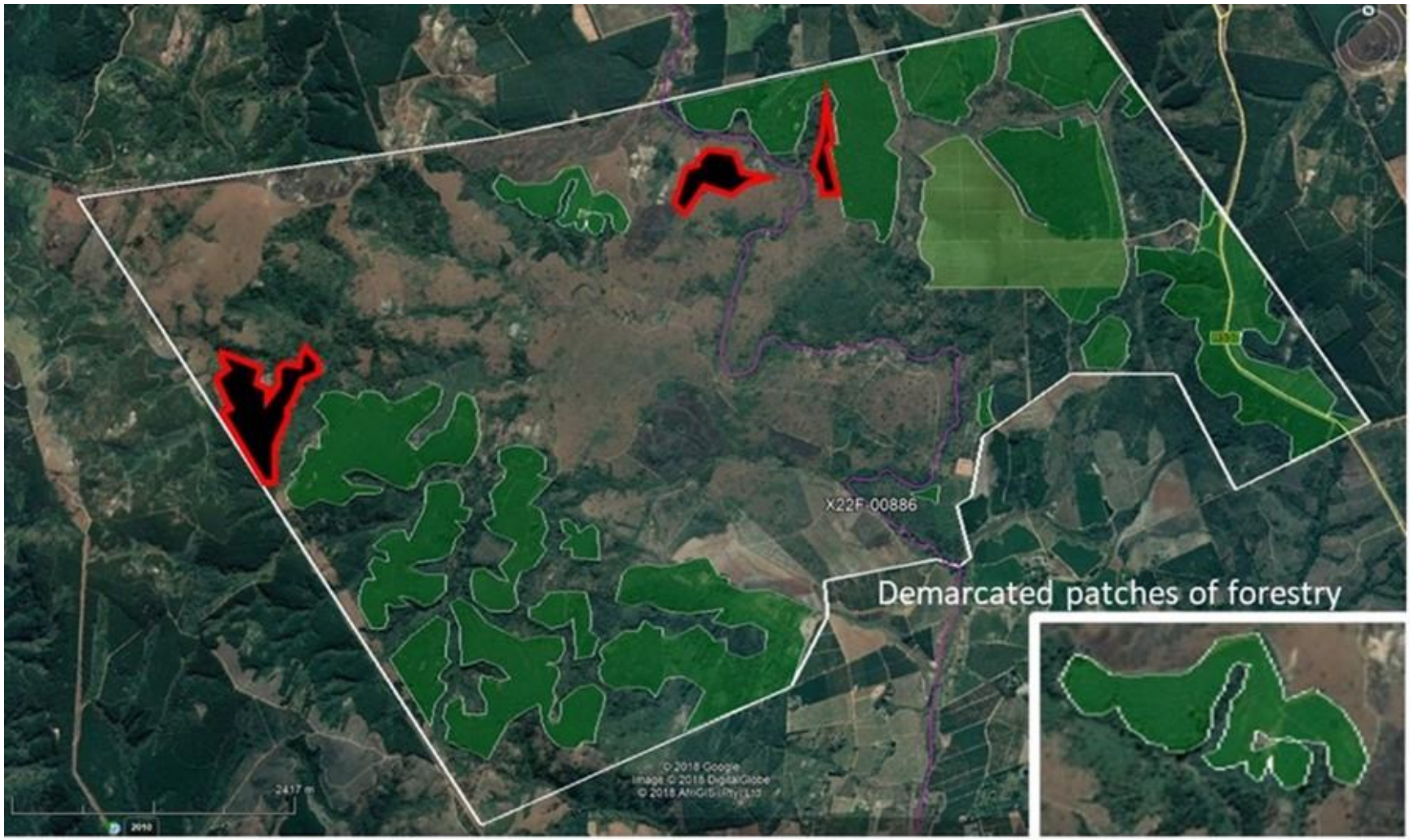


Figure 29: A Google Earth map indicating the total area of forestry on the Krokodilspruit property, a number of forestry patches have already been removed and replaced by orchards.

Figure 30: A Google Earth map indicating the demarcated patches of old lands (lands) and current cultivation in the project area. Site 1 highlighted because of the portion of fallow land in the northern section of the site.

4.2 Ecological survey transects in the Krokodilspruit project area.

A major component of this study is the characterisation of habitat types and associated fauna (obtained from regional distribution records) of the available landscape/environment. This information is used as a basis for predicting the potential impacts of the proposed project and other human-induced activities, on the composition of threatened fauna in the study area. Representative survey sites were selected in all prominent vegetation types of the study area. Extensive transects (400-3000m) were then surveyed for potential habitat and all associated fauna. GPS readings provide fixed locations of these transects for future monitoring (Table 23; Figures 31 to 33).

Table 23: Description of transects or point counts conducted for habitat, micro-habitat, influences and impacts, birds, mammal signs and herpetofauna (February, March, July 2022). Some transects are shared (e.g., left side/right side - e.g., wetland left, grassland right).

Habitat	Coordinates		Length (m)	Total (m)
	Start	End		
Untransformed vegetation/habitat				
1. Untransformed Grassland				
Transect 1 (shared with drainage line)	25°15'52.28"S 30°55'52.90"E	25°16'7.44"S 30°55'46.52"E	517	
Transect 2	25°16'3.13"S 30°55'49.88"E	25°16'14.10"S 30°55'51.07"E	340	
Transect 3	25°16'1.82"S 30°55'50.65"E	25°16'13.40"S 30°55'51.80"E	376	
Transect 4	25°16'8.13"S 30°55'47.07"E	25°16'14.10"S 30°55'49.63"E	220	
Transect 6	25°16'7.10"S 30°55'22.33"E	25°16'11.50"S 30°55'14.63"E	257	
Transect 7	25°16'8.08"S 30°55'19.26"E	25°16'13.88"S 30°55'10.01"E	401	
Transect 8	25°16'7.09"S 30°55'17.48"E	25°16'4.04"S 30°55'8.55"E	271	
Transect 9 (shared with riparian)	25°16'4.63"S 30°55'12.27"E	25°16'6.34"S 30°55'23.15"E	670	
Transect 10	25°16'7.45"S 30°55'9.13"E	25°16'14.34"S 30°55'2.14"E	285	
Transect 11 (shared with forestry)	25°17'21.10"S 30°52'38.84"E	25°17'40.29"S 30°52'52.58"E	701	
Transect 12	25°17'21.06"S 30°52'42.49"E	25°17'37.99"S 30°52'55.26"E	636	
Transect 13 (shared with forest)	25°17'29.07"S 30°52'50.09"E	25°17'16.76"S 30°53'1.07"E	535	
Transect 14 (shared with forest)	25°17'15.64"S 30°53'1.50"E	25°17'16.54"S 30°52'54.40"E	1099	
Transect 15	25°17'9.37"S 30°52'39.95"E	25°17'19.05"S 30°52'43.94"E	493	
Transect 16	25°17'24.96"S 30°52'47.38"E	25°17'10.06"S 30°52'47.29"E	564	
Transect 17 (shared with forest)	25°17'23.94"S 30°52'58.29"E	25°17'35.65"S 30°52'55.02"E	386	
			Total	**7751**

3. Perennial rivers				
Transect 9 (shared with grassland)	25°16'4.63"S 30°55'12.27"E	25°16'6.34"S 30°55'23.15"E	670	
			Total	**670**
4. Seasonal and ephemeral drainage lines				
Transect 1 (shared with primary grassland)	25°15'52.28"S 30°55'52.90"E	25°16'7.44"S 30°55'46.52"E	517	
			Total	**517**
5. Forests - Eastern Dry Afrotemperate Forest				
Transect 13 (shared with forest)	25°17'29.07"S 30°52'50.09"E	25°17'16.76"S 30°53'1.07"E	535	
Transect 14 (shared with forest)	25°17'15.64"S 30°53'1.50"E	25°17'16.54"S 30°52'54.40"E	1099	
Transect 17 (shared with forest)	25°17'23.94"S 30°52'58.29"E	25°17'35.65"S 30°52'55.02"E	386	
			Total	**2020**
Transformed vegetation/habitat				
8. Forestry				
Transect 11 (shared with grassland)	25°17'21.10"S 30°52'38.84"E	25°17'40.29"S 30°52'52.58"E	701	
			Total	**701**
9. Secondary Grassland: Old and fallow lands.				
Transect 5	25°15'54.36"S 30°55'52.82"E	25°15'59.79"S 30°55'52.90"E	170	
			Total	**170**

GPS coordinates, acquired in the field (Table 23), were added to Google Earth to illustrate and demarcate the study area and survey transects. Seventeen transects were completed to assess resident biota and their associated habitats. Specific habitat features were identified to provide an indication of available habitat for different animals favouring a specific biotope (specifically medium-sized fauna across all vertebrate groups)

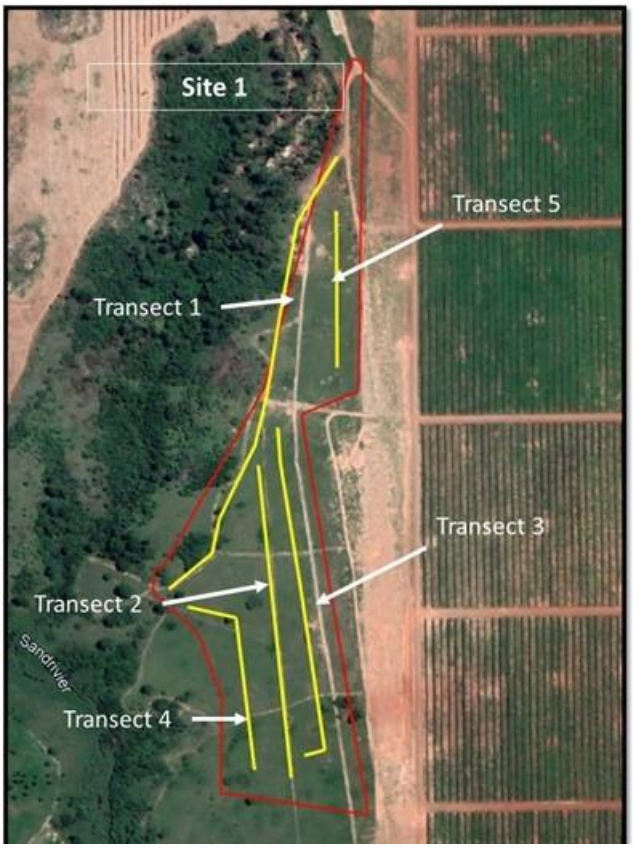


Figure 31: The localities of the detailed biota- and associated habitat transects at Site 1 (see Table 23).

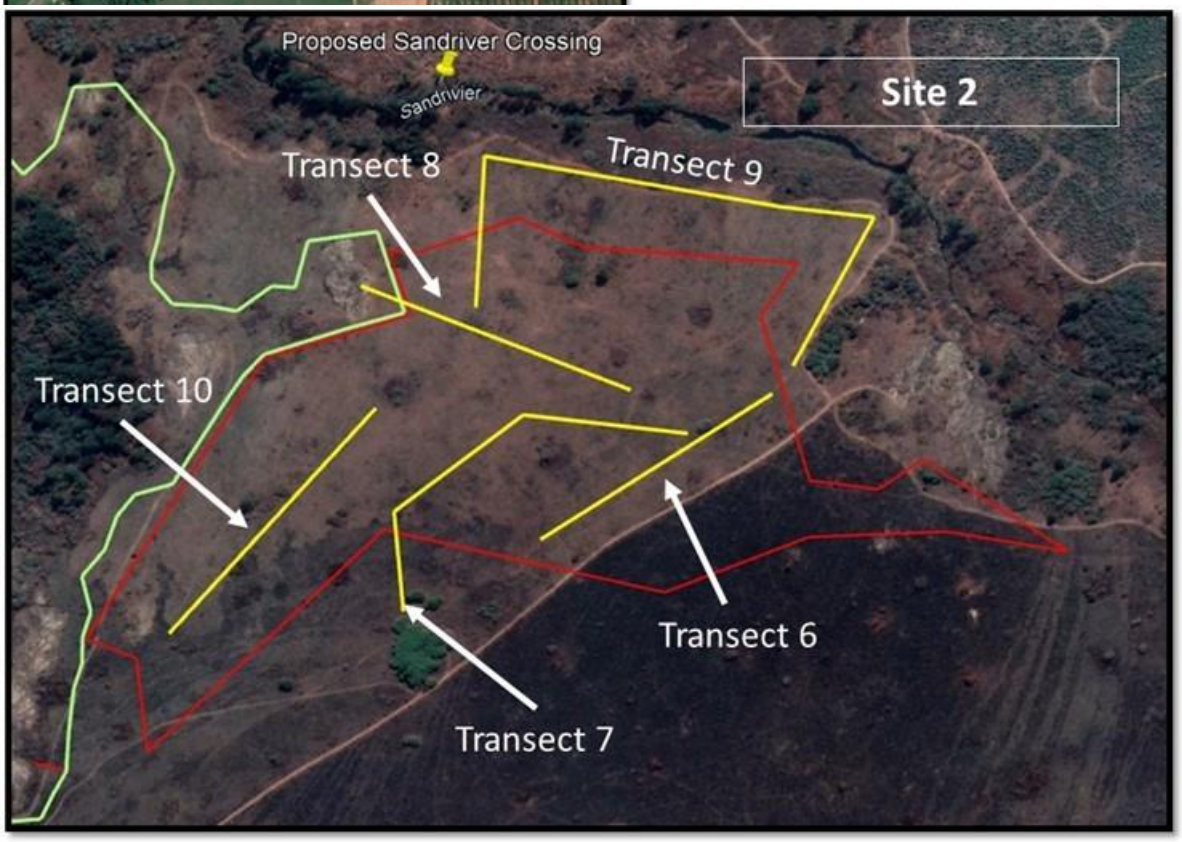


Figure 32: The localities of the detailed biota- and associated habitat transects at Site 2 (see Table 23).

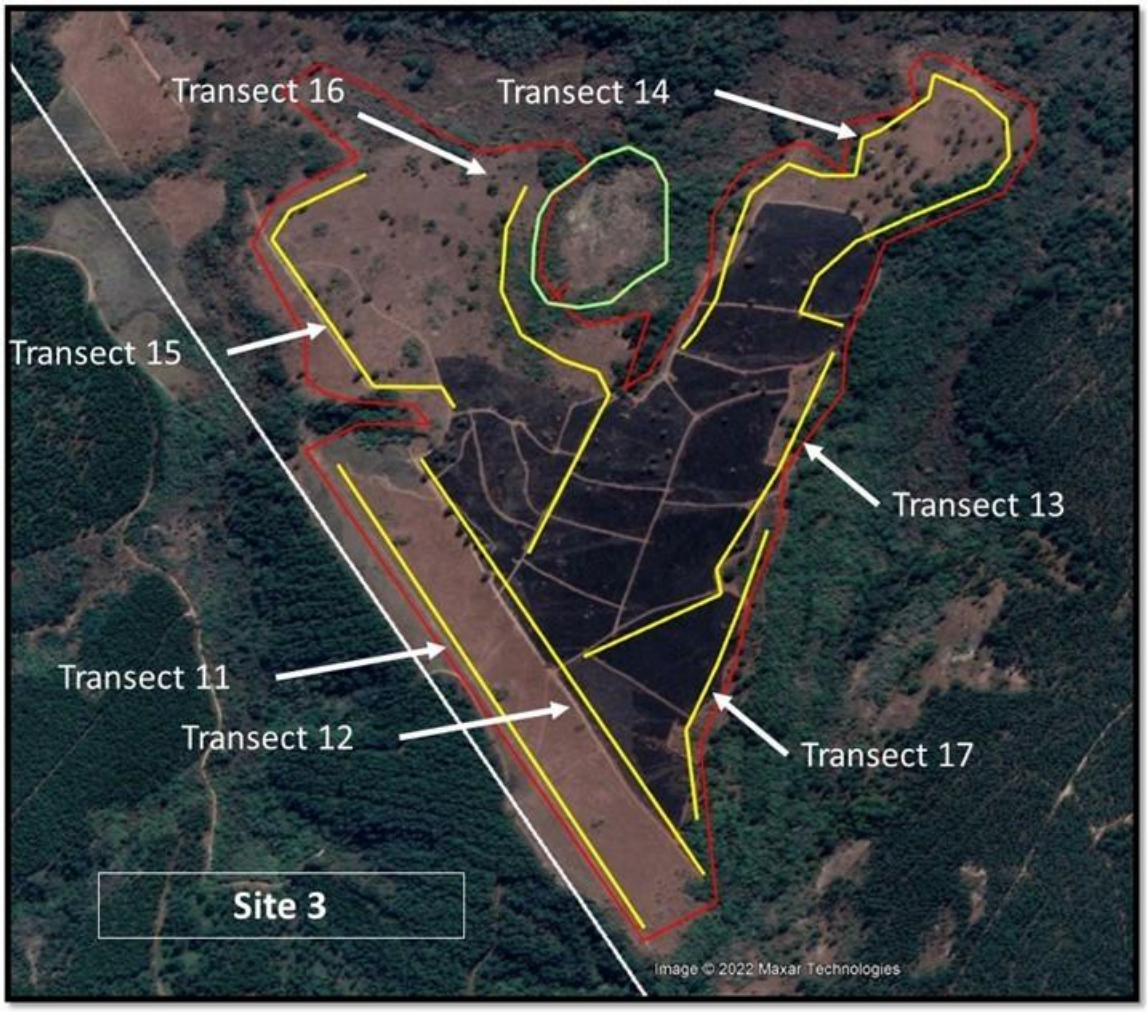


Figure 33: The localities of the detailed biota- and associated habitat transects at Site 3 (see Table 23).

4.3 Ecosystems: Baseline description

According to the Biodiversity Protocol, the assessment must provide a baseline description of the site which includes, as a minimum, the following aspects:

> 2.3.1. A description of the biodiversity and ecosystems on the site (terrestrial as well as aquatic), including;
>
> > (a) ecosystem types; and
> > (b) Presence of fauna and flora and composition of species communities, their habitat, distribution and movement patterns.

Three sites have been approved of and delineated as the preferred sections. The hectare coverage of these sections differs from the initial assessment of arable areas (Table 29) (MTC, 2022).and this is due to the presence of *Aloe simii* buffers and the fact that the management respects and adheres to the recognised buffers.

Table 24: Hectare coverage of the evaluated for the development of orchards.

Section	Area (ha)
1	8.24
2	17.7
3	46.6
Total	72.5

The arable areas were chosen because they are uniform and there are no rocky, steep or wetland areas within the sections assessed for the orchards. The screening study ensured that buffers were established around the *Aloe simii* colonies, no obvious areas of concern were encountered and there is sufficient water available to establish orchards.

Figure 49: A Google Earth image of the 3 areas demarcated as the preferred sites for orchard development.

Biota assemblages of the Krokodilspruit project areas

The fieldwork component of this study was conducted during February, March and July 2022. The survey methods described herein make use of a habitat surrogate technique, where habitat type and availability are used as a baseline assessment, with species' presence used to verify habitat integrity. The specialist report includes detailed species lists obtained from an extensive background review and the field monitoring results, with emphasis on the following:

- Probability of occurrence of species with high conservation value and assessment of the availability of their habitat on the property, as well as potential risks or threats to these species.
- Detailed overview on the current biodiversity status of the area in terms of terrestrial and wetland biota.
- Status of habitat, habitat preference and probability of occurrence.

During the biodiversity assessments of the Krokodilspruit landscape, different vegetation and land cover units were identified. By definition, ecosystem status reflects the ecosystem's ability to function naturally, at a landscape scale and in the long-term. Vegetation types provide a good representation of terrestrial biodiversity because most animals, birds, insects and other organisms are associated with specific vegetation types (Table 25).

In order to establish a baseline of faunal occurrence, an assessment was made of the ecosystem template. The ecosystem template is a function of the geomorphology (abiotic) and the vegetation (biotic) structure of the area. By using species occurrence data from the previous (2018) and the current (2022) surveys, as well as expected occurrence records of known species distributions and preferred habitat type, the baseline integrity of the study is established.

Ecosystem status reflects the ecosystem's ability to function naturally, at a landscape scale and in the long-term. The single biggest cause of biodiversity loss in South Africa is the loss and degradation of natural habitat. Vegetation types provide a good representation of terrestrial biodiversity, as they often reflect specific habitat types and associated animals, birds, insects and other organisms. The vegetation/land cover types were thus classified on the basis of structural and functional characteristics with the following objectives in mind:

- To assess the status of vegetation/land cover types impacted by development: due to either historical and/or present farming practices, residential occupation and/or mining practices;
- To assess the status of faunal assemblages in the study area, with emphasis on Species of Special Concern.

The next step is to establish the likelihood of Species of Special Concern, occurring in the vicinity (include degree of confidence). For this report, the category "Species of Special Concern" is considered to include all threatened taxa listed by South African Red Data lists (Species of Conservation Concern), Threatened or Protected Species (NEMBA) and all South African endemic taxa.

Conservation-important plant species listed for the quarter-degree grid 2530BD in the Mpumalanga Tourism & Parks Agency's (MTPA) threatened species database were used to produce a list of the most likely occurring species, which were searched for during fieldwork.

Due to their limited distribution and range in South Africa, endemic species are also included as species of special interest. Traditionally, an endemic species will have a global distribution restricted to >90% of the atlas region.

Species of special concern are those that have particular ecological, economic or cultural importance and include: those that are rare, endemic or threatened; species with unusual distributions; and medicinal and other indigenous species that are exploited commercially or for traditional use. A ‘Species of Special Concern’ is any species or subspecies of biota, native to the province that has entered a long-term state of decline in abundance or is vulnerable to a significant decline due to low numbers, restricted distribution, dependence on limited habitat resources, or sensitivity to environmental disturbance. These are species that are threatened, or, if not, their population number is a special concern with reference to the following ecological foundations:

- Occur in small, isolated populations or in fragmented habitat, and are threatened by further isolation and population reduction;
- Show marked population declines. Population estimates are unavailable for the vast majority of taxa. Species that show a marked population decline, yet are still abundant, do not meet the Special Concern definition, whereas a marked population decline in uncommon or rare species is an inclusion criterion;
- Depend on a habitat that has shown substantial historical or recent declines in size. This criterion infers the population viability of a species based on trends in the habitat types upon which it specialises;
- Occur only in or adjacent to an area where habitat is being converted to land uses incompatible with the animal's survival;
- Have few records, or which historically occurred here but for which there are no recent records; and
- Occur largely on public lands, but where current management practices are inconsistent with the species persistence.

Threatened faunal species represent a decline in biological diversity because of their numbers decreasing and their genetic variability is severely diminished. Rare species, as well as those of special concern carry challenges different to most other large and common species; characteristics of these species are:

- extremely small or localised range
- requiring a large territory
- having low reproductive success
- needing specialised breeding areas
- needing specialised feeding areas
- habitat specificity
- life-histories not captured completely in the area (migrants)

4.3.1 Vegetation communities

The vegetation communities of the Krokodilspruit study area are classified as the **Legogote Sour Bushveld, which has a conservation status of "Endangered", and** the Northern Escarpment Quartzite Sourveld with **conservation status of "Vulnerable" (**NSBA)**.**

Plant surveys

A total of 92 indigenous plant species were recorded during fieldwork (Table 25); as well as six exotic species, some declared alien invaders.

Table 25: Plant species recorded during the 2018 and 2022 fieldwork.

Trees:

1. African protea *(Protea gaguedi)*
2. Black bird-berry *(Psychotria capensis)*
3. Bladdernut (*Diospyros whyteana)*
4. Blue guarri *(Euclea crispa)*
5. Bluebush *(Diospyros lycioides)*
6. Broad-leaved beechwood *(Faurea rochetiana)*
7. Broad-leaved coral tree *(Erythrina latissima)*
8. Broom cluster fig *(Ficus sur)*
9. Bushman's grape *(Rhoicissus tridentata)*
10. Bushveld water berry *(Syzygium guineensis)*
11. Cabbage tree *(Cussonia spicata)*
12. Camphor bush *(Tarchonanthus camphoratus)*
13. Common coral tree *(Erythrina lysistemon)*
14. Common hook thorn *(Vachellia caffra)*
15. Common spike thorn *(Gymnosporia buxifolia)*
16. Common wild currant *(Searsia pyroides)*
17. Flame thorn *(Vachellia ataxacantha)*
18. Forest fever tree (bigleaf) *(Anthocleista grandiflora)*
19. Forest lavender tree *(Heteropyxis canescens)*
20. Grassland tree fern *(Cyathea dregei)*
21. Matumi *(Breonadia salicina)*
22. Mitzeeri (*Bridelia micrantha)*
23. Mobola plum *(Parinari curatellifolia*)
24. Moepel (*Mimisops zeyheri)*
25. Monkey's tail *(Xerophyta retinervis)*
26. Mountain karee *(Searsia leptodictya)*
27. Nana-berry *(Searsia dentata)*
28. Natal guarri *(Euclea natalensis)*
29. Natal plane *(Ochna natalitia)*
30. Paperbark thorn (*Vachellia sieberana*)
31. Sickle bush *(Dichrostachys cinerea)*
32. Smooth wild-medlar *(Vangueria madagascariensis)*
33. Stamvrug *(Englerophytum magalismontanum)*
34. Strawberrybush *(Cephalanthus natalensis)*
35. Thorny karee (*Searsia gueinzii*)
36. Thorny rope *(Dalbergia armata)*
37. Transvaal currant *(Searsia transvaalensis)*
38. Transvaal teak *(Pterocarpus angolensis)*

39. Tree fuscia *(Halleria lucida)*
40. Velvet bushwillow *(Combretum molle)*
41. Water berry *(Syzygium cordatum)*
42. Wild custard-apple *(Annona senegalensis)*
43. Wild mulberry *(Trimeria grandifolia)*
44. Wild pear *(Dombeya rotundifolia)*
45. Willow beechwood *(Faurea saligna)*

Forbs:

1. Barberton daisy (*Gerbera jamesonii)*
2. Bearded-leaved brooms and brushes *(Acalypha depressinerva)*
3. Bietou *(Dimorphotheca spectabilis)*
4. Bird's brandy *(Lantana rugosa)*
5. Bushman's tea *(Athrixia phylicoides)*
6. Cooper's anthericum *(Anthericum cooperi)*
7. *Crossandra zuluensis*
8. Doll's powderpuff *(Cyanotus speciosa)*
9. Dwarf elephant root *(Elephantorrhiza elephantina)*
10. Dwarf hairy jackalberry *(Diospyros galpinii)*
11. *Dyschoriste setigera*
12. *Eulophia parviflora*
13. False gerbera *(Haplocarpha scaposa)*
14. Fever tea *(Lippia javanica)*
15. Golden star drops *(Asclepias aurea)*
16. Heart-leaved eriosema *(Eriosema cordatum)*
17. *Hermannia lancifolia*
18. Ifafa lily *(Cyrtanthus bicolor)*
19. Ink plant *(Cycnium adonense)*
20. Lightning bush *(Clutia hirsuta)*
21. Melkbol *(Euphorbia trichadenia)*
22. Milkweed *(Gomphocarpus physocarpus)*
23. Miniature granadilla *(Basananthe sandersonii)*
24. Ox-eye daisy *(Callilepis laureola)*
25. Pompom cartwheels *(Asclepias adscendens)*
26. Prickle head *(Crabbea angustifolia)*
27. Red-stemmed cryptolepis *(Cryptolepis oblongifolia)*
28. Resurrection plant *(Myrothamnua flabellifolius)*
29. Small yellow gerbera (*Gerbera piloselloides)*
30. Stainpod *(Flemingia grahamiana)*
31. Thick slime-lily *(Albuca setosa)*
32. Thorny rope *(Smilax anceps)*
33. Waving pelargonium *(Pelargonium luridum)*
34. White cat's paws *(Acrotome hispida)*
35. Wild foxglove *(Ceratotheca triloba)*

Grass and sedges:

1. Annual three awn (*Aristida adscensionis*)
2. Boat grass (*Monocymbium ceresiiforme*)
3. Bristle leaved red top (*Melinis nerviglumis*)
4. Broad leaved bristle grass (*Setaria megaphylla*)
5. Broadleaved bluestem (*Diheteropogon amplectens*)

6. Bur bristle grass (*Setaria verticillata*)
7. Common paspalum (*Paspalum dilatatum*) (Exotic)
8. Common reed (*Phragmites australis*)
9. Common russet grass *(Loudetia simplex)*
10. Common thatching grass *(Hyparrhenia hirta)*
11. Cottonwool grass *(Imperata cylindrica)*
12. Couch grass (*Cynodon dactylon*)
13. Curly leaf (*Eragrostis chloromelas*)
14. Curly leaf (*Eragrostis rigidior*)
15. Curly leaved dropseed (*Sporobolus nitens*)
16. Fine thatching grass *(Hyparrhenia filipendula)*
17. Garden bristle grass *(Setaria pallide-fusca)*
18. Giant spear grass (*Trachypogon spicatus*)
19. Giant three awn (*Aristida meridonalis*)
20. Giant turpentine grass (*Cymbopogon validus (nardus?)*
21. Golden bristle grass (*Setaria sphacelata var. sericea*)
22. Hairy trident grass (*Tristachya leucothrix*)
23. Heart seed love grass (*Eragrostis capensis*)
24. Herringbone grass (*Pogonarthria squarrosa*)
25. Lehmann's love grass (*Eragrostis lehmanniana*)
26. Matjiesgoed *(Cyperus sexangularis)*
27. Narrow-leaved turpentine grass *(Cymbopogon plurinodis)*
28. Natal red top *(Melenis repens)*
29. Nine-awned grass (*Enneapogon cenchroides*)
30. Purple finger grass (*Digitaria tricholaenoides*)
31. Rats tail dropseed (*Sporobolus africanus*)
32. Red autumn grass (*Schizachyrium sanguineum*)
33. Red grass (*Themeda triandra*)
34. Spear grass (*Heteropogon contortus*)
35. Thatching reed *(Phragmites mauritianum)*
36. Turpentine grass (*Cymbopogon excavatus*)
37. Vlei bluestem (*Andropogon appendiculatus*)
38. Vlei bristle grass (*Setaria incrassata*)
39. Vlei finger grass (*Dichanthium annulatum*)
40. Weeping love grass *(Eragrostis curvula)*
41. White-flowered sedge *(Cyperus obtusiflorus var. obtusiflorus)*
42. Wireleaf daba grass (*Miscanthus junceus*)
43. Yellow thatching grass (*Hyperthelia dissoluta*)

Alien vegetation:

1. Bramble (*Rubus* spp)
2. Bugweed *(Solanum mauritianum)*
3. Christmas berry *(Lantana camara)*
4. Guava *(Psidium guajava)*
5. Patula pine (*Pinus patula)*
6. Peanut senna *(Senna didymobotrya)*

According to the SANBI website of Southern African plant names and floristic details, 1 766 plant species were recorded in the 2530BD quarter-degree grid. A search of plant species in a rectangle closer to the project area, produced a list of 35 species, of which three species are listed as Species of Concern:

- *Aloe simii* - IUCN: CR
- *Aloe kniphofioides* - IUCN: VU
- *Disa extinctoria* - IUCN: NT

Vegetation cover on the project area of 72 ha on the Krokodilspruit farm

Following are detailed descriptions of the current vegetation cover of the three sites earmarked to be cleared for orchards**.**

Site 1: A portion of Site 1 is situated on an old land (approximately 1.51 ha) in the northern portion of the site (Figure 30). The site is flanked by a cleared block to the east and a drainage line to the west. The drainage line is very eroded and the donga has been invaded by alien *Eucalyptus* trees.

The composite Figure 34 illustrates the land cover on the different portions of Site 1:

a. The drainage line is very eroded and invaded by alien *Eucalyptus* trees.
b. Old fallow lands.
c. Eroded areas on Site 1.
d. Adjacent area cleared.
e. Secondary grassland.
f. Small area of primary grassland.
g. Some less impacted grassland.

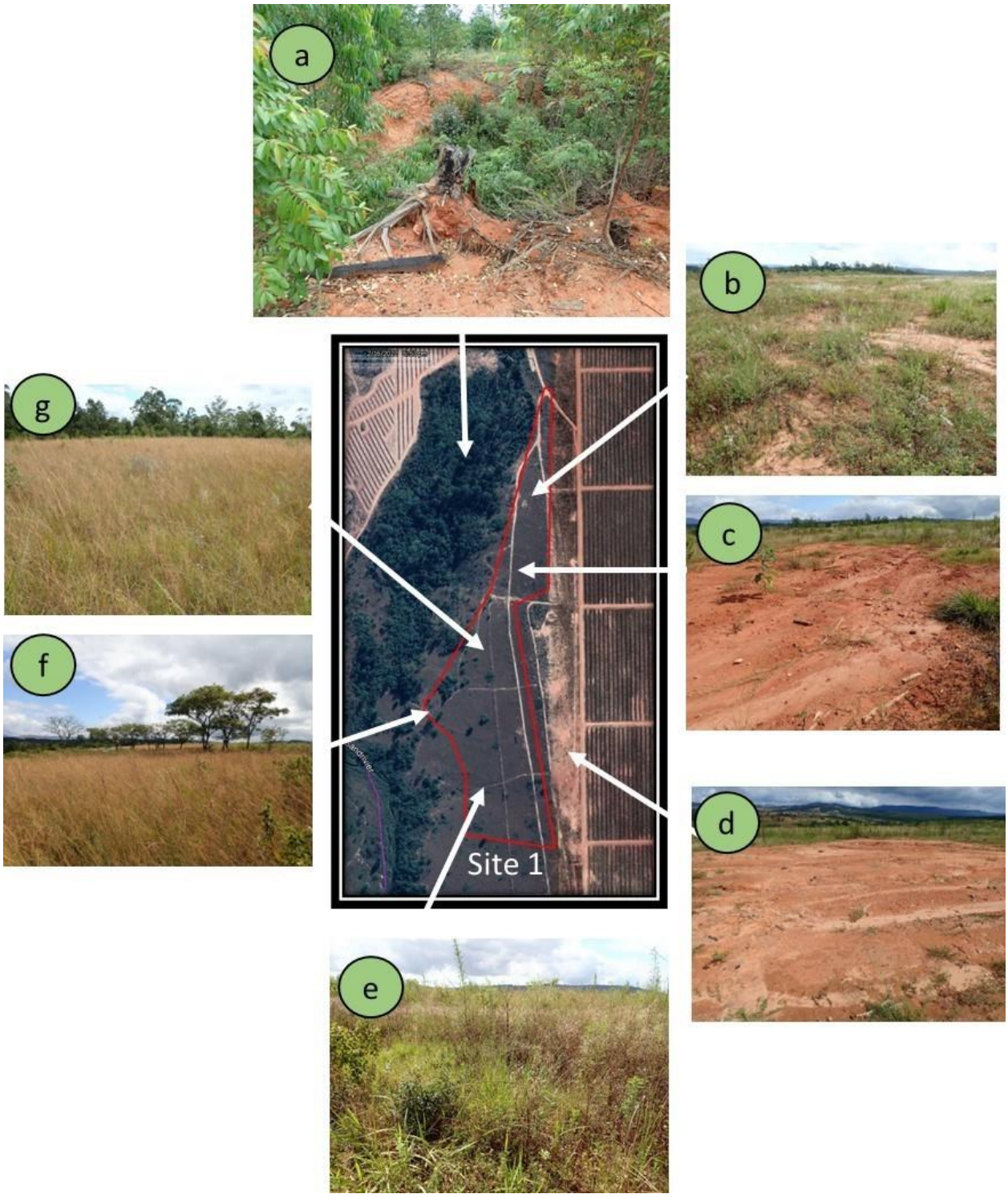


Figure 34: The land cover on the different portions of Site 1 (see explanations above).

Plant species observed during surveys at the project sites

Table 26: The following plants species were recorded at Site 1 in the project area, as well as in adjoining biotopes.

Site 1	**Woodland and primary grassland**
Blue guarri *(Euclea crispa)*	Blue guarri *(Euclea crispa)*
Cabbage tree (*Cussonia spicata*)	Common hook thorn *(Senegalia caffra)*
Paperbark thorn *(Vachellia sieberana*)	Bladdernut *(Diospyros whyteana)*
	Stainpod *(Flemingia grahamiana)*
Alien trees	Lowveld bitter tea (*Gymnanthemum colorata*)
Patula pine (*Pinus patula*)	Common wild currant (*Searsia pyroides)*
Christmas berry (*Lantana camara*)	Cabbage tree (*Cussonia spicata*)
Bugweed (*Solanum mauritianum*)	Tree fuscia *(Halleria lucida)*
	Common spike thorn (*Gymnosporia buxifolia*)
Shrubs	Dogwood (*Rhamnus prinoides*)
Fever tea (*Lippia javanica*)	Willow beechwood (*Faurea saligna*)
Thorny rope *(Smilax anceps)*	Forest fever tree *(Anthocleista grandiflora)*
	Water berry (*Syzygium cordatum*)
	Alien trees
	Patula pine (*Pinus patula*)
	Shrubs
	Poison bulb (*Boophone disticha*)
	Thorny rope *(Smilax anceps)*

Site 2: Sites 2 is covered with approximately 80% Untransformed Grassland with very few woody species. The site is associated with large inselbergs (outcrops) situated to the north-east of the site (Figure 35g) and the Sandspruit to the east.

The composite Figure 35 illustrates the land cover on the different portions of Site 2:

a. A view towards the Sandspruit to the north.
b. One of the few wood clumps on the treeless site.
c. A single kiaat (*Pterocarpus angolensis*) in Site 2.
d. The open grassland dominating the site.
e. The abundant *Aloe barbertoniae* should not be confused with *Aloe simii*.
f. Rooigras (*Themeda triandra*) forms part of the primary grassland.
g. The Rocky outcrop adjacent to Site 2.

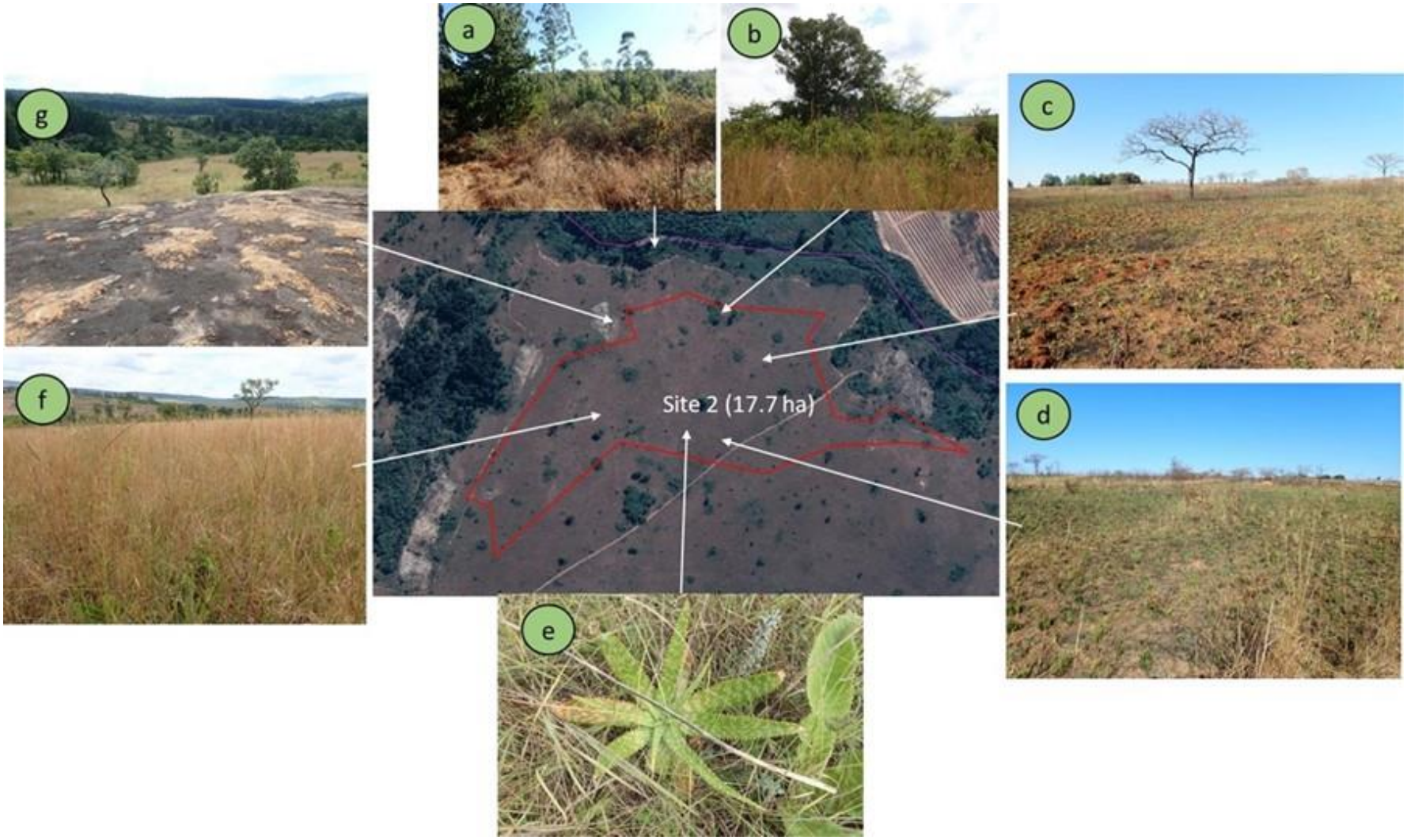


Figure 35: The land cover on the different portions of Site 2 (see explanations above).

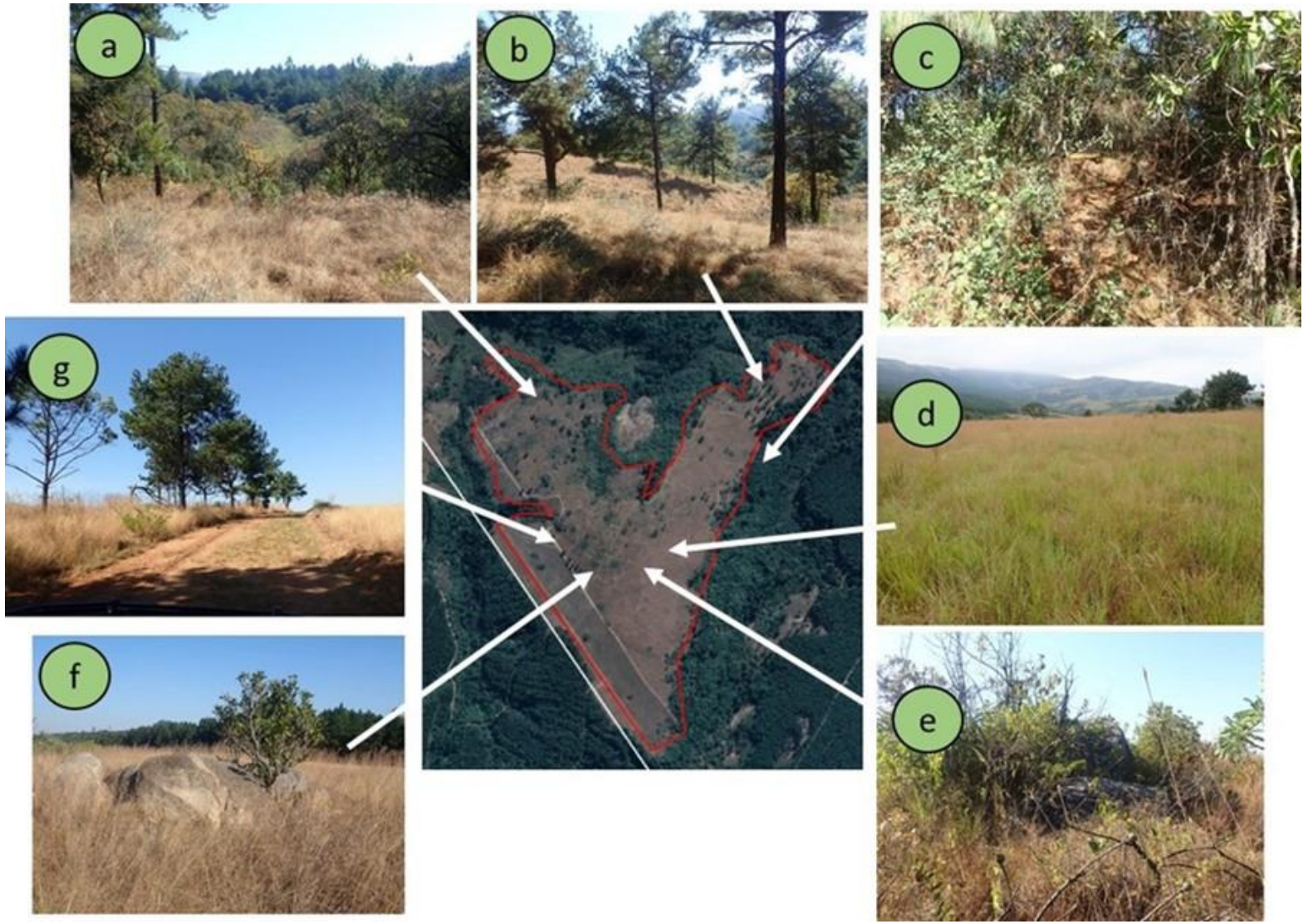


Figure 36: The land cover on the different portions of Site 3 (see explanations below).

Table 27: The following plants species were recorded at Site 2 in the project area, as well as in adjoining biotopes.

Site 2	**Woodland and primary grassland**
Grassveld plane (*Ochna confusa*)	Mobola plum (*Parinari curatellifolia)*
Tree fuscia *(Halleria lucida)*	Mitzeeri (*Bridelia micrantha*)
Blue guarri *(Euclea crispa)*	Tree fuscia *(Halleria lucida)*
Paperbark thorn *(Vachellia sieberana*)	Bladdernut *(Diospyros whyteana)*
Mobola plum (*Parinari curatellifolia)*	Stainpod *(Flemingia grahamiana)*
	Wild mulberry (*Trimeria grandifolia*)
Alien trees	Flame thorn *(Acacia ataxacantha)*
Christmas berry (*Lantana camara*)	**Alien trees**
Bugweed (*Solanum mauritianum*)	
	Christmas berry (*Lantana camara*)
	Bugweed (*Solanum mauritianum*)
	Guava (*Psidium guajava*)

Site 3: The entire Site 3 is located inside the Nature Reserve. The 46.6 ha is grassland, enclosed by the edges of Afrotemperate Forests. The area around Site 3 contains extensive closed canopy forest (Figure 36c), but alien pine trees also form part of the forests.

The composite Figure 36 illustrates the land cover on the different portions of Site 3:

a. A view towards the northern part of the reserve.
b. A number of tall pine trees are scattered in the grass covered site.
c. The edges of Afrotemperate Forests skirting the grassland.
d. The open grassland dominating the site.
e. One of the few wood clumps on the treeless site.
f. A small rock outcrop forms part of the primary grassland habitats.
g. The firebreak with a lane of pines.

Table 28: The following plants species were recorded at Site 3 in the project area, as well as in adjoining biotopes.

Site 2	**Woodland and primary grassland**
Stainpod *(Flemingia grahamiana)*	Stainpod *(Flemingia grahamiana)*
Lowveld bitter tea (*Gymnanthemum colorata*)	Climbing turkey-berry *(Keetia gueinzii)*
Tree fuscia *(Halleria lucida)*	Common hook thorn *(Senegalia caffra)*
Broad-leaved beechwood (*Faurea rochetiana*)	Broad-leaved beechwood (*Faurea rochetiana*)
Buffalo-thorn (*Ziziphus mucronata*)	Water pear *(Syzygium guineense)*
Common wild currant (*Searsia pyroides)*	**Alien trees**
Alien trees	Christmas berry (*Lantana camara*)
Christmas berry (*Lantana camara*)	**Shrubs**
Shrubs	Thorny rope *(Smilax anceps)*
Thorny rope *(Smilax anceps)*	

Species of Concern: Plants

Table 29 lists the expected plant species of concern in the region as per the SANBI website. According to these records, and records obtained from the MTPA Species Status Report Map in the vicinity of the farm in Grid 2530BD,

Table 29: A list of Plants of Special Concern that have distribution ranges and habitat preferences that overlap with the study area (in the vicinity of the farm in Grid: 2530BD).

Species	Habitat (SANBI 2019)	Status (SANBI 2019)
Aloe simii	Open woodland and grassland, along drainage lines and wetlands, 600-1100 m. Sabie southwards to White River and around Nelspruit.	SA Red Data: Critically Endangered; Mpumalanga: Critically Endangered; South African endemic; Five severely fragmented subpopulations. Declining due to afforestation, drying up of its wetland habitat as a result of adjacent plantations and water extraction, alien plant invasion, urban expansion and rural development.
Habenaria mossii	Open grassland on dolomite or in black, sandy soil.	SA Red Data: Endangered; These occur as six scattered subpopulations, there is a continuing decline due to the rapid urban expansion.
Aloe kniphofioides	Montane grassland. High altitude grasslands of Mpumalanga, KwaZulu-Natal and north-eastern Eastern Cape.	SA Red Data: Vulnerable; Mpumalanga Vulnerable; South African endemic. Loss of habitat as a result of afforestation, inappropriate fire management, loss of pollinators, mining and alien plant invasion over the past 50-80 years.
Disa extinctoria	Crest of the escarpment in damp grassland and swamps, 1000-1300 m. Swaziland to Tzaneen.	SA Red Data: Near-threatened; Mpumalanga: Near-threatened. Loss has been the result of afforestation, urban expansion and alien plant invasion, decline is ongoing.
Curtisia dentata	Evergreen forest from coast to 1800 m. Cape Peninsula to the Zimbabwe-Mozambique highlands.	SA Red Data: Near-threatened; Mpumalanga Near-threatened. The species has been exploited over most of its South African range due to timber extraction and bark harvesting for the traditional medicine trade.
Gladiolus calcaratus	Grassy mountain slopes, in deeper soils in wet sites or around the edges of damp depressions. 2100-2400m. Mpumalanga Highveld, between Dullstroom, Pilgrim's Rest and Lydenburg.	SA Red Data: Least Concern; Mpumalanga Vulnerable; South African endemic. This species has lost habitat to timber plantations in the past, but this is not an ongoing threat, with plantations not significantly expanding. It is possibly threatened in places by competition from unmanaged alien invasive plants.
Crinum macowanii	Mountain grassland and stony slopes in hard dry shale, gravely soil or sandy flats.	SA Red Data: Least Concern; Declining; A widespread species that is suspected to be declining due to its constant presence in medicinal markets. It is a long-lived species and susceptible to over-exploitation, but is still relatively common in the wild, and not likely to be nearing thresholds for increased extinction risk.
Adenia gummifera var. gummifera	Forested ravines, forest patches and forest margins, forest scrub, miombo woodland, savanna, dune	SA Red Data: Least Concern; Declining; This taxon is regularly found in medicinal markets and local declines have been observed.

	forest, on stony slopes, termitaria and littoral bush, 0-1 800 m.	
Gunnera perpensa	Damp marshy area and vleis from coast to 2400 m. Western Cape to Ethiopia.	SA Red Data: Least Concern; Declining; high volumes traded, successive harvesting will have an impact on the population in conjunction with the degradation and decline of its habitat.
Hypoxis hemerocallidea	Terrestrial; Occurs in a wide range of habitats, including sandy hills on the margins of dune forests, open, rocky grassland, dry, stony, grassy slopes, mountain slopes and plateaus. Appears to be drought and fire tolerant. Widespread in the eastern part of southern Africa from the Eastern Cape to Botswana and Mozambique.	SA Red Data: Least Concern; Mpumalanga: Least Concern. Declining. Hailed as `miracle muti' and `wonder potato'. Many plants are collected due to their popularity as a medicinal remedy. Since the plants do not re-seed easily, the demand for the tubers may cause the plants in the wild to decline. *It* is not listed as a threatened plant in the Red List.
Schizobasis intricata (NOW *Drimia intricata*)	Rocky places in seasonally dry areas. Widespread across the drier areas of southern Africa.	SA Red Data: Least Concern; Mpumalanga Muthi.
Eucomis autumnalis	Damp, open grassland and sheltered places from the coast to 2450 m. South Africa, Swaziland, Lesotho, Botswana, Zimbabwe and Malawi.	Declining. Declining. Has experienced large population declines and is a very popular medicinal plant.

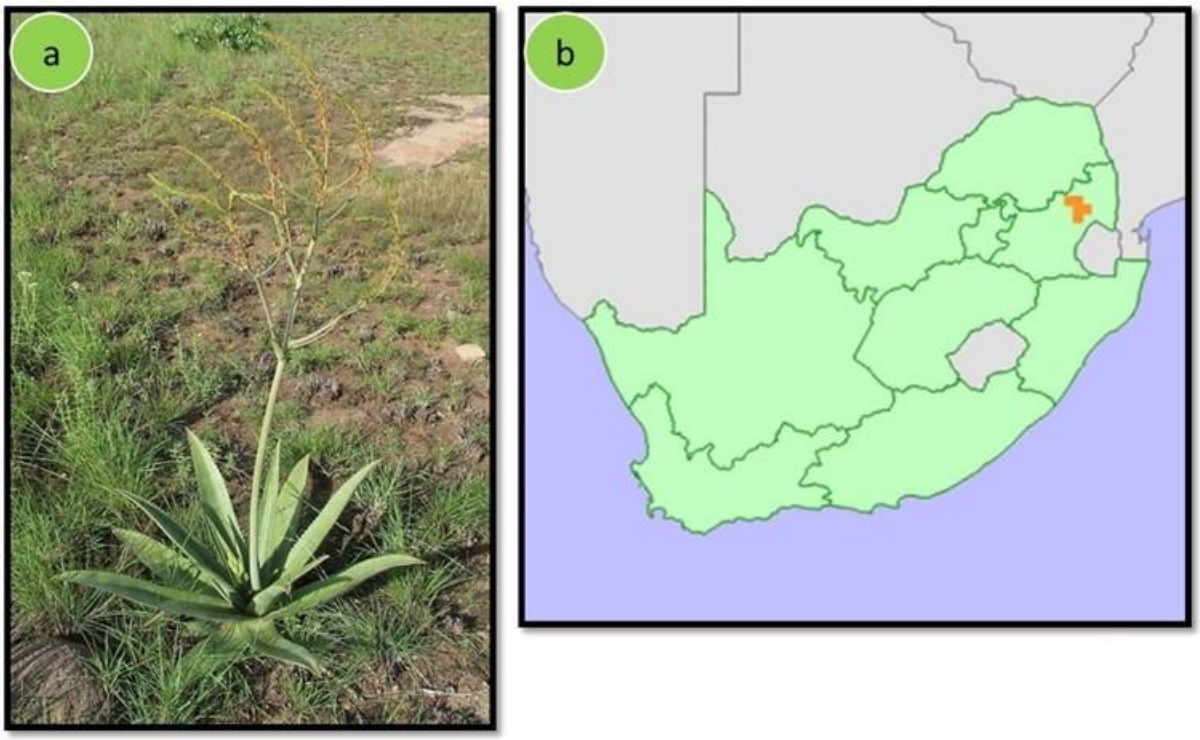


Figure 37: a) *Aloe simii* (Critically Endangered). b) Distribution of *Aloe simii.*

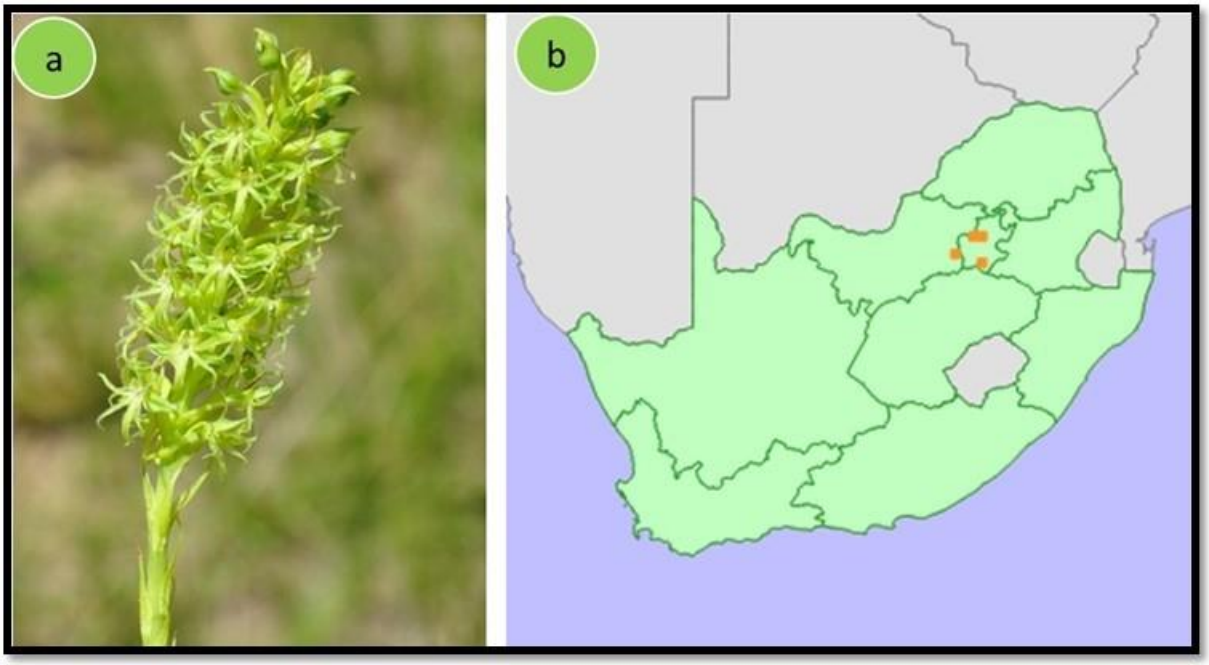


Figure 38: a) *Habenaria mossii* (Endangered). b) Distribution of *Habenaria mossii.*

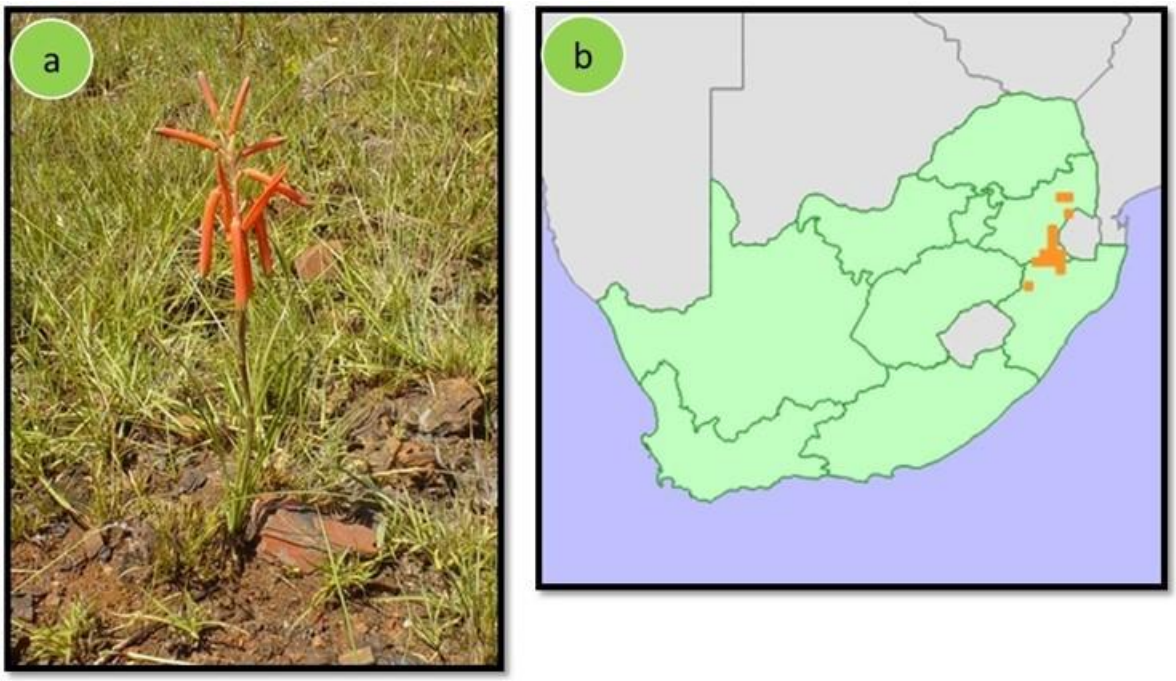


Figure 39: a) *Aloe kniphofioides* (Vulnerable). b) Distribution of *Aloe kniphofioides.*

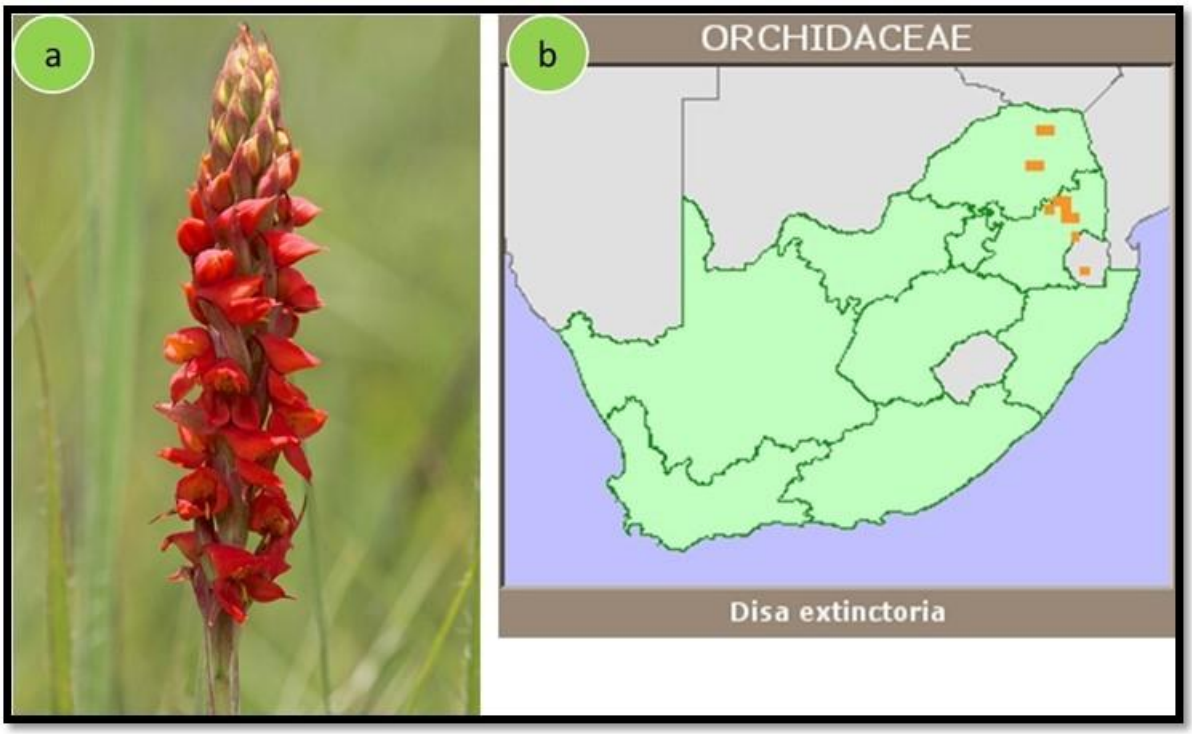


Figure 40: a) *Disa extinctoria* (Near threatened). b) Distribution of *Disa extinctoria.*

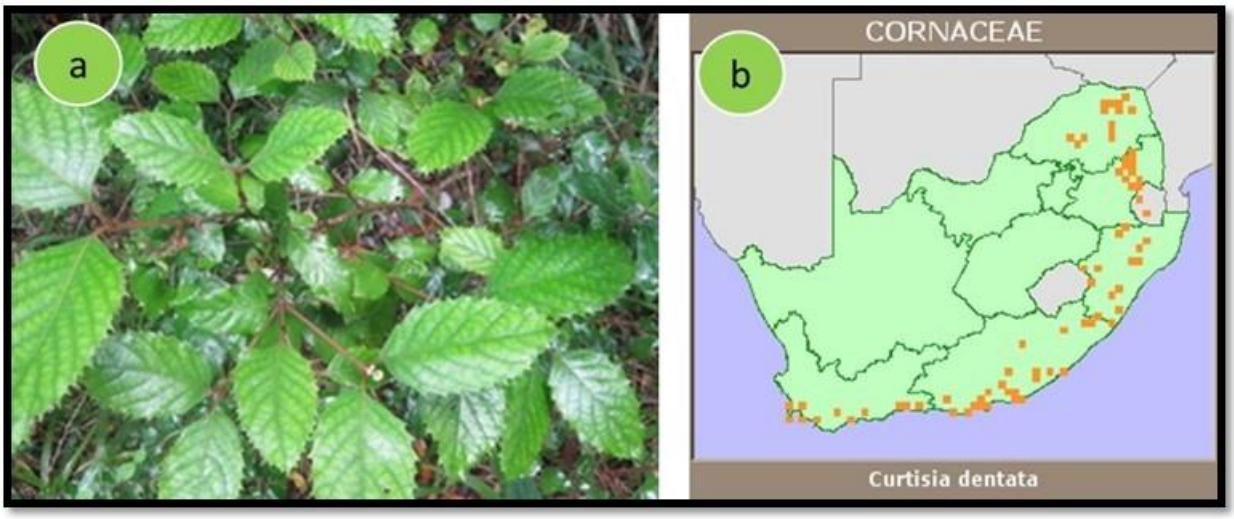


Figure 41: a) *Curtisia dentata* (Near threatened). b) Distribution of *Curtisia dentata.*

Figure 42: *Gladiolus calcaratus* (Mpumalanga Vulnerable). **Figure 43:** *Hypoxis hemerocallidea* (Declining).

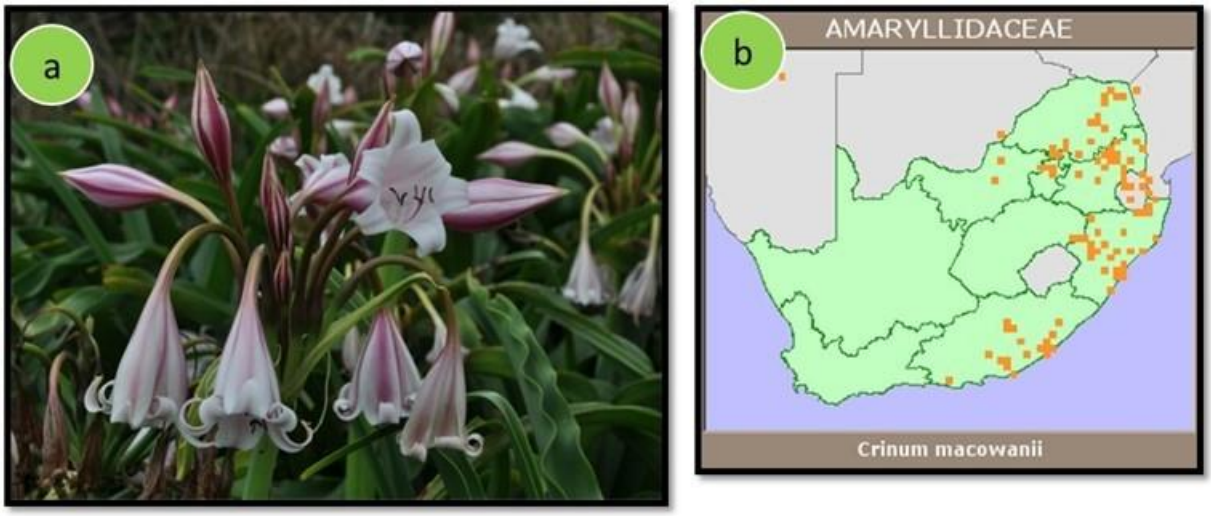


Figure 44: a) *Crinum macowanii* (Declining). b) Distribution of *Crinum macowanii.*

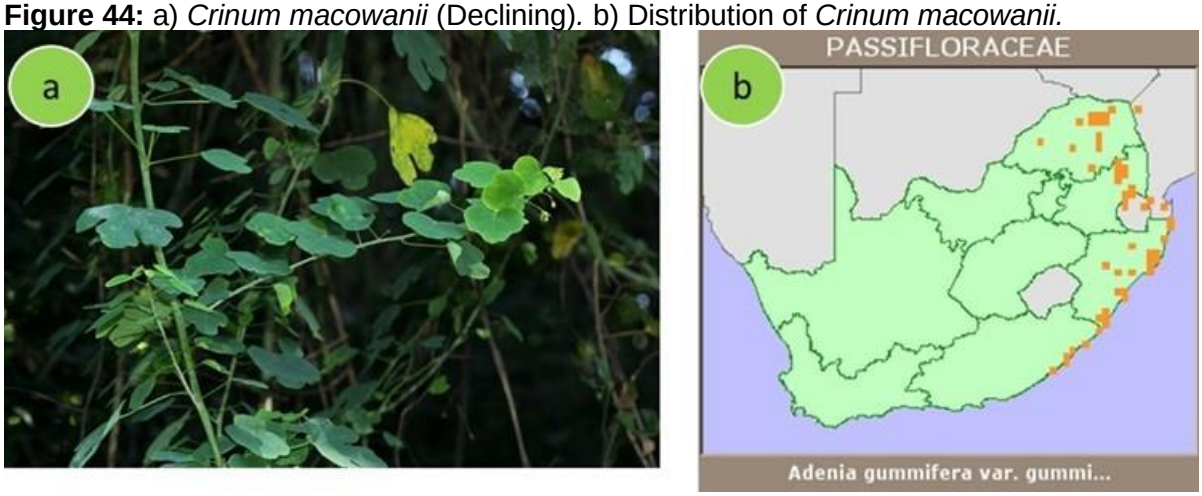


Figure 45: a) *Adenia gummifera var. gummifera* (Declining). b) Distribution of *Adenia gummifera var. gummifera***.**

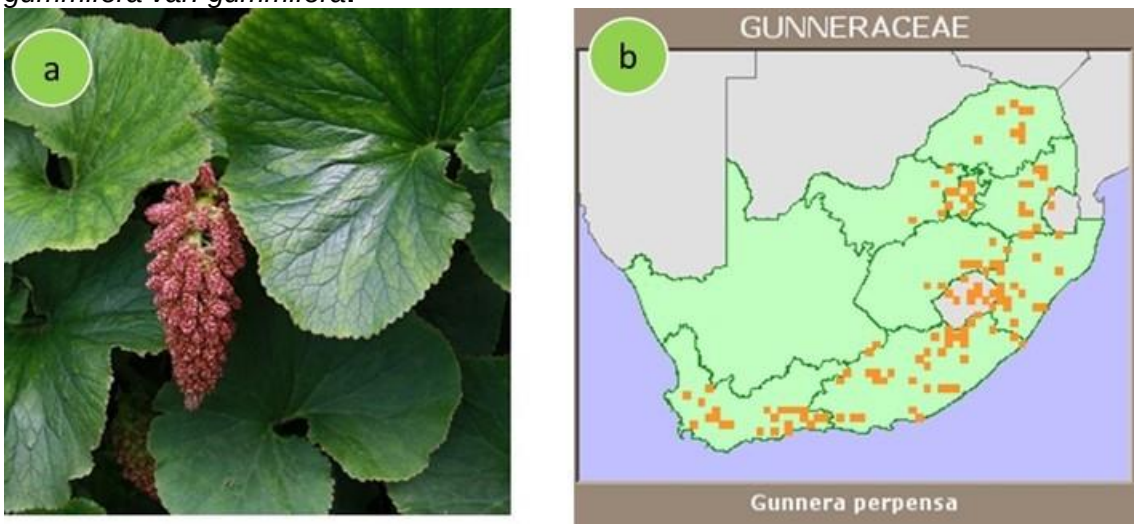


Figure 46: a) *Gunnera perpensa* (Declining). b) Distribution of *Gunnera perpensa***.**

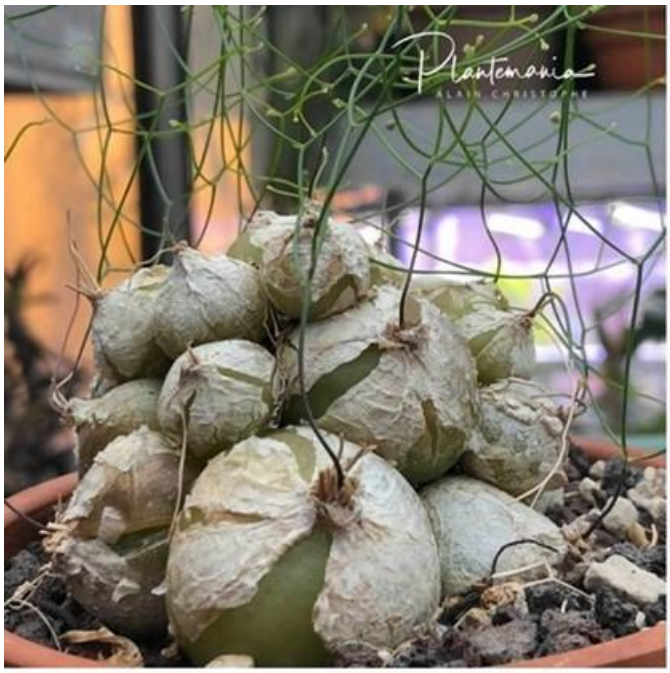


Figure 47: *Drimia intricata* (Mpumalanga Muthi). **Figure 48:** *Eucomis autumnalis* (Declining).

4.3.2 Aquatic ecosystem types

Aquatic habitat assessment

Aquatic surveys and biomonitoring are essential components of ecological risk assessments and aim to measure present biological conditions and trends in the aquatic ecosystem. It attempts to relate the observed variation to changes in available habitat, as dictated by physical system drivers of the system such as water quality, geomorphology, and hydrology (Kleynhans & Louw, 2008).

Macro-invertebrates and fish are good indicators of river health. By making use of established and accepted survey methods (SASS5 for invertebrates and FRAI-based surveys for fish) and incorporating the habitat aspects, a proper basis for biological diversity can be obtained.

The Sandspruit is a medium fast flowing river with clear, turbulent flows over ample bedrock and bolder cobbles. At the proposed river crossing, the river flows through a bedrock-dominated stretch with deep water pools and runs, fringed with reeds and overhanging marginal vegetation. The u-shaped river bottom consists mainly of bedrock with very little sediment due to the scouring flows.

The site is ideal for a river crossing due to the stable bedrock formation; however, any aquatic surveys are nearly impossible due to the depth of the reach, and it would also refrain from supplying any indication of the river health and biodiversity integrity. For this reason, a more diverse and workable site was chosen downstream to evaluate the invertebrate, habitat and fish integrity.

Figure 50: The instream habitat and associated marginal vegetation of the proposed river crossing site, as well as the adjacent riparian zone, are illustrated in these photos.

50a. Deep run with emergent reeds upstream of the site.
50b. The proposed river crossing site.
50c. A deep, slow-flowing pool at the crossing site.
50d. Marginal reeds and mainly alien Eucalyptus trees in the riparian zone at the site.

An area with diverse habitat types was chosen 1.9 km downstream of the crossing site for the aquatic surveys (Figure 51). The diverse habitat types at this site included deep slow-flowing pools with rocky bottoms; shallower edges with overhanging and emerging reeds; bedrock controls with multiple small riffles and larger rapids (Figures 51a to d). The surveys at this site will provide a much clearer picture of the diversity of aquatic biota in the river.

Figure 51: The aquatic survey area downstream of the crossing site consisted of a diversity of aquatic habitat types.

51a. Bedrock pool.
51b. Series of rocky rapids.
51c. Rocky runs and shallow pools.
51d. Large, deep pools, surrounded by emergent reeds and overhanging vegetation.

Figure 52: An area with diverse habitat types was chosen 1.9 km downstream of the crossing site for the aquatic surveys.

During the monitoring survey in July 2022 the following parameters were measured - IHAS (Integrated Habitat Assessment System) and HQI (Habitat Quality Index) with the results summarised in Table 30.

Table 30: The habitat parameters as measured at the alternative crossing site.

SITE	IHAS%	CATEGORY	HQI%	CATEGORY
SITE 1	81	Good	65	Fair

The IHAS obtained a “Good” 81% score for the healthy diverse habitat present (Table 30), while the lower HQI score was “Fair”, mostly due to the alien vegetation on the riverbanks.

4.3.2.2 Aquatic invertebrate assessment

The aquatic macro-invertebrates were sampled according to the SASS5 method at the alternative site and Table 31 lists the macro-invertebrates sampled at the site and reflects the SASS5 scores for the survey.

Table 31: SASS5 scores of the different habitat types at the sampling pool site (a complete table of this summarised version can be viewed in Appendix 2).

TAXON	Stones	Vegetation	GSM	Total
Turbellaria 3	A			A
Oligochaeta 1			A	A
Leeches 3	1			1
Potamonautidae 3	A			A
Atyidae (Shrimp) 8		A		A
Baetidae 2 spp 6	B	A	1	B
Caenidae 6			A	A
Heptageniidae 10	A	1		A
Tricorythidae 9	A			A
Coenagrionidae 4		B		B
Aeshnidae 8		A		A
Gomphidae 6			A	A
Corixidae 3			A	A
Gerridae 5		A	A	B
Naucoridae 7			1	1
Nepidae 3		1		1
Pleidae 4		A	A	A
Veliidae 5		1		1
Hydropsychidae 1= 4	A			A
Philopotamidae 10	1			1
Leptoceridae 6		A		A
Dytiscidae 5		1		1
Gyrinidae 5		B	A	B
Chironomidae 2		A	A	B
Muscidae 1			1	1
Simuliidae 5	A			A
Physidae 3		A		A
Corbiculidae 5			A	A
SASS Score	53	74	51	140
No of families	9	14	12	28
ASPT	5.8	5.2	4.2	5.0

Estimated abundance: 1=1; A=2-10; B=11-100; C=101-1000; D=>1000

Table 32: Comparing IHAS, HQI and SASS scores at the monitoring site during the survey.

SURVEY SITE	Habitat scores		SASS5 Scores			
	IHAS %	HQI %	SASS score	Number of families	ASPT	Condition
Alternative crossing site	81% Good	65% Fair	140	28	5.0	Good

Judging from Table 32, the habitat scores varied from "Good" to "Fair". According to the ASPT scores which signify the macro-invertebrate integrity at the site (Table 33), the site classifies as "Good". The SASS score, represented by the number of taxa (140), borders on an "Excellent" condition.

Table 33: Categories used to classify Habitat, SASS and ASPT values:

HABITAT	SASS4	ASPT	CONDITION
>100	>140	>7	Excellent
80-100	100-140	5-7	Good
60-80	60-100	3-5	Fair
40-60	30-60	2-3	Poor
<40	<30	<2	Very poor

4.3.3 Fish communities - Fish Response Assessment Index (FRAI)

The purpose of the Fish Response Assessment Index (FRAI) is to provide a habitat-based cause-and-effect interpretation underpinning the deviation of the fish assemblage from the reference condition.

The application of the FRAI is based on the following:

- The FRAI is an assessment index based on the environmental intolerances and preferences of the reference fish assemblage and the response of the constituent species of the assemblage to particular groups of environmental determinants or rivers.
- These intolerance and preference attributes are categorised into metric groups with constituent metrics that relates to the environmental requirements and preferences of individual species.
- Assessment of the response of the species metrics to changing environmental conditions occur either through direct measurement (surveys) or are inferred from changing environmental conditions (habitat). Evaluation of the derived response of species metrics to habitat changes are based on knowledge of species ecological requirements. Usually, the FRAI is based on a combination of fish sample data and fish habitat data.
- Changes in environmental conditions are related to fish stress and form the basis of ecological response interpretation.

Frequency of Occurrence (FROC)

The fish reference Frequency of Occurrence (FROC) database (Kleynhans, Louw, & Moolman, 2007), which provides consistent reference frequency of occurrence for more than 700 fish sites in South Africa, was used to establish the baseline data for this report.

Fish are considered to be one of the important indicators of river health and their responses to modified environmental conditions are measured in terms of the Fish Response Assessment Index (FRAI) (Kleynhans 1999; Kleynhans *et al*. 2005). This index is based on a combination of fish species habitat preferences as well as intolerance to habitat changes, and the present frequency of occurrence of species compared to the reference frequency of occurrence (Kleynhans, Louw, & Moolman, 2007).

The list of species is based on species that are known to be present or to have been present under close to reference habitat conditions. Species that are meant to have been present under relatively recent reference habitat conditions are also identified. The resulting species reference list is a combination of both of the above approaches.

Table 34: The FROC list (and the description of the column headings) and the PESEIS fish distribution for the Sandspruit in the study area.

FROC SITE CODE	5IF163	
LATITUDE	-25,2832	
LONGITUDE	30,9379	
WMA	Inkomati	
QUAT	X22E	
MAJOR RIVERS	Crocodile	
TRIBUTARY	Sandspruit (X22F-00886)	
ECOREGION	3,07	
GEOMORPH ZONE	D	
ALTITUDE	892	
FISH SPP FROC	Expected (PESEIS)	Observed Sandspruit
	Anguilla mossambica	
Amphilius uranoscopus	*Amphilius uranoscopus*	
	Enteromius argenteus	
Enteromius eutaenia		
Enteromius trimaculatus		*Enteromius trimaculatus*
Enteromius unitaeniatus		
Enteromius anoplus	*Enteromius anoplus*	*Enteromius anoplus*
Labeobarbus marequensis	*Labeobarbus marequensis*	*Labeobarbus marequensis*
	Clarias gariepinus	*Clarias gariepinus*
	Chiloglanis pretoriae	
Micralestes acutidens		
Labeo molybdinus		
Labeo ruddi		
Pseudocrenilabrus philander	*Pseudocrenilabrus philander*	*Pseudocrenilabrus philander*
		Tilapia sparrmanii

Execute the FRAI model

The FRAI model makes use of the fish intolerance and preference database that was compiled in 2001 (Kleynhans 2003). This information was built into the FRAI. The approach followed included the ranking, weighting and rating of metric groups. A large component of the FRAI is based on an automated calculation of rankings, weights and ratings.

Table 35 indicates the weights of the different metric groups. According to this, the flow modification metric group carries the most weight followed by the velocity-depth and cover metric groups. The first two have a strong link with flow, and this also have an influence on the physico-chemical metric. No introduced species are present.

Table 35: The weight allocated to the different metric groups in the model (for Sandspruit).

WEIGHT OF METRIC GROUPS	
METRIC GROUP	**WEIGHT (%)**
VELOCITY-DEPTH	**100,00**
COVER	**94,59**
FLOW MODIFICATION	**81,08**
PHYSICO-CHEMICAL	**72,97**
MIGRATION	**43,24**
IMPACT OF INTRODUCED	**13,51**

During the 2019 assessment the relative FRAI score of this reach of the Sandspruit was placed within the limits of a fish integrity category Class A/B (91.0%), which means this reach is “Unmodified, or approximate natural conditions closely” (Table 36). The Class ratings are explained in Table 36.

Table 36: Ratings for the fish integrity classes.

	FRAI ASSESSMENT CLASSES	
Class rating	Description of generally expected conditions for integrity classes	Relative FRAI score (% of expected)
A	Unmodified, or approximate natural conditions closely	90 to 100
B	Largely natural with few modifications. A change in community characteristics may have taken place but species richness and presence of intolerant species indicate little modification.	80 to 89
C	Moderately modified. A lower than expected species richness and presence of most intolerant species. Some impairment of health may be evident at lower limits of this class.	60 to 79
D	Largely modified. A clearly lower than expected species richness and absence or much lowered presence of intolerant and moderate intolerant species. Impairment of health may become more evident at the lower limit of this class.	40 to 59
E	Seriously modified. A strikingly lower than expected species richness and general absence of intolerant and moderately intolerant species. Impairment of health may become very evident.	20 to 39
F	Critically modified. Extremely lowered species richness and an absence of intolerant and moderately intolerant species. Only tolerant species may be present with a loss of species at the lower limit of the class. Impairment of health generally very evident.	0 to 19

4.3.3.1 Frogs

Frog fauna is a product of the diversity of the region's topography, climate and associated habitat types. Although frogs have adapted to almost every type of environment, many species are highly specialised to suit conditions in a particular locality. This can leave a species vulnerable when a habitat is degraded or irreversibly changed (Du Preez & Carruthers, 2009). Recent work has shown that amphibian species are declining worldwide as a result of global habitat loss. Their small areas of occupancy make them more susceptible to extinction due to habitat loss and degradation compared to other vertebrates. Suitable environmental conditions, especially breeding sites, are critically important, and species are often very specific to those habitat types. Therefore, habitat conservation should be a priority for amphibian preservation.

The amphibian populations in the Mpumalanga Province are faced with several environmental threats. Major threats include habitat destruction and invasion by alien vegetation resulting in a fragmentation of populations. Agriculture has already resulted in the rapid destruction and fragmentation of habitat types responsible for supporting populations of many species discussed here. Overgrazing and severe fires in the grassland catchment areas have resulted in extensive silting of streams and wetlands, thereby also threatening the breeding habitat of these frogs. For many reasons, frogs are important and useful indicators of environmental health. Factors that make frogs particularly sensitive to environmental deterioration include (Du Preez & Carruthers, 2009):

- Absorbent skin surface – absorbs water and any solvents it may contain
- Food contaminants – tadpoles are susceptible to ingesting pollutants
- Fragmented distribution – habitat losses may isolate surviving populations
- Sequestered tissue contaminants – disrupting hormone interference
- Temperature – extreme environmental temperature fluxes affect their biology
- Amphibious lifestyle – frogs are exposed to aquatic as well as terrestrial environments and are thus affected by changes to both
- Trophic level – important prey items to a wide array of predators

In addition, water pollution is another major concern, which may arise from different contamination sources of, including:

- Chemical contamination
- Agricultural pesticides and herbicides
- Acid precipitation (atmospheric pollution)
- Heavy metals
- Eutrophication (fertiliser run-off)
- Endocrine-disrupting contaminants

Other factors include out-of-season fires caused by humans, road mortalities, diseases and climate change.

Amphibians are localised in their movement and habitat choices. Although most frogs can live away from water, they need water to lay their eggs and for the larval stage. An absence of standing water will therefore denote an absence of frog species in the area. After good rains when standing water is replenished, frogs believed absent may emerge to feed and breed. The rest of the year they will seek shelter in damp places in order to escape the dry or cold climate.

Their permeable skin gives them the advantage of being amphibious, but it is also this permeable skin that makes them very susceptible to air- and water pollution. Frog surveys therefore, give a good indication of water quality and overall environmental condition. The

frog diversity in areas less affected by mining activities might appear moderately healthy, although the effects of air pollution or disease on these assemblages are unknown.

Wetlands are interlinking systems, as such upstream or wetland-adjacent impacts can adversely affect the ecosystems downstream. Numerous water quality-related problems may exist in a farming area, and these will have further negative impacts on the wetland systems in the area if not contained. In compiling the expected frog lists, detailed frog distribution records (from the old Transvaal compiled by Jacobsen 1989) were used, along with interpolated distribution maps, and data from the frog atlas project (Minter et al 2004). Additional information from the latest comprehensive work of Du Preez and Carruthers (2009) was also consulted.

Frog surveys

According to the 2004 Frog Atlas (Minter, *et al* 2004), the Krokodilspruit project area is situated in the Bushveld District. The accompanying frog distribution maps, confirms 29 frog species are expected to be present in the study area. Of these frog species that are expected to occur within the study area, we anticipate all 29 species will reside in the project area, accommodated by potential habitat in the area. The Bushveld District has a relatively high species richness (>30 species per grid cell), decreasing westwards, but is moderate in endemic species (7-10 species) (Minter *et al*, 2004). During surveys of the frog species (September 2018 and February 2022), 11 of the 29 expected species were encountered in the Krokodilspruit project area (See Appendix 3 for detail):

- Guttural toad (*Amietophrynus gutturalis*)
- Flat-backed toad (*Amietophrynus maculatus*)
- Red toad (*Schismaderma carens*)
- Painted reed frog (*Hyperolius marmoratus taeniatus*)
- Bubbling kassina/ Running Frog (*Kassina senegalensis*)
- Brown-backed Tree Frog (*Leptopelis mossambicus*)
- Bushveld rain frog (*Breviceps adspersus*)
- Dwarf puddle frog (*Phrynobatrachus mababiensis*)
- Plain grass frog (*Ptychadena anchietae*)
- Common river frog (*Amietia angolensis*)
- Natal sand frog (*Tomopterna natalensis*)

Most of the expected species will be found in the perennial rivers, seasonal and ephemeral drainage lines and valley-bottom wetland. Certain species such as rain frogs and sand frogs are not so dependent on perennial water supplies and are thus more resilient and able to survive the dry conditions of the region. Although most of these frogs will move away from wetlands in their life span, they will inevitably return to breed. Most of them aestivate in sheltering places and burrow into the soil, venturing sometimes far from wetlands during the dry cold winters. Frogs, such as the rain frogs, might be found in the grassland areas as they dig into the loam-sandy soil.

Species of Concern: Frogs

According to the South African Frog Atlas map (Minter, *et al.* 2004) the study area potentially contains 7-10 endemic species. Using distribution maps and habitat quality, seven endemic species are expected to occur in the Krokodilspruit project area:

- Raucous toad (*Amietophrynus rangeri*)
- Natal ghost frog (*Heleophryne natalensis*)
- Yellow-striped reed frog (*Hyperolius semidiscus*)
- Rattling frog (*Semnodactylus wealii*)
- Plaintive rain frog (*Breviceps verrucosus*)
- Mountain caco (*Cacosternum nanum parvum*)
- Clicking stream frog (*Strongylopus grayii*)

Currently no threatened frog species is expected to occur in the area.

Viability and estimated population size: Frogs

Comparing the habitat requirements of Species of Concern species with habitat availability in the vegetation/land, the following units have habitat assemblages that correspond with the optimal requirements of these frogs, which will have a direct influence on their viability and estimated population size:

Table 37: Probability of occurrence of these frogs based on habitat availability and the viability and estimated population size for frog species of concern in the study area.

Frog species	**Habitat requirements**	**Vegetation/land cover type with the appropriate habitat, suitability for the species**
Raucous toad (*Amietophrynus rangeri*) - common	Rivers, large ponds and stream-side pools along **slow-flowing streams** in grassland; **shallow water near banks, or among reed beds**. Aquatic vegetation.	3. Perennial rivers - Good 4. Drainage lines - Moderate 6. Valley-bottom wetland - Good
Natal ghost frog (*Heleophryne natalensis)*	Forest and Grassland biomes. **Forested ravines and high-altitude montane grasslands. Clear, swift-flowing streams in mountainous terrain. Flow through wooded and forested habitat; headwaters in montane grassland.**	1. North-eastern Mountain Grassland - Good 5. Forests - Optimal 6. Valley-bottom wetland - Good
Yellow-striped reed frog (*Hyperolius semidiscus)*	**Low-lying areas** of east-coast savanna.	3. Perennial rivers - Good 4. Drainage lines - Moderate 6. Valley-bottom wetland - Good
Rattling frog (*Semnodactylus wealii*)	Breeds in **well-vegetated pans and pools** in both subtropical and temperate regions.	6. Valley-bottom wetland - Good
Plaintive rain frog (*Breviceps verrucosus)*	**Forest and adjacent grassland** along the eastern escarpment.	1. North-eastern Mountain Grassland - Good 5. Forests - Optimal 6. Valley-bottom wetland - Good
Mountain caco (*Cacosternum nanum parvum)*	**High altitude grassland habits**. Calling from beneath grass at the edge of shallow puddles in inundated grassland;	1. North-eastern Mountain Grassland - Good

	seep on grassy slope.	
Clicking stream frog (*Strongylopus grayii*)	Breeds in almost any **shallow body of water** which is well provided with vegetation.	4. Drainage lines - Good 6. Valley-bottom wetland - Good

* Viability and estimated population size scores: Poor 1; Low 2; Medium 3; Good 4; Optimal 5

According to Table 37, all endemic species of concern have at least some "Good" habitat available in the study area, therefore, should these biotopes be managed properly, the survival of these species will be secured. However, it is anticipated that these species have small population sizes in this area.

4.3.3.2 Reptiles

Current knowledge of reptiles within the study area is derived from the Reptile Atlas Project (Bates, et al. 2014). In compiling the expected reptile lists, the detailed distribution records by Jacobsen (1989) of the herpetofauna of the old Transvaal were used together with the distribution maps. The Animal Demographic Unit's reptile atlas project data (ADU, 2010), collated in the Atlas and Red List of the Reptiles of South Africa, Lesotho and Swaziland, was also referenced (Bates, et al. 2014).

We conclude that the following factors played a role in lower numbers of reptile species being recorded across all project sites:

- Subterranean lifestyle of many species
- Nocturnal lifestyle of many species
- Secretive and retiring lifestyle of many species
- Small size of most of the species
- Well-camouflaged species

Surveys in primary habitats

The savanna is the most extensive ecoregion in the subregion, occurring over much of the northern parts of southern Africa. Savanna has a well-developed, grassy layer and a medium density of scattered trees. Rains occur during summer and fire is an important regulator of the balance between densities of grass- and woody vegetation. Reptile species richness and endemism is extremely high, but this is partially a result of the large extent of the ecoregion. Few savanna reptiles are classified as threatened and many have extensive ranges (Alexander & Marais, 2007).

According to the distribution of reptiles in South Africa, 86 species have distribution ranges extending into the region. All 86 of these species are expected to occur in the area (Jacobsen, 1989; Animal Demographic Unit, 2010) as adequate habitat is available. During the surveys of reptile species (2018 and 2022), 16 of the 86 expected species were recorded in the different habitat types of the Krokodilspruit project area (See Appendix 4 for detail). Additional species observed by the local inhabitants were also added to the list:

- Leopard tortoise (*Stigmochelys pardalis*)
- Marsh terrapin/Helmeted terrapin (*Pelomedusa subrufa)*
- Brown house snake *(Lamprophis capensis)*
- Cape wolf snake *(Lycophidion capense capense)*
- Spotted bush snake *(Philothamnus semivariegatus)*
- Rainbow rock skink (*Trachylepis quinquetaeniata margaritifer*)
- Striped skink *(Trachylepis striata striata)*
- Variable skink (*Trachylepis varia)*

- Yellow-throated plated lizard *(Gerrhosaurus flavigularis)*
- Giant plated lizard *(Gerrhosaurus validus validus)*
- Wilhelm's flat lizard *(Platysaurus intermedius wilhelmi)*
- Water monitor *(Varanus niloticus niloticus)*
- Southern rock agama *(Agama atra atra)*
- Southern tree agama *(Acanthocercus atricollis)*
- Cape dwarf gecko *(Lygodactylus capensis)*
- Moreau's tropical house gecko (*Hemidactylus mabouia mabouia*)

Species of Concern: Reptiles

Threatened reptile species are rated by standards established by the *International Union for Conservation of Nature (IUCN) 2016,* National Environmental Management: Biodiversity Act (NEMBA) of 2004, and the SA Red List (Bates, et al. 2014). There are more endemic reptiles in southern Africa than any other vertebrates, and new species are being discovered regularly in this country.

Due to their limited distribution and range in South Africa, endemic species are included as species of special interest below. According to the South African Reptile Atlas (ADU, 2010), there are 16 endemic reptile species expected to be found in the study area (SA endemic - Including Lesotho & Swaziland):

- Distant's thread snake *(Leptotyphlops distanti)*
- Dusky-bellied water snake (*Lycodonomorphus laevissimus)*
- Swazi rock snake *(Lamprophis swazicus)*
- Natal purple-glossed snake *(Amblyodipsas concolor)*
- Striped harlequin snake *(Homoroselaps dorsalis)*
- Spotted harlequin snake *(Homoroselaps lacteus)*
- Western Natal green snake *(Philothamnus natalensis occidentalis)*
- Southern brown egg eater *(Dasypeltis inorata)*
- Boulenger's Half-banded garter snake (*Elapsoidea boulengeri*)
- Montane dwarf burrowing skink (*Scelotes mirus*)
- Shortheaded legless skink *(Acontias breviceps)*
- Thin-tailed legless skink *(Acontias gracilicaudata gracilicaudata)*
- Delalande's sandveld lizard *(Nucras lalandii)*
- Barberton girdled lizard (*Cordylus warreni barbertonensis*)
- Common crag lizard (*Pseudocordylus melanotus melanotus*)
- Spotted dwarf gecko *(Lygodactylus ocellatus)*

There are eight threatened reptile species expected to occur in the area (including MTPA conservation status):

- Southern African python (*Python natalensis*) - NEMA TOPS 2007: Protected;
- Striped harlequin snake *(Homoroselaps dorsalis)* - IUCN 2014: Near-threatened. SARCA Red Data: Near-threatened; Mpumalanga: Near-threatened;
- Southern brown egg eater *(Dasypeltis inorata)* - Mpumalanga: Near-threatened;
- Many-spotted snake (*Amplorhinus multimaculatus*) - Mpumalanga: Near-threatened;
- Giant legless skink (*Acontias plumbeus*) - Mpumalanga: Near-threatened;
- Wilhelm's flat lizard *(Platysaurus intermedius wilhelmi)* - Mpumalanga: Near-threatened;
- Large-scaled grass lizard *(Chamaesaura macrolepis)* - IUCN 2015: Near-threatened; SARCA 2015: Near-threatened; Mpumalanga: Near-threatened;
- Cape grass lizard *(Chamaesaura anguina)* - Mpumalanga: Near-threatened.

Viability and estimated population size: Reptiles

Comparing the habitat requirements of the Species of Concern with the habitat availability in the biotopes, the following units have habitat assemblages that correspond with the optimal requirements of reptiles, which will have a direct influence on their viability and estimated population size:

Table 38: Probability of occurrence based on habitat availability and the viability and estimated population size for reptile species of concern in the study area.

Reptile species	**Habitat requirements**	**Vegetation/land cover type with the appropriate habitat, suitability for the species**
Southern African python (*Python natalensis*)	Open savanna regions, particularly rocky areas and **riverine scrub**. Moist, rocky, **well-wooded valleys, reed-beds or even bush country, seldom venture far from permanent water**. Eggs are laid in hollow tree trunks, antbear holes, caves or old termite hills. Fond of water in which they may lie and hunt. Dive into deep pools, remain submerged for long periods.	2. Woodland - Good 3. Perennial rivers - Optimal 4. Seasonal and ephemeral drainage lines - Good 5. Forests - Eastern Dry Afrotemperate Forest Subtype - Good 6. Valley-bottom wetland - Medium 7. Rocky outcrops or Granite Inselbergs - Optimal
Striped harlequin snake *(Homoroselaps dorsalis)*	**Moist savanna and Grassland**. Mainly in the Highveld or Savanna but extends into the Natal midlands. Old termitaria, under stones.	1. Untransformed Grassland – Optimal 2. Woodland - Good 9. Secondary Grassland – Medium 12. Transformed woodland - Medium
Southern brown egg eater *(Dasypeltis inorata)*	**Montane grassland, woodland** and grassland. 1200-1600m. Rock on rock or soil, under grass tussocks.	1. Untransformed Grassland – Optimal 2. Woodland - Good 7. Rocky outcrops or Granite Inselbergs - Good 9. Secondary Grassland – Medium 12. Transformed woodland - Medium
Many-spotted snake (*Amplorhinus multimaculatus*)	**Mountain streams and vleis. Reed beds and waterside vegetation.**	3. Perennial rivers - Good 4. Seasonal and ephemeral drainage lines - Optimal
Giant legless skink (*Acontias plumbeus*)	Lowveld in woodland and alluvial **sandy areas, forested areas**. Fossorial: Usually found below soil surface in sandy soil admixed with vegetable matter, accumulated leaf litter and humic soils in damp situations. Under stones, logs and other rotting vegetation, termitaria and among roots of trees.	2. Woodland – Good 6. Valley-bottom wetland - Optimal

Wilhelm's flat lizard *(Platysaurus intermedius wilhelmi)*	Lowveld; mesic highveld grassland. Commonly occurs on granite **outcrops and inselbergs** where it uses open, exposed rock with associated boulders. Narrow rock crevices are important for refuge. Vegetation surrounding rock outcrops is frequently quite dense and juveniles may escape predators by running into it.	7. Rocky outcrops or Granite Inselbergs - Optimal
Large-scaled grass lizard *(Chamaesaura macrolepis)*	**Montane grassland. Rocky hillsides covered with grass; flat rocks and grass tussocks.**	1. Untransformed Grassland – Optimal 7. Rocky outcrops or Granite Inselbergs - Optimal
Cape grass lizard *(Chamaesaura anguina)*	**Montane grassland**, gentle slopes. Flat rocks and grass tussocks.	1. Untransformed Grassland – Optimal 7. Rocky outcrops or Granite Inselbergs - Good

*Viability and estimated population size scores: Poor 1; Low 2; Medium 3; Good 4; Optimal 5

According to Table 38, all species of concern have “Optimal” habitat available in the study area, therefore, should these biotopes be managed properly, the survival of these species will be secured. However, it is anticipated that these species have small population sizes in this area.

4.3.3.3 Birds

Birds are important species in many ecosystems, fortunately they are also relatively easy to observe and count. Bird count data has been shown to accurately detect environmental change. A decline in species richness and diversity, as determined by routine monitoring, may serve as an early warning of environmental degradation. The presence or absence of bird species with specific habitat requirements can be indicative of the state of the environment.

The Bird Atlas (Harrison et al. 1997, Volumes 1 & 2) formed the basis of the distribution data used in this report, as it is currently the most updated printed information sources on South African birds available. Roberts Birds of southern Africa (Hockey, et al. 2005) was also consulted for habitat- and bird data. Of the bird species expected to be found in the study area, certain birds were resident and thus remain in the area throughout the year. Nomadic species periodically move to other areas further away from the study area for feeding- or breeding purposes. Of the expected migratory bird species, some North African visitors will only appear during the warmer seasons where they will feed and likely breed. The Palaearctic migrants spend our winters in Eurasia and are summer visitors to the warm south during the cold winters up north, however very few breed in southern Africa.

Surveys in primary habitats

During the September 2018 and February 2022 surveys, a variety of biotopes and sites were surveyed for bird species, including both transformed and untransformed lands. A total of 307 bird species were observed in this region during the Bird Atlas project (Harrison *et al.* 1997) (Appendix 5). If bird distribution and local habitat are evaluated, it is clear that a total of 296 species of birds are likely to utilise the different biotopes of the study area. One of these species is an alien exotic bird:

- House Sparrow (*Passer domesticus*)

The 2018/2022 surveys produced a total of 102 bird species across all transects in the Krokodilspruit project area.

Table 39: During the 2018/2022 surveys the following bird species were recorded (**Red** = "Species of Special Concern"):

1. Reed cormorant (*Phalacrocorax africanus*)	53. Black Saw-wing (*Psalidoprocne holomelas*)
2. Grey heron (*Ardea cinerea*)	54. Fork-tailed Drongo (*Dicrurus adsimilis*)
3. Little egret (*Egretta garzetta*)	55. Black-headed Oriole (*Oriolus larvatus*)
4. Cattle egret (*Bubulcus ibis*)	56. Pied Crow (*Corvus albus*)
5. Hadeda Ibis (*Bostrychia hagedash*)	57. Dark-capped Bulbul (*Pycnonotus barbatus*)
6. Hamerkop (*Scopus umbretta*)	58. Sombre Greenbul *(Andropadus importunus)*
7. African black duck (*Anas sparsa*)	59. Southern Black Tit (*Parus niger*)
8. Black-shouldered Kite (*Elanus caeruleus*)	60. Arrow-marked Babbler (*Turdoides jardineii*)
9. Yellow-billed Kite (*Milvus migrans parasitus*)	61. African Stonechat *(Saxicola torquata)*
	62. White-browed robin-chat *(Cossypha heuglini)*
10. African Harrier-Hawk (*Polyboroides typus*)	63. White-browed Scrub-Robin *(Cercotrichas leucophrys)*
11. African Goshawk (*Accipiter tachiro*)	
12. Steppe Buzzard (*Buteo vulpinus*)	64. Green-backed Camaroptera *(Camaroptera brachyura)*
13. Martial Eagle (*Polemaetus bellicosus*)	
14. Long-crested Eagle (*Lophaetus occipitalis*)	65. Lesser swamp-warbler (*Acrocephalus gracilirostris*)
15. Natal Francolin (*Francolinus natalensis*)	
16. Red-winged Francolin (*Scleroptila levaillantii*)	66. Long-billed Crombec (*Sylvietta rufescens*)
	67. Redfaced Cisticola (*Cisticola erythrops*)
17. Swainson's Spurfowl (*Pternistes swainsonii*)	68. Rattling Cisticola (*Cisticola chiniana*)
	69. Wailing Cisticola *(Cisticola lais)*
18. Helmeted Guineafowl (*Numida meleagris*)	70. Tawny-flanked prinia (*Prinia subflava*)
19. Kurrichane Buttonquail (*Turnix sylvatica*)	71. Neddicky (*Cisticola fulvicapilla*)
20. Three-banded plover (*Charadrius tricollaris*)	72. African Paradise Flycatcher (*Terpsiphone viridis*)
21. African Wattled plover (*Vanellus senegallus*)	73. Chinspot Batis *(Batis molitor)*
	74. Southern Black Flycatcher (*Melaenornis pammelaina*)
22. Spotted Thick-knee *(Burhinus capensis)*	75. African pied wagtail (*Motacilla aguimp*)
23. Laughing dove (*Streptopelia senegalensis*)	76. Common Fiscal *(Lanius collaris)*
24. Red-eyed Dove (*Streptopelia semitorquata*)	77. Black-backed puffback (*Dryoscopus cubla*)
	78. Black-crowned Tchagra (*Tchagra senegala*)
25. Emerald-spotted Wood-Dove (*Turtur chalcospilos*)	79. Southern Boubou *(Laniarius ferrugineus)*
	80. Orange-breasted Bush-Shrike *(Telophorus sulfureopectus)*
26. Tambourine Dove (*Turtur tympanistria*)	81. Olive Bush-Shrike *(Telophorus olivaceus)*
27. African Green Pigeon (*Treron calva*)	82. Grey-headed Bush-Shrike *(Malaconotus blanchoti)*
28. Purple-crested Turaco (*Tauraco porphyreolophus*)	83. Red-winged Starling *(Onychognathus morio)*
29. Grey go-away-bird (*Corythaixoides concolor*)	84. Cape Glossy Starling *(Lamprotornis nitens)*
30. Burchell's Coucal (*Centropus burchellii*)	

31. Red-chested Cuckoo (*Cuculus solitarius*) 32. Klaas's Cuckoo (*Chrysococcyx klaas*) 33. Diederik Cuckoo (*Chrysococcyx caprius*) 34. Alpine Swift *(Apus melba)* 35. Little Swift *(Apus affinis)* 36. White-rumped Swift (*Apus caffer*) 37. Speckled Mousebird *(Colius striatus)* 38. African Hoopoe *(Upupa africana)* 39. Common Scimitarbill (*Rhinopomastus cyanomelas*) 40. Brown-hooded Kingfisher (*Halcyon albiventris*) 41. Pied kingfisher (*Ceryle rudis*) 42. White-fronted bee-eater *(Merops bullockoides)* 43. Little Bee-eater *(Merops pusillus)* 44. European Bee-eater (*Merops apiaster*) 45. African Grey Hornbill (*Tockus nasutus*) 46. Yellow-fronted Tinker Barbet (*Pogoniulus chrysoconus*) 47. Black-collared Barbet (*Lybius torquatus*) 48. Crested Barbet (*Trachyphonus vaillantii*) 49. Golden-tailed Woodpecker (*Campethera abingoni*) 50. Sabota Lark (*Mirafra sabota*) 51. Barn Swallow (*Hirundo rustica*) 52. Lesser Striped Swallow (*Hirundo abyssinica*)	85. Amethyst Sunbird *(Chalcomitra amethystina)* 86. Collared Sunbird (*Anthreptes collaris*) 87. Southern Double-collared Sunbird *(Cinnyris chalybea)* 88. White-bellied Sunbird (*Nectarinia talatala*) 89. Cape White-eye *(Zosterops pallidus)* 90. Northern Grey-headed Sparrow *(Passer griseus)* 91. Spectacled Weaver (*Ploceus ocularis*) 92. Cape weaver (*Ploceus capensis*) 93. Red-billed Quelea (*Quelea quelea*) 94. Fan-tailed Widowbird *(Euplectes axillaris)* 95. Bronze Mannikin *(Lonchura cucullata)* 96. African Firefinch (*Lagonosticta rubricata*) 97. Common Waxbill (*Estrilda astrild*) 98. Blue Waxbill (*Uraeginthus angolensis*) 99. Pin-tailed Whydah (*Vidua macroura*) 100. Yellow-fronted Canary (*Serinus mozambicus*) 101. Cinnamon-breasted Bunting *(Emberiza tahapisi)* 102. Golden-breasted Bunting (*Emberiza flaviventris*)

The Untransformed Woodland is the most diverse habitat type in terms of expected bird assemblages, being home to 153 species. Transformed Woodland has only 62 expected species due to the impact of alien vegetation in this biotope. The riverine environment of the perennial rivers has 106 expected species and Seasonal and ephemeral drainage lines have 85 expected species. The smaller area of the Valley-bottom wetland has only 33 expected species. The Untransformed North-eastern Mountain Grassland has 79 expected bird species, while the Transformed Grassland only has 37 species due to the lack of diverse aspects of habitat similar to that of Untransformed Grassland.

The Eastern Dry Afrotemperate Forest has an expected bird total of 52 and the Rocky outcrop bioptope has an expected bird occupancy of 20 species. The transformed categories of Forestry, Current cultivation and Infrastructure does not contribute much to bird habitat on the farm.

Species of Special Concern: Birds

Through comparisons with expected bird lists, a total of 20 bird species expected to be found in the area are listed as “Species of Special Concern”. If bird distribution and local habitat are evaluated, all the Species of Special Concern birds are likely to utilise the different biotopes of the study area.

Currently three endemic bird species are expected to occur in the area:

- Cape Rock-Thrush *(Monticola rupestris)*
- Sentinel Rock-Thrush *(Monticola explorator)*
- Buff-streaked Chat *(Oenanthe bifasciata)*

The following threatened bird species are expected to occur in the area (IUCN, 2014; NEMBA, 2014; Red Data Book, 2015; MTPA Species Status Report Map Grid 2530BD):

- Yellow-billed stork (*Mycteria ibis*) - IUCN 2016 Status: Least concern. SA Red Data (Taylor 2015): Endangered.
- Black stork (*Ciconia nigra*) - IUCN 2016 Status: Least concern. SA Red Data (Taylor 2015): Vulnerable, TOPS (2007): Vulnerable. Mpumalanga: Vulnerable.
- Abdim’s stork (*Ciconia abdimii*) - IUCN 2016 Status: Least concern. SA Red Data (Taylor 2015): Near threatened. Mpumalanga: Near threatened.
- African Finfoot *(Podica senegalensis)* - IUCN 2015: Least concern; SA Red Data (Taylor 2015): Vulnerable. Mpumalanga: Vulnerable.
- Cape Vulture *(Gyps coprotheres)* - NEMA (TOPS): Endangered species; IUCN 2010 Vulnerable; SA Red Data (Barnes 2000): Vulnerable.
- Secretary bird (*Sagittarius serpentarius*) - IUCN 2015 VU Vulnerable; SA Red Data (Taylor 2015): Vulnerable. NEMBA (TOPS 2007): Vulnerable species.
- Martial Eagle *(Polemaetus bellicosus)* - IUCN 2015 Status: Near-threatened; SA Red Data (Taylor 2015): Endangered; NEMBA TOPS (2015): Endangered species.
- African Crowned Eagle *(Stephanoaetus coronatus)* - IUCN 2015 Status: Near-threatened. SA Red Data (Taylor 2015): Vulnerable. NEMBA (TOPS 2007): Vulnerable species. Mpumalanga: Vulnerable.
- Lanner Falcon *(Falco biarmicus)* - IUCN 2015 Status: Least concern. SA Red Data (Taylor 2015): Vulnerable.
- Peregrine Falcon *(Falco peregrinus)* - IUCN 2015 Status: Least concern; SA Red Data (Taylor 2015): Least concern; Mpumalanga: Vulnerable.
- African Grass-owl (*Tyto capensis*) - IUCN 2016 - Least Concern; SA Red Data (Taylor 2015): Vulnerable. Mpumalanga: Vulnerable.
- Half-collared Kingfisher *(Alcedo semitorquata)* - IUCN 2015 Status: Least concern; SA Red Data (Taylor 2015): Near-threatened. Mpumalanga: Near threatened.
- European Roller (*Coracias garrulus*) - IUCN 2010 NT: Near-threatened.
- Southern Ground-Hornbill *(Bucorvus leadbeateri)* - IUCN (2014) VU Vulnerable. NEMBA TOPS (2015): Endangered species; SA Red Data (Taylor 2015): Endangered.
- Blue Swallow *(Hirundo atrocaerulea)* - NEMA (TOPS): Critically Endangered species; IUCN 2015: Vulnerable; SA Red Data (Taylor 2015): Critically endangered.
- Orange Ground-Thrush *(Zoothera gurneyi)* - SA Red Data (Taylor, 2015): Near-threatened. Mpumalanga: Near threatened. IUCN 2010 Status: Least concern.
- Broad-tailed Warbler *(Schoenicola brevirostris)* - IUCN 2014 Status: Least concern; SA Red Data (Taylor 2015): Least concern. Mpumalanga: Near threatened.

Viability and estimated population size: Birds

Comparing the habitat requirements of Species of Concern with habitat availability in the biotopes, the following units have habitat assemblages that correspond with the optimal requirements of these birds, which will have a direct influence on their viability and estimated population size. The reporting rates supplied by the ADU Atlas report provide an indication of the population sizes of these birds in the area:

Table 40: Probability of occurrence of these birds based on habitat availability and the viability and estimated population size for bird species of concern in the study area.

Bird species	Habitat requirements	Habitat potential
Cape Rock-Thrush *(Monticola rupestris)*	Rocky, mountainous habitats in relatively high-rainfall areas; **gorges, incised river valleys, foothills** & lowlands adjacent to mountains. Cliffs, rocky gorges, **boulder strewn hillsides** and scree slopes, usually with scattered low trees, bushes and succulents, such as Euphorbia and Aloe species.	1. Untransformed Grassland – North-eastern Mountain Grassland - Good 7. Rocky outcrops or Granite Inselbergs - Optimal
Sentinel Rock-Thrush *(Monticola explorator)*	**Rocky uplands in grassland** biome. High rolling grasslands, rocky slopes, burnt areas, felled plantations.	1. Untransformed Grassland – North-eastern Mountain Grassland - Good 7. Rocky outcrops or Granite Inselbergs - Optimal
Buff-streaked Chat *(Oenanthe bifasciata)*	Sour grasslands – **rocky habitat** on mountains, hills, ridges and escarpments (1500-1700). Avoids woodlands, including aliens.	1. Untransformed Grassland – North-eastern Mountain Grassland - Good 7. Rocky outcrops or Granite Inselbergs - Optimal
Yellow-billed stork (*Mycteria ibis*)	**Dams, large marshes, swamps, estuaries, margins of lakes and large rivers,** seasonal wetlands. Wetlands, including alkaline and freshwater lakes, rivers, pans, flood plains, flooded grasslands, small pools or streams.	3. Perennial rivers - Good 4. Seasonal and ephemeral drainage lines - Good 6. Valley-bottom wetland - Poor
Black stork (*Ciconia nigra*)	**Shallow water: streams, large rivers, marshes, floodplains**, coastal estuaries, flooded grassland; large and small dams; dry land. Shallows of rivers, pools in dry riverbeds. Uncommon in seasonal pans lacking fish.	3. Perennial rivers - Good 4. Seasonal and ephemeral drainage lines - Good 6. Valley-bottom wetland - Poor
Abdim's stork (*Ciconia abdimii*)	**Grasslands**, pastures and cultivated fields.	1. Untransformed Grassland – North-eastern Mountain Grassland - Good 9. Secondary Grassland: Old and fallow lands - Optimal

African Finfoot *(Podica senegalensis)*	Quiet wooded streams and rivers flanked by thick riparian vegetation and overhanging trees. Forest and woodland areas: **Streams and rivers lined with reeds, overhanging trees and shrubs**. Avoids stagnant and fast flowing water. Perennial watercourses, clear water. Reclusive species that seldom ventures into open water. Climbs up and roosts in branches overhanging water. Forages close to water's edge and riverbanks, usually under overhanging vegetation.	3. Perennial rivers - Good
Cape Vulture *(Gyps coprotheres)*	Both open country (grasslands) and woodland. Reliant on tall cliffs for breeding and roosting. **Wanders widely**.	1. Untransformed Grassland – North-eastern Mountain Grassland - Good 2. Woodland - Medium 9. Secondary Grassland: Old and fallow lands - Medium
Secretary bird (*Sagittarius serpentarius*)	Open country: Savanna, **open woodland, grassland** and dwarf shrubland.	1. Untransformed Grassland – North-eastern Mountain Grassland - Optimal 2. Woodland - Medium 9. Secondary Grassland: Old and fallow lands - Good
Martial Eagle *(Polemaetus bellicosus)*	**Open grassland** and scrub. Large trees for nests. Wide range of vegetation types: deserts, densely **wooded and forested areas**.	1. Untransformed Grassland – North-eastern Mountain Grassland - Optimal 2. Woodland - Medium 5. Forests - Eastern Dry Afrotemperate Forest Subtype - Medium 9. Secondary Grassland: Old and fallow lands - Medium
African Crowned Eagle *(Stephanoaetus coronatus)*	**Dense indigenous forest, including riverine gallery forest**; may range far from forest to hunt.	3. Perennial rivers - Medium 5. Forests - Eastern Dry Afrotemperate Forest Subtype - Good 8. Forestry - Poor
Lanner Falcon *(Falco biarmicus)*	**Open habitats**. Cliff-nester, also in old nests in trees.	1. Untransformed Grassland – North-eastern Mountain Grassland - Optimal 7. Rocky outcrops or Granite Inselbergs - Optimal 9. Secondary Grassland: Old and fallow lands - Medium

Peregrine Falcon *(Falco peregrinus)*	Cliffs, mountains, steep gorges; **may hunt over open grassland, farmland and forests**; rarely enters cities to hunt pigeons.	1. Untransformed Grassland – North-eastern Mountain Grassland - Optimal 7. Rocky outcrops or Granite Inselbergs - Good 9. Secondary Grassland: Old and fallow lands - Medium
African Grass-owl (*Tyto capensis*)	**Rank grass and marshes are the preferred habitat. Usually in open habitat at fairly high altitudes.**	1. Untransformed Grassland – North-eastern Mountain Grassland - Optimal 6. Valley-bottom wetland - Medium 9. Secondary Grassland: Old and fallow land - Medium
Half-collared Kingfisher *(Alcedo semitorquata)*	**Clear fast flowing perennial streams, rivers** and estuaries; clear water and well-wooded banks; often near rapids; narrow and secluded with dense marginal vegetation. Broken escarpment terrain. Well-vegetated lake shores and coastal lagoons.	3. Perennial rivers - Good
European Roller (*Coracias garrulus*)	**Woodlands, bushveld and grasslands. Open woodland.**	1. Untransformed Grassland – North-eastern Mountain Grassland - Good 2. Woodland - Good 9. Secondary Grassland: Old and fallow lands - Medium 12. Transformed woodland - Poor
Southern Ground-Hornbill *(Bucorvus leadbeateri)*	Any **woodland, savanna, open grassveld**, agricultural lands.	1. Untransformed Grassland – North-eastern Mountain Grassland - Good 2. Woodland - Good 9. Secondary Grassland: Old and fallow lands - Medium 12. Transformed woodland - Poor
Blue Swallow *(Hirundo atrocaerulea)*	**Moist montane grassland**, usually with sinkholes, dongas and potholes, often close to evergreen mistbelt forest, usually with nearby stream.	1. Untransformed Grassland – North-eastern Mountain Grassland - Good
Orange Ground-Thrush *(Zoothera gurneyi)*	**Moist evergreen montane forest, especially along streams.**	4. Seasonal and ephemeral drainage lines Good 5. Forests - Eastern Dry Afrotemperate Forest Subtype - Good
Broad-tailed Warbler *(Schoenicola brevirostris)*	**Vleis, marshy grassland**, moist grassy hillsides, boggy drainage lines, coarse high grassland.	4. Seasonal and ephemeral drainage lines - Good

*Viability and estimated population size scores: Poor 1; Low 2; Medium 3; Good 4; Optimal 5

4.3.3.4 Mammals

Of all the mammal species that have distribution ranges in the region, 109 coincide with the Krokodilspruit project area (Friedman & Daly, 2004). Under natural conditions the area has the potential to accommodate all these species. However, due to persecution by humans and habitat loss, some of the expected larger game species are most likely lost to the area:

- Leopard (*Panthera pardus*)

Thus, 108 of the mammal species remain and are expected to occur in the area.

During the 2018 surveys, signs and/or sightings of 13 mammal species were recorded or reported by the staff on the farm:

- Chacma baboon (*Papio ursinus*)
- Vervet monkey (*Cercopithecus aethiops*)
- Banded mongoose (*Mungos mungo*)
- Bushpig (*Potamochoerus porcus*)
- Grey duiker (*Sylvicapra grimmia*)
- Kudu (T*ragelaphus strepsiceros*)
- Mountain reedbuck (*Redunca fulvorufula*)
- Red duiker *(Cephalophus natalensis)*
- Bushbuck (T*ragelaphus scriptus*)
- Blue wildebeest *(Connochaetes taurinus)*
- Cape Porcupine *(Hystrix africaeaustralis)*
- Common Molerat *(Cryptomys hottentotus)*
- Scrub hare (*Lepus saxatilis*)

Species of Concern: Mammals

Of the 108 remaining mammal species in the study area, potential habitat aspects are present and are expected to be capable of accommodating all these species, if human influence does not escalate. Twelve species are listed as Species of Special Concern, most of which are considered threatened. One endemic mammal, the Rough-haired golden mole *(Chrysospalax villosus)* is listed for the area.

Species of Concern: Habitat requirements

None of the Species of Special Concern were encountered during our surveys. This is not surprising as these species have obviously reached this level of IUCN concern, due to their scarcity. Since some of the larger mammals no longer occur here, they are not listed or discussed further as Red Data species. The following 12 mammal species that are expected to occur in the area and which are considered threatened are listed below (SA Red List, 2016; IUCN*, 2014*; NEMBA, 2007; Red Data Book, 2000; MTPA Species Status Report Map Grid 2530BD):

- Rough-haired golden mole *(Chrysospalax villosus)* - IUCN (2014): Vulnerable; SA Red Data (Child 2016): Vulnerable. NEMBA TOPS (2007): Critically endangered. Endemic.
- Samango monkey (*Cercopithecus mitis*) - IUCN (2014) Vulnerable; SA Red Data (Child 2016): Vulnerable; NEMBA (TOPS 2015): Vulnerable species.
- Brown hyaena (*Parahyaena brunnea*) - IUCN 2015: Near threatened; SA Red Data (Child 2016): Near threatened; NEMBA (TOPS 2007): Protected species.
- Leopard (*Panthera pardus*) - IUCN (2016): Vulnerable. SA Red Data (Child 2016) Vulnerable. NEMBA (TOPS 2015): Protected species.
- Serval (*Leptailurus serval*) - IUCN (2016) Least concern. SA Red Data (Child 2016): Near threatened; NEMBA (TOPS 2015): Protected species.

- Cape clawless otter (*Aonyx capensis*) - IUCN (2016): NT Near-threatened; SA Red Data (Child 2016): Near-threatened; NEMBA (TOPS 2007): Protected species.
- Spotted-necked otter (*Lutra maculicollis*) - IUCN (2016): NT Near-threatened; SA Red Data (Child 2016): Vulnerable; NEMBA (TOPS 2007): Protected species.
- Honey badger (*Mellivora capensis*) - NEMBA (TOPS) 2007: Protected species.
- Oribi (Ourebia ourebi) - SA Red Data (Child 2016): Endangered. TOPS NEMA: Endangered species.
- Reedbuck (*Redunca arundinum*) - TOPS NEMBA (2007): Protected.
- Pangolin (*Manis temminckii*) - IUCN (2016) Vulnerable. SA Red Data (Child 2016): Vulnerable. NEMBA (TOPS 2015): Vulnerable species.
- Giant rat (Cricetomys gambiensis) - IUCN (2016) Least concern. SA Red Data (Child 2016): Least concern. NEMBA (TOPS 2015): Vulnerable species.

Viability and estimated population size: Mammals

During the evaluation of the suitability of habitat types for the mammal species of concern, the entire habitat assemblage per Vegetation unit and land cover type was assessed. Comparing the habitat requirements of Species of Concern species with habitat availability in the Vegetation unit and land cover type, the following units have habitat assemblages that correspond with the optimal requirements of these mammals, which will have a direct influence on their viability and estimated population size:

Table 41: Probability of occurrence of these mammals based on habitat availability and the viability and estimated population size for mammal species of concern in the study area.

Mammal species	Habitat requirements	Habitat potential
Rough-haired golden mole *(Chrysospalax villosus)*	**Grassland, dry ground on the fringes of marshes or damp vleis**. Excavate burrows; loose piles of soil.	1. Untransformed Grassland – North-eastern Mountain Grassland - Good 4. Seasonal and ephemeral drainage lines - Good 6. Valley-bottom wetland - Optimal
Samango monkey (*Cercopithecus mitis*)	**Open forest.**	5. Forests - Eastern Dry Afrotemperate Forest Subtype - Good
Brown hyaena *(Parahyaena brunnea*)	**Semi-desert, open scrub and open woodland savanna. Nocturnal, holes in ground.**	2. Woodland - Good 4. Seasonal and ephemeral drainage lines - Medium 7. Rocky outcrops or Granite Inselbergs - Medium
Leopard (*Panthera pardus*)	Widespread. **Broken country or forests**. Nocturnal & solitary.	1. Untransformed Grassland – North-eastern Mountain Grassland - Medium 2. Woodland - Good 3. Perennial rivers - Good 4. Seasonal and ephemeral drainage lines - Good 5. Forests - Eastern Dry Afrotemperate Forest Subtype - Good 7. Rocky outcrops or Granite Inselbergs - Good

Serval *(Leptailurus serval*)	Proximity to **water essential requirement**, coupled with availability of adequate cover**; tall grass**, underbrush or reed beds - during day. Wet grassland, vleis and reed beds.	1. Untransformed Grassland – North-eastern Mountain Grassland - Medium 2. Woodland - Medium 3. Perennial rivers - Good 4. Seasonal and ephemeral drainage lines - Good 6. Valley-bottom wetland - Optimal 9. Secondary Grassland: Old and fallow lands - Poor
Cape clawless otter (*Aonyx capensis*)	Predominantly aquatic; freshwater an essential requirement: **Rivers, lakes, swamps and dams**. Widespread. Tributaries of rivers into small streams - habitat with food. Litters born in holes in banks of rivers. Estuarine and sea water.	3. Perennial rivers - Optimal
Spotted-necked otter (*Lutra maculicollis*)	Aquatic, confined to **larger rivers, lakes, swamps and dams** with extensive areas of open water. Stay close to water edge. Lie up in holes of riverbanks, in rock crevices or in dense reeds.	3. Perennial rivers - Optimal
Honey badger (*Mellivora capensis*)	Widespread. Not in desert. **Use crevices in rocky areas, will also dig refuges.** Rocky koppies, scrub sandveld, **open grassland**, open woodland, riverine woodland and floodplain grassland.	1. Untransformed Grassland – North-eastern Mountain Grassland - Good 2. Woodland - Good 3. Perennial rivers - Good 4. Seasonal and ephemeral drainage lines - Good 6. Valley-bottom wetland - Medium 7. Rocky outcrops or Granite Inselbergs - Optimal 9. Secondary Grassland: Old and fallow lands - Medium
Oribi (*Ourebia ourebi*)	**Open habitat. Open grassland, flood plain; sparse scattering of trees and bushes.**	1. Untransformed Grassland – North-eastern Mountain Grassland - Optimal 4. Seasonal and ephemeral drainage lines - Medium 6. Valley-bottom wetland - Good 9. Secondary Grassland: Old and fallow lands - Medium
Reedbuck (*Redunca arundinum*)	Open water with cover; stands of tall **grass or reed beds.**	1. Untransformed Grassland – North-eastern Mountain Grassland - Medium 3. Perennial rivers - Medium 4. Seasonal and ephemeral drainage lines - Good 6. Valley-bottom wetland - Optimal

Pangolin (*Manis temminckii*)	**Wide habitat tolerance**, absent from forests. Day – piles of leaves or other vegetable debris, holes in the ground.	1. Untransformed Grassland – North-eastern Mountain Grassland - Good 2. Woodland - Optimal 4. Seasonal and ephemeral drainage lines - Good 9. Secondary Grassland: Old and fallow lands - Medium
Giant rat (Cricetomys gambiensis)	**Evergreen forests and woodland**. Urban areas. Linear forest, termite mounds.	2. Woodland - Good 3. Perennial rivers - Good 4. Seasonal and ephemeral drainage lines - Good 5. Forests - Eastern Dry Afrotemperate Forest Subtype - Optimal

*Viability and estimated population size scores: Poor 1; Low 2; Medium 3; Good 4; Optimal 5

4.3.3.5 Summary of all vertebrate fauna

Table 42: A summary of the expected faunal groups per habitat type.

Biotope	1. Untransformed Grassland	2. Woodland	3. Perennial rivers	4. Drainage lines in forests	7. Rocky outcrops	9. Old lands
Krokodilspruit expected fauna						
Frogs	7	7	13	20	0	6
Reptiles	39	52	11	13	29	26
Birds	79	153	106	85	20	37
Mammals	37	69	49	31	17	16
Totals	162	281	179	149	66	85
% of total						
Species of Special Concern						
Frogs	2	1	3	4	0	1
Reptiles	10	9	4	4	9	7
Birds	11	6	5	1	4	5
Mammals	4	4	6	5	1	1

Assessing the conservation status of species has become a critical aspect of monitoring trends in biodiversity conservation at both a national- and global level but identifying threatened species using internationally accepted criteria and through a standardised process is also a useful tool for the conservation of priority species.

Proposed developments that will involve a change of land use may cause loss of natural habitat or alteration of such habitat. Habitat destruction and habitat change are the greatest threats to fauna in South Africa. In terms of some of the principles of the National Environmental Management Act (Act 107 of 1998) (NEMA, 1998), sustainable development requires the consideration of disturbance and loss of biodiversity, which should be avoided or, if that is not possible, should be minimised and mitigated.

According to the project brief, the large number of Red Data listed and endemic species requires a monitoring programme to assess their numbers and status in the project area. Twenty-six Species of Special Concern that have a high probability of occurring in the region, are expected to frequent the Krokodilspruit farm. In the event that any threatened or near-threatened animal species are recorded within the study area in future, appropriate conservation measures should be developed in consultation with the relevant conservation authorities.

The three areas proposed to be cleared for agriculture, consists mainly of primary grassland. Most of the mammal and bird SCC will be able to move out of the areas during clearing process due to their size and mobility. It is only the subterranean species such as golden moles that will be at risk if present. Burrowing frogs and reptiles will also be at risk by vegetation clearing and it is suggested that any species caught during the process, should be translocated to the grassland areas in the Nature reserve.

5. Impact Assessment

5.1 Present Ecological State of the Project Area

During the 2018 EIA study, 1235 ha of forestry covered large areas of the farm, however, some of the plantations have been cleared to make way for orchards. Transformed grasslands, which are mostly old lands that were ploughed as long ago as 1936, covered an area of 531 ha. Patches of Transformed Woodland which have been degraded by the invasion of many different alien- and invasive plant species, covering approximately 130 ha, mostly to the east of the farm.

Adding all these transformed areas together, a total of 2000 ha have been changed over the years and cannot be considered natural any longer. From an ecological perspective, these are the areas to be targeted for the proposed development.

The area that was covered by the untransformed habitat types are summarised in Table 43.

Table 43: Areas covered by the untransformed habitat types.

Vegetation unit and land cover type	Hectares area cover
1. Untransformed Grassland – North-eastern Mountain Grassland	737.4 ha
2. Woodland	303.9 ha
3. Perennial rivers and its riparian corridor and buffer	224.4 ha with buffers
4. Seasonal and ephemeral drainage lines and buffers	251.3 ha with buffers
5. Forests - Eastern Dry Afrotemperate Forest Subtype.	717.5 ha
6. Valley-bottom wetland	4.3 ha
7. Rocky outcrops or Granite Inselbergs.	65.0 ha
Total	2 303.8 ha

Currently, the proponent plans to clear additional land in order to establish orchards for agricultural use, primarily to plant macadamias. The new area earmarked for development consists mostly of Untransformed Grassland. The estimated 737 ha of this untransformed biotope will decline from 737.4 ha to 667ha due to the clearing (72.5 ha), however, the more than 50 ha of buffers around the *Aloe simii* colonies gains back some of the lost grassland.

5.2 Environmental screening results and assessment outcomes

Screening Report

The National Web based Environmental Screening Tool is a geographically based web-enabled application which allows a proponent intending to submit an application for environmental authorisation in terms of the Environmental Impact Assessment (EIA) Regulations 2014, as amended to screen their proposed site for any environmental sensitivity.

The Screening Tool also provides for the site-specific EIA process and review of information, for example, the Screening Tool may identify if an industrial development zone, minimum information requirement, Environmental Management Framework or bio-regional plan applies to a specific area.

Finally, the Screening Tool allows for the generating of a Screening Report referred to in Regulation 16 (1)(v) of the Environmental Impact Assessment Regulations 2014, as amended whereby a Screening Report is required to accompany any application for Environmental Authorisation and as such the tool has been developed in a manner that is user friendly and no specific software or specialised GIS skills are required to operate this system.

A screening report was compiled for an environmental authorisation or for a part two amendment of an environmental authorisation as required by the 2014 EIA regulations, evaluating the proposed development footprint for environmental sensitivity. Following is an abstract from the original Screening Tool application:

The following sections contain a summary of any development incentives, restrictions, exclusions or prohibitions that apply to the proposed development footprint as well as the most environmental sensitive features on the footprint based on the footprint sensitivity screening results for the application classification that was selected.

According to the Screening Report, the project area is situated in a South African Conservation Area and there is an Environmental Management Framework (EMF) relevant to the area. An Environmental Management Framework was created in order to manage future developments to be sustainable as well as monitor and control the cumulative impacts of human activity on the natural environment. The EMF is meant to be a guideline to assist the decision-making process and it integrates frameworks, policies and different government mandates.

Proposed Development Area Environmental Sensitivity

The following summary of the development footprint environmental sensitivities were identified. Only the highest environmental sensitivity is indicated. The footprint environmental sensitivities for the proposed development footprint as identified, are indicative only and must be verified on site by a suitably qualified person before the specialist assessments identified below can be confirmed.

Table 44: The development footprint environmental sensitivities (Figure 53).

Theme	Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
Agriculture Theme	**X**			
Animal species		**X**		
Aquatic Biodiversity Theme	**X**			
Archaeological and Cultural Heritage Theme				**X**
Civil Aviation Theme		**X**		
Defence Theme				**X**
Plant Species Theme			**X**	
Terrestrial Biodiversity Theme	**X**			

Maps in Figure 53 represent the results of the screening for environmental sensitivity of the proposed footprint for the relative agriculture theme sensitivity associated with the project classification.

Table 45: Sensitivity features of the project area.

Theme	Sensitivity	Feature
Agriculture Theme	Medium	Land capability; Moderate to Low
Animal species theme	High	Aves: *Stephanoaetus coronatus*
	Medium	Aves: *Podica senegalensis* *Aquila rapax* Mammalia: *Amblysomus robustus* *Cercopithecus albogularis schwarzi* *Lycaon pictus* *Chrysospalax villosus* *Crocidura maquassiensis* *Dasymys robertsii* *Hydrictis maculicollis* *Ourebia ourebi ourebi* Insecta *Chrysoritis phosphor borealis* *Lepidochrysops irvingi* Invertebrate *Thoracistus jambila*
Aquatic biodiversity	Low	Very High sensitivities - Strategic water source area; Wetlands (Figure 53).
Archaeological and Cultural Heritage Theme	Low	Low sensitivity
Plant Species Theme	Medium-Low	"Medium-Low" Sensitive species Argyrolobium muddii Hesperantha brevicaulis Woodia singularis
Terrestrial Biodiversity Theme	Very High	Critical biodiversity area 2: Selati Game Reserve Strategic Water Source Areas Protected Areas Expansion Strategy Vulnerable ecosystem

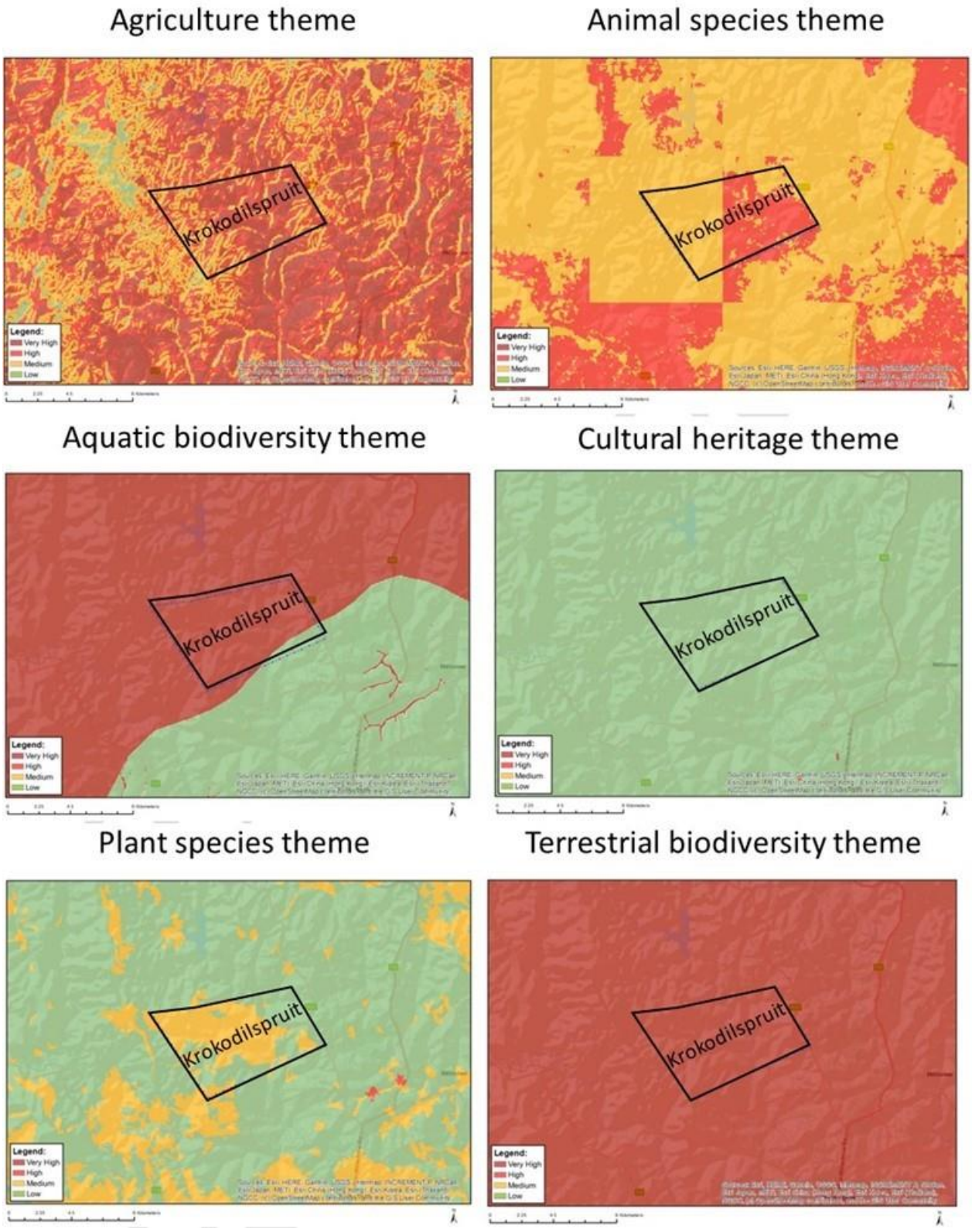


Figure 53: Maps of relative theme sensitivity important for selected themes (Table 44).

5.3 Sensitivity mapping

Sensitivity assessments identify those sections of the study area that have high conservation value or that may be sensitive to disturbance. Sensitivities could be determined based on:

- areas containing untransformed natural vegetation and associated faunal habitat;
- irreplaceability of the vegetation type and associated faunal habitat;
- ecological importance of vegetation and faunal habitat;
- high diversity or complexity of faunal habitat;
- observations of the abundance and diversity of floral and faunal species present at the time of the assessment;
- occurrence of Species of Conservation Concern (SCC);
- systems vital to sustaining ecological functions;
- presence or absence of CBAs and ESAs;
- degree of disturbance encountered as a result of historical activities.

In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to have a low sensitivity.

An ecological sensitivity map of the project area was produced by integrating the information collected on-site with the available ecological and biodiversity information available in the literature and various relevant reports. This includes delineating the different vegetation and habitat units identified in the field and assigning sensitivity values to the units based on their ecological properties. Additionally, values and potential presence of vegetation and fauna species diversity, as well as species of conservation concern, were evaluated.

Five, broad-scale botanical biodiversity ‘sensitivity’ categories were identified and were developed for practical mapping purposes. They are intended as a summary of the perceived botanical biodiversity value and sensitivity, of mapped broad-scale vegetation and land-cover type units. Based on the assessment, the sensitivity of the project footprint can be divided into five categories of sensitivity: Very high, High, Moderate, Low and Negligible. These categories are listed as biodiversity sensitivity categories in Table 46.

Table 46: Important parameters relating to faunal diversity and landscape sensitivity listed in the different vegetation and land cover types in order to establish the biodiversity sensitivity and value of the project area.

Vegetation/ Land cover type unit	**Status and sensitivity of vegetation type**	**CBA Category**	**Expected faunal species and SSC**	**Faunal biodiversity value and sensitivity**	**Overall ecological value and sensitivity**
1. Untransformed Grassland – North-eastern Mountain Grassland	Northern Escarpment Quartzite Sourveld - Vulnerable	Other natural areas	162 species; 27 SSC species	Very High	**Very High**
2. Woodland	Legogote Sour Bushveld - Endangered	Area in south east corner: ESA: Important sub-catchments and Fish support areas	281 species; 20 SSC species	High	**High**
3. Perennial rivers	Present Ecological State: C	Other natural areas	179 species; 18 SSC species	Moderate	**High**
4. Forests - Eastern Dry Afrotemperate Forest Subtype.	Critical Biodiversity Area: CBA Optimal; riparian buffers	Other natural areas and CBA Optimal	69 species; 9 SSC species	High	**Very High**
5. Rocky outcrops or Granite Inselbergs.	Critical Biodiversity Area: CBA Optimal	CBA Optimal	66 species; 14 SSC species	High	**Very High**
6. Forestry	Heavily modified	Heavily modified	N/a	Negligible	**Negligible**
7. Secondary Grassland: Old and fallow lands.	Moderately modified	Moderately modified	162 species; 27 SSC species	High	**Moderate**

1. Untransformed Grassland – North-eastern Mountain Grassland

Grasslands are in urgent need of conservation for their intrinsic value as a global and national biodiversity asset and because the ecosystem services they provide are vital for economic growth and social development.

Untransformed Grassland represents habitat that is considered suitable for seven of the Plants of Special Concern listed in Table 29, thus it provides suitable habitat for *Aloe simii, Habenaria mossii, Aloe kniphofioides, Gladiolus calcaratus, Crinum macowanii, Hypoxis hemerocallidea,* and *Eucomis autumnalis*. The vegetation of this unit is representative of the Northern Escarpment Quartzite Sourveld vegetation type (Mucina & Rutherford, 2007), which is considered to be Vulnerable at a national level. This vegetation unit is therefore considered to have a **Very High** sensitivity and value in terms of biodiversity conservation.

2. Untransformed Woodland

The savanna is the most extensive ecoregion in the subregion, occurring over much of the northern parts of southern Africa. Apart from the conservation importance inherent to such vegetation itself, it is also likely to be of considerable importance due to the fundamental role played by vegetation in determining habitat suitability for animals (food source, physical habitat etc.). The Untransformed Woodland is the most diverse habitat type in terms of expected faunal assemblages, being home to 281 species.

The vegetation of this unit is representative of the Legogote Sour Bushveld vegetation type (Mucina & Rutherford, 2007), which is considered to be Endangered at a national level. This vegetation unit is therefore considered to have a **High** sensitivity and value in terms of biodiversity conservation.

3. Perennial rivers

Although the Sandspruit River that transects the farm has a moderate habitat diversity and a "Moderately modified" integrity class status due to upstream and local agriculture and forestry impacts, the areas with stable riparian zones and the high-quality water supports a number of riverine faunal species. The migration corridor provided by the riparian zone is favoured by retreating and mobile animal species and is used as an interlinking network with adjacent areas.

The Ecological Importance of this vegetation unit is rated as "High", while the Ecological Sensitivity is rated as "Very High". This vegetation unit is therefore considered to have a **High** sensitivity and value in terms of biodiversity conservation.

4. Forests - Eastern Dry Afrotemperate Forest Subtype

These forests refer to the closed canopy of indigenous and often evergreen trees and shrubs but excludes commercial timber plantations. Indigenous forests protect water sources rather than drying them out, as is the case with timber plantations of pine and gum trees. Maintaining these forests in a healthy state is dependent on the connectedness of patches, achieved through riverine linkages that allow access by specialised forest thickets.

Drainage lines in other areas of the farm are flanked by riparian zones of varying densities of riverine vegetation which play an important role as migration corridors and to buffer these important wetland areas.

Despite their scattered distribution and small patch size these forests support a rich diversity of plant- and animal species, including two Plants of Special Concern as they provide suitable habitat for *Curtisia dentata* and *Adenia gummifera var. gummifera*. This vegetation unit is therefore considered to have a Very High sensitivity and value in terms of biodiversity conservation.

5. Rocky outcrops or Granite Inselbergs

These inselbergs are scattered over the farm and provide a great number and variety of ecological niches which support a host of plant communities and animal species. They are also characterised by a number of endemic plant species.

These habitat types occur on near pristine North-eastern Mountain Grassland and Legogote Sour Bushveld (Mucina & Rutherford, 2006), vegetation types considered to be Vulnerable and Endangered (respectively) at a national level. This vegetation unit is therefore considered to have a **Very High** value in terms of biodiversity conservation.

6. Forestry

This vegetation unit consists of habitat types completely transformed through the planting and invasion of alien trees. This secondary vegetation has a very low species richness in terms of indigenous species. Furthermore, this habitat does not provide potentially suitable habitat for any threatened species. Rehabilitation of these areas after the removal of the trees is often extremely difficult or impossible, as soil characteristics are often more or less irreversibly altered. This unit therefore has a **Negligible** sensitivity and value in terms of biodiversity conservation.

7. Secondary Grassland

Secondary grassland has undergone extensive modification and a fundamental shift from their original state but have been allowed to return to a ‘grassland’ state. Although secondary grasslands may superficially look like primary grasslands, they differ markedly with respect to species composition, vegetation structure, ecological functioning and the ecosystem services they deliver. The vegetation of this unit has a **Moderate** sensitivity and value in terms of biodiversity conservation.

5.4 The use of CBA maps in Environmental Impact Assessments

Ideally, all land-users and people who make decisions about land and the use of natural resources should be aware of spatial biodiversity priorities and should know how to take these into consideration in their planning and decision-making processes. This is so that they can proactively identify the ecological opportunities and constraints within a landscape and use these to locate different land-uses appropriately (Cadman *et al.*, 2010).

Systematic biodiversity planning provides a powerful set of tools (maps and land-use guidelines) that facilitate this in a wide range of sectors, at both the policy-making and operational decision-making levels.

It is important to note that all decisions regarding land-use applications in Mpumalanga are going to be evaluated by the authorities using the CBA maps and data, so it makes sense to consider these proactively, either prior to, or during, the EIA process (MBSP Handbook, 2014).

Mpumalanga Biodiversity Sector Plan (MBSP) and Threatened Ecosystems

Critical Biodiversity Area (CBA) maps and their associated land-use guidelines are used to determine the biodiversity context of a proposed land-use site, ahead of making the first site visit. Although the CBA maps supply crucial guidelines for the assessment, additional background information is required to develop a broader understanding of the study area.

A number of resources and tools are therefore used to establish how important the proposed development site is for meeting biodiversity targets. Specifically, the Land-Use Decision Support Tool (LUDS) and the Mpumalanga Biodiversity Sector Plan (MBSP) are extensively used to compile reports (BGIS, 2015). LUDS was developed to facilitate and support biodiversity planning and land-use decision-making at a national and provincial level.

The conservation status of the Eastern Highveld Grassland is “Endangered” with a target of 24%. Only a very small fraction of the grassland is conserved in statutory reserves. Some 44% is already transformed primarily by cultivation, plantations, mines, urbanisation and by building of dams (Mucina & Rutherford 2006).

The Krokodilspruit Project Area falls within the planning domain of the Mpumalanga Biodiversity Sector Plan. The potential impact of the development on Critical Biodiversity Areas should be considered in detail as these areas have been identified through systematic conservation planning exercises and represent biodiversity priority areas which should be maintained in a natural to near natural state in order to safeguard biodiversity patterns and ecological processes. The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to meet national biodiversity objectives.

Critical Biodiversity Areas (CBAs) are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. If these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannot be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.

Its primary objective is to serve as a guide for biodiversity planning but should not replace specialist ecological assessments. To maintain an area in a ‘natural’ state, a variety of biodiversity-compatible land uses and resource uses should be followed.

Critical Biodiversity Areas

Overlaying the BGIS Critical Biodiversity Areas onto the Krokodilspruit Farm, resulted in the compilation of Figures 58 and 59. The optimal Critical Biodiversity Areas were mostly associated with Drainage lines of perennial and ephemeral systems. Other Natural Areas are a combination of Grassland and Woodland, while Old Lands covers large expanses, as well as Heavily Modified areas consisting mostly of Forestry.

While determining the area and distribution of a core habitat is important, it is equally important that appropriate management measures be defined to ensure the core habitat continues to function effectively. The goal is to maximise connectivity in CBAs and ESAs, the retention of intact natural habitat and avoid fragmentation: Design project layouts and select locations that minimise loss and fragmentation of remaining natural habitat and maintain spatial components of ecological processes, especially in ecological corridors, buffers around wetlands, CBAs and ESAs. Activities that are proposed for CBAs must be consistent with the desired management objectives for these features and should not result in fragmentation.

In order to establish areas appropriate for the farming of the orchards, all the Critical Biodiversity Areas and other sensitive habitat types must be delineated and protected from the proposed farming activity in order to minimise impact on the environment.

The guidelines for land-use practices or activities that impact on water quantity in freshwater CBAs includes: Generic buffers should be established around streams within these catchments. These buffers can be refined based on a site visit and applying the DWS's wetland delineation tool.

Any potential risks must be managed and mitigated to ensure that no deterioration to the water resource takes place. Standard management measures should be implemented to ensure that any on-going activities do not result in a decline in water resource quality.

In the case of the Krokodilspruit study, it was decided to delineate the following biotopes and add buffers to these areas:

- Perennial rivers - Riparian areas are protected by the National Water Act (Act 36 of 1998);
- Seasonal and ephemeral drainage lines - Identification and detailed spatial definition and delineation of riparian area water resources which are described in the National Water Act;
- Eastern Dry Afrotemperate Forest Subtype – Natural forests are protected by the National Forests Act;
- Rocky outcrops or Granite Inselberg - Minimum requirements guidelines from the Mpumalanga Tourism and Parks Agency.

Perennial rivers – Sandspruit River: This perennial river is delineated as prescribed by the DWS Guidelines (DWA, 2008). A buffer of 50m on both sides of the riparian corridor is suggested as illustrated in Figure 21.

Seasonal and ephemeral drainage lines:

- **Drainage lines in Eastern Dry Afrotemperate Forests:** Where drainage lines are surrounded by forests, it is proposed that the biotope created by this association should be considered as one entity. In this case the forest is delineated which will automatically form a buffer for the drainage line Figure 26.
- **Drainage lines in open habitats (grassland and open woodland):** Where drainage lines dissect open areas, a buffer of 30m on both sides of the delineated riparian corridor is protected as illustrated in Figure 26.

- **Rocky outcrops:** It is suggested that a 30 m wide buffer is implemented around all the Rocky outcrops, which will include any woodland associated with the biotope (Figure 27).

Buffers associated with the new project sites

Following are detailed descriptions of the biotopes on the three sites that need buffering:

- **Site 1:** Site 1 is skirted by a transformed drainage line to the west and the Sandspruit in the south. The drainage line is very eroded and the donga has been invaded by alien *Eucalyptus* trees The Sandspruit is protected by a 50m buffer, while the drainage line is buffered by a 30m buffer (Figure 54).
- **Site 2:** Site 2 is surrounded by an array of sensitive habitats. To the north the Sandspruit with its 50m riparian buffer flows past the site; to the west a complex of inselbergs or rocky outcrops and their associated marginal woodland are protected by a 30m buffer; while to the south and east, colonies of *Aloe simii* are surrounded by a 75m buffer, which will probably ensure the continued existence a population in the wild (Figure 55).
- **Site 3:** A large portion of Site 3 is encircled by Afrotemperate Forest, creating a natural buffer for the drainage lines in the areas adjacent to the site. A prominent drainage line to the north of the site. does not have such a natural buffer and therefore, a 30m buffer was established on the southern bank (Figure 56) to protect the watercourse from the proposed clearing activities. A rocky outcrop on the edge of the site is also buffered by a 30m ecological buffer (Figure 56).

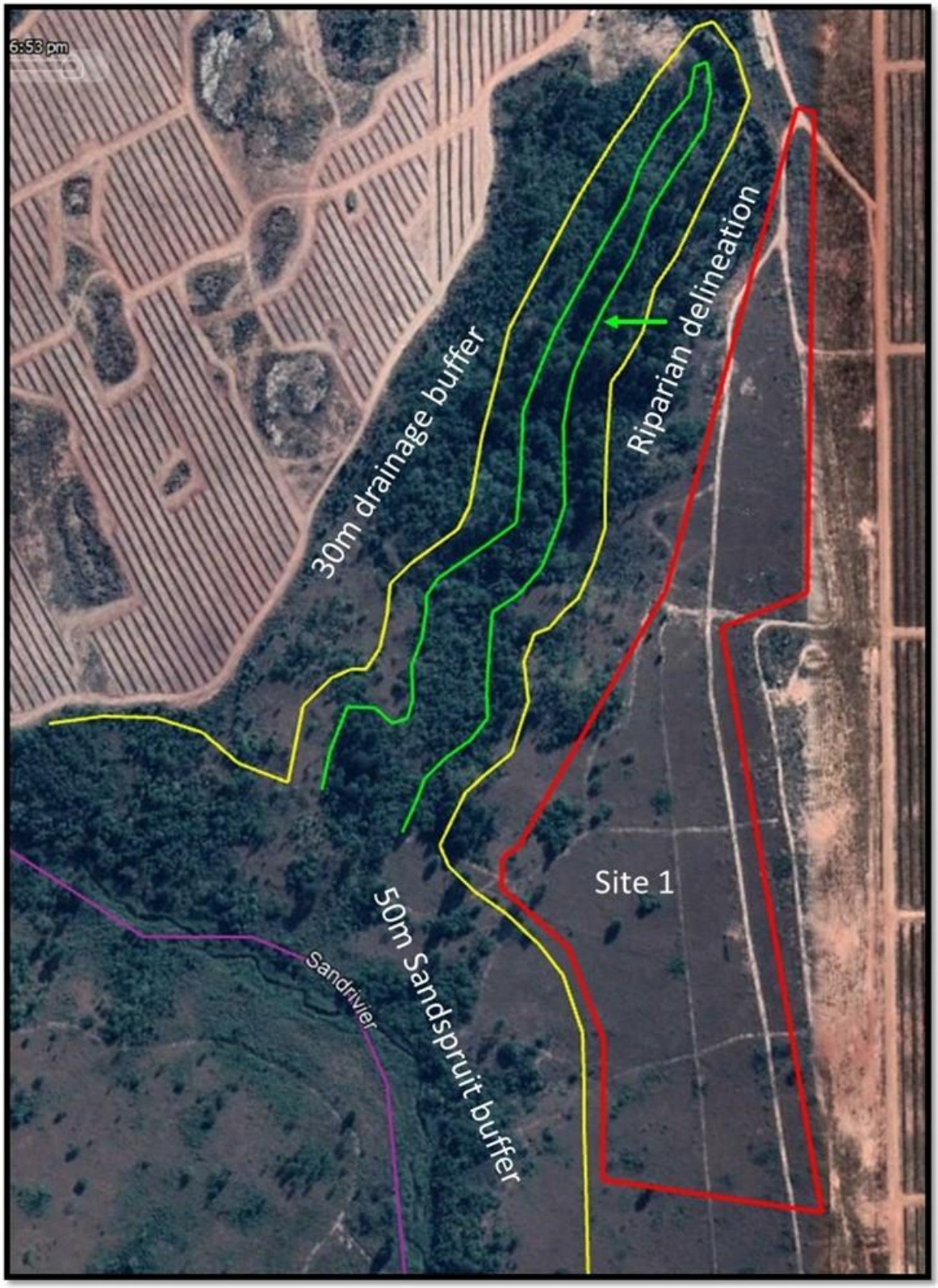


Figure 54: The Sandspruit is protected by a 50m buffer, while the drainage line is protected by a 30m buffer.

Figure 55: The Rocky outcrop adjacent to Site 2 is buffered by a 30m ecological buffer (light green delineation).

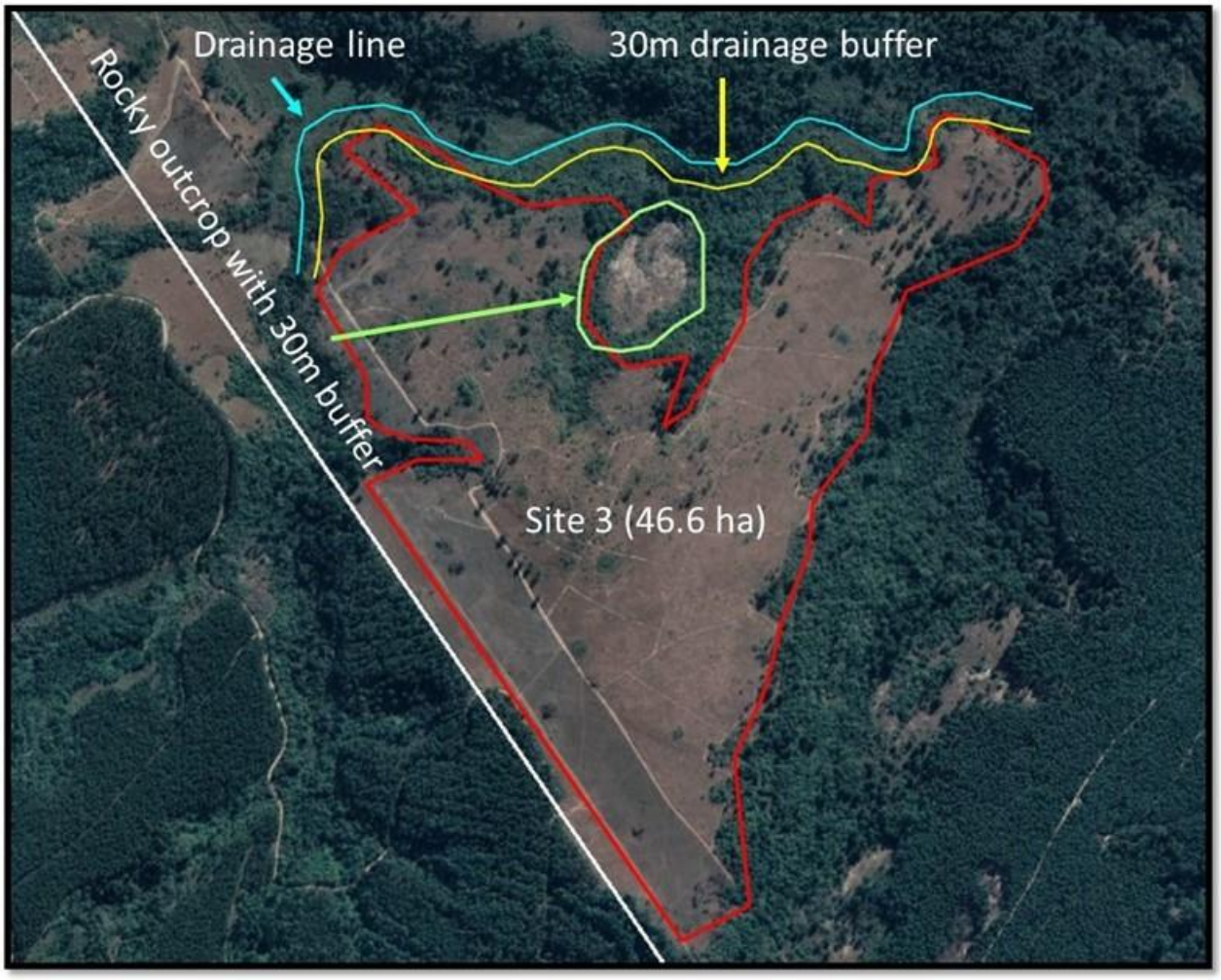


Figure 56: A prominent drainage to the north of the site is protected by a 30m on the southern bank (yellow line), while a rocky outcrop adjacent to site is also buffered by a 30m ecological buffer (light green delineation).

5.5 Land-use planning and Decision-making

The team must first establish how important the site is for meeting biodiversity targets. To do this, it is necessary to answer the following three simple but fundamentally important questions:

- How important is the site for meeting biodiversity objectives (e.g., is it in a CBA or Ecological Support Area (ESA)?
- Is the proposed land-use consistent with these objectives or not (to be checked against the land-use guidelines)?
- Does the sensitivity of this area trigger the MTPA requirements for assessing and mitigating environmental impacts of developments, or in terms of the listed activities in the EIA regulations?

The key results of the Biodiversity Geographic Information System (BGIS) maps and LUDS Report are summarised in Table 47.

Table 47: The key results of the LUDS Report as extracted for the Krokodilspruit project area from national datasets available from BGIS.

National Data Set	Aspect	Present
National terrestrial information: Portion 248 JT of the farm Krokodilspruit in the White River area, Mpumalanga.		
South African District	Ehlanzeni	
South African municipal boundaries	Municipality name: Thaba Chweu/ mbombela	MP321
Quarter-degree grid square		2530BD
Terrestrial CBAs		
Bioregion	**National vegetation map**	**Status**
Savanna Biome (Lowveld)	**SVI 9** Legogote Sour Bushveld	**Threatened ecosystem status:** Endangered
Grassland Biome (Mesic Highveld Grassland)	**Gm 23** Northern Escarpment Quartzite Sourveld	**Threatened ecosystem status:** Vulnerable
Aquatic Critical Biodiversity Areas		
Water Management Area (WMA)	Inkomati WMA	
Sub Water Management Area	Crocodile Catchment	
Ecological Support Areas	Top 50% of strategic water resource area; Important sub-catchments	ESA: Strategic water source areas (Figure 59)
Ecoregion 1	North-Eastern Highlands and Lowveld	Farm straddles 2 ecoregions (Figure 13)
Ecoregion 2	4.04 and 3.07	Farm straddles 2 ecoregions
Ecological Support Areas	Fish support areas	South-eastern corner of farm (Figure 58)
River unit (NFEPA)	Sandspruit (X22F-00886)	3_P_L
PES	C	Moderately modified
Mean Ecological Importance	High	
Mean Ecological Sensitivity	Very high	

Maintaining biodiversity patterns and ecological processes and the ecosystem services derived from these, requires integrated management over large areas of land. The landscape approach to conservation is a system wide one where protected areas are embedded in a matrix of land-uses that strive for biodiversity compatibility. Herein, biodiversity management objectives are integrated into the plans, decisions and practices of a wide range of land users. These land-use guidelines are designed to help achieve this (Lötter et al, 2014 / MTPA, 2014).

Different categories of CBA have specific management objectives, according to their biodiversity priority (Table 48). In broad terms, the biodiversity priority areas need to be maintained in a healthy and functioning condition, whilst those that are less important for biodiversity can be used for a variety of other land-use types (Lötter et al, 2014).

Table 48: The different categories on the CBA maps have specific management objectives, according to their biodiversity priority.

Map Category	Definition	Desired management objectives
Protected Areas	Those areas that are proclaimed as protected areas under national or provincial legislation, including gazetted Protected Environments.	Areas that are meeting biodiversity targets and therefore must be kept in a natural state, with a management plan focused on maintaining or improving the state of biodiversity.
Critical Biodiversity Areas (CBAs)	Areas that are required to meet biodiversity targets, for species, ecosystems or ecological processes.	Must be kept in a natural state, with no further loss of habitat. Only low-impact, biodiversity-sensitive land-uses are appropriate.
Ecological Support Areas (ESAs)	Areas that are not essential from meeting biodiversity targets, but that play an important role in supporting the functioning of protected areas or CBAs and for delivering ecosystem services.	Maintain in a functional, near-natural state, but some habitat loss is acceptable. A greater range of land-uses over wider areas is appropriate, subject to an authorisation process that ensures the underlying biodiversity objectives are not compromised.
Other Natural Areas (ONAs)	Areas that have not been identified as a priority in the current systematic biodiversity plan but retain most of their natural character and perform a range of biodiversity and ecological infrastructural functions. Although they have not been prioritised for biodiversity, they are still an important part of the natural ecosystem.	An overall management objective should be to minimise habitat and species loss and ensure ecosystem functionality through strategic landscape planning. These areas offer the greatest flexibility in terms of management objectives and permissible land-uses, but some authorisation may still be required for high-impact land-uses.
Heavily or Moderately Modified Areas	Areas that have been modified by human activity to the extent that they are no longer natural, and do not contribute to biodiversity targets. These areas may still provide limited biodiversity and ecological infrastructural functions, even if they are never prioritised for conservation action.	Such areas offer the most flexibility regarding potential land-uses, but these should be managed in a biodiversity-sensitive manner, aiming to maximise ecological functionality and authorisation is still required for high-impact land-uses. Moderately modified areas (old lands) should be stabilised and restored where possible, especially for soil carbon and water-related functionality.

Figure 57 illustrates the Critical Biodiversity Areas superimposed onto the Krokodilspruit farm plan with certain buffered areas included. Following is a summary of the status that these CBAs will have in the project area:

- **CBA optimal:** All the CBA areas are incorporated either in the buffered Eastern Dry Afrotemperate Forest, the Nature Reserve or the buffered drainage lines and no development will take place in these areas.
- **Other natural areas (ONAs):** All three of the proposed areas (approximately 71.0 ha) for this EIA will be situated in ONAs.
- **Moderately modified (Old lands):** A portion of Site 1 will be situated on an old land (approximately 1.51 ha).

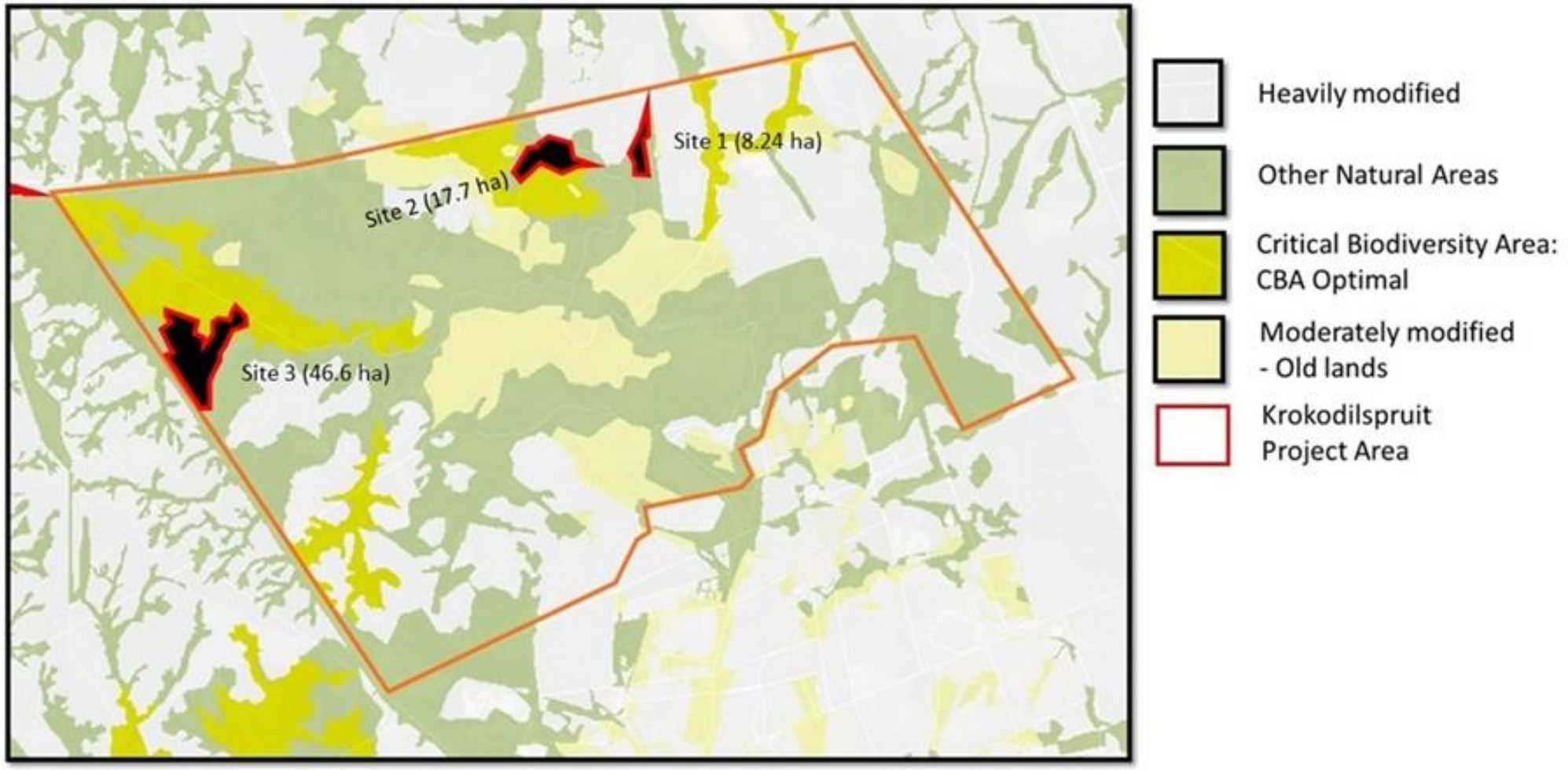


Figure 57: The Terrestrial CBAs (LUDS: BGIS, 2015) in the study area and the proposed project sites in black polygons.

It is thus concluded that the delineated “CBA optimal” will be protected in either the Nature Reserve, or in buffered areas where no development will be allowed.

During the Krokodilspruit 2018 EIA study (Deacon, 2018), the following information was obtained:
Habitat components to be impacted by the clearing of land for the orchards.

Total area cleared for agriculture: 1589 ha
Transformed habitat: 1245 ha (78% of cleared)
Untransformed habitat: 344 ha (22% of cleared)

The Nature Reserve including all the buffers zones as well as areas of no development, large areas which includes the CBAs and Other Natural Areas (ONAs) were not earmarked to be developed for the 2018 project.

Table 49: The protection of untransformed land types in the project area (2018).

	Total cover of land type	**Protected in the Reserve or by buffer zones**	**To be impacted by the project**	**% in project area protected**
1. Untransformed Grassland	737.4 ha	475 ha	258 ha	64%
2. Untransformed Woodland	303.9 ha	83 ha	86 ha	27%
3. Perennial rivers	224 ha	224 ha	0 ha	100%
4. Drainage lines	251 ha	251 ha	0 ha	94%
5. Forests	717 ha	717 ha	0 ha	100%
6. Floodplain wetland	80 ha	80 ha	0 ha	100%
7. Rocky outcrops	64.8 ha	64.8 ha	0 ha	100%

With the added project sites to be cleared, some of the sizes of these areas have changed (Figure 57).

Although the perennial rivers and associated riparian zones and buffers (224 ha), Eastern Dry Afrotemperate Forest and associated drainage lines (717 ha), floodplain wetland and buffer (80 ha), and the 64 ha of the buffered Rocky outcrops remains intact, the total area of Untransformed Grassland has changed.

Should the application to clear the additional 72.5 ha of land be granted, 70.9 ha of Untransformed North-eastern Mountain Grassland and 1.51 ha of secondary grassland will be affected. The 475 ha of Untransformed Grassland protected in 2018 will be reduced to 404 ha. However, more than 50 ha of grassland have been allocated to the *Aloe simii* buffers and thus the grassland in these protected patches will also be secured, resulting in approximately 458 ha of Untransformed Grassland to be secured for protection.

Finally, the original 64% of Untransformed Grassland which was protected on the farm, has been reduced to 62% of Untransformed North-eastern Mountain Grassland. Considering the 2% reduction in protected grassland, against the permanent protection of over 50 ha for all the *Aloe simii* populations on the Krokodilspruit farm, is commendable.

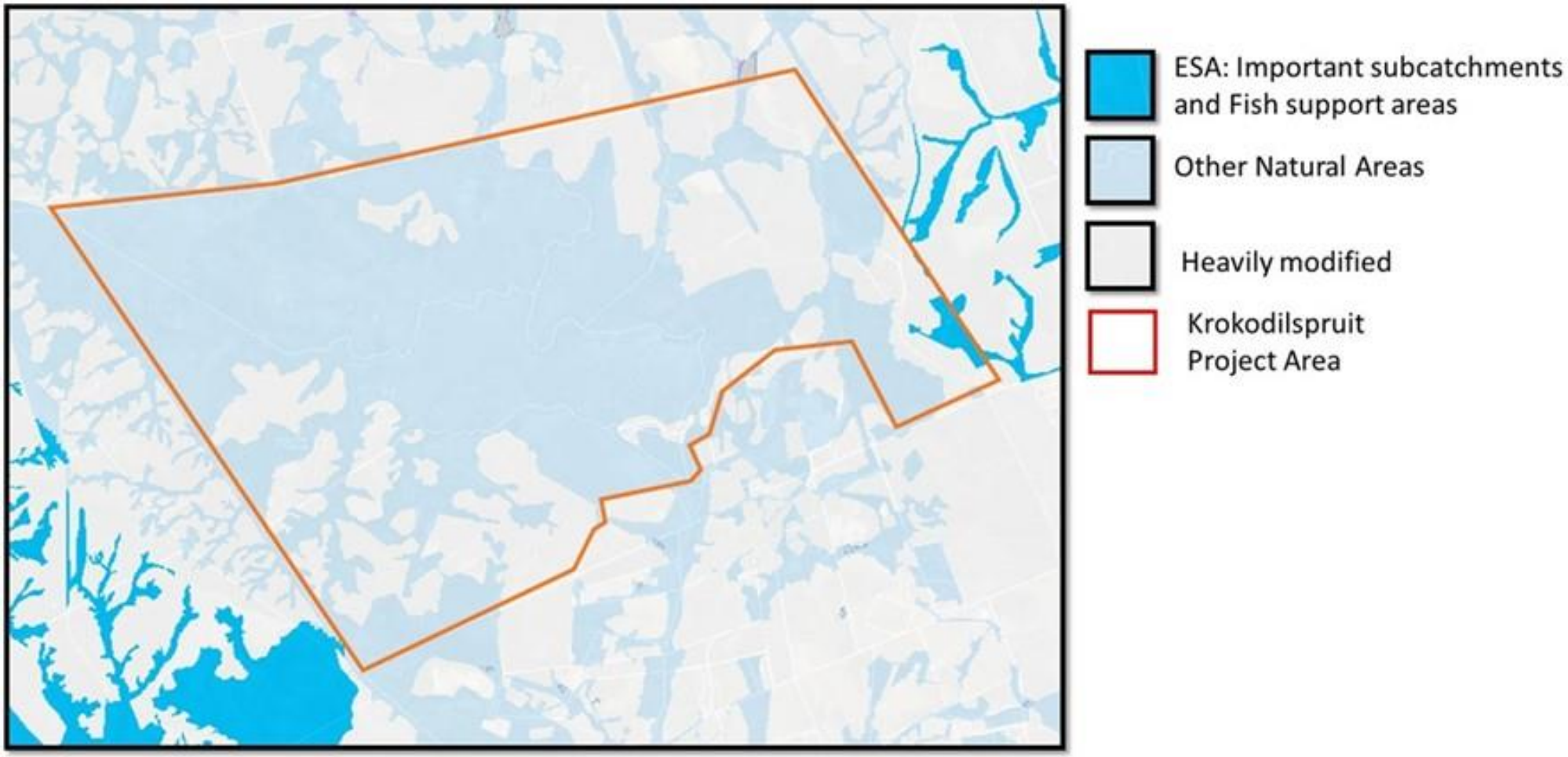


Figure 58: Freshwater CBAs and ESAs (LUDS: BGIS, 2015) and the positioning of the Krokodilspruit Farm.

Freshwater CBAs and ESAs

Figure 58 illustrates the Freshwater CBAs and ESAs (LUDS: BGIS, 2015) and the positioning of the Krokodilspruit Farm, which shows that the area covered by forestry and current cultivation are classified as “Heavily Modified”, while the rest of the farm is mostly classified as “Other Natural Areas”.

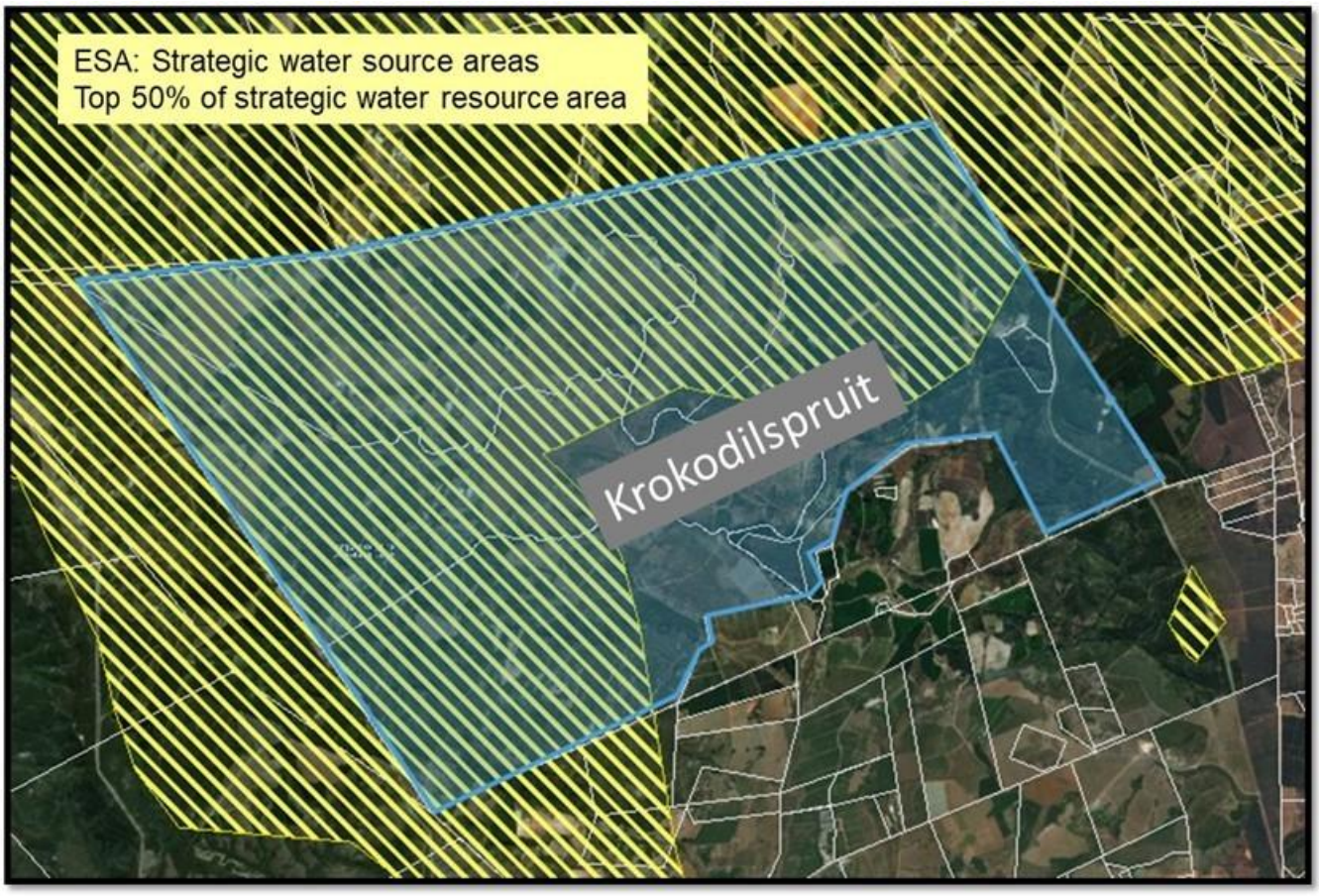


Figure 59: Overlap of the Strategic Water Resource Areas with the Krokodilspruit Farm (LUDS: BGIS, 2015).

A major portion of the Krokodilspruit Farm is identified as part of a Strategic Water Resource Area (Figure 59). Water source areas are those areas that supply a disproportionate amount of mean annual runoff to a geographical region of interest. Strategic water source areas can be regarded as natural "water factories", supporting growth and development needs that are often far away.

Deterioration of water quality and quantity in these areas can have a disproportionately large negative effect on the functioning of downstream ecosystems and the overall sustainability of growth and development in the regions they support. Appropriate management of these areas, which often occupy only a small fraction of the land surface area, can greatly support downstream sustainability of water quality and quantity.

5.6 Corridors for Connectivity

Landscape connectivity may be achieved through several main types of habitat configurations that function as linkages for species, communities or ecological processes. Linkages are used as pathways by animals undertaking a range of movements, including daily or regular movements, seasonal and migratory movements, dispersal movements, and range expansion. Linkages also contribute to other ecological functions in the landscape and, in particular, have an important role to play in providing habitat for plants and animals in human-dominated environments (Bennett, 2003).

Figure 60 illustrates a network of corridors provided by the proposed buffers on the Krokodilspruit Farm:

- Buffers around rivers;
- Buffers around drainage lines;
- Buffers around wetlands;
- Buffers around inselbergs;
- Forests serve as buffers around valley drainage lines.

These corridors buffer all the CBA areas and connect most of the farm with the proposed Nature Reserve. These buffers protect all of the Sandspruit, Afrotemperate Forests, Floodplain wetlands and Rocky outcrops. All the areas covered by this continuous network made up 2 593 ha of untransformed habitat.

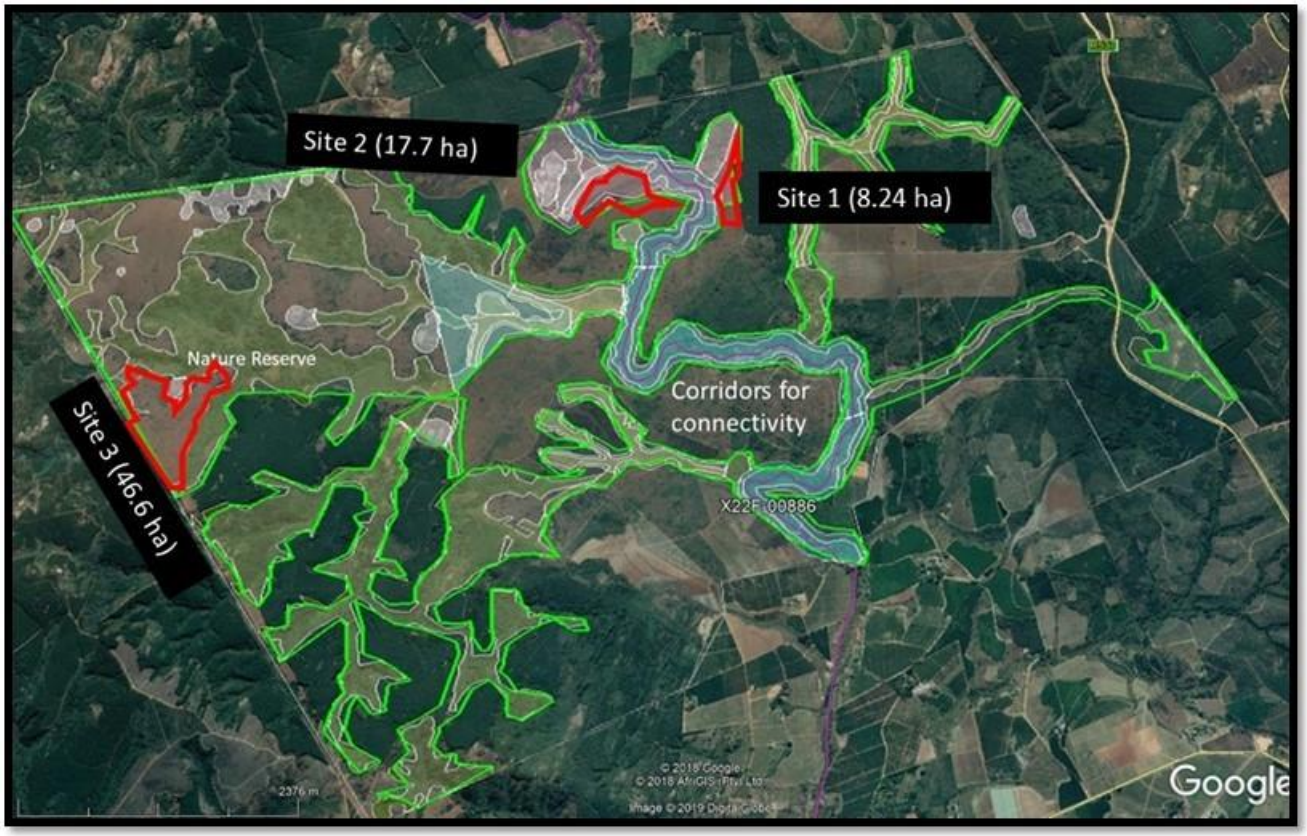


Figure 60: Corridors created by areas of no development, buffers around special habitats and the Nature Reserve, form an ideal network for connectivity (network defined by the green lines). The new areas intended for development (Sites 1 to 3) are indicated as proposed (red polygons).

This network will provide viable corridors and dwellings for animals. The protected network, which includes the Nature Reserve will be a sanctuary for both animals and plants, which includes a number of Red listed and protected species.

When the current areas of proposed development are overlaid on this corridor layout, it reveals that all three of the sites are included in these corridors of connectivity. Sites 1 and 2 are placed in areas not intended for clearing during the previous proposal, however now the developers would like to add the two sites to be developed. Although the combined 25.9 ha of intact corridor will be removed from the network, the areas were originally not included because of their ecological functions, but merely because it was deemed unnecessary at the time of planning.

The entire Site 3 is located inside the Nature Reserve. The 46.6 ha is grassveld, bordered by the edges of Afrotemperate Forests. No development was planned to take place in the Nature Reserve, but due to the buffer zones being added to the protected *Aloe simii* populations (Figure 61), resulting in a loss of approved agricultural land, 46.6 ha of the reserve will now replace the area lost to the ecological buffers. A discussion related to the buffering of the *Aloe simii* clusters follows.

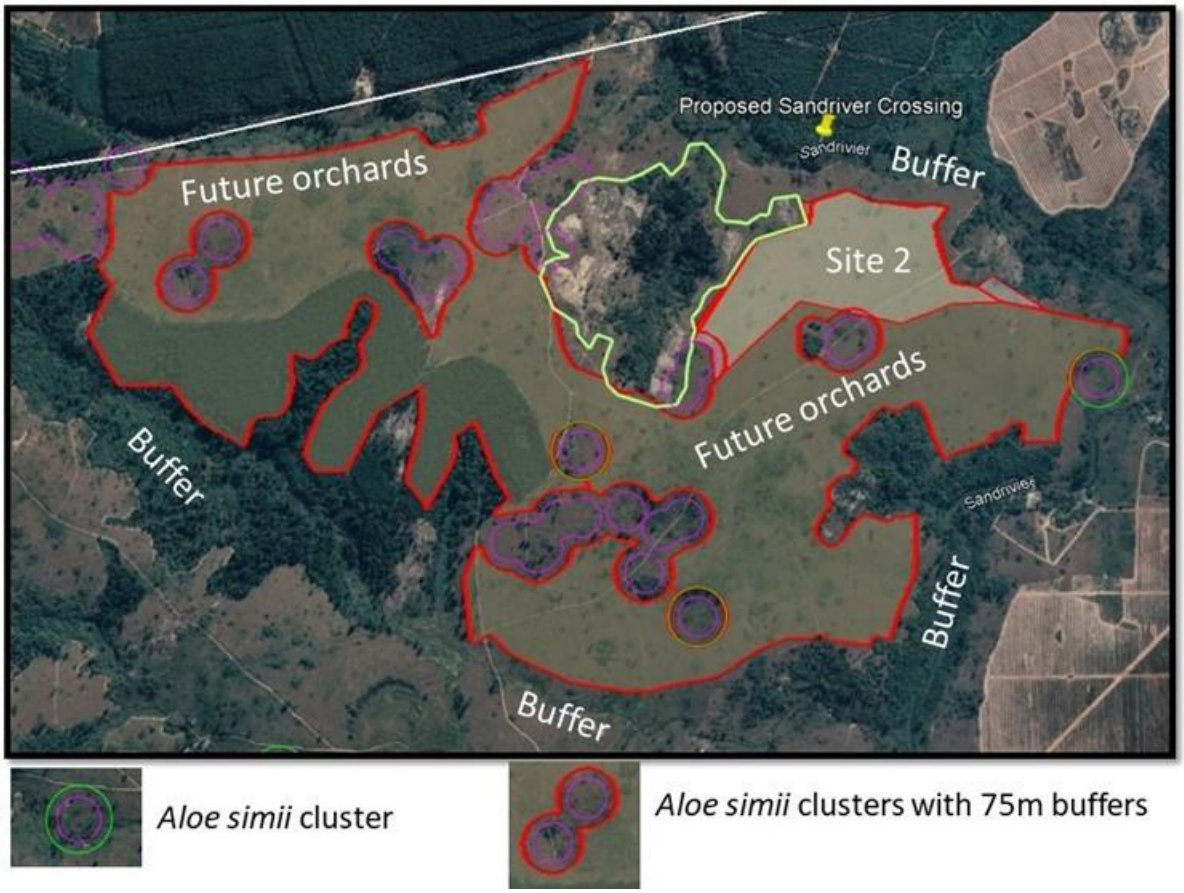


Figure 61: The *Aloe* colonies have been buffered and provided with corridors or incorporated into existing buffers, and five major colonies have been identified and buffered:

In order to protect the *Aloe* colonies, each individual *Aloe simii* plant (sometimes a number of plants grouped close together as a cluster) has been allocated a 75m buffer around it (information of localities and buffer options received from Willem van Staden and Mervyn Lotter, MTPA). Although the buffer option of 75m may not be considered as an optimal buffer, the clumping of these buffered colonies and incorporation into an existing protected corridor, will provide them with a larger combined buffer. These merged buffers provide

corridors which will afford pollinators protected access between the colonies and then ultimately link them to the larger conservation area to the north-west of the farm.

5.7 Assessment of impacts

The potential impacts of the project on the biodiversity of the study area are assessed under seven broad impacts, namely:

- Impact 1: River Crossings.
- Impact 2: Clearing of approximately 72 ha of transformed and untransformed land types.
- Impact 3: Erosion and siltation.
- Impact 4: Habitat fragmentation.
- Impact 5: Disturbance to Fauna.
- Impact 6: Human interference impacting on biota.
- Impact 7: Linear structures: Impacts of roads and pipelines.
- Impact 8: Alien invasive vegetation.
- Impact 9: Loss of Red listed and protected fauna/flora species.
- Impact 10: Impact of clearing activities on birds.

To evaluate Impact 1 with regards to the proposed River Crossings, it is required that a Risk Assessment is undertaken in accordance with the Risk Matrix (Based on DWS 2015 publication: Section 21 (c) and (I) water use Risk Assessment Protocol and as listed as Appendix A in GN509 of 26 August 2016).

Risk Matrix Assessment for watercourses

Results from the Risk assessment protocol with associated matrix for expected project-related impacts, are provided in Table 50. The assessment refers to:

(c) Impeding or diverting the flow of water in a watercourse
(i) Altering the bed, banks, course or characteristics of a watercourse

The DWS developed risk assessment protocol to assess impacts related to Section 21 (c) and (i) activities is encompassing and flexible enough that it can be used to assess the full range of potential project-related impacts that can affect identified wetlands. It is therefore also used as an impact assessment method that can be applied to the EIA phase. Values and categories provided in the impact risk assessment table (Table 50), refers solely to the ‘with mitigation’ scenario, meaning that it assumes all of the recommended mitigation measures, including impact avoidance recommendations, which will be implemented.

It is important to note that the impact assessment as provided in Table 50 will change in the event that the recommended impact avoidance measures related to changes in the current infrastructure layout design, as described in Section 6.1, cannot be implemented for whatever reason. Changes to the proposed infrastructure footprints or the inability to implement other recommended mitigation measures will therefore require a re-evaluation of assessed impacts and can result in a change in impact rating categories.

Following is an abstract from the completed Risk Matrix (Table 50) to indicate the significance of the project activities on the Krokodilspruit Project Area:

Table 50: An abstract from the Risk Assessment Matrix for the Krokodilspruit Project with reference to all probable expected impacts relating to the **river crossing**, the significance of these impacts (rated after mitigation is considered) including mitigation using control measures.

Phases	Activity	Aspect	Potential Impact	Risk Rating	Control Measures
	Construction of the river crossing	Clearing of construction area	Potential of Erosion and silting up of the site and downstream areas.	**(L) Low Risk**	Erosion control should be implemented in the bank cuttings towards the crossing. During construction, the Contractor shall protect all areas susceptible to erosion by installing necessary temporary and permanent drainage works as soon as possible and by taking any other measures necessary to prevent storm water from concentrating in streams and scouring slopes, banks, etc. The use of silt fences, turbidity barriers, sedimentation ponds, cofferdams and the timely mulching and seeding or sodding of roadway slopes and other exposed areas will reduce runoff and siltation for all of the build alternatives.
		Timing of work	Impacting on ephemeral flow events and influencing breeding birds and fish - implementing the project during the low-flow period will improve this issue.	**(L) Low Risk**	Work should be undertaken during the dry winter months when there is low flow in these systems; thus, low impact on flow of water or any biota utilising the system.
		Working/storage distances from watercourse	Ecological disturbance (impact on soil surface) and pollution (proximity to stream)	**(L) Low Risk**	A small working area will be confined to the terrestrial area above the macro-channel bank and must be rehabilitated completely after construction. Storage will be at the main center of the farm, away from the rivers.
		Isolation of works area; material stockpiles	Ecological disturbance (cover natural areas) and pollution	**(L) Low Risk**	Material stockpiles will be stored at the main center of the farm maintenance area.
		Site compounds/parking areas	Ecological disturbance (impact on soil surface) and pollution	**(L) Low Risk**	Site compounds/parking areas will be at the main center of the farm maintenance area.

		Fuel and chemical storage/refueling areas	Ecological disturbance and pollution (degradation of groundwater resource)	**(L) Low Risk**	Fuel and chemical storage/refueling areas will be at the main centre of the farm maintenance area.
Construction		Site clearance; clearing of vegetation through the flood bench down to the bridge	Degradation/Loss of riparian habitat and biota. Direct disturbance of the banks and bed of rivers; impacting indigenous vegetation.	**(L) Low Risk**	Clearing of natural vegetation shall be kept to a minimum. The removal, damage and disturbance of natural vegetation without the written approval of the ECO are prohibited. Removal of any vegetation should be mitigated by replanting the original species where possible. The Contractor shall be responsible for informing all employees about the need to prevent any harmful effects on natural vegetation on or around the construction site as a result of their activities.
		Creating access roads	Erosion and vegetation clearing	**(L) Low Risk**	Farm roads already exist. The bridge site is directly aligned with current roads and very little vegetation clearing will be necessary for the road connection.
		De-watering of excavations	Water level reduction and contamination. Local erosion; impact on subsurface flows; impact on downstream habitats.	**(L) Low Risk**	The Contractor shall not work within river flood lines, watercourses and wetlands without written approval from the ECO as required for the execution of the work. Actual in-river construction for any bridge structure would stir up bottom sediment. Re-suspension of the sediments would increase turbidity, release nutrients, and increase the oxygen demand on the river. This type of sedimentation is difficult to control and is an unavoidable impact of bridge construction. However, minimising the use of in-river construction techniques and through the use of cofferdams, silt screens, and turbidity barriers will reduce sedimentation.
		Temporary cofferdams	Natural flow of water affected. Local erosion; impact on subsurface flows; impact on downstream habitat; pollution.	**(L) Low Risk**	The use of coffer dams should be avoided, where practical, and if necessary, should only be considered in consultation with a riverine specialist. During construction, flow-diversion is necessary to ensure the delivery of flows to the downstream channel. If a cofferdam is required, and this is constructed from sandbags, the entire structure must be covered with bidum or a suitable geo-textile to prevent breakage of bags in the event of unanticipated high runoff events. The cofferdam can serve to trap any sediments which may wash towards the downstream

					channel. Any such sediments must be physically removed with earth moving equipment from the channel before the cofferdam is removed.
		Run-off from exposed ground and material stockpile	Ecological disturbance (impact on soil surface) and pollution (proximity to stream)	**(L) Low Risk**	A small working area will be confined to the terrestrial area above the macro-channel bank and will be rehabilitated completely after construction.
		Potential sources of pollution; run-off of contaminated water from vehicle activity during construction (Fuels and oils).	Ecological disturbance and pollution (degradation of the subsurface water resource)	**(L) Low Risk**	The construction will be concentrated in a small area for a relative short period.
		Spreading invasive non-native plants	Competing with indigenous plant species.	**(L) Low Risk**	Should alien plants be observed, these will be removed by the management of the farm.
		Disruption to the free passage of fish and aquatic animals.	Preventing the free passage of aquatic animals and fish.	**(L) Low Risk**	The pipes underneath the bridge must be large enough to let free flow through and the bottom circumference should be covered by the water level without a fall of more than 15 cm on the downstream side. Debris obstructing free flow should be actively removed.
Operation	Usage of a river crossing	Run-off from roads to the river crossing	Erosion, sedimentation and siltation in the river.	**(L) Low Risk**	Cut-off drains. Prevent road run-off from entering the watercourse.
		Risk of erosion; bank or bed erosion.	Alterations to local flow patterns cause induced or accelerated bed and bank erosion, or sediment deposition or increased flood risk. Risks of bank erosion during high flow events and rainfall run-off	**(L) Low Risk**	The project area is small and will be used regularly. The erosion probability is moderate but contained in a small area. Any erosion detected will be rehabilitated as the maintenance of the crossing is important to the applicant.

			causing silt/sediment pollution.		
		Scouring downstream of the causeway.	Eroding the bridge structure.	**(L) Low Risk**	The integrity of the construction will be important to the applicant and any damage to the structure will be repaired as soon possible.
		Debris and sediment accumulation at the upstream end.	Impacting on the aquatic habitat.	**(L) Low Risk**	Debris obstructing free flow should be actively removed.
		Potential flood risks	Alterations to local flow patterns cause induced or accelerated bed and bank erosion, or sediment deposition or increased flood risk.	**(L) Low Risk**	The pipes underneath the bridges should be wide enough to prevent a damming effect and let medium floods through.
		Causeway restricting flows	Damming and flooding upstream; impact on normal hydraulic regime.	**(L) Low Risk**	The pipes underneath the bridges should be wide enough (1800mm) not to create a damming effect and let even medium floods through. Debris obstructing free flow should be actively removed.
		Maintenance and repair of existing access roads.	Ecological disturbance (impact on soil surface) and pollution (proximity to stream)	**(L) Low Risk**	The integrity of the low-level crossing will be important to the applicant and any damage to the roads will be repaired as soon possible.

The impact assessment of all the other perceived impacts provided below, describes each broad impact, determines the significance of the impact and lists summarised mitigation and monitoring measures for each impact.

Impact 1: River Crossings

Applicable Phase: Construction phase
Applicable activity: Construction of a river crossing.

Nature of impact: This impact refers to the activities around the construction of the river crossing.

A low-level river crossing is envisaged to accommodate equipment and vehicles during harvesting- and general farming operations. The structure will be a basic, low level concrete crossing with concrete pipes or culverts.

Table 51: River crossing**:** Criteria used to determine the consequence of the impact.

ISSUE:	**River crossings**	
Project Phase	**Construction**	**Operation**
Nature	Negative	Negative
Extent	Site (1)	Site (1)
Intensity	Medium (2)	Low (1)
Duration	Short-term (1)	Long-term (3)
Consequence	Very low (4)	Very low (4)
Project Phase	Construction	Operation
Probability	Possible	Possible
Degree to which impact cannot be reversed	Low	Low
Degree to which Impact may cause irreplaceable loss of resources	Low	Low
Confidence level	High	High
Significance Pre- Mitigation	Medium (-ve)	Low (-ve)
Significance Post Mitigation	Low (-ve)	Low (-ve)
Degree of Mitigation	High	Medium
Preferred Alternative		

- **Significance Post Mitigation: LOW -** the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact 2: Clearing of approximately 72 ha of transformed and untransformed land types.

Applicable Phase: Clearing phase
Applicable activity: Clearing of transformed and untransformed habitat for orchards.

Nature of impact: This impact refers to the loss of transformed and untransformed habitat assemblages. The clearing of vegetation within the agricultural footprint will result in the permanent removal of potentially 70.9 ha of Untransformed North-eastern Mountain Grassland and 1.51 ha of secondary grassland. The proposed clearing of these biotopes was mapped on areas identified in the Mpumalanga Biodiversity Sector Plan and none are impacting on any CBA or ESA features.

The clearance of vegetation for orchard establishment and associated infrastructure will result in the direct loss of vegetation and indirect loss of habitat that will decrease the viability of biota by reducing the size of populations that can be supported on the project site.

Mitigation of Impact 2:

Mitigation Description: Avoid environmentally sensitive areas identified on the Sensitivity Mapping exercise and maintain a high regard for all the buffers introduced to protect these areas.

More than 50 ha of grassland have been allocated to the *Aloe simii* buffers and thus the grassland in these protected patches will also be secured, resulting in approximately 458 ha of Untransformed Grassland to be secured for protection.

Before clearing, demarcate the extent of the orchards footprint and ensure that clearing impacts are contained within this area and do not affect areas of natural habitat. Limit the removal of vegetation to the development footprint only.

Table 52: Clearing of land: Criteria used to determine the consequence of the impact.

ISSUE:	**Clearing of land**
Project Phase	**Clearing and Operation**
Nature	Negative
Extent	Site (1)
Intensity	High (3)
Duration	Long term (2)
Consequence	Medium (6)
Probability	Definite
Degree to which impact cannot be reversed	High
Degree to which Impact may cause irreplaceable loss of resources	Medium
Confidence level	High
Significance Pre- Mitigation	**Medium (-ve)**
Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	Medium
Preferred Alternative	The exchange of grassland for *Aloe simii* protected areas.

- **Significance Post Mitigation: LOW -** the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact 3: Erosion and siltation.

Applicable Phase: Clearing and operational phases
Applicable activity: Clearing vegetation for orchards and linear structures.

Nature of impact: Erosion of cleared areas and siltation of water courses.

During both site preparation and clearing of fields for the orchards, as well as the construction of access roads and trenching for pipelines, soil erosion may increase and result in sediment input into the river. This will result in elevated instream turbidity levels and changes in instream habitat conditions.

These activities could also result in infilling of the river channel and transport and deposition of sediment downstream. Inadequate storm water erosion-control in the newly established fields and along linear structures could result in sediment-laden water entering the adjacent watercourses. Furthermore, both vegetation clearing (exposed soil surfaces) and compacted surfaces (access roads) may alter the hydrological nature of the area by increasing the surface run-off velocities, while reducing the potential for any run-off to infiltrate into the soils,

which escalates the potential for erosion and sedimentation to occur. Recharge of groundwater and surface run-off patterns may also be altered.

Mitigation of Impact 3:

Clearing and development should take place during the driest time of the year, however storm events can happen at any time. Clearing time should be kept as short as possible and planting or rehabilitation of cleared or excavated areas should commence as soon as the development activity is completed.

Management actions should be implemented, i.e., the re-establishment of indigenous vegetation wherever possible, control of storm water run-off and ongoing repair and stabilisation of any erosion. Where steeper slopes are cleared of vegetation, stop-boards should be erected at the commencement of clearing to prevent wash-off down-slope.

Strict measures must be taken to prevent erosion and sediment-laden water from entering the adjacent watercourses. Storm water management measures are to be included in roadways especially at water course crossings. The vegetated riparian buffer zone should remain intact along all watercourses to facilitate the containment of sediment-laden run-off from orchards.

Sediment basins (including debris basins, desilting basins, or silt traps) shall be installed at the project site in conjunction with the initial grading operations and maintained through the development process to remove sediment from runoff waters.

Sediment traps are considered temporary structures and often placed at the site on an “as needed” basis by field personnel. Construct traps of rock (mixed with smaller stone), rock-filled fibre bags, or use approved commercial sediment trap products installed and spaced according to manufacturer’s instructions. Silt fences and straw bales are used to form silt traps and dykes to keep sediment from washing downstream during excavation and other activities that disturb soil at crossings and that could lead to temporary sediment flushing.

Table 53: Erosion and siltation: Criteria used to determine the consequence of the impact.

ISSUE:	**Erosion and siltation**	
Project Phase	**Clearing and Operation**	
Nature	Negative	
Extent	Local (2)	
Intensity	Medium (2)	
Duration	Medium-term (2)	
Consequence	Medium (6)	
Probability	Possible	
Degree to which impact cannot be reversed	Medium	
Degree to which Impact may cause irreplaceable loss of resources	Medium	
Confidence level	Medium	
Significance Pre- Mitigation	Medium (-ve)	
Significance Post Mitigation	Low (-ve)	
Degree of Mitigation	Medium	
Preferred Alternative		

- **Significance Post Mitigation: LOW -** the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact 4: Habitat fragmentation.

Applicable Phase: Clearing and operational phases
Applicable activity: The clearance of vegetation will cause habitat fragmentation.

Nature of impact: Fragmentation will interfere with migration corridors and linking biotopes.

The clearance of vegetation will cause habitat fragmentation. Fragmentation is a process whereby large tracts of the natural landscape are gradually developed and subdivided until only patches of original habitat remain. Habitat fragmentation is a less obvious consequence of development, reducing both the quantity and quality of habitat.

Fragmented habitat will create isolated subpopulations of animals, disrupt individual behaviour, prevent gene flow between populations, prevent species interaction and inhibit ecological processes. The patches are often too small and too far apart to support the basic survival and reproductive needs of many wildlife species during various stages of their life cycle or in different times of the year. When a species' habitat is separated by distances that make movement from one patch to another impossible, the impacts on the genetic health of the population are significant and reduce a species ability to reproduce and withstand stress.

Mitigation of Impact 4:

A network of corridors is provided by buffers on the Krokodilspruit Farm:
- Buffers around rivers;
- Buffers around drainage lines;
- Buffers around wetlands;
- Buffers around inselbergs;
- Buffers around *Aloe simii* populations,
- Forests utilised as buffers around valley drainage lines.

These corridors buffer all the CBA areas and connect most of the farm with the proposed Nature Reserve and other no-go areas. These buffers protect the Sandspruit River, Afrotemperate Forests, Floodplain wetlands, *Aloe simii* populations and Rocky outcrops.

This network will provide viable corridors and dwellings for animals undertaking a range of movements, including daily or regular movements, seasonal and migratory movements, dispersal movements, and range expansion. The network, which includes the Nature Reserve, will be a sanctuary for both animals and plants, which includes a number of Red listed and protected species.
In the process of demarcating the agricultural land, larger areas were clumped together to refrain from creating unconnected spaces.

Table 54: Habitat fragmentation: Criteria used to determine the consequence of the impact.

ISSUE:	**Habitat fragmentation**
Project Phase	**Clearing**
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Long-term (3)
Consequence	Medium (6)
Project Phase	Clearing
Probability	Probable
Degree to which impact cannot be reversed	Medium

Degree to which Impact may cause irreplaceable loss of resources	Medium
Confidence level	High
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	High
Preferred Alternative	

- **Significance Post Mitigation: LOW -** the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact 5: Disturbance to Fauna

Applicable Phase: Clearing phase
Applicable activity: Clearing activities may lead to the disturbance of fauna.

Nature of impact: This impact refers to the human-related disturbances of fauna that reside on the site.

Clearing activities may lead to disturbance of fauna that reside on the site. Increased levels of noise, pollution, disturbance, and human presence during the clearing phase, will be detrimental to fauna. Retreating mammals would likely move away from the area, particularly during the clearing phase as a result of the noise and human activities present.

Mitigation of Impact 5:

The disturbance factor will be high during the bush clearing activities.

During the operational phase of the project, fewer people partake in the farming activities in the orchards and thus the visual disturbance and noise is lower. This also pertains to the movement and noise factor of farming vehicles and other implements.

During all phases it is important to establish no-go zones for both workers and their vehicles, especially in the Nature Reserve area. People presence and movement in the buffer areas will disturb animals, chances of interference (poaching and collecting) with both plants and animals, trampling of plants and pet dogs are all possible adverse influences that impacts on the local ecology.

Table 55: Disturbance to fauna**:** Criteria used to determine the consequence of the impact.

ISSUE:	**Disturbance to fauna**		
Project Phase	**Clearing**	**Operation**	
Nature	Negative	Negative	
Extent	Site (1)	Site (1)	
Intensity	Medium (2)	Low (1)	
Duration	Long-term (3)	Long-term (3)	
Consequence	Medium (6)	Low (5)	
Project Phase	Clearing	Operation	
Probability	Possible	Possible	
Degree to which impact cannot be reversed	High	Low	
Degree to which Impact may cause irreplaceable loss of resources	Medium	Low	
Confidence level	High	High	

Significance Pre-Mitigation	Medium (-ve)	Medium (-ve)	
Significance Post Mitigation	Low (-ve)	Low (-ve)	
Degree of Mitigation	Medium	Medium	
Preferred Alternative			

- **Significance Post Mitigation: LOW -** the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact 6: Human interference impacting on biota.

Applicable Phase: Clearing and operational phases
Applicable activity: People presence may lead to collecting, persecution, poaching and the presence of pets which will have an impact on local biota.

Nature of impact: Human interference and utilisation impacting on biota.

Disturbance or persecution of fauna during the clearing phase may occur. Poaching of animals (hunting with dogs, snares and trapping) – especially game birds (francolin and guinea fowl) and small mammals (steenbok and duiker).

Some mammals (hedgehogs, pangolin) and reptiles, such as tortoises would be vulnerable to illegal harvesting or poaching during the clearing phase. Indiscriminate persecution of snakes and other reptiles due to superstition and fear may occur.

Predation on wildlife by wandering pet dogs and cats. Domestic pets, particularly cats, may prey excessively on wildlife, such as ground-nesting birds. Pet dogs running free will eventually scare away all mammals (even nocturnal) that are able to survive by hiding in the dense woodland/outcrop habitats.

Other activities such as the unsustainable collecting of wood for fire (both dead logs and chopping down trees), sedges and thatching grass, rocks and boulders for building, clay from termite mounds for building, sand mining, etc., will impact on the diversity of viable aspects of habitat.

Mitigation of Impact 6:

The collection, hunting or harvesting of animals at the project site should be strictly forbidden. No animals should be intentionally killed or destroyed and poaching and hunting should not be permitted on the project site and adjacent areas.

There should be a stringent and dedicated control of collection, poaching, hunting or harvesting of animals. All personnel should be informed not to harm or collect species such as snakes and tortoises.

Faunal species encountered during construction activities should be removed by the ECO from the immediate site and relocated to an adjacent, suitable area.

Poaching could be a significant threat. If any external labour teams are used during soil preparation and planting, then these teams should preferably be accommodated off site; if this is not possible then teams should be carefully monitored to ensure that no unsupervised access to plant- and animal resources takes place. Site access to be controlled and no unauthorised persons should be allowed onto the site.

Any slow-moving fauna (particularly tortoises, hedgehogs, golden moles and subterranean species) disturbed during the clearing phase should be relocated to another site and not harmed in any way.

Check open trenches daily for trapped animals (e.g., bullfrogs, hedgehogs and reptiles), which should be caught and relocated according to the specifications of a relevant specialist. Limit construction impacts to the development footprints only. Ensure that unnecessary impacts on natural habitat do not occur, e.g., driving around in the grassland or wetland. Highlight all prohibited activities to workers using training workshops.

Table 56: Human interference impacting on biota**:** Criteria used to determine the consequence of the impact.

ISSUE:	**Human interference impacting on biota**	
Project Phase	**Clearing**	**Operation**
Nature	Negative	Negative
Extent	Site (1)	Site (1)
Intensity	Medium (2)	Low (1)
Duration	Long-term (3)	Long-term (3)
Consequence	Medium (6)	Low (5)
Project Phase	Clearing	Operation
Probability	Possible	Possible
Degree to which impact cannot be reversed	High	Low
Degree to which Impact may cause irreplaceable loss of resources	Medium	Low
Confidence level	High	High
Significance Pre- Mitigation	Medium (-ve)	Medium (-ve)
Significance Post Mitigation	Low (-ve)	Low (-ve)
Degree of Mitigation	Medium	Medium
Preferred Alternative		

- **Significance Post Mitigation: LOW -** the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact 7: Linear structures: Impacts of roads and pipelines

Applicable Phase: Clearing and operational phases
Applicable activity: Impacts created by the linear structures on the ecology of the farm.

Nature of impact: Clearing of areas along the linear structures results in erosion and siltation, being barriers and an increase in alien invasive vegetation.

During both site preparation and construction, particularly for construction of access roads and trenching for pipelines may increase soil erosion and result in sediment input into the river. This will result in elevated instream turbidity levels and changes in instream habitat conditions. These activities could also result in infilling of the river channel and transport and deposition of sediment downstream.

The potential increase in alien invasive plants will impact on habitat integrity.

Vehicle movement generating dust during operational activities will impact on sensitive habitats.

Mitigation of Impact 7:

Refrain from creating unnecessary new roads or tracks, make use of current routes as far as possible.

Management actions should be implemented such as the re-establishment of indigenous vegetation wherever possible, control of storm water run-off and ongoing repair and stabilisation of any erosion. Where steeper slopes are cleared of vegetation, stop-boards should be erected at the commencement of the clearing to prevent wash-off down-slope.

Refrain from incorporating continuous low solid barricades such as road curbs or steep-walled ditches that might act as barriers to smaller vertebrates moving or migrating through the area. Check open trenches daily for trapped animals (e.g., bullfrogs, hedgehogs and reptiles), which should be carefully caught and relocated according to the specifications of a relevant specialist.

Develop and implement an alien plant control programme for the study area in order to prevent the further degradation of the faunal habitat.

Table 57: Roads and pipelines: Criteria used to determine the consequence of the impact.

ISSUE:	**Roads and pipelines**
Project Phase	**Construction and Operation**
Nature	Negative
Extent	Site (1)
Intensity	Medium (2)
Duration	Medium-term (2)
Consequence	Low (5)
Project Phase	Construction and Operation
Probability	Possible
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	Low
Confidence level	High
Significance Pre- Mitigation	Low (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	Medium

- **Significance Post Mitigation: LOW -** the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact 8: Alien invasive vegetation.

Applicable Phase: Clearing and operational phases
Applicable activity: The invasion of weeds and exotic plants.

Nature of impact: Competition.

Alien Plant Infestation within Orchard areas

The spread of alien plants causes a gradual change in the structure and diversity of the vegetation. This can lead to a substantial change in the character of the ecosystem and habitat within the area. Exotic invader plants and trees deteriorate the natural environment and reduce biodiversity.

Key factors in weed invasion appear to be:

- Soil disturbance (e.g., tracks, clearing, erosion).
- Grazing by domestic animals (e.g., cattle and horses introduce and spread weeds).
- The presence of adjoining agricultural land with weed species.
- Too-frequent fires.

If a seed-base of invasive alien species is present, an invasion by these species could increase as bare soil is exposed.

The disturbance to the vegetation and soils, during the clearing and orchard preparation phase, could increase the risk of an alien plant invasion, especially where soils are exposed. Some of the natural vegetation along roads and pipelines and orchard areas will be lost during the orchard establishment phase of the project. Loss of habitat adjacent to roads and pipelines may result in an increase in alien invasive plant species. Roads and traffic may facilitate the invasion of weeds and exotic plants as seeds attached to undercarriages in mud and dirt may transport seeds from a large catchment and move them across the landscape rapidly.

Inappropriate maintenance activities during the operational phase would also promote the invasion or dominance of alien plant species at the site. A high abundance of alien plant species within the site would impact adjacent plant communities and promote the invasion of alien species into the intact vegetation. Alien species are already present on the farm and will colonise any area of disturbance should they not be actively controlled.

The spread of alien invasive species is an ongoing problem as alien plants in the surrounding landscape and the gum and wattle plantation act as a long-term source of seeds and future spread. In terms of the Conservation of Agricultural Resources Act (CARA, Act No. 43 of 1984), alien species must be managed and controlled in terms of their respective categories. All aggressive alien species, as indicated above, should be removed.

Mitigation of Impact 8:

An alien invasive plant management- and control plan should be put in place for both the construction- and operational phases on the farm. A programme for the eradication, or at least control, of alien plants present within the project area must be developed.

The Contractor and Farm Manager, during orchard establishment, and the various construction phases, should ensure that immediate removal of alien invasive species (seedlings) is implemented as these species establish themselves rapidly within disturbed areas. Mechanical removal is preferred and should follow the guidelines laid down in an alien plant management and control plan.

Alien plant removal should include in the natural biotopes not impacted by the development. The farmer indicated that he would remove the scattered alien trees in the Nature Reserve once the farm is established.

Table 58: Alien invasive vegetation**:** Criteria used to determine the consequence of the impact.

ISSUE:	**Alien invasive vegetation**
Project Phase	**Clearing and Operation**
Nature	Negative
Extent	Regional (3)
Intensity	Medium (2)
Duration	Medium-term (2)
Consequence	High (7)
Project Phase	Construction and Operation
Probability	Possible
Degree to which impact cannot be reversed	Low
Degree to which Impact may cause irreplaceable loss of resources	Medium
Confidence level	High
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Low (-ve)
Degree of Mitigation	High

- **Significance Post Mitigation: LOW -** the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact 9: Loss of Red listed and protected fauna/flora species

Applicable Phase: Clearing and operational phases
Applicable activity: Clearing and operation of the project having an influence on the presence of protected fauna/flora species.

Nature of impact: Displacement of protected fauna/flora species.

Several Red listed and protected faunal and plant species are expected to be present in the project area. Twelve plant species of concern are expected to occur in different habitat types on the farm.

Species of Concern: Plants

1. *Aloe simii*
2. *Habenaria mossii*
3. *Aloe kniphofioides*
4. *Disa extinctoria*
5. *Curtisia dentata*
6. *Gladiolus calcaratus*
7. *Crinum macowanii*
8. *Adenia gummifera var. gummifera*
9. *Gunnera perpensa*
10. *Hypoxis hemerocallidea*
11. *Schizobasis intricata (NOW Drimia intricata)*
12. *Eucomis autumnalis*

Of all the faunal Species of Special Concern, 26 species of animals have a High Probability of occurring in the different habitat types of the project area:

1. Raucous toad
2. Natal ghost frog
3. Plaintive rain frog
4. Mountain caco
5. Clicking stream frog
6. Southern African python
7. Southern brown egg eater
8. Many-spotted snake
9. Giant legless skink
10. Wilhelm's flat lizard
11. Large-scaled grass lizard
12. Cape grass lizard
13. Cape Rock-Thrush
14. Sentinel Rock-Thrush
15. Buff-streaked Chat
16. Abdim’s stork
17. Secretary bird
18. Martial Eagle
19. Lanner Falcon
20. Peregrine Falcon
21. Half-collared Kingfisher
22. European Roller
23. Serval
24. Cape clawless otter
25. Spotted-necked otter
26. Honey badger

The main impact that probably have an adverse impact on the SCC species, is process of clearing fields for planting of crops. The main reasons for this involve the clearance of 72.5 ha Untransformed Grassland and a small area of old lands that have recovered to a certain level.

Twenty-six Species of Special Concern (SCC) that have a high probability of occurring in the region, are expected to frequent the Krokodilspruit farm. The three areas proposed to be cleared for agriculture, consists mainly of primary grassland. Most of the mammal and bird SCC will be able to move out of the areas during clearing process due to their size and mobility. It is only the subterranean species such as golden moles that will be compromised if present. Burrowing frogs and reptiles will also be compromised by vegetation clearing.

Mitigation of Impact 9:

The new areas earmarked for development consist mostly of Untransformed Grassland. Should the application to clear the additional 72.5 ha of land be granted, 70.9 ha of Untransformed North-eastern Mountain Grassland and 1.51 ha of secondary grassland will be implicated. The 475 ha of Untransformed Grassland protected in 2018 will be reduced to 404 ha. However, more than 50 ha of grassland have been allocated to the *Aloe simii* buffers and thus the grassland in these protected patches will also be secured, resulting in approximately 458 ha of Untransformed Grassland to be secured for protection.

Where total vegetation clearing is going to take place:

- Specified faunal species must be captured and relocated to suitable habitat in the area.
- The operations must be handled by specialists with expertise in the area of environmental concern (GIS Guideline document).
- Species data (GIS point locality, species name and date) must be forwarded to the MTPA.

It is suggested that any species caught during the process, should be translocated to the grassland areas in the Nature reserve. Relocation plans of plants of conservation importance should be included and this relocation should be undertaken by specialists that have expertise in the area of environmental concern.

Table 59: Red listed and protected species**:** Criteria used to determine the consequence of the impact.

ISSUE:	**Red listed and protected species**
Project Phase	**Construction and Operation**
Nature	Negative
Extent	Local (2)
Intensity	Medium (2)
Duration	Long-term (3)
Consequence	High (7)
Project Phase	Construction and Operation
Probability	Possible
Degree to which impact cannot be reversed	Medium
Degree to which Impact may cause irreplaceable loss of resources	High
Confidence level	High
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	**Low (-ve)**
Degree of Mitigation	Low

- **Significance Post Mitigation: LOW -** the potential impact **may not** have any meaningful influence on the decision regarding the proposed activity/development.

Impact 10: Impact of clearing activities on birds.

Applicable Phase: Clearing phase
Applicable activity: Clearing of the project having an influence on the bird assemblages in the untransformed habitat types.

Nature of impact: Displacement of resident birds and creating barriers impacting on migrating species.

The areas earmarked for clearing mostly involves grasslands. Site 1 is mostly transformed while Sites 2 and 3 are untransformed, Site 3 is in the Nature Reserve. The bird assemblages are mainly grassland species, some of the smaller species are resident, nesting and breeding in the grasslands.

Clearing entire patches of grassland (up to 46ha areas) will completely eradicate the natural grassland habitat and replace it with orchards which will not provide habitat for the displaced bird assemblages.

Mitigation of Impact 10:

In order to lessen the disruption of the clearing activities on the birds, it is proposed that the clearing should take place when birds are not breeding and the migratory species (Palearctic breeding migrants and intra-African breeding migrants) already left the grasslands, usually in autumn. Most local birds will breed in early summer through to late summer, thus the most appropriate time to start the bush clearing will be in the winter months.

A positive feature of the Krokodilspruit development is the fact that most of the landscape are covered with a network of corridors which interlink the different habitat types with very little interruption to migration routes. Birds driven from these grassland areas will be able to reach other similar habitat types and also link to the nature reserve with its pristine grassland habitat.

Corridors protecting *Aloe simii* colonies, will add to the diversity of potential habitat on the farm. It is essential to respect all natural areas and refrain from impacting on proposed buffers, no-go areas, corridors and the Nature Reserve. These areas will provide corridors for movement of migrating species as well as local movement. Areas not suitable for agriculture should become part of the network of natural sanctuaries. Only by providing additional, appropriate habitat for displaced bird species, will a level of mitigation be achieved.

Table 60: Bird assemblages**:** Displacement of resident birds and creating barriers impacting on migrating species.

ISSUE:	**Displacement of resident birds**
Project Phase	**Construction and Operation**
Nature	Negative
Extent	Local (2)
Intensity	High (3)
Duration	Long-term (3)
Consequence	Very high (8)
Project Phase	Construction and Operation
Probability	Probable
Degree to which impact cannot be reversed	Medium
Degree to which Impact may cause irreplaceable loss of resources	High
Confidence level	High
Significance Pre- Mitigation	Medium (-ve)
Significance Post Mitigation	Medium (-ve)
Degree of Mitigation	Low

- **Significance Post Mitigation: Medium -** Medium: Where the impact can have an influence on the environment and the decision and should be mitigated

Impact Assessment Summary

Table 59: A summary of the impact assessment post mitigation.

No	Issue and aspect	Phases	Significance without mitigation	Significance with mitigation
1	Construction of a river crossing	Construction and Operation	**Medium (-ve)**	**Low (-ve)**
2	Clearing of land	Clearing and Operation	**Medium (-ve)**	**Low (-ve)**
3	Erosion and siltation	Clearing and Operation	**Medium (-ve)**	**Low (-ve)**
4	Habitat fragmentation	Clearing	**Medium (-ve)**	**Low (-ve)**
5	Disturbance to fauna	Operation	**Medium (-ve)**	**Low (-ve)**
6	Human interference impacting on biota	Operation	**Medium (-ve)**	**Low (-ve)**
7	Linear structures	Clearing and Operation	**Low (-ve)**	**Low (-ve)**
8	Alien invasive vegetation	Clearing and Operation	**Medium (-ve)**	**Low (-ve)**
9	Red listed and protected species	Clearing and Operation	**Medium (-ve)**	**Low (-ve)**
10	Displacement of resident birds and creating barriers impacting on migrating species.	Clearing	**Medium (-ve)**	**Medium (-ve)**

5.8 Conditions for inclusion in the environmental authorisation

These conditions are based on the identification of mitigation measures and solutions that minimise impacts on biodiversity and conflicts in land-use by making use of use of CBA maps in the Environmental Impact Assessment.

a) **Retain natural habitat and connectivity in CBAs and ESAs**: The avoidance of environmentally sensitive areas identified during the Sensitivity Mapping exercise is regarded as the single most effective possible mitigation measure for mitigating impacts on the ecology of the project area.

- The proposed clearing of areas should not impact on any CBA or ESA features: CBAs have been identified and all of these areas are all conserved or buffered by either the Nature Reserve, areas of no development or inside buffered areas.
- Avoid environmentally sensitive areas identified on the Sensitivity Mapping exercise.
- Maximise connectivity in CBAs and ESAs, the retention of intact natural habitat and avoid fragmentation: All the areas covered by a continuous network of buffers and no-go areas.

b) Apply the mitigation hierarchy?
By making use of “best practice guidelines” during the construction- and operational phases, identify the best practicable environmental options by avoiding loss of biodiversity and disturbance to ecosystems, especially in CBAs, by applying the mitigation hierarchy and the land-use guidelines recommended. In particular:

Management actions should be implemented such as:

- the re-establishment of indigenous vegetation wherever possible;
- control of storm water run-off;
- ongoing repair- and stabilisation of any erosion;
- implement an alien plant control programme;
- make use of current roads or tracks as far as possible;
- implement a veld management plan for the conservation area, which emphasises the use of sustainable grazing and controlled fires;
- prevent erosion and sediment-laden water from entering the adjacent watercourses;
- generic buffers should be established around wetlands;
- strict management of potential sources of agrochemical pollution;
- avoid over irrigation;
- Maintaining an intact riparian corridor.

c) Remedy degradation and fragmentation through rehabilitation:

- A network of corridors will be established by the buffers to CBAs and other sensitive habitat and connect most of the farm with the proposed Nature Reserve and other no-go areas:

  - Buffers around rivers;
  - Buffers around drainage lines;
  - Buffers around wetlands;
  - Buffers around inselbergs;
  - Buffers around *Aloe simii* populations,
  - Forests utilised as buffers around valley drainage lines.

- In the process of demarcating the agricultural land, larger areas were clumped together to prevent creating unconnected spaces.
- Planting or rehabilitation of cleared or excavated areas should commence as soon as the development activity is completed.
- Clear invasive alien vegetation and rehabilitate existing degraded habitats.
- Areas in the Nature reserve not utilised for orchards, should be incorporated into the reserve again.

d) Secure priority biodiversity in CBAs and ESAs through biodiversity stewardship

Set aside land of high biodiversity importance for conservation through biodiversity stewardship options. Where biodiversity losses are unavoidable, set aside another piece of land of equivalent or greater biodiversity importance for conservation:
More than 50 ha of grassland have been allocated to the *Aloe simii* buffers and thus the grassland in these protected patches will also be secured, resulting in approximately 458 ha of Untransformed Grassland to be secured for protection.

e) Promote long-term persistence of taxa of special concern

Of the approximate 4113 ha on the farm, 2303 ha consists of untransformed habitat. The planned Nature Reserve will conserve 743 ha, which includes 41% of all the untransformed vegetation types. The conserved areas of buffered habitat which forms a favourable network of connecting corridors, will form a refuge for most of the species of conservation importance Faunal species can then move to these areas.

f) Integrating *in situ* biodiversity-sensitive management into the overall design and operation of the proposed land-use development

- The state-of-the-art technology utilised on the farm involves the use of permeable/breathable agricultural fabric to all but eliminate weed growth and limit the competition for growth.
- The fabric also retains water, limits evaporation and maintains a healthy soil temperature. This water saving low flow irrigation system has a broader water distribution, allows for better nutrient utilisation, larger and enhanced yields as well as lower nutrient usage.
- The system of controlled traffic farming is described as a concept that was developed to increase crop yield by reducing soil compaction.
- Irrigation is placed underneath the agricultural fabric; the low flow drip ensures no over irrigation.

Fertilisers used:

Water soluble fertilisers are mixed on the farm and dosed into the irrigation lines. The same principles above apply, fertiliser is only injected into targeted areas therefore there will be no negative impact on indigenous trees or shrubs.

5.9 Monitoring requirements

Environmental performance monitoring should be designed to ensure that mitigation measures are implemented. The monitoring programme should clearly indicate the linkages between impacts, indicators to be measured, measurement methods and definition of thresholds that will signal the need for corrective actions.

The applicant must appoint an independent ECO that will have the responsibility of monitoring and reporting on compliance with the conditions of the Environmental Authorisation (EA, as well as monitoring and reporting on the implementation of the approved EMPr.

A monitoring programme for the biodiversity associated with the project, would ideally be to record the reaction of the biota to changes in the environment due to the impacts of the project.

- A short-term riverine monitoring programme (riparian and aquatic) should be established to monitor the effects of the river crossing.
- Before the clearing of untransformed habitats, a botanist must be part of the identification-, relocation or removal programme of plant species of conservation importance.
- Establish an effective record keeping system regarding veld condition, alien vegetation presence and burning should be included in as a monitoring programme:
- Establish an effective record keeping system for each area where soil is disturbed for whatever purposes. The monitoring will evaluate whether the erosion and sedimentation control techniques that are employed throughout the site preparation activities are effective in minimising erosion of exposed areas and sedimentation of site surface water.
- The large number of Red Data listed and endemic species (26 species have a high probability of occurring on the Krokodilspruit farm) necessitates a monitoring program to assess their numbers and status in the project area. An inventory system should be established in a concerted effort with regular staff working in the project area to identify Red Data or Species of Special Concern and record these species. In the event that any threatened or near-threatened animal species are recorded within the study area in future, appropriate conservation measures should be developed in consultation with the relevant conservation authorities.

5.10 Recommendations

5.10.1 Reasoned opinion

The potential impacts of the project on biodiversity of the study area are assessed under 17 broad impacts. The following list provides a summary of the impact assessment post mitigation.

Impact 1: River Crossings

Construction Phase – Medium improves to Low significance
A low-level river crossing is required to accommodate equipment and vehicles during harvesting- and general farming operations. These structures will be basic in nature with concrete pipes that will allow the free flow of water. The crossing will not be large as the stream is relatively small. The impacts of construction should also be minimal.

Operational Phase – Low significance remains Low.
If management actions regarding ongoing erosion and sedimentation control are implemented, the impacts will be of Low significance.

Impact 2: Clearing of approximately 72 ha of transformed and untransformed land types.

Clearing and Operational Phase – Medium improves to Low significance
More than 50 ha of grassland have been allocated to the *Aloe simii* buffers and thus the grassland in these protected patches will also be secured, resulting in approximately 458 ha of Untransformed Grassland to be secured for protection.

Impact 3: Erosion and siltation.

Clearing and Operational Phase – Medium improves to Low significance
If management actions are implemented such as the re-establishment of indigenous vegetation, control of storm water run-off and ongoing repair and stabilisation of any erosion, the impacts will be of Low significance.

Impact 4: Habitat fragmentation.

Clearing and Operational Phase – Medium improves to Low significance
The proposed corridors will buffer all the CBA areas and connect most of the farm with the proposed Nature Reserve and other no-go areas. These buffers protect all of the Sandspruit, Afrotemperate Forests, *Aloe simii* buffers, Floodplain wetlands and Rocky outcrops. All the areas covered by this continuous network will protect the untransformed habitat.

Impact 5: Disturbance to Fauna.

Clearing Phase – Medium improves to Low significance
Clearing activities may lead to the disturbance of fauna that reside on the site. Increased levels of noise, pollution, disturbance, and human presence during the clearing phase, will be detrimental to fauna.

Operational Phase – Medium improves to Low significance
During the operational phase of the project, the visual and noise disturbance will decline. This also pertains to the movement and noise factor of farming vehicles and other implements. During all the phases it is important to establish no-go zones for both workers and their vehicles.

Impact 6: Human interference impacting on biota.

Clearing and Operational Phase – Medium improves to Low significance

There should be a stringent and dedicated control of collection, poaching, hunting or harvesting of animals. All personnel should be informed not to harm or collect species such as snakes and tortoises.

Impact 7: Linear structures: Impacts of roads and pipelines.

Clearing and Operational Phase –Low significance remains Low.

Refrain from creating unnecessary new roads or tracks, make use of current routes as far as possible. Management actions should be implemented such as the re-establishment of indigenous vegetation wherever possible, control of storm water run-off and ongoing repair and stabilisation of any erosion.

Impact 8: Alien invasive vegetation.

Clearing and Operational Phase – Medium improves to Low significance

An alien invasive plant management and control plan must be put in place for both the construction- and operational phases on the farm. A programme for the eradication of alien plants within the project area must be developed.

Impact 9: Loss of Red listed and protected fauna/flora species

Clearing and Operational Phase – Medium improves to Low significance

It is suggested that any species caught during the process, should be translocated to the grassland areas in the Nature reserve. Relocation plans of plants of conservation importance should be included and this relocation should be undertaken by specialists that have expertise in the area of environmental concern.

Impact 10: Impact of clearing activities on birds.

Clearing Phase – Medium remains Medium significance

It is essential to respect all natural areas and refrain from impacting on proposed buffers, no-go areas, corridors and the Nature Reserve. These areas will provide corridors for movement of migrating species as well as localised species movement. Areas not suitable for agriculture should become part of the network of natural sanctuaries. Only by providing additional, appropriate habitat for displaced bird species, will a level of mitigation be achieved.

5.10.2 Consultation process

The input from Mr. Ralf Kalwa regarding the status of grasslands and grass species was very valuable during the field surveys. The input of Mervyn Lotter and Willem van Staden regarding the conservation of *Aloe simii* is appreciated.

6. Conclusion

a) It is clear that the implementation of buffers around sensitive habitat types is regarded as the most effective possible mitigation measure for mitigating impacts to the biodiversity of the project.

b) A network of corridors will be provided by proposed buffers to CBAs and other sensitive habitats and connect most of the farm with the proposed Nature Reserve and other no-go areas:

- Buffers around rivers;
- Buffers around drainage lines;
- Buffers around wetlands;
- Buffers around inselbergs;
- Buffers around *Aloe simii* populations,
- Forests utilised as buffers around valley drainage lines.

c) Most of the 72ha earmarked for clearing is untransformed habitat. No development was planned to take place in the Nature Reserve, but due to the buffer zones being added to the protected *Aloe simii* populations, resulting in a loss of approved agricultural land, 46.6 ha of the reserve will replace the area lost to the ecological buffers.

d) Due to the Nature Reserve and buffers, as well as areas of no development, large areas which includes the CBAs and Other Natural Areas (ONAs) will not be developed. Untransformed habitats on the farm will be protected in the Nature Reserve, no-go areas or in buffer zones.

e) The arable areas were chosen because they are uniform and there are no rocky, steep or wetland areas within the sections assessed for the orchards. The screening study ensured that buffers were established around the *Aloe simmi* colonies, no obvious areas of concern were encountered and there is also sufficient water to establish orchards.

f) These corridors buffer all the CBA areas and connect most of the farm with the proposed Nature Reserve and other no-go areas. These buffers protect all of the Sandspruit, Afrotemperate Forests, Floodplain wetlands and Rocky outcrops.

g) The proposed river crossing is situated in the northern part of the Krokodilspruit farm. The advantages of this proposed crossing will enable more sufficient and quicker firefighting activities along the northern boundary of the farm without having to take a long detour and for use during harvesting activities. The location found suitable for the proposed low-level crossing consists out of large rock formations which will allow for the construction of a strong and reliable crossing.

h) By making use of “best practice guidelines” during the construction- and operational phases, identify the best practicable environmental options by avoiding loss of biodiversity and disturbance to ecosystems, especially in CBAs, by applying the mitigation hierarchy and the land-use guidelines recommended. In particular:

i) All the expected impacts were assessed and all were confirmed to be “Low” or mitigated to attain a “Low” risk level, except the impact on bird communities in the grasslands. By providing buffers and corridors to appropriate habitat could mitigate the loss of bird habitat.

By implementing all the mitigation measures and managing the system on a continuous basis as prescribed by the Risk Assessment, all the impacts will be addressed to a satisfactory level. Therefore, it is proposed that the project should be authorised with the provision that the mitigation measures prescribed in this document, where applicable, are included in the EMPr

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Appendices

Appendix 1: Declaration of interest

The specialist appointed in terms of the Regulations_

10.4 The Specialist

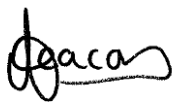
Note: Duplicate this section where there is more than one specialist.

I …Dr Andrew Richard Deacon…, as the appointed specialist hereby declare/affirm the correctness of the information provided as part of the application, and that I:

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

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

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



Signature of the specialist
Andrew Deacon Environmental Consultant

Name of company
18 December 2022
Date

Appendix 2: The complete SASS 5 form.

TAXON	Stones	Vegetation	GSM	Total
Porifera 5				
Coelenterata 3				
Turbellaria 3				
Oligochaeta 1				
Leeches 3				
Amphipoda 15				
Potamonautidae 3				
Atyidae (Shrimp) 8				
Palaemonidae 10				
Hydracarinae 8				
Notonemouridae 14				
Perlidae 12				
Baetidae 1 spp 4				
2 spp 6				
>2 spp 12				
Caenidae 6				
Ephemeridae 15				
Heptageniidae 10				
Leptophlebiidae 13				
Oligoneuridae 15				
Polymitarcyidae 10				
Prosopistomatidae 15				
Teloganodidae 12				
Tricorythidae 9				
Calopterydidae 10				
Chlorocyphidae 10				
Chlorolestidae 8				
Coenagrionidae 4				
Lestidae 8				
Platycnemidae 10				
Protoneuridae 8				
Zygoptera 6				
Aeshnidae 8				
Cordulidae 8				
Gomphidae 6				
Libellulidae 4				
Belostomatidae 3				
Corixidae 3				
Gerridae 5				
Hydrometridae 6				
Naucoridae 7				
Nepidae 3				
Notonectidae 3				
Pleidae 4				
Veliidae 5				
Corydalidae 8				
Sialidae 6				
Dipseudopsidae 10				
Ecnomidae 8				
Hydropsychidae 1= 4				
2spp = 6				
>2spp =12				
Philopotamidae 10				

Polycentropodidae 12				
Psychomyiidae/Xip. 8				
Barbarochthonidae 13				
Calamoceratidae 11				
Glossosomatidae 11				
Hydroptilidae 6				
Hydrosalpingidae 15				
Lepidostomatidae 10				
Leptoceridae 6				
Petrothrincidae 11				
Pisuliidae 10				
Sericostomatidae 13				
Dytiscidae 5				
Elmidae/Dryopidae 8				
Gyrinidae 5				
Haliplidae 5				
Helodidae 12				
Hydraenidae 8				
Hydrophilidae 5				
Limnichidae 8				
Psephenidae 10				
Athericidae 13				
Blepharoceridae 15				
Ceratopogonidae 5				
Chironomidae 2				
Culicidae 1				
Dixidae 13				
Emphididae 6				
Ephydridae 3				
Muscidae 1				
Psychodidae 1				
Simuliidae 5				
Syrphidae 1				
Tabanidae 5				
Tipulidae 5				
Ancylidae 6				
Bulininae 3				
Hydrobidae 3				
Lymnaeidae 3				
Physidae 3				
Planorbidae 3				
Thiaridae 3				
Viviparidae 5				
Corbiculidae 5				
Spaeridae 3				
Uniondae 6				
SASS Score				
No of families				
ASPT				

Estimated abundance: 1=1; A=2-10; B=11-100; C=101-1000; D=>1000

APPENDIX 4.5.3:
HERITAGE SPECIALIST REPORT

SPECIALIST REPORT

PHASE 1 ARCHAEOLOGICAL/HERITAGE IMPACT ASSESSMENT FOR 74ha AGRICULTURAL (ORCHARDS) DEVELOPMENT ON THE FARM KROKODILSPRUIT 248 JT, WHITE RIVER, MPUMALANGA PROVINCE

REPORT PREPARED FOR

RHENGU ENVIRONMENTAL SERVICES

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APRIL 2022

ADANSONIA HERITAGE CONSULTANTS

ASSOCIATION OF SOUTHERN AFRICAN PROFESSIONAL ARCHAEOLOGISTS

REGISTERED WITH SAHRA

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EXECUTIVE SUMMARY

A Phase 1 Heritage Impact Assessment (HIA) regarding archaeological and other cultural heritage resources was conducted on 76ha of the farm KROKODILSPRUIT 248JT, near White River. The study area is situated on topographical map 1:50 000, 2530BD NELSPRUIT, which is in the Mpumalanga Province. This area falls under the jurisdiction of the Ehlanzeni District Municipality, and Mbombela Local Municipality.

The National Heritage Resources Act, no 25 (1999)(NHRA), protects all heritage resources, which are classified as national estate. The NHRA stipulates that any person who intends to undertake a development, is subjected to the provisions of the Act.

The applicant, DANROC (Pty) Ltd., in co-operation with RHENGU Environmental Services, is requesting an agricultural development for macadamia orchards. An archaeological and heritage impact assessment was done for other sections on the same farm, in 2018, and the agricultural development was approved. Large sections on the property were historically cultivated with bluegum plantations (since 1977), and agricultural lands (since 1936). Many drainage lines from the rocky slopes, feed into two main rivers, the Sandspruit and Krokodilspruit, which flow through the farm. The rocky sections on the property are natural and undisturbed with indigenous vegetation cover. The area is zoned as agricultural and no rezoning will take place.

The survey took place during late summer (April 2022), and vegetation was dense and lush. Visibility during the survey was restricted, and therefore some information from the 2018 report was used. The survey in 2018 took place when large sections of the farm were burnt, which made visibility excellent at the time. The farm was historically a commercial farm with large sections of agricultural fields.

All open areas in the study sections were investigated for any archaeological or heritage features, but none was observed during the 2022 survey. No archaeological or heritage features were identified in Sections 1 & 3. The 2018 survey, which covered part of Section 2, revealed fragments of potsherds and lower grinders. No mitigation measures are proposed (see discussion in text). No graves were observed on any of the three sections, during the field investigation. Mr. Josiah Manhique, who accompanied us during the survey, has not encountered any graves in the study areas.

It is recommended that the applicant be made aware that distinct archaeological material or human remains may only be revealed during the development phase. Such sub-surface finds must be assessed by a qualified archaeologist after which, an assessment can be made.

Based on the survey and the findings in this report, Adansonia Heritage Consultants state that there are no compelling reasons which may prevent the proposed agricultural development, within the study area, to continue.

Disclaimer: *Although all possible care is taken to identify all sites of cultural significance during the investigation, it is possible that hidden or sub-surface sites could be overlooked during the study. Christine Rowe trading as Adansonia Heritage Consultants will not be held liable for such oversights or for costs incurred by the client as a result.*

……
C. Rowe
APRIL 2022

CONTENTS

PHASE 1 ARCHAEOLOGICAL/HERITAGE IMPACT ASSESSMENT FOR 76ha AGRICULTURAL (ORCHARDS) DEVELOPMENT ON THE FARM KROKODILSPRUIT 248 JT, WHITE RIVER, MPUMALANGA PROVINCE

A. BACKGROUND INFORMATION TO THE PROJECT

DANROC (Pty) Ltd, in co-operation with RHENGU Environmental Services, is requesting an agricultural development on natural as well as historically transformed lands on the farm Krokodilspruit 248JT, near White River, in Mpumalanga. The development is for three small sections, with a total of 76ha. [1] [2]

The farm Krokodilspruit, is situated approximately 8km west of the town of White River. Large sections on the property were blue gum plantations (see Map 3), which were recently converted into agricultural lands (macadamias). The farm originally belonged to a Mr. Webster, who farmed extensively with maize and cattle. He sold the farm in 1941 to Mr. Beckenstrater (the previous owner). The plantations were established during 1977. [3] Aerial maps from 1936 were studied during the previous survey and showed the sections which were cultivated at the time (see maps 7 & 9). These are situated roughly in the middle of the farm and have been fallow for many years. Many drainage lines are sloping from low hills towards the Sand- and Krokodilspruit which flow from north to south through the farm. Several earth water furrows were constructed by Mr. Webster, to channel water to the cultivated areas in earlier years. The water furrows were lined with concrete during the 1960's. [4] The water furrows are not relevant in the current report, as they fall outside of the study area.

The rocky sections on the property are natural and undisturbed with indigenous vegetation cover and consist of granite outcrops (east, west and sections in the north-east). Most of the rocky sections are in the north-western corner of the farm (see map 9).

Adansonia Heritage Consultants were appointed by RHENGU Environmental Services, to conduct a Phase 1 heritage impact assessment (HIA) on archaeological and other heritage resources which might occur on the three sections (Section 1, 2 & 3). A literature study, relevant to the study area as well as a foot survey was done, to determine that no archaeological or heritage resources will be impacted upon by the proposed development (See Map 9: topographical map 1:50 000, 2530BD NELSPRUIT).

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1 Deacon, AR., Krokodilspruit Screening Report, 2022-03-28.
2 Personal communication: Mr. R. Kalwa, Rhengu Environmental Services, 2022-03-25.
3 Personal communication: Mr. P. Beckenstrater, 2018-10-08.
4 Personal communication: Mr. P. Beckenstrater, 2018-10-08.

The aims of this report are to source all relevant information on archaeological and heritage resources within the study area, and to advise the client on sensitive heritage areas as well as where it is viable for the development to take place in terms of the specifications as set out in the National Heritage Resources Act no., 25 of 1999 (NHRA). Recommendations for maximum conservation measures for any heritage resources will also be made. The study area is indicated in maps 1 - 11, & Appendix 1 - 2.

- This study forms part of an EIA, Consultant: RHENGU Environmental Services, Mr. Ralf Kalwa, P.O. Box 1046, Malelane, 1320, Cell: 0824147088/Fax: 0866858003/e-mail: rhengu@mweb.co.za.
- Type of development: Agricultural development on the farm KROKODILSPRUIT 248JT, White River, Mpumalanga Province.
- The study area consists of natural indigenous vegetation cover as well as historically disturbed or transformed land. The farm has rocky outcrops to the east, west and north-east which slope towards the valley floor where the Sandspruit and Krokodilspruit are situated (see Map 6). The area is zoned as agricultural and no rezoning will take place.
- Location of Province, Magisterial district / Local Authority and Property (farms): The area falls within the Mpumalanga Province under the jurisdiction of the Ehlanzeni District Municipality and Mbombela Local Municipality.
- Landowner & applicant: DANROC (Pty) Ltd, Mr. Warren Hearne.

Terms of reference: As specified by section 38 (3) of the NHRA, the following information is provided in this report.

a) The identification and mapping of heritage resources where applicable;
b) Assessment of the significance of the heritage resources;
c) Alternatives given to affected heritage resources by the development;
d) Plans for measures of mitigation.

Legal requirements:

The legal context of the report is grounded within the National Heritage Resources Act no. 25, 1999, as well as the National Environmental Management Act (Act No. 107 of 1998) (NEMA as amended).

- **Section 38 of the NHRA**

This report constitutes a heritage impact assessment investigation linked to the environmental impact assessment required for the development. The proposed development is a listed activity in terms of Section 38 (1) of the NHRA. Section 38 (2) of the NHRA requires the submission of an HIA report for authorisation purposes to the responsible heritage resources agency, (SAHRA).

Heritage conservation and management in South Africa is governed by the NHRA and falls under the overall jurisdiction of the South African Heritage Resources Agency (SAHRA) and its provincial offices and counterparts.

Section 38 of the NHRA requires a Heritage Impact Assessment (HIA) to be conducted by an independent heritage management consultant, for the following development categories:

- The construction of a road, wall, powerline, pipeline, canal or similar form of linear development or barrier exceeding 300m in length;
- Any development or other activity which will change the character of a site: exceeding 5000m² in extent;
- the rezoning of a site exceeding 10 000m² in extent;

In addition, the new EIA regulation promulgated in terms of NEMA, determines that any environmental report will include cultural (heritage) aspects.

The end purpose of this report is to alert RHENGU Environmental Services as well as the applicant, interested and affected parties about existing heritage resources that may be affected by the proposed development, and to recommend mitigation measures aimed at reducing the risks of any adverse impacts on these heritage resources. Such measures could include the recording of any heritage buildings or structures older than 60 years prior to demolition, in terms of section 34 of the NHRA and also other sections of this act dealing with archaeological sites, buildings and graves.

The NHRA section 2 (xvi) states that a “heritage resource” means any place or object of cultural significance, and in section 2 (vi) that “cultural significance” means aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. Apart from a heritage report assisting a client to make informed development decisions, it also serves to provide the relevant heritage resources authority with the necessary data to perform their statutory duties under the NHRA. After evaluating the heritage scoping report, the heritage resources authority will decide on the status of the resource, whether the development may proceed as proposed or whether mitigation is acceptable, and whether the heritage resources require formal protection such as Grade I, II or III, with relevant parties having to comply with all aspects pertaining to such a grading.

- **Section 35 of the NHRA**

Section 35 (4) of the NHRA stipulates that no person may, without a permit issued by SAHRA, destroy, damage, excavate, alter or remove from its original position, or collect, any archaeological material or object. This section may apply to any significant archaeological

sites that may be discovered. In the case of such chance finds, the heritage practitioner will assist in investigating the extent and significance of the finds and consult with an archaeologist about further action. This may entail removal of material after documenting the find or mapping of larger sections before destruction. Fragments of clay potsherds and lower grinders were observed in Section 2 (during the 2018 survey). See discussion in text.

- **Section 36 of the NHRA**

Section 36 of the NHRA stipulates that no person may, without a permit issued by SAHRA, destroy, damage, alter, exhume or remove from its original position or otherwise disturb any grave or burial ground older than 60 years, which is situated outside a formal cemetery administered by a local authority. It is possible that chance burials might be discovered during development of road infrastructure or agricultural activities. No grave sites were observed during the current survey.

- **Section 34 of the NHRA**

Section 34 of the NHRA stipulates that no person may alters, damage, destroy, relocate etc., any building or structure older than 60 years without a permit issued by SAHRA or a provincial heritage resources authority. No structures or foundations were observed during the current survey.

- **Section 37 of the NHRA**

This section deals with public monuments and memorials but does not apply in this report.

- **NEMA**

The regulations in terms of Chapter 5 of the National Environmental Management Act, (107/1998), provides for an assessment of development impacts on the cultural (heritage) and social environment and for specialist studies in this regard.

B BACKGROUND TO ARCHAEOLOGY AND HISTORY OF THE STUDY AREA

- **Literature review, museum databases & previous relevant impact assessments**

The study area on the farm KROKODILSPRUIT 248JT, is located approximately 8km west of White River, turning towards Sabie on the R537.

The wider area is quite rich in archaeological history and the first evidence of ancient mining occurred between 46 000 and 28 500 years ago during the Middle Stone Age. Hematite or red ochre was mined at Dumaneni (near Malelane, approximately 45km south-east of the study area) and is regarded as one of the oldest mines in the world. Iron ore was also mined in the area, and a furnace as well as iron slag was documented.[5]

Bushman (or San) presence is evident in the area as research by rock art enthusiasts revealed 109 sites in the Kruger National Park,[6] and over 100 rock art sites at Bongani Mountain Lodge and its immediate surrounds[7] (south-east of the study area), as well as many sites in the Nelspruit, Rocky's Drift and White River (Legogote). Thirty- one rock art sites were recorded by the author on the Mpumalanga Drakensberg Escarpment, of which three sites are near Sabie. Rock art sites were also recorded in Swaziland. [8] [9] The Bushman painters most probably obtained the ochre which was used as a pigment in the paintings, from the Dumaneni ochre mine.[10] [11]

History in the wider vicinity is closely connected to the study area and is briefly outlined below. The name Komati appears in historical records for the first time in 1589, in the form *Macomates*. It was recorded by a traveler on board the Portuguese ship Sao Thome*,* which sailed from Cochin, South India and ran aground on the shores of the Land of the Makomati, near Lake Sibayi, in what became known as KwaZulu Natal. The Land of Makomati comprised the entire hinterland as far north as the Limpopo River, as far south as St Lucia, and as far west as the Drakensberg escarpment, therefore the study area is included. It was the trading zone of the Komati gold and ivory traders who had established themselves in Delagoa Bay (which was known, up to the 17th century as Makomati), long before the arrival of the first Portuguese in 1498.[12]

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5 Bornman, H., *The Pioneers of the Lowveld*, p. 1.
6 English, M. Die Rotskuns van die Boesmans in die NKW, *in De Vos Pienaar, U., Neem uit die Verlede*, p. 18-24.
7 Hampson, et al., The rock art of Bongani Mountain Lodge, SA Archaeological Bullitin 57: p. 15.
8 Rowe, C. 2009. Heritage Management of Archaeological, Historical and Industrial resources on the Blyde River Canyon Nature Reserve, MA dissertation. Pretoria: UP.
9 Masson, J. 2008. Views from a Swaziland Cave. The Digging Stick, Vol. 25 no 1: 1-3.
10 Bornman, H. The Pioneers of the Lowveld, p. 1.
11 Masson, J. 2008. Views from a Swaziland Cave. *The Digging Stick,* Vol. 25 no 1: 1-3.
12 Bornman, H., *The Pioneers of the Lowveld*, p. 9.

Primary and secondary sources were consulted to place the surrounding area in an archaeological context. Ethnographical and linguistic studies by early researchers such as Ziervogel and Van Warmelo shed light on the cultural groups living in the area since ca 1600. historic and academic sources by Meyer, Voight, Bergh, De Jongh, Evers, Myburgh, Thackeray and Van der Ryst were consulted, as well as historical sources by Makhura and Webb.

Primary sources were consulted from the Pilgrim's Rest Museum Archives for a background on the pre-history and history of the study area. Several circular stone-walled complexes and terraces as well as graves have been recorded in the vicinities of Hazyview [13], Bushbuckridge, Graskop and Sabie. Clay potsherds and upper as well as lower grinders, are scattered at most of the sites.[14] Many of these occur in caves as a result of the Swazi attacks during the 1900's on smaller groups. The 1972 topographical map show several footpaths and huts on the farm (outside the study area), as well as structures, cultivated lands, orchards & plantations as well as natural bush sections. The 1920 topographical map (Degree Sheet 21) of Machadodorp revealed no historical black settlements in the immediate area (see Map 2).[15] Granite rocky outcrops to the east, west and north-east slope towards the Sand- & Krokodilspruit streams, which cuts through the property.

The author was also involved in desktop studies and surveys in the area, such as:

- *Study for the Proposed Eskom Powerlines, Hazyview – Dwarsloop* (2008);
- *Inspection of Umbhaba Stone-walled settlement, Hazyview,* (2001);
- *Phase 1 Archaeological and Heritage Impact Assessment for 132Kv Powerlines from Kiepersol substation (Hazyview), to the Nwarele substation Dwarsloop (2002);*
- *Phase 1 Archaeological and Heritage Impact Assessment for a proposed traffic training academy, Calcutta, Mkhuhlu, Bushbuckridge* (2013*);*
- Phase 1 Archaeological and Heritage Impact Assessment for the proposed *Nkambeni* cemetery in Numbi, Hazyview *(2013);*
- Phase 1 Archaeological and Heritage Impact Assessment for a *Development on the farm Agricultural Holding no 56 JU,* White River (2013) was done in the wider area;
- Phase 1 Archaeological and Heritage Impact Assessment for proposed *agricultural development on the farm SIERAAD,* Komatipoort area, (2013) revealed one possible Late Stone Age borer which was identified in a soil sample, one meter below the surface;

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13 PRMA: Information file 9/2.
14 D. Ziervogel, *The Eastern Sotho, A Tribal, Historical and Linguistic Survey,* p. 3.
15 Map: 1920 Topographical Map: Machadodorp Degree Sheet no. 21.

- Phase 1 AIA / HIA for *proposed debushing of natural land for agricultural use: Portion 10 of the farm Thankerton 175JU, Hectorspruit,* Mpumalanga Province (2013); revealed some Later Stone Age artifacts which were all out of context and a burial site;
- Phase 1 AIA / HIA for the *proposed residential township, Tekwane extension 2, portion 7 of the farm Tekwane 537 JU.* No archaeological material of significance was identified.
- Report on Grave site found at *portion 7 of the farm Tekwane 537 JU, in way of amended Bulk Sewer Pipeline, Kanyamazane, Mpumalanga Province (2017)* – Large graveyard identified.
- Phase 1 AIA / HIA *for the proposed construction of a 0.75ML/D water treatment plant and bulk line on government land at Makoko Village (near White River) Kabokweni, Mpumalanga Province (2017) residential township, Tekwane extension 2, portion 7 of the farm* – no significant archaeological sites were observed;
- Letter of recommendation for the exemption from a Phase 1 AIA / HIA *for the proposed new position for the Gutshwa substation, Gutshwa (near White River) (2016);*
- Phase 1 AIA / HIA for the *proposed 2ha development of the Msogwaba Youth Development Centre on a portion of the farm Nyamasaan 647JU, Msogwaba, Mpumalanga province* - no significant archaeological sites were observed (2018).
- Phase 1 AIA / HIA for the proposed agricultural development of the farm, Krokodilspruit 247JT, White River, Mpumalanga Province (2018). A few clay potsherds, lower grinders, iron slag, historical features and graves were observed.

The SAHRA database for archaeological and historical impact assessments was consulted and revealed other recent Archaeological Impact assessment reports in the wider area:

- J. Van Schalkwyk: *Proposed new Lebombo Port of Entry and upgrade of Komatipoort railway station between Mpumalanga (SA) and Mozambique (2008)* – Some historic buildings were identified but no archaeological remains were identified;
- A. Van Vollenhoven: *Report on a cultural Heritage Impact Assessment for the proposed Kangwane Antracite Mine, Komatipoort (2012)* – An archaeological site with Middle and Late Stone Age tools were identified as well as some Iron Age artifacts and decorated pottery. Mitigation measures were recommended by exclusion from the development or a Phase 2 study;
- JP Celliers: *Report on Phase 1 Archaeological Impact assessment on erven at Komatipoort 182 JU Extension 4, Komatipoort (2012)* – Revealed two pieces of undecorated sherds of pottery which was of low significance. It was recommended

that any earthmoving activities be monitored by a qualified archaeologist.

- A. Van Vollenhoven: *Archaeological Impact Assessment for Border site at Komatipoort (2012)* – Revealed historic remains linked to the Steinaeker's Horse regiment during the South African War.
- A. Van Vollenhoven: *A Report on a basic assessment relating to cultural heritage resources for the proposed ESKOM Tekwane North line and substations, Mupumalanga Province (2013)* – revealed historic remains of low significance and a cemetery.

Very little contemporary research has been done on prehistoric African settlements in the study area. Later Stone Age sites in the Kruger National Park date to the last 2500 years and are associated with pottery and microlith stone tools.[16] The only professionally excavated Early Iron Age site near the area, besides those in the Kruger National Park, was the Plaston site near White River, dating ca 900 AD.[17] No other archaeological excavations have been conducted to date within the study area, which have been confirmed by academic institutions and specialists in the field.[18] [19] A stone walled settlement with terracing was recorded by C. Van Wyk (Rowe) close to Hazyview,[20] as well as several which were documented in the southern parts of the Kruger National Park.[21]

The southern Kruger Park and Nelspruit / Bongani Nature Reserve areas have an abundance of San rock art sites,[22] as mentioned above, but none were identified on the farm Krokodilspruit 248JT.

Several early ethnographical and linguistic studies by early researchers such as D. Ziervogel and N.J. Van Warmelo, revealed that the study area was mainly inhabited by the Sotho groups (Pulana & Pai), Swazi from before the 18th century, as well as small groups of Tsonga (Nhlanganu and Tšhangana).[23] [24] (See Map 1: 1935: Map of Van Warmelo). When concentrating on ethnographical history, it is important to include a slightly wider geographical area for it to make sense. Van Warmelo based his 1935 survey of *Bantu Tribes*

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16 J.S. Bergh (red).,*Geskiedenis Atlas van Suid Afrika: Die vier Noordelike Provinsies,* p. 95.
17 M.M. Van der Ryst., Die Ystertydperk, *in J.S. Bergh (red.), Geskiedenis Atlas van Suid Afrika: Die vier Noordelike Provinsies.* p. 97.
18 Personal information: Dr. J. Pistorius, Pretoria, 2008-04-17.
19 Personal information: Dr. MS. Schoeman, University of Pretoria, 2008-03-27.
20 C. Van Wyk, *Inspection of Umbhaba Stone-walled settlement, Hazyview,* pp. 1-2.
21 Eloff J.F., Verslag oor Argeologiese Navorsing in die Krugerwildtuin, June / July, 1982.
22 Hampson, J., et al., The rock art of Bongani Mountain Lodge and its environs, *South African Archaeological Bulletin* 57: pp. 17-28.
23 N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa.* pp. 90-92 & 111.
24 H. S. Webb, The Native Inhabitants of the Southern Lowveld, *in Lowveld Regional Development Association, The South-Eastern Transvaal Lowveld.* p.16.

of South Africa on the number of taxpayers in an area. The survey does not include the extended households of each taxpayer, so it was impossible to reliably indicate how many people were living in one area.[25]

The whole district is divided in two, with the Drakensberg Escarpment in the west, and the Low Veld (in which the study area is situated) towards the east. Today, we found that the boundaries of groups are intersected and overlapping.[26] Languages such as Zulu, Xhosa, Swazi, Nhlanganu, Nkuna, sePedi, hiPau and seRôka, are commonly spoken throughout this area.[27]

During the middle of the 18th century some Sotho and Swazi groups combined under a fighting chief Simkulu. The tribe so formed became known as the BakaNgomane. The principal settlement of Simkulu was in the vicinity of the confluence of the Crocodile and Komati Rivers. It is believed that the BakaNgomane chiefs were buried there.[28]

The Swazi under Mswati II (1845), commenced on a career of largescale raids, on the prosperous tribal lands to the north of Swaziland. His regiments such as the *Nyatsi* and the *Malelane* brought terror to African homes as far afield as Mozambique.[29] During their northern expansion they forced the local inhabitants out of Swaziland, or absorbed them.[30] There is evidence of resistance, but the Eastern Sotho groups who lived in the northern parts of Swaziland, moved mainly northwards.[31] This appears to have taken place towards the end of the 18th century,[32] when these groups fled from Swaziland to areas such as Nelspruit, White River, Bushbuckridge, Klaserie, Blyde River and Komatipoort.[33]

Mswati II built a line of military outposts from west to east of the upper Komati River and the Mlambongwane (Kaap River). At each outpost, he stationed regiments to watch and stop the BaPedi returning to their old haunts.[34] Shaka in the course of his military actions, came into conflict with Zwide Mkhatshwa (1819). Notwithstanding Zwide's numerical superiority, Shaka defeated him. The remnants of Zwide's tribe fled into the Eastern Transvaal where they

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25 N.J. van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa*, p.9.
26 N.J. van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa*, p. 51.
27 M. De Jongh (ed)., *Swatini,* p. 21.
28 Bornman H., *The Pioneers of the Lowveld* pp. 10-11.
29 Bornman H., *The Pioneers of the Lowveld* p 11.
30 A.C. Myburgh, *The Tribes of Barberton District*, p. 10.
31 N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa.* p. 111.
32 H. S. Webb, The Native Inhabitants of the Southern Lowveld, *in Lowveld Regional Development Association, The South-Eastern Transvaal Lowveld.* p. 14
33 *Ibid.,* p. 16.
34 Bornman, H., *The Pioneers of the Lowveld* p. 12.

settled. They ultimately found a new kingdom in Gaza land, which extended from just north of the current Maputo, up the east coast as far as the Zambezi River.[35]

Soshangane was a very powerful chief of the Gaza people, even though he was under the rule of Zwide. Soshangane decided to leave and was given full passage through Swaziland. He passed on his way through the Komati gorge, today known as Komatipoort, taking with him a great booty of cattle and women. Meanwhile more Shangane arrived and by 1896 some 2000 refugees settled between Bushbuckridge and Acornhoek where they are still living today. With the establishment of the Sabie Game Reserve (later known as the Kruger National Park), the BakaNgomane, their Shangaan protégés and Swazis who lived within its borders, were evicted in 1902, and went westward into Klaserie and Bushbuckridge areas, or south of the Crocodile River and established themselves in the Tenbosch and Coal Mine (Strijdom Block) areas, west and south of Komatipoort. The Swazi of Khandzalive moved to Mjejane or Emjejane, the current name for Hectorspruit,[36] east of the study area (see also: Map 1: 1935 Van Warmelo).

Swazi

The Swazi people descend from the southern Bantu (Nguni) who migrated from central Africa in the 15th and 16th centuries.[37] The differences between the Swazi and the Natal Nguni were probably never great, their culture as far as is known from the comparatively little research being carried out, does not show striking differences. Their language is a 'Tekeza' variation of Zulu, but through having escaped being drawn into the mainstream of the Zulus of the *Shaka* period, they became independent and their claim to be grouped apart as a culture is now well founded.[38]

Eastern Sotho group: The Pai

Van Warmelo identified the groups in northern Swaziland and the Pilgrim's Rest district before 1886 (including Sabie, Hazyview and White River), as Eastern Sotho (Pulana, Pai and Kutswe). According to Von Wielligh, the **Pai** occupied the area as far south as the Komati River (umLumati). Most of the younger generation has adopted the Swazi language.[39]

The Swazi constantly attacked the Eastern Sotho groups during the nineteenth century. The Pai fled to the caves in the mountains near MacMac (between Sabie and Pilgrim's Rest), while some of them (which were subjugated by a Swazi leader) fled from *Mswazi* in about

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35 Bornman, H., *The Pioneers of the Lowveld*, p.17.
36 Bornman, H., *The Pioneers of the Lowveld*, p.19.
37 Swaziland: http://en.wikipedia.org/wiki/Swaziland p.1.
38 N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa*, p. 83.
39 D. Ziervogel, *The Eastern Sotho, A Tribal, Historical and Linguistic Survey,* pp. 3-5.

1853 to Sekukuniland (Steelpoort area) but decided to turn back towards their country along the Sabie River (1882). By this time, Europeans had already settled in this area when gold was discovered in 1873.[40]

Eastern Sotho group: The Pulana

The history of the **Pulana** goes back to the Barberton area from where they trekked via Krokodilpoort (Nelspruit district) to settle north-east of Pretoriuskop (near Hazyview). When the Swazi invaded them, they moved on and split up under several chieftainships,[41] of who chief Kobêng (after which Kowyns' Pass was named), is well-known in the area's history.

The Pulana roughly lived in the following areas: north of the Crocodile River, west of the western boundary of the Kruger National Park as far north as its crossing the Sabie River, south of the Sabie river until its cutting through the main road from Pretoriuskop (including Hazyview and close to White River), to Bushbuckridge, west of this road as far as Klaserie, south of a line drawn from Klaserie to the confluence of the Blyde and Orighstad rivers, and east of the Blyde River. This large area is divided in two by the main road from Pilgrim's Rest to Bushbuckridge. This road was since ancient times the only connection between the Low Veld and Escarpment and became known as "Kowyns' Pass".[42] The majority of Pulana lived to the north of this line, while south of this line the Pulana are scattered in groups into which are wedged Pai groups on both sides of the Sabie River, and Swazi peoples in the south, and south-eastern portions.[43] [44]

Eastern Sotho group: The Kutswe

The **Kutswe** trekked from the northern parts of Swaziland northwards as a result of pressure from the Swazi in the south.[45] The Kutswe settled north-east of the present Nelspruit at a river called Kutswe (Gutshwa)[46] from where they got their present name. From here they moved on and settled at various places, and ruins of their kraals are scattered from Pretoriuskop, Hazyview (Phabeni) as well as on the farms Welgevonden 364, Lothian 258, Boschhoek 47, Sandford 46, Culcutta 51 and Oakley 262.[47] They occupied additional areas between **White River and Sabie**, and had sufficient influence amongst the Pai during the early 20th century, to establish authority over more than 2000 individuals living on farms on

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40 D. Ziervogel, *The Eastern Sotho, A Tribal, Historical and Linguistic Survey,* p. 11.
41 *Ibid.,* p. 108.
42 M. De Jongh, (ed)., *Swatini,* p. 21.
43 D. Ziervogel, *The Eastern Sotho, A Tribal, Historical and Linguistic Survey,* p. 107.
44 N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa.* p. 111.
45 *Ibid.,* p. 110.
46 T. Makhura, Early Inhabitants, *in Delius, P. (ed)., Mpumalanga: History and heritage.* p.105.
47 D. Ziervogel, *The Eastern Sotho, A Tribal, Historical and Linguistic Survey,* p. 110.

both sides of the Sabie River from the town of Sabie as far as the main road from **White River / Hazyview to Bushbuckridge.**[48]

Tsonga groups: The Nhlanganu and Tšhangana

The Nhlanganu and Tšhangana (also generally known as the Shangaan-Tsonga)[49] form part of the larger Tsonga group, who occupied the whole of Mozambique (Portuguese East Africa), and it has been recorded that by 1554, they were already living around the Delagoa Bay area (Maputo).[50] They fled from the onslaughts of the Zulu (Nguni) nation from the Natal area, and great numbers of emigrants sought safety in the "Transvaal" as recently as the 19th century, especially in the greater Pilgrim's Rest district (including the study area that we are concerned with). The Tsonga also moved west from Mozambique into the "Transvaal". They have never formed large powerful tribes but were mostly always subdivided into loosely knit units and absorbed under the protection of whichever chief would give them land.[51] They were originally of Nguni origin.[52] The term "Shangaan" is commonly employed to refer to all members of the Tsonga division.[53]

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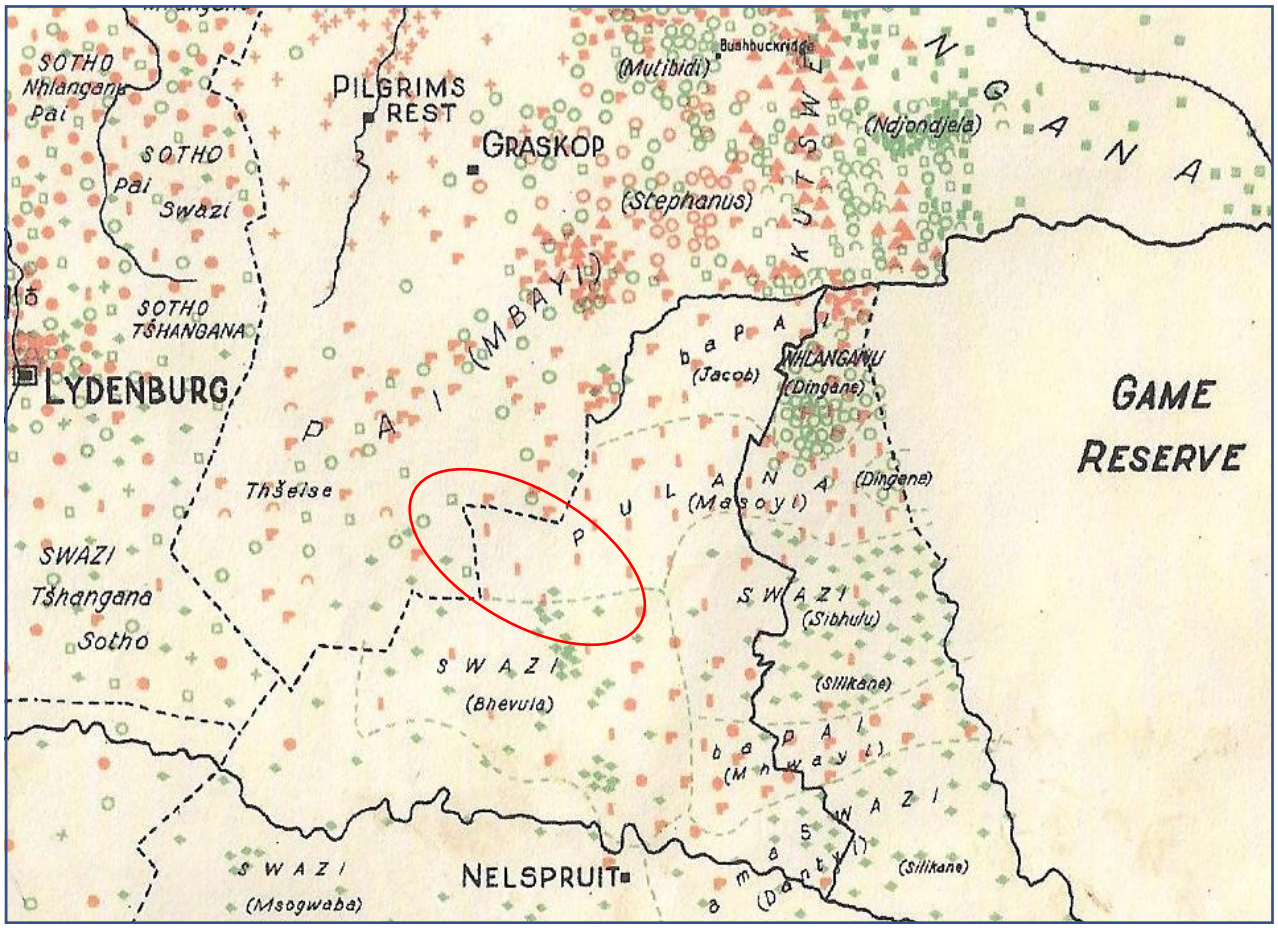
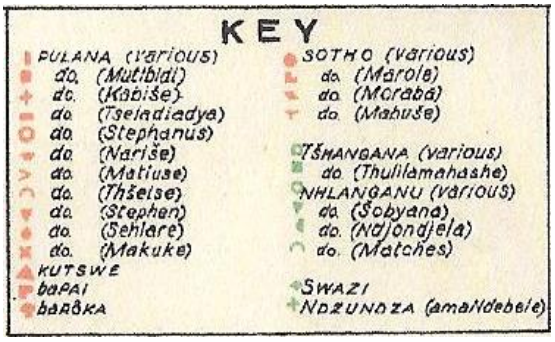
48 *Ibid.,* pp. 4-10.
49 M. De Jongh (ed)., *Swatini,* p. 24.
50 N.J. Van Warmelo, Grouping and Ethnic History, *in Schapera I., The Bantu-Speaking Tribes of South Africa. An Ethnographical survey,* p. 55.
51 N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa*, pp. 90-91.
52 N.J. Van Warmelo, Grouping and Ethnic History, *in Schapera I., The Bantu-Speaking Tribes of South Africa. An Ethnographical survey,* p. 55.
53 N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa*, p. 92



MAP 1: Van Warmelo: 1935: Krokodilspruit, the study area, is indicated by the red oval.



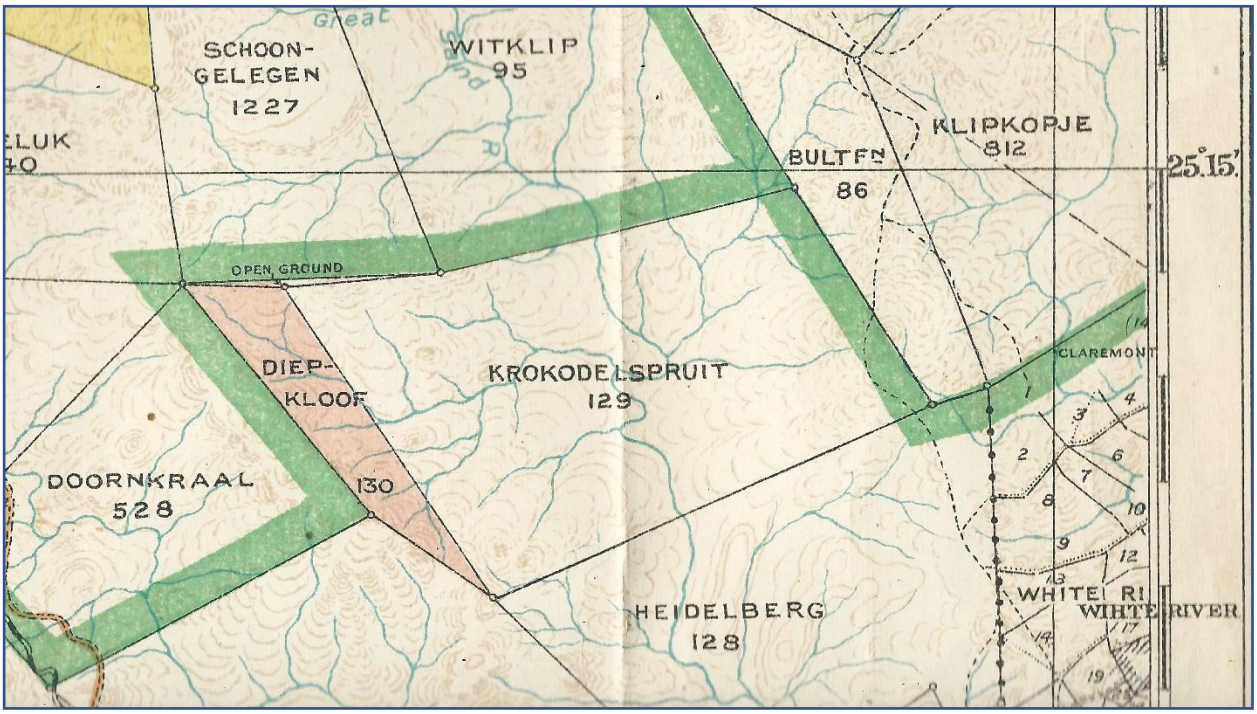
The **Nhlanganu** occupied the Low Veld area in their efforts to escape the Zulu raids during 1835-1840. They lived side by side with the Tšhangana, and the differences between the two are inconsiderable. They have mixed extensively with other tribes.[54]

The **Tšhangana** are also of Nguni origin who fled in the same way as the Nhlanganu and settled in the "Transvaal" a little later than the former. Most of the Tsonga were subjects to *Soshangane,* who came from Zululand.[55] The downfall of *Ngungunyana* (son of

[54] N.J. Van Warmelo, A Preliminary Survey of the Bantu Tribes of South Africa, pp. 91-92.
[55] N.J. Van Warmelo, Grouping and Ethnic History, *in Schapera I., The Bantu-Speaking Tribes of South Africa. An Ethnographical survey,* p. 57.

Soshangane) saw his son seeking sanctuary in the "Transvaal", and the latter became known as *Thulamahashi,*[56] the name that is still used for the area east of Bushbuckridge.

The historical background of the study area confirmed that it was occupied since the 17th century by the Tsonga groups (Nhlanganu and Tšhangana). These groups have intermarried extensively or were absorbed by other groups in time.[57]



MAP 2: 1920 Topographical map (Degree Sheet: Machadodorp No 21). No historical or cultural features of interest were indicated on this map.

- **History of White River**

Early white settlers reported that there were relatively few black people in the district at the turn of the century, due to a combination of malaria, tsetse fly and the marauding Swazi impi's. There were however isolated kraals from the present Drum Rock Hotel in White River to Bushbuckridge (south-east of the study area). [58]

Just after the Anglo-Boer War, the High Commissioner of South Africa, Lord Alfred Milner, was investigating areas with favorable and healthy climates, fertile soil and lots of water, for farming. The ideal area that was identified was White River (or the White River Valley as it was then known).[59] Many ex-servicemen settled in the area but conditions were harsh and by 1911 only a Scot named Macdonald successfully farmed with citrus. [60]

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56 N.J. Van Warmelo, *A Preliminary Survey of the Bantu Tribes of South Africa*, p. 92.
57 M. De Jongh (ed)., *Swatini,* p. 40.
58 Nevill C., White River Remembered, p. 68.
59 Borman, H., *Baanbrekers van die Laeveld*, p. 39.

Today, citrus from this area is one of the main forms of agriculture in the Province. [61] Massive timber plantations were planted around White River and one of the biggest timber mills with the latest technology was built in 1982 in the town.[62]

C. DESCRIPTION OF THE AREA TO BE AFFECTED BY THE PROPOSED DEVELOPMENT

The applicant, DANROC (Pty) Ltd., in co-operation with RHENGU Environmental Services, is requesting the alteration of natural as well as transformed land for agricultural use, to establish macadamia orchards (see maps 3- 6). The project will involve three areas which were identified for the proposed expansion of the orchards. [63] The sections are named Section 1, 2 & 3, for the purposes of this report, and to correspond with the Krokodilspruit Screening report. [64]

Aerial maps from 1936 were studied and revealed that large sections on the farm were historically used for agricultural purposes (see map 7 & Appendix 2). [65]

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60 Nevill, C., *White River Remembered*, p. 3.
61 Delius, P. & Hay, M., *Mpumalanga, an illustrated history*, p. 156.
62 *Ibid*. p. 162.
63 Deacon, AR., Krokodilspruit Screening Report, 2022-03-28.
64 Deacon, AR., Krokodilspruit Screening Report, 2022-03-28.
65 Personal communication: Mr. P. Beckenstrater, 2018-10-08.

MAP 3: The three proposed sections for development are indicated in red on this map. (Map provided by AR Deacon, Krokodilspruit Screening report). [66] Sections 1 & 2 are situated on the north-eastern side, and Section 3 along the western boundary, of the farm.

SECTION 1:

Section 1 is situated to the east of the Sandspruit (see maps 3 &4). The area for the proposed development is 8.42ha and consists of previously disturbed (since 1936), agricultural land (see aerial map 7), with sections of untransformed grassland (see figs. 1 - 10). [67] The area in the south consists of grassland with a section in the south which has been invaded with pioneer vegetation such as Sickle bush – *Dichrostachys cinerea.* Sickle bush occurs in the bushveld and is often invasive and thicket forming particularly in disturbed or overgrazed areas (figs. 7 & 8). [68] Some open sections occur in the study area and have been studied for any possible archaeological or historical remains (figs. 4, 5 & 9), but none were observed.

66 Deacon, AR., Krokodilspruit Screening Report, E-mail access: 2022-03-28.
67 Deacon, AR., Krokodilspruit Screening Report, p. 3.
68 Van Wyk, B., & Van Wyk P., Field Guide to Trees of Southern Africa, 1997, p. 500.

MAP 4: Section 1, to the east of the Sandspruit.

MAP 5: Section 2, to the west of the Sandspruit.

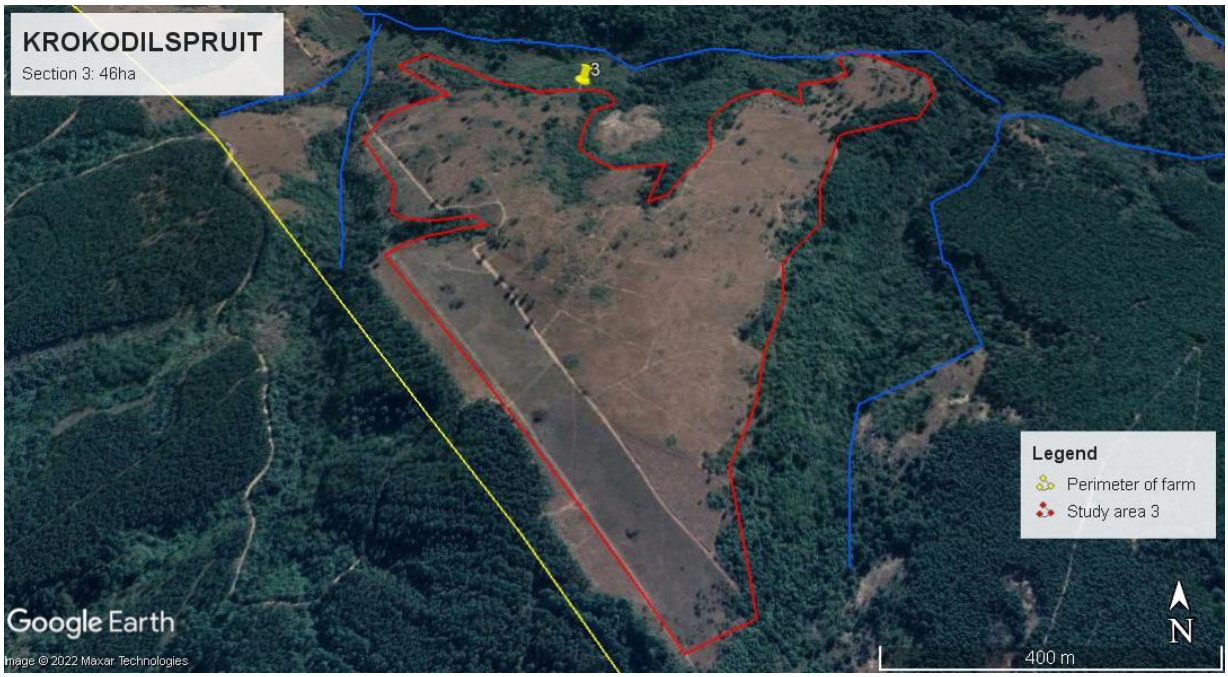
SECTION 2:

Section 2 is situated to the west and east of the Sandspruit (see map 5). The area for the proposed development is 17ha (figs. 11 – 26). A part of this section was assessed in 2018 for the previous development application (fig. 21), and visibility during this survey was excellent. During the 2022 survey, the grass was dense and visibility was restricted. The

area consisted of untransformed grassland, [69] of which some sections have been historically disturbed as is indicated by the 1936 Aerial Photographs (see map 7). The 2018 survey revealed some clay potsherds and Lower Grinding stones (figs. 22 – 26). None of these features are within an archaeological context and they have already been impacted upon by previous agricultural developments. [70] The possibility exists that the cultural material, potsherds and Lower Grinders, are of a more recent nature, as the 1980 topographical map (map 9), also indicate footpaths and huts on the farm. Clay potsherds and grinding stones are still widely used in rural areas, today. There is no cultural value to these objects which could link them as of outstanding importance to a certain community. No mitigation is recommended.

Some rocky outcrops occur to the west and the north of the site. Rocky sections on the property are natural and undisturbed with indigenous vegetation cover, and consist of granite outcrops. Many drainage lines from these sections (east and west on the farm), feed into the Sandspruit and Krokodilspruit rivers.

SECTION 3:

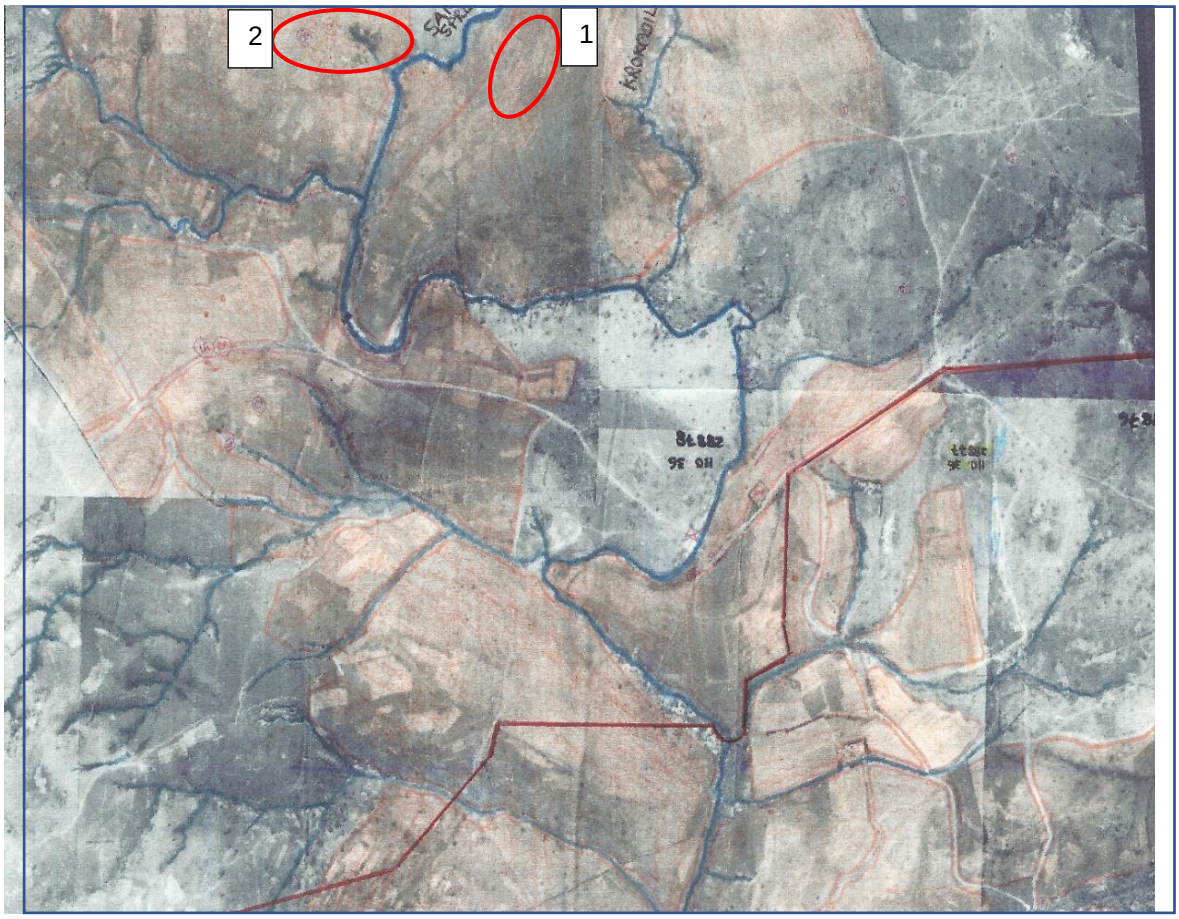


MAP 6: Section 3, which is situated on the western boundary of Krokodilspruit.

Section 3 is situated next to the western boundary of Krokodilspruit farm (see map 6). The area for the proposed Section 3 development is 46ha (figs. 27 - 38). This section consists mostly of reasonably untransformed grassland. A deep gulley forms the southern boundary

69 Deacon, AR., Krokodilspruit Screening Report, p. 4.
70 Rowe, C., Phase 1 AIA/HIA for the proposed agricultural development of the farm, Krokodilspruit 247JT, White River, Mpumalanga Province, 2018.

of the site, and a large, wooded drainage line forms the south-eastern boundary. [71] The survey was conducted in April 2022 and the vegetation (grassland) was dense. Visibility was restricted, although all open areas were inspected for any signs of an archaeological or historical nature (figs. 31, 33 & 38). Rocky sections occur towards the north of this section. No archaeological or historical remains were identified in Section 3.



MAP 7: A combination of aerial maps from 1936, show the extent of the cultivated lands (orange), on the farm.

RIVER CROSSING:

A River crossing is planned to the east of Section 2 (figs. 39 -41). The crossing will be over a solid rock bank and there are no archaeological or historical remains within this section. Technically the ecozone representing this area is referred to as *Lowveld Sour Bushveld* (Acocks, 1952 and Low & Rebelo 1996). The distribution is from the lower eastern slopes and hills of the north-eastern escarpment from Mariepskop in the north through White River and Nelspruit, terminating in the south (Barberton area). [72]

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71 Deacon, AR., Krokodilspruit Screening Report, p. 5.
72 Personal Communication: Dr. Andrew Deacon, 2018-11-22 / 2022-03-28.

Vegetation includes dense woodland, including many medium to large shrubs often dominated by *Parinari curatellifolia* and *Bauhinia galpinii* with *Hyperthelia dissoluta* and *Panicum maximum* in the undergrowth. Short thicket dominated by *Acacia ataxacantha* occurs on less rocky sites. Exposed granite outcrops have low vegetation cover. Dominant trees include *Acacia sieberiana*, A. c*lavyi, Dichrostachys cinerea* and *Rhus pyroides* with grasses *Hyperthelia* disso*luta, Hyparrhenia* species, and shorter grass species such as *Themeda triandra* and *Loudetia simplex.* [73] [74]

The typical granite and dolerite plains have sandy soils and clayey soils in the lower areas. Most of the area is underlain by gneiss and migmatite of the Nelspruit Suite. Soils are of Mispah, Glenrosa and Hutton forms, shallow to deep, sandy or gravelly and well drained. [75] [76] [77]

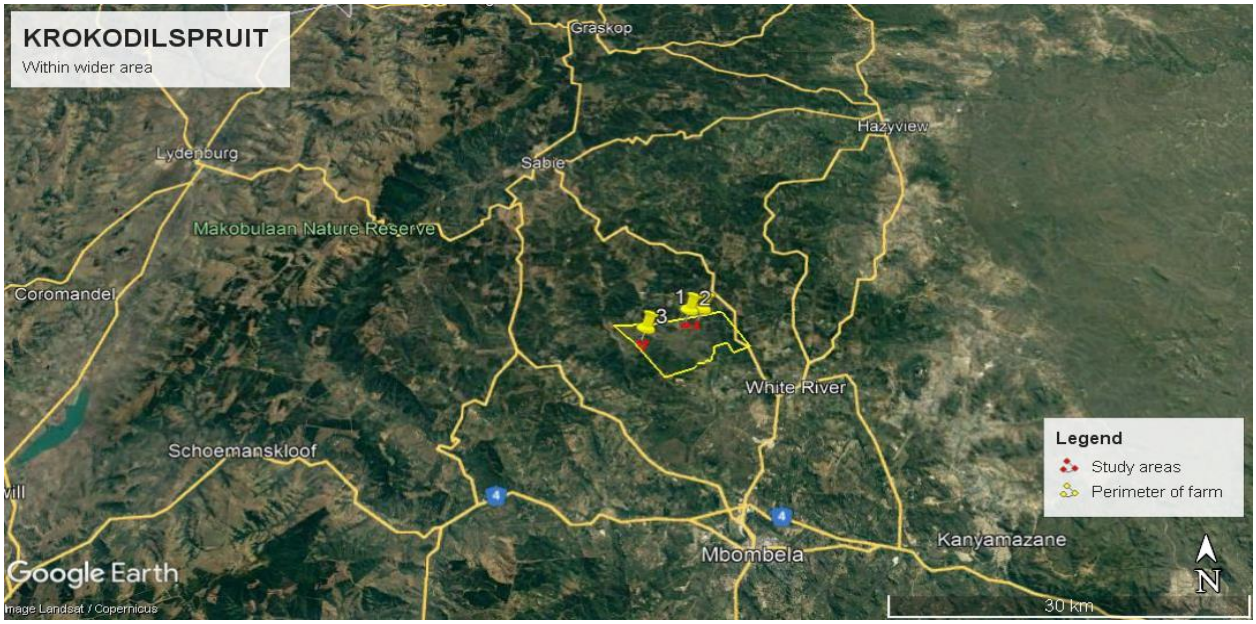
[73] Personal Communication: Dr. Andrew Deacon, 2018-11-22 / 2022-03-28.
[74] Van Wyk, B., & Van Wyk P., Field Guide to Trees of Southern Africa, 1997
[75] SANPARKS, Visitors Guide to the Kruger National Park, p. 2.
[76] Van Wyk, B., & Van Wyk P., Field Guide to Trees of Southern Africa, 1997, p. 500.
[77] Personal Communication: Dr. Andrew Deacon, 2018-11-22 / 2022-03-28.

D. LOCALITY

The proposed site for the development on the farm KROKODILSPRUIT 248JT is situated between Sabie and White River, with access from the R537 road. The study area is approximately 8 km north-west of White River. A section of the R537 road cuts through the eastern border of the farm.

The study area is indicated on the 1980 topographical map (2530BD NELSPRUIT), as well as a 1920 topographical map (Machadodorp, Degree Sheet 21), which were studied for any possible historical features (see maps 2 & 9).

The site falls within the Ehlanzeni District Municipality, and the Mbombela Local Municipal in the Mpumalanga Province (maps 1 - 11 & Appendix 2, figs. 1 – 41 for the study area).



MAP 8: The farm Krokodilspruit as seen within the wider geographical context

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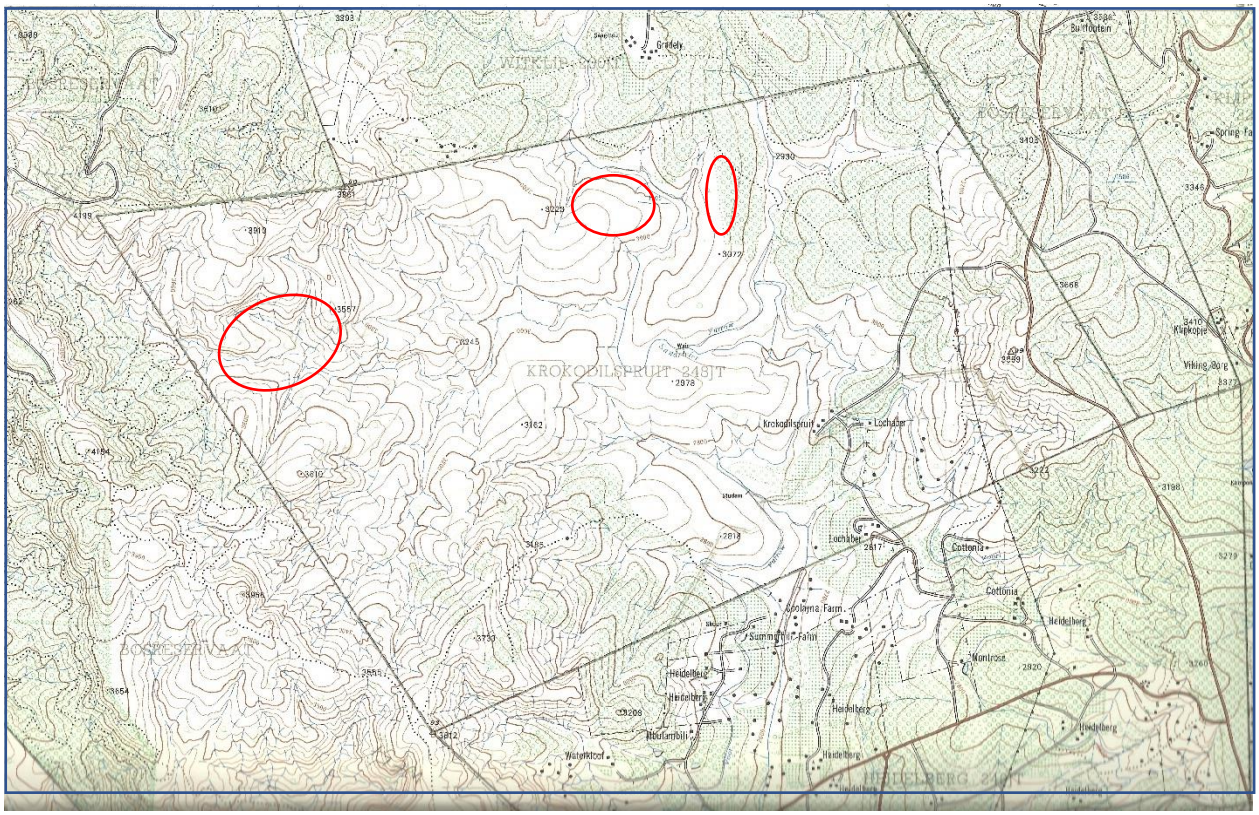

MAP 9: Topographical Map (1980) 2530BD NELSPRUIT. The three proposed sections are indicated by the red ovals.

Description of methodology:

The 1980 topographical map, (2530BD NELSPRUIT, map 9), a 1920 map (Degree Sheet 21, MACHADODORP), Google images as well as aerial images dating from 1936, were intensively studied to assess the current and historically disturbed areas and infrastructure on the farm Krokodilspruit (maps 2 - 11).

In order to reach a comprehensive conclusion regarding the cultural heritage resources in the study area, the following methods were used:

- The desktop study consisted mainly of archival sources studied on distribution patterns of early African groups who settled in the area since the 17th century, and which have been observed in past and present ethnographical research and studies.
- Literary sources, books and government publications, which were available on the subject, have been consulted, in order to establish relevant information. The previous study which was done in 2018 on Krokodilspruit, was also used.
- Specialists currently working in the field of anthropology and archaeology have also been consulted on the subject.

-Literary sources: A list of books and government publications about prehistory and history of the area were cited, and revealed some information;
-The archaeological database of SAHRA as well as the National Cultural History Museum were consulted. Heritage Impact Assessment reports of specialists who worked in the area were studied and are quoted in section B.

- The fieldwork and survey were conducted extensively by four people on foot and per vehicle. Existing tracks and paths were also used to access sections (see Appendix 1).
- The survey was conducted during late summer when the grassland vegetation was dense. Visibility was restricted. A comprehensive survey was done in 2018 when visibility was excellent, and information from the 2018 report was used, where relevant. (Appendix 1 & 2).
- The relevant data was located with a GPS instrument (Garmin Oregon 750) datum WGS 84 and plotted. Co-ordinates were within 3 meters of identified sites.
- Evaluation of the resources which might be impacted upon by the footprint, was done within the framework provided by the National Heritage Resources Act, no. 25 (1999);
- Personal communication with environmental practitioner Ralf Kalwa, [78] as well as the Mr. J. Manhique (who accompanied us during the survey), [79] and the previous owner Mr. Peter Beckenstrater, [80] (for the previous survey), were held.

GPS co-ordinates were used to locate the perimeters and any heritage features within the study areas:

GPS CO-ORDINATES			
Location	**South**	**East**	**Elevation**
Section 1	S 25° 16' 11.75"	E 30° 55' 50.52"	924m
Section 2	S 25° 16' 08.30"	E 30° 55' 13.75"	933m
Section 3	S 25° 17' 23.99"	E 30° 52' 49.02"	1099m
River Crossing	S 25° 16' 02.52"	E 30° 55' 28.04"	898m

[78] Personal communication: Environmental Practitioner, Mr. Ralf Kalwa, 2022-03-25.
[79] Personal communication: Farm Supervisor: Mr. Josiah Manhique, 2022-04-13.
[80] Personal communication: Previous Owner, Mr. P. Beckenstrater, 2018-10-08.

E. DESCRIPTION OF IDENTIFIED SITES

DANROC (Pty) Ltd., (the applicant), in co-operation with Rhengu Environmental Services, is requesting the development of agricultural land on three sections to a total of 74ha (Section 1 is 8.42ha, Section 2 is 17ha and Section 3 is 46ha). Sections 1 & 2 are mainly transformed land, while Section 3 is untransformed on the farm Krokodilspruit 248JT (maps 3 - 6). [81] The survey took place in late summer and the vegetation in the proposed areas was dense and lush. The general terrain varied from even and accessible (for Sections 1 & 2), to more difficult to access in Section 3. Visibility was restricted and information was used from the 2018 survey, which was done for the same property (see Appendix 2, figs. 1 – 41). The features which were identified during the 2018 investigation, are discussed below.

All comments should be studied in conjunction with the maps, figures and appendices, which indicate the study area, and which correspond with the summary below. Photographs in Appendix 2 show the general view of the study area, as well as the heritage features which were identified (figs. 22 - 26).

A 1920 topographical map (map 2) does not indicate any historic or pre-historic settlements directly in, or close to the study area. The 1980 topographical map (map 9), indicate a hut settlement with a distinct footpath in the south-western corner of the farm, as well as distinct footpaths in the eastern section of the farm (south to north). A Late Iron Age (LIA) stone wall was observed in the eastern section but falls outside of the study area. Hut settlements were also indicated in the south-eastern section.

Eight aerial photographs of the farm, dating from 1936, were studied to establish the extent of previously cultivated lands. Vegetables and fruit were in great demand in the White River district between the First- and Second World Wars (see section B). Large sections on the farm Krokodilspruit were under cultivation (see orange sections on map 7 & Appendix 2). Water furrows (earth canals) were established to supply water to cultivated lands during this time (early 20th century). These furrows were lined with concrete during 1960. [82] The water furrows are not within the current study area and will not be discussed in this report.

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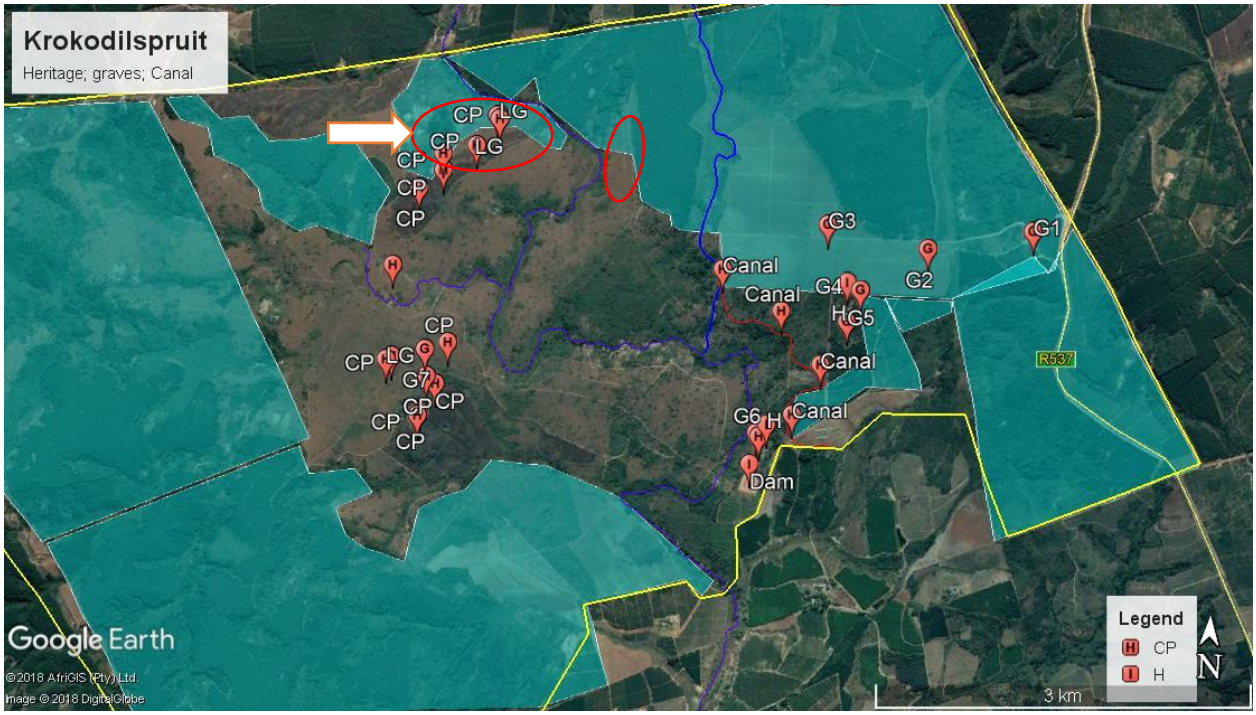
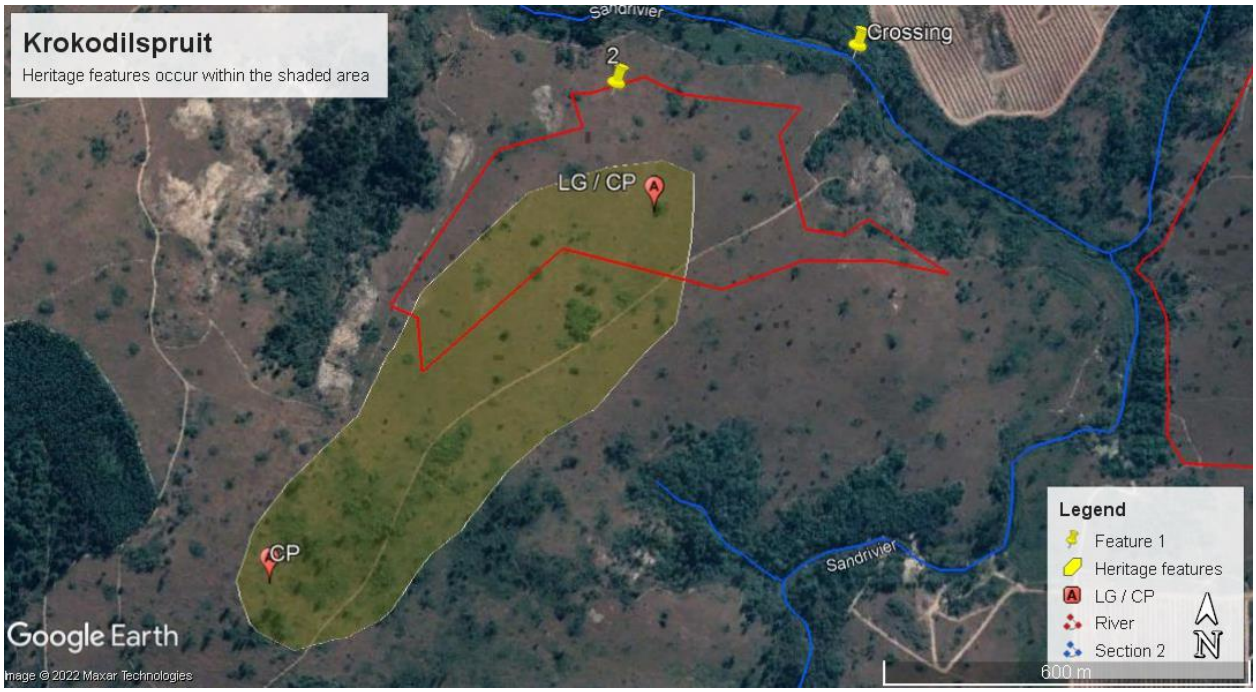
[81] Deacon, AR., Krokodilspruit Screening Report, p. 5.
[82] Personal communication: Previous Owner, Mr. P. Beckenstrater, 2018-10-08.



MAP 10: Google image of the position of all heritage features and graves which were identified during the 2018 survey. Only the clay potsherds (CP) and Lower grinders (LG), fall within the current study area (Section 2, which is indicated by the arrow).



MAP 11: Section 2 where heritage features (clay potsherds = CP, and Lower Grinders = LG, were identified during the 2018 survey. The shaded area indicates the distribution within as well as outside of the current study area.

Features which were observed during the 2018 survey (see maps 10 & 11):

Feature/Site	Description / Comments	Site Location
LIA HERITAGE FEATURES		
Lower grinders Clay potsherds	Fragments of clay potsherds scattered over a wide area, in various sizes. Some have a distinct rim and only one had an incised decoration. (Inside study area, Section 2). Figs. 22 - 26	25°16'29.34"S 30°54'52.66"E **(outside study area)** Between Elev. 957 & 937m 25°16'09.10"S 30°55'14.62"E

F. DISCUSSION ON THE FOOTPRINT OF THE PROPOSED DEVELOPMENT

ACT	*COMPONENT*	*IMPLICATION*	*RELEVANCE*	*COMPLIANCE*
NHRA	S 34	Impact on buildings and structures older than 60 years	None	None
NHRA	S35	Impacts on archaeological heritage resources	Clay potsherds & Lower grinders out of archaeological context	None
NHRA	S36	Impact on graves	None	None
NHRA	S37	Impact on public monuments	None present	None
NHRA	S38	Developments requiring an HIA	Development is a listed activity	HIA done
NEMA	EIA regulation	Activities requiring an EIA	Development is subject to an EIA	HIA is part of EIA

- **Summarised identification and cultural significance assessment of affected heritage resources: General issues of site and context:**

Context		
Urban environmental context	No	NA
Rural environmental context	No	NA
Natural environmental context	No	NA
Formal protection (NHRA)		
(S. 28) Is the property part of a protected area?	No	NA
(S. 31) Is the property part of a heritage area?	No	NA
Other		
Is the property near to or visible from any protected heritage sites	No	NA
Is the property part of a conservation area of special areas in terms of the Zoning scheme?	No	NA
Does the site form part of a historical settlement or townscape?	No	NA
Does the site form part of a rural cultural landscape?	No	NA
Does the site form part of a natural landscape of cultural significance?	No	NA
Is the site adjacent to a scenic route?	No	NA

Context		
Is the property within or adjacent to any other area which has special environmental or heritage protection?	No	NA
Does the general context or any adjoining properties have cultural significance?	No	NA

Property features and characteristics		
Have there been any previous development impacts on the property?	Yes	Agriculture & Forestry
Are there any significant landscape features on the property?	No	NA
Are there any sites or features of geological significance on the property?	No	NA
Does the property have any rocky outcrops on it?	Yes	Rocky outcrops occur
Does the property have any fresh water sources (springs, streams, rivers) on or alongside it?	Yes	Drainage lines & Sandspruit & Krokodilspruit rivers

Heritage resources on the property		
Formal protection (NHRA)		
National heritage sites (S. 27)	No	NA
Provincial heritage sites (S. 27)	No	NA
Provincial protection (S. 29)	No	NA
Place listed in heritage register (S. 30)	No	NA
General protection (NHRA)		
Structures older than 60 years (S. 34)	No	NA
Archaeological site or material (S. 35)	Yes	See evaluation
Graves or burial grounds (S. 36)	No	NA
Public monuments or memorials (S. 37)	No	NA
Other		
Any heritage resource identified in a heritage survey (author / date / grading)	No	NA
Any other heritage resources (describe)	No	NA

NHRA S (3)2 Heritage resource category	***ELEMENTS***	***INDICATORS OF HERITAGE SIGNIFICANCE***										***RISK***
		Historical	Rare	Scientific	Typical	Technological	Aesthetic	Person or community	Landmark	Material condition	Sustainability	
Buildings / structures of cultural significance	No	-	-	-	-	-	-	-	-		-	NA
Areas attached to oral traditions / intangible heritage	No	-	-	-	-	-	-	-	-	-		NA
Historical settlement/ townscapes	No	-	-		-	-	-	-	-	-	-	NA
Landscape of cultural significance	No	-	-	-	-	-	-	-	-	-	-	NA
Geological site of scientific/ cultural importance	No	-	-	-	-	-	-	-	-	-	-	NA
Archaeological sites	Yes	-	-	-	-	-	-	-	-	-	-	No risk as material is out of context – see evaluation

NHRA	*ELEMENTS*	*INDICATORS OF HERITAGE SIGNIFICANCE*										*RISK*
Grave / burial grounds	No	-	-	-	-	-	-	-	-	-	-	NA
Areas of significance related to labour history	No	-	-	-	-	-	-	-	-	-	-	NA
Movable objects	No	-	-	-	-	-	-	-	-	-	-	NA

- **Summarised recommended impact management interventions**

NHRA S (3)2 Heritage resource category	***SITE***	***IMPACT SIGNIFICANCE Cultural significance rating***		***Impact management***	***Motivation***
		Cultural significance	***Impact significance***		
Buildings / structures of cultural significance	No	No	None	None	NA
Areas attached to oral traditions / intangible heritage	No	None	None	-	NA

NHRA S (3)2 Heritage resource	***SITE***	***IMPACT SIGNIFICANCE Cultural significance rating***		***Impact management***	***Motivation***
Historical settlement/ townscape	No	None	None	-	NA
Landscape of cultural significance	No	None	None	-	NA
Geological site of scientific/ cultural importance	No	None	None	-	NA
Archaeological sites	Yes	None	None	No impact	No risk as the material is out of context and therefore of no significance
Grave / burial grounds	No	No	None	-	NA
Areas of significance related to labour history	No	None	None	-	NA
Movable objects	No	None	None	-	NA

ACT	***COMPO-NENT***	***IMPLICATION***	***RELEVANCE***	***COMPLIANCE***
NHRA	S 34	Impact on buildings and structures older than 60 years	None present	None
NHRA	S35	Impacts on archaeological heritage resources	Clay potsherds & lower grinders - out of historical / archaeological context	None needed
NHRA	S36	Impact on graves	None present	None
NHRA	S37	Impact on public monuments	None present	None
NHRA	S38	Developments requiring an HIA	Development is a listed activity	Full HIA
NEMA	EIA regulation	Activities requiring an EIA	Development is subject to an EIA	HIA is part of EIA

G. STATEMENT OF SIGNIFICANCE & EVALUATION OF HERITAGE RESOURCES

Section 38 of the NHRA, rates all heritage resources into National, Provincial or Local significance, and proposals in terms of the above are made for all identified heritage features.

- **Evaluation methods**

Site significance is important to establish the measure of mitigation and / or management of the resources. Sites are evaluated as *HIGH (National importance), MEDIUM (Provincial importance) or LOW, (local importance),* as specified in the NHRA. It is explained as follows:

- **National Heritage Resources Act**

The National Heritage Resources Act no. 25, 1999 (NHRA) aims to promote good management of the national estate, and to enable and encourage communities to conserve their legacy so that it may be bequeathed to future generations. Heritage is unique and it cannot be renewed and contributes to redressing past inequities.[83] It promotes previously neglected research areas.

All archaeological and other cultural heritage resources are evaluated according to the NHRA, section 3(3). A place or object is considered to be part of the national estate if it has cultural significance or other special value in terms of:
(a) its importance in the community, or pattern of South Africa's history;
(c) its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
(g) its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
(h) its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.[84]

- **The significance and evaluation of the archaeological and cultural heritage features on the farm Krokodilspruit 248JT, during the 2022 investigation:**

SAHRA regards all graves and burial sites (inside or outside of the study areas), as of high significance, but none were identified during the survey of the proposed Sections 1, 2 & 3, and the River crossing, on the farm.

Please note that the evaluation and discussion below is only applicable to heritage resources which will be impacted upon by the proposed agricultural development (inside the study

[83] National Heritage Resources Act, no. 25 of 1999. p. 2.
[84] National Heritage Resources Act, no. 25 of 1999. pp. 12-14

area), unless otherwise worthy of mentioning. The significance and evaluation of the archaeological and cultural heritage features can be summarized as follows:

LIA / RECENT HERITAGE FEATURES:

Site	***Cultural Heritage Features***	***Significance***	***Measures of Mitigation***
Clay potsherds, Lower Grinders,	**INSIDE STUDY AREA: SECTION 2** None of these features are within an archaeological context. They have already been impacted upon by previous agricultural development. It is also argued that they may have been used in recent times as these items are still widely used in rural areas today	**LOW**	No mitigation measures are recommended (as they are not in any clear archaeological context).

Recommendation & discussion:

LIA/RECENT Heritage features:

Many fragments of clay potsherds and lower grinding stones which may be associated with the Late Iron Age, were observed in and outside of the study area. The clay potsherds in particular were all small fragments as they were mainly found in historically disturbed agricultural lands (figs. 22 – 26). None of these features are within an archaeological context and they have already been impacted upon by previous agricultural developments. The possibility exists that the cultural material, potsherds and lower grinders, are of a more recent nature, as the 1980 topographical map (map 9), also indicate footpaths and huts, which suggest recent settlement on the farm. Clay pots and grinding stones (upper and lower), are still widely used in rural areas, today. There is no cultural value to these objects which could link them as of outstanding importance to a certain community (NHRA 3.3a); or its potential to yield social, cultural or spiritual information or to link it to a particular community which may contribute to an understanding of South Africa's cultural heritage (NHRA 3.3c & g).[85] No mitigation is recommended.

[85] National Heritage Resources Act, no. 25 of 1999.

H. CONCLUSION

It is not believed that the archaeological features which were identified during the 2018 survey in Section 2, have any significance in terms of historic or cultural value which might prevent the proposed development to continue. No other archaeological-, historical- or cultural material, or graves were identified in the sections for the proposed agricultural development.

Archaeological material or graves are not always visible during a field survey and therefore some significant material may only be revealed during the agricultural development. Based on the survey and the findings in this report, Adansonia Heritage Consultants state that there are no compelling reasons which may prevent the proposed development (in Sections 1, 2, & 3 and the River Crossing) to continue. It is recommended that an assessment and recommendation be done by a qualified archaeologist, should any other archaeological material be found during development activities.

Adansonia Heritage Consultants cannot be held responsible for any archaeological material or graves which were not located during the survey.

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PERSONAL INFORMATION

- Personal communication: Dr. Andrew Deacon, 2022-03-28 & 2018-11-22.
- Personal communication: Rhengu Environmental Services, Ralf Kalwa, e-mail access: 2022-03-25.
- Personal communication: Previous owner: Mr. P. Beckenstrater, 2018-10-08.

MISCELLANEOUS

- Aerial Photographs: 1936, Maps provided by Mr. W. Hearne, 2018-09-20.
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- Map: 1920 Topographical Map: Machadodorp Degree Sheet no. 21.
- Rhengu Environmental Services, Notice of EIA, 22 November 2018.
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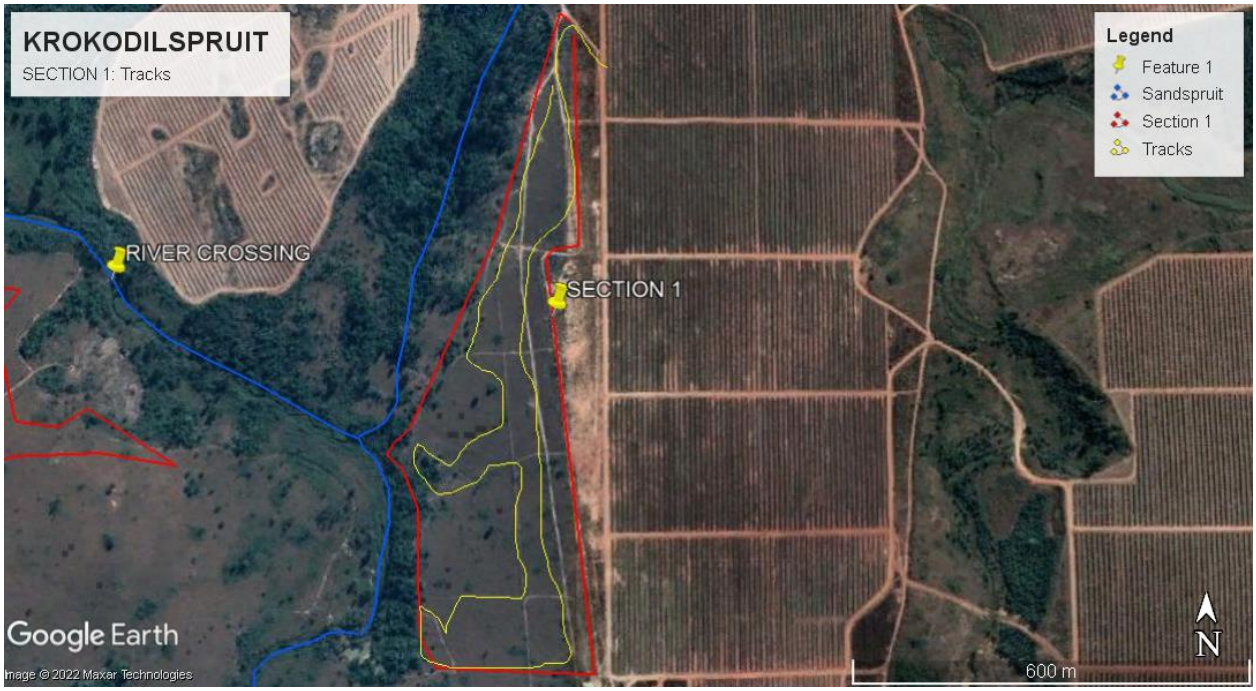
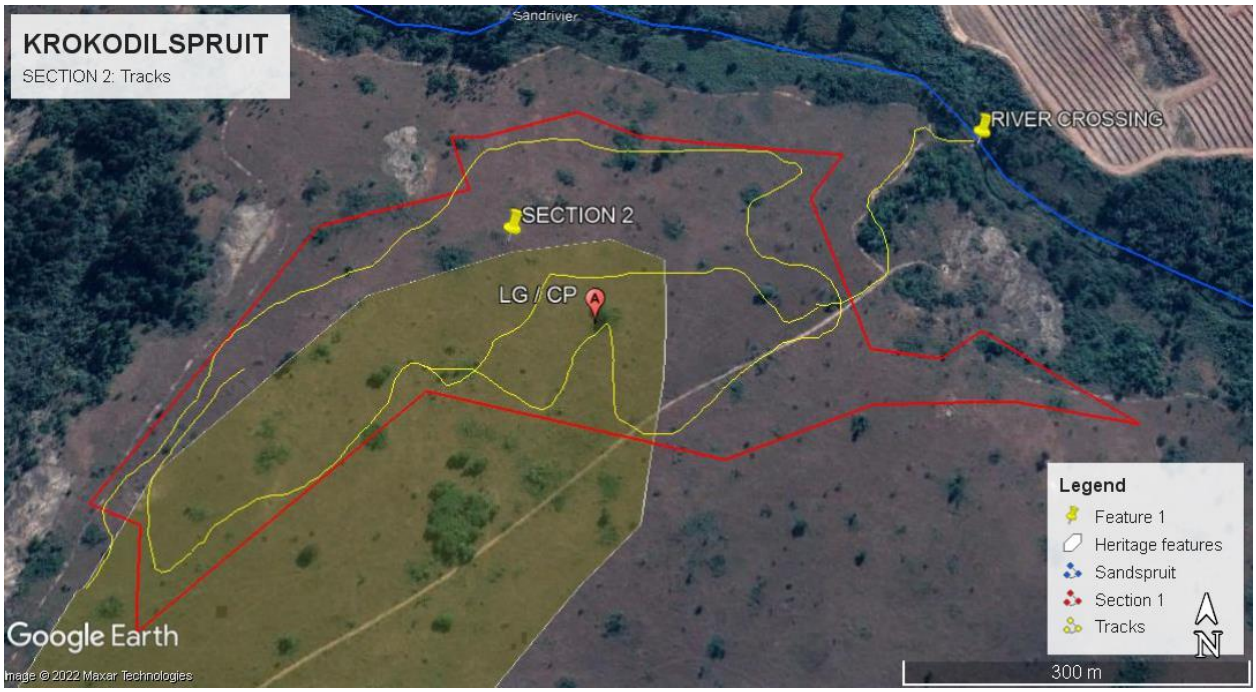
APPENDIX 1

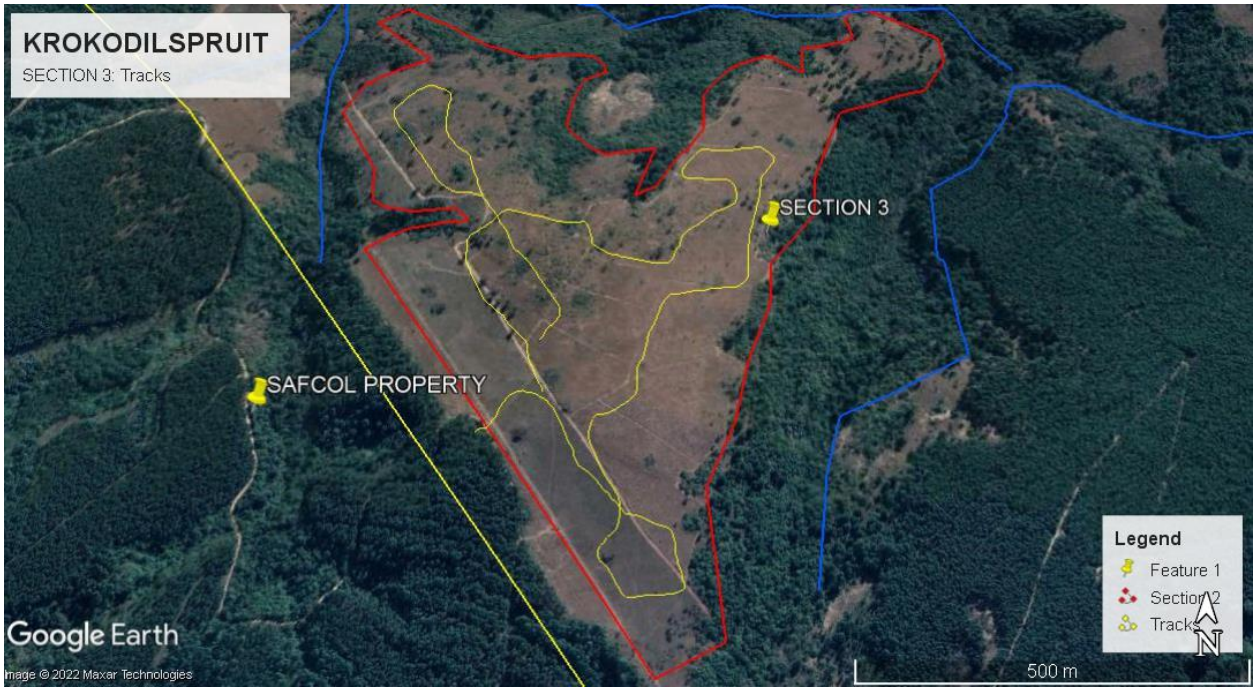
Track and Paths used to access the study area



Tracks and paths which were used on Section 1.



Tracks and paths which were used on Section 2 & River Crossing.



Tracks and paths which were used on Section 3.

APPENDIX 2: PHOTOGRAPHIC DOCUMENTATION KROKODILSPRUIT 2022
SECTION 1:

Fig. 1: A general view of Section 1 – the grass cover was dense and visibility was restricted at the time of the survey.

Fig. 2: A general view from the eastern border to the west (the river is towards the west where the tree line is situated.

Fig. 3: A general view from the western section towards the east.

Fig. 4: A view from the southern boundary road towards the river in the west.

Fig. 5: A view from the northern section to the south. The access road in the middle of Section 1 is visible.

Fig. 6: A view from the south to north, where the northern section ends.

Fig. 7: The southern section of the study area has pioneer vegetation, which indicates previously disturbed areas.

Fig. 8: Sections in the south where pioneer vegetation is visible.

Fig. 9: Middle of study area: Open road sections were investigated for any signs of archaeological material.

Fig. 10: Another view of the middle of section 1 facing north. All open areas were investigated for any signs of archaeological remains.

SECTION 2:

Fig. 11: Section 2 as seen from the east – from Section 1.

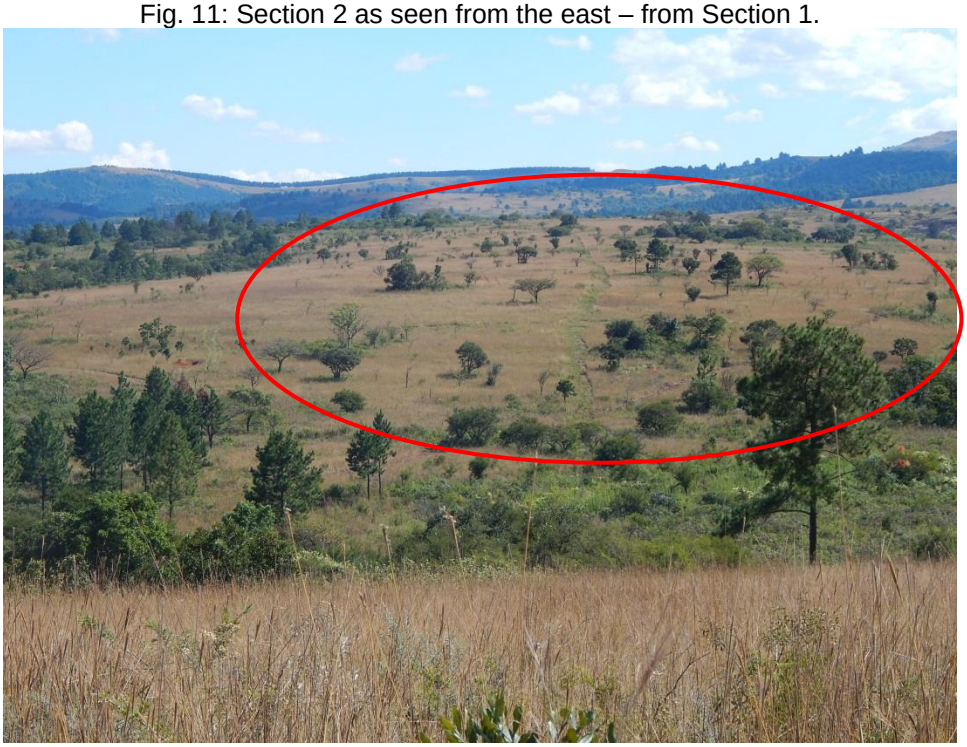


Fig. 12: A closer view of Section 2 as seen from Section 1. The Krokodilspruit River is in the gravity low area.

Fig. 13: A general view of Section 2.

Fig. 14: A few rocky outcrops are present in the western section of the study area.

Fig. 15: A general view of Section 2 from east to west.

Fig. 16: A general view of Section 2 from west to east.

Fig. 17: A general view of Section 2 from north to south.

Fig. 18: All open sections were investigated for any signs of an archaeological nature. (Photograph taken from east facing west).

Fig. 19: Soil test pits were studied for any possible archaeological remains.

Fig. 20: Soil test pits were studied for any possible archaeological remains.

The following photographs were used from the 2018 survey when visibility was excellent. A part of Section 2 was also investigated during that time:

Fig. 21: The study area (section 2) during the 2018 survey. The area had been burnt and visibility was excellent. Sections in the study area (Section 2), were previously cultivated lands.

Fig. 22: The north-eastern section of the study area: Lower grinders and potsherds were observed in previously cultivated lands (photograph taken in 2018).

Fig. 23: One clay potsherd had a distinct incised pattern. Photograph taken in 2018.

Fig. 24: Several lower grinding stones were observed in the northern section. Photograph taken in 2018.

Fig. 25: Clay potsherds were scattered on the north-western side of Section 2. Photograph was taken in 2018.

Fig. 26: Another clay potsherd with a distinct rim, which was observed in the north-western side of Section 2 during 2018.

SECTION 3:

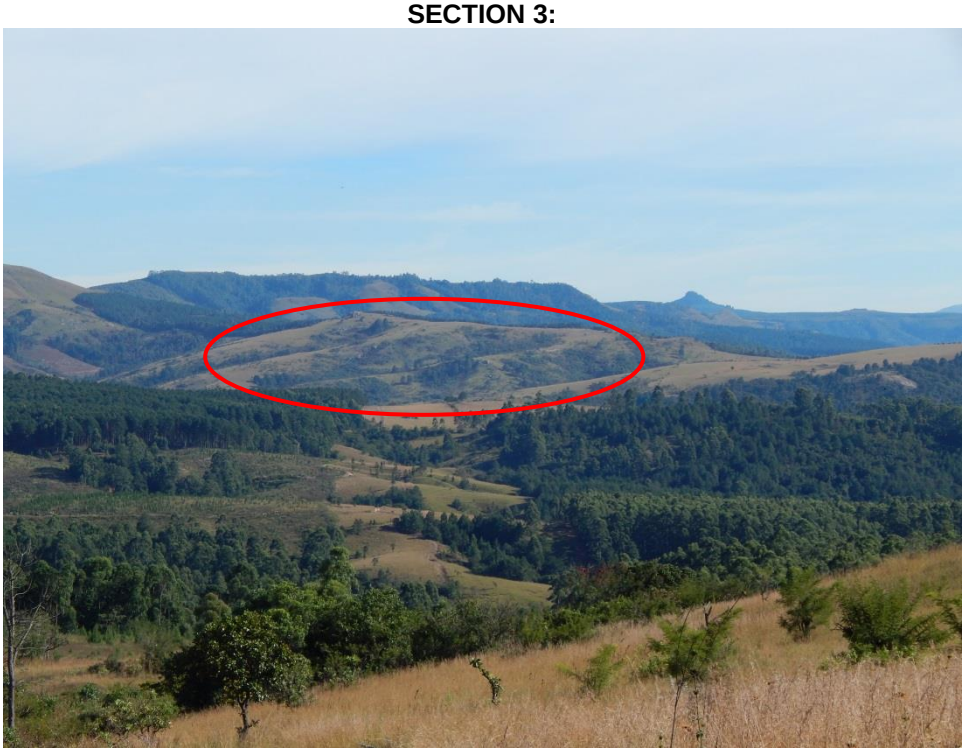


Fig. 27: Section 3 is situated on the western boundary of Krokodilspruit, at a higher elevation.

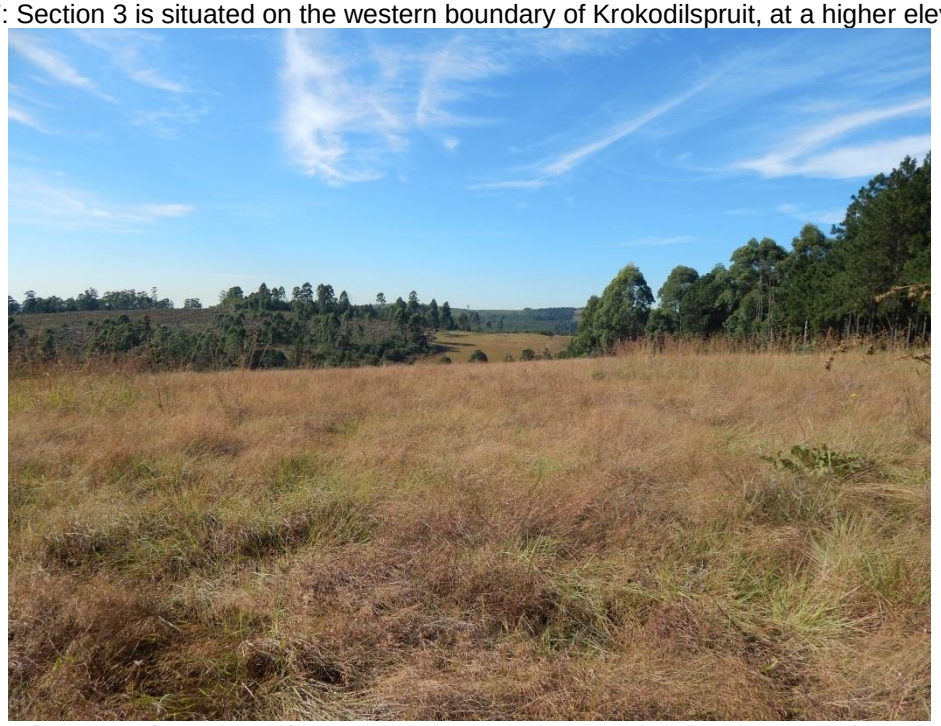


Fig. 28: **Southern section of Section 3**: View from north to south. The SAFCOL plantation is visible to the right, which forms the western boundary of Krokodilspruit.

Fig. 29: **Southern section of Section 3**: View from north to south.

Fig. 30: **Southern section of Section 3**: View from south to north. The SAFCOL plantation is to the left.

Fig. 31: **Northern section of Section 3:** View from north to south. The access road in the middle of the study area is visible.

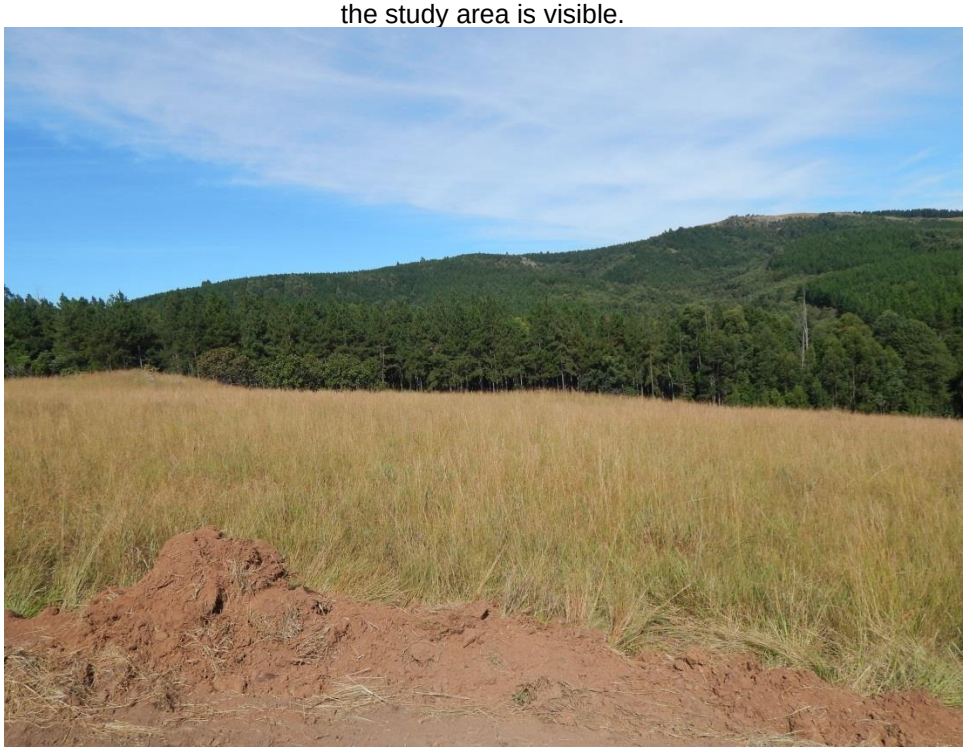


Fig. 32: **Northern section of Section 3:** View from north to south. The SAFCOL plantation is directly to the front.

Fig. 33: **Northern section of Section 3:** View from south to north.

Fig. 34: **Eastern section of Section 3:** View from west to east.

Fig. 35: **Eastern section of Section 3:** View from west to east.

Fig. 36: **Eastern section of Section 3:** View from east to west.

Fig. 37: **Eastern section of Section 3:** View from east to west.

Fig. 38: **Eastern section of Section 3:** View from east to west.

PROPOSED RIVER CROSSING OVER SANDSPRUIT:

Fig. 39: The path to the proposed river crossing.

Fig. 40: The section next to the river where the river crossing is proposed.

Fig. 41: The proposed river crossing area is over a solid rock bank in the Sandspruit River.

APPENDIX 5:
ENVIRONMENTAL MANAGEMENT PROGRAMME

ALTERATION OF NATURAL LAND AND TRANSFORMED LAND (OLD LANDS) FOR AGRICULTURAL USE AND CLEARANCE OF AN AREA OF 80 HA AND THE CONSTRUCTION OF A LOW-LEVEL CROSSING ON THE FARM: KROKODILSPRUIT 248 JT: WHITE RIVER AREA, MPUMALANGA. PROJECT NR.: 1/3/1/16/1E-405.

1. ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPr): DEVELOPMENT ACTIVITIES

1.1. The environmental management programme will address the development phase of the proposed activity. This will include the harvesting of all trees and plants of commercial value by wood carvers; builders; carpenters and nurserymen. Furthermore, it will include the preparation of the orchards and the installation of services (irrigation) and construction of the low-level river crossing.

1.2. The EMPr will primarily be used by the applicant/bush clearing/construction teams under the guidance of the ECO. For this purpose the EMPr must serve a number of functions. These are:

- Instructions and conditions included in the EMPr must be written in a clear, down to earth language.
- All aspects of the EMPr must be practical and unambiguous.
- Instructions and conditions must be concise and to the point.
- Aspects of the EMPr must reflect the recommendations and mitigation measures listed in the Environmental Impact Assessment Report/s.
- Aspects of the EMPr must reflect the recommendations and mitigation measures listed in the Specialist Studies and the comments by Interested and Affected Parties/Government Departments. See **Appendices 2 and 4** in the EIR.
- The EMPr must be used to monitor compliance to the conditions stipulated in the Authorisation of the Project as issued by DARDLEA.
- Aspects of the EMPr can be referred to in an Operational Management Programme (OMPr) during future Environmental Audit Assessments.
- The EMPr must ensure the protection of the natural environment and cover all aspects of rehabilitation/sustainable preparation of the impacted sites.
- The EMPr will guide the process from initiation until sign off the project.
- **Note:** The EMPr will remain a dynamic document which can be updated with the approval by DARDLEA.

1.3. The implementation of the EMPr will be guided by an Environmental Control Officer (ECO).

- The applicant/developer is responsible for the appointment of the ECO.
- The name and contact details of the ECO must be submitted to DARDLEA once the project commences.
- All Interested and Affected Parties (I&AP's) must be informed of the name and contact details of the ECO.

1.4. Monitoring and Auditing

The Environmental Control Officer (ECO) will ensure that all the **conditions** as set out in the **Environmental Authorisation (EA**) **and any other requirements as issued by DARDLEA or any other applicable Department, e.g., DWS**, are met and implemented as stipulated.

The ECO must submit to DARDLEA, a **quarterly audit report** on the activities of the development. Quarterly audit reports will be made available to I&AP's on request.

The role of the ECO and independent audit teams are well defined within the framework of Integrated Environmental Management (IEM). The developer, together with the ECO will ensure **compliance** in terms of this process**.**

1.5. Initial Role-players: Contact Details:

1. Developer/Applicant/Representative: Warren Hearne	Cell: 083 679 9366.
2. ECO: To be appointed	Cell: To be confirmed.
3. EAP: Ralf Kalwa	Cell: 082 414 7088.

2. DEVELOPMENT PHASE: ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPr)

This programme must be read in conjunction with the **Contract Documents** for the project. This environmental management programme will address the development/preparation phase of the proposed development as described in Environmental Impact Assessment Report.

KEY ISSUES: EMPr

This programme is designed for the entire development period and includes the rehabilitation of areas where development/storage activities took place. The Contractor/Applicant (debushing agent/Krokodilspruit team), together with the Environmental Control Officer (ECO) will be responsible to ensure that all construction workers, sub-contractors, suppliers and relevant personnel associated with the development:

- Understand the contents of the Environmental Management Programme (EMPr).
- Ensure that all the construction personnel are fully aware of all environmental issues relating to the development activities.
- Adhere to all the precautionary and mitigating measures described in the EMPr.
- Ensure that all the construction personnel understand the implications and stipulations of the Environmental Rules and Regulations described in the Development Contract.
- The ECO shall instruct the Applicant/Developer to suspend the works if the Contractor and/or any Sub-Contractors do not comply with the contents of the EMPr.
- The ECO will submit **quarterly audit** reports to DARDLEA, the Contractor and the Developer.
- The EMPr describes the responsibilities of all the staff during the development phase.
- The ECO will oversee the operations and ensure compliance with the EMPr.

Non-Compliance: The Contractor/Applicant is deemed NOT to have complied with the EMPr, the Environmental Authorisation and the EIA if:

- Within the boundaries of the site, site extensions and haul/access roads there is evidence of contravention of the Specifications of the EMPr;
- Environmental damage ensues due to negligence;
- The Contractor fails to comply with corrective or other instructions issued by the ECO within a specific time-frame;
- The Contractor fails to respond adequately to complaints from the public;

2. DEVELOPMENT PHASE: ENVIRONMENTAL MANAGEMENT PROGRAMME: The ECO will monitor compliance of this EMPr		
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
1. Site Establishment and Logistics.	**1. Site Office and Logistics**: Establish a site office for the development. The Farmer's Office (Business Unit Charlie) can serve this purpose. The following procedures and equipment must be made available at the office: • Copies of the EIA and the EMPr. • Copy of the Environmental Authorisation. • Copies of the Development/Site Layout Plan (Low Level Crossing). • A Complaints Register. • A Corrective Actions and Site Instruction Register. • An Emergency/Evacuation Procedure. • A Monitoring- and Audit Register. • Emergency Contact Numbers including but not limited to telephone contact details for medical doctors; hospitals; emergency helicopters; emergency fire management; the ECO and Project/Site Manager. • Fire Extinguishers. • First Aid Kit. • A register of all applicable Standard Operational Procedures and Method Statements (e.g., handling of hazardous materials) of materials and equipment that are used and stored on site.	**Contractor or Debushing Agent.**
	2. Final Walk Inspection (Pre-Construction): A final walk through the site with the ECO to point out the presence sensitive areas, e.g., Special Plants/Habitat/Drainage Line, or any other aspect which requires protection has to be undertaken prior to site establishment.	
	• All staff must be trained to respect the importance of rare/conservation significant plants and artefacts. This is specifically applicable to the no go area around the drainage lines, rocky outcrops and buffer areas.	
	• Special features (rocky outcrops; large indigenous trees; rivers; wetland; etc.) must be indicated on the development map and demarcated on site prior to construction. Damage to such features must be rehabilitated to the satisfaction of the ECO and the developer.	
	• All drainage lines must be demarcated to ensure that all machinery is kept out of these zones.	
	• **Timing**: All development should take place in the period March-September.	
	3. Demarcation: Demarcate the boundaries of the total development site (low level crossing) for management purposes using steel droppers/standards spaced at regular intervals with a combination of nylon rope/barrier tape between the droppers. **This will be required in the vicinity of the riparian zones, rocky outcrops and sites with special plants of concern.**	

	• The Contractor shall maintain the demarcation line and ensure that materials used for construction on site do not blow on or move outside the site or pose a threat to any neighbours or adjoining property owners.	
	• Where applicable, structures must be located in such a manner as to reduce visual intrusion and minimal disturbance to neighbouring properties. Make use of coloured netting or corrugated cladding to hide unsightly features.	
	• Construction activities are restricted within these boundaries, thus all construction equipment, materials and personnel will remain within this demarcated area at all times.	
	• Ensure that access to the site including related infra-structure and machinery is restricted to authorised personnel only.	
	4. Site Control: Limit the construction/development site to existing infrastructure and or to disturbed areas.	
	• Ensure that only approved workers and Sub-Contractors are accommodated and allowed access to the site.	
	5. Site Facilities: The construction site and storage areas must be safeguarded against fire. • Ensure that the Contractors Site is fully functional in terms of water- and sewerage supply (temporary toilets) prior to the contractors coming on site.	
	• Contractor to be held responsible for providing construction-, drinking- and washing water for all the activities on site.	
	6. Access Routes and Control: No temporary access routes and haul roads are required for this activity. • No vehicle movement outside demarcated areas/routes/existing roads is permitted without authorisation from the ECO.	
	• Dust control measures, i.e., dampening access routes with water, must be implemented where necessary.	
	• Damage to any existing roads as a result of construction activities will be repaired to the satisfaction of the ECO and the Applicant/Developer.	

	7. Storage- and Material Laydown Areas: The need for laydown/storage areas will be minimal however irrigation piping, pumps, cement, re-inforcing etc. will require a site when these materials are delivered and until these items are installed/used.	
	• All equipment, materials; pipelines etc. must be stored at the farm maintenance centre (Business Unit Charlie).	
	8. Site Closure: Once the development period e.g., bridge crossing site has been completed the following conditions will apply:	
	• The Contractor shall ensure that all temporary structures/facilities, equipment, materials and waste used for construction activities are removed after completion of development.	
	• The contractor shall clear and clean the construction site to the satisfaction of the ECO and the developer upon completion of the development.	
	• Remove all components of demarcation when the development phase is completed.	
	• Rehabilitate disturbed areas. This will include but not be limited to: • Break up any hardened soil surfaces allowing seeds and rainwater an opportunity to penetrate the soil surface. • Hyrdoseed the embankments with indigenous grasses if the bare areas do not recover naturally. • Brush pack/landscape bare areas and reduce the potential run off of water. • Shape/level off any unnatural areas to fit in with the surrounding landscape.	
	Site Closure: Should the site be closed for a period of more than one week, a report on compliance will be lodged with the ECO, and the following will be confirmed: • Stores will be left at as low a volume as practically possible with no leaks. • The storage area will be secure and locked. • Fire extinguishers will be serviced and accessible. • The area will be secure from accidental damages. • Emergency- and contact numbers will be available and prominently displayed. • Toilets will be empty and secured. • Refuse bins will be empty and secured. • Access to the site must be limited to authorised personnel only. • Security staff will patrol and guard the site.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
2. Site Biodiversity Management. (The ECO must be consulted at all times during this process).	**1. Vegetation Management**: Vegetation clearing must be undertaken in a judicious and responsible manner. The following approach will apply:	**Contractor or Debushing Agent and ECO where applicable.**
	• Six weeks prior to the vegetation being cleared all Protected Tree Species must be clearly marked by the ECO and DFFE/MTPA Permits must be obtained to ensure permitted removals and translocations.	
	• Local nurseries will be informed to remove all commercial plants at their own cost. The applicant must apply for MTPA permits for all removals and translocations.	
	• The developer will translocate all applicable plants/trees to the Nature Reserve as required.	
	• All other parties, e.g., carpenters, wood carvers etc. will be given an opportunity to remove wood for building, carving and woodcraft purposes.	
	• The debushing agent will remove all the remaining vegetation and clear the land for orchards.	
	• **Vegetation Clearing:** During the clearing of vegetation in the project area most vertebrates will move away from the project site. • During this activity the project team may encounter slow moving reptiles and smaller mammals. These animals should be allowed to move away unharmed or be assisted and relocated to the Nature Reserve Area.	
	• **Riparian Corridor:** All drainage lines and riparian zones as identified by the Project Ecologist will be kept intact. The riparian zones will act as a corridor for migrating fauna.	
	2. Alien Invader Plants: Control of alien invasive species will be undertaken on the development footprint in line with the requirements of the Conservation of Agricultural Resources Act. The ECO will identify plants (where applicable) which require removal and management. The applicant has commenced with this process as part of his Best Practice philosophy.	
	• Alien invasive plant material will be preferentially removed through mechanical means (e.g., chainsaw, hand-pulling of smaller specimens).	
	• Chemical control is only required as a last resort or as a support mechanism to control coppicing and sprouting.	
	• All exotic plants must be identified and earmarked for removal. The ECO will assist with identifications (where applicable).	
	• A number of workers must be used to remove the vegetation i.e., 4/6 workers. ECO to monitor.	
	• If during the establishment period, any noxious or excessive weed growth occurs, such vegetation will be removed by the contractor.	

	3. Fauna and Flora Management: Collection of firewood/seeds/fruit/plants/animals or any biological material (where applicable) is strictly prohibited.	
	• No animals including snakes should be killed or injured by workers during the construction- and or the operational phases of the project.	
	• No poaching will be allowed on site.	
	• The Contractor is not allowed to deface, paint or mark and/or damage natural features/vegetation on the site.	
	4. Topsoil Protection: Topsoil will have to be removed/moved from all areas where pipelines are to be installed.	
	• Topsoil to be handled twice only; once to strip and stockpile (in low heaps of 1m) in the Right of Way (ROW) next to the trench and secondly to replace along the contour, level, shape and scarify.	
	• The topsoil must be replaced as soon as possible.	
	• Topsoil may not be compacted, nor should any object be stored or stockpiled upon it.	
	• No vehicle traffic will be allowed on the topsoil.	
	• The Contractor shall prevent pollution incidents on the topsoil. ECO to monitor.	

	• **Biodiversity Protection: See Appendices 1 and 4.5.2. Refer to applicable maps.** • **Mitigation 1: Important Areas are protected in some form or another:** • **CBA optimal**: All the CBA areas are incorporated either in the buffered Eastern Dry Afrotemperate Forest, the Nature Reserve or the buffered drainage lines and no development will take place in these areas. • **Other natural areas (ONAs)**: All three of the proposed project areas (approximately 71.0 ha) are located in ONAs. • **Moderately modified (Old lands)**: A portion of Site 1 will be situated on an old land (approximately 1.51 ha). • **General Comment:** Should the application to clear the additional 72.5 ha of land be granted, 70.9 ha of Untransformed North-eastern Mountain Grassland and 1.51 ha of secondary grassland will be affected. • The 475 ha of Untransformed Grassland protected in 2018 will be reduced to 404 ha. However, more than 50 ha of grasslands have been allocated to the *Aloe simii* buffers and thus the grassland in these protected patches will also be secured, resulting in approximately 458 ha of Untransformed Grassland being protected. • Finally, the original 64% of Untransformed Grassland which was protected on the farm, has been reduced to 62% of Untransformed North-eastern Mountain Grassland. • Although there will be a 2% reduction in protected grassland more than 50ha of rare aloe populations will be protected. These buffer areas will link up as ecological corridors with the Nature Reserve.	
	• **Mitigation 2: Ecological Corridors:** The corridors created by buffers connect the CBA areas and most of the farm with the proposed Nature Reserve. • This network (including the areas around the rare aloe) will provide viable corridors and dwellings for animals undertaking a range of movements, including daily or regular movements, seasonal and migratory movements, dispersal movements and range expansion. • The protected network, which includes the proposed Nature Reserve will be a sanctuary for both animals and plants, which includes a number of potential Red Data- and protected species.	

	• **Summary of Impact Mitigation on Biodiversity Components**: **ECO to monitor and control**: • **Impact 1:** River Crossings. • **Mitigation Description:** • A low-level river crossing is envisaged to accommodate equipment and vehicles during harvesting- and general farming operations. • The structure will be a basic, low level concrete crossing with concrete pipes or culverts. • **Erosion Control**: Erosion control should be implemented in the bank cuttings towards the crossing. During construction, the Contractor shall protect all areas susceptible to erosion by installing necessary temporary and permanent drainage works as soon as possible and by taking any other measures necessary to prevent storm water from concentrating in streams and scouring slopes, banks, etc. The use of silt fences, turbidity barriers, sedimentation ponds, cofferdams and the timely mulching and seeding or sodding of roadway slopes and other exposed areas will reduce runoff and siltation for all of the build alternatives. • **Timing:** Work should be undertaken during the dry winter months when there is low flow in these systems; thus, low impact on flow of water or any biota utilising the system. • **Vegetation**: Clearing of natural vegetation shall be kept to a minimum. The removal, damage and disturbance of natural vegetation without the written approval of the ECO are prohibited. Removal of any vegetation should be mitigated by replanting the original species where possible. • **Coffer Dams**: The use of coffer dams should be avoided, where practical, and if necessary, should only be considered in consultation with a riverine specialist. During construction, flow-diversion is necessary to ensure the delivery of flows to the downstream channel. If a cofferdam is required, and this is constructed from sandbags, the entire structure must be covered with bidum or a suitable geo-textile to prevent breakage of bags in the event of unanticipated high runoff events. The cofferdam can serve to trap any sediments which may wash towards the downstream channel. Any such sediments must be physically removed with earth moving equipment from the channel before the cofferdam is removed. • **Flow:** The pipes/culverts underneath the bridge must be large enough to let free flow through and the bottom circumference should be covered by the water level without a fall of more than 15 cm on the downstream side. Debris obstructing free flow should be actively removed.	

	• **Impact 2:** Clearing of approximately 72 ha of transformed and untransformed land types. • **Mitigation Description:** Avoid environmentally sensitive areas identified on the Sensitivity Mapping exercise and maintain a high regard for all the buffers introduced to protect these areas. • More than 50ha of grassland have been allocated to the *Aloe simii* buffers and thus the grasslands in these protected patches will also be secured. • Together with areas already set aside for conservation approximately 458 ha of Untransformed Grassland will be protected. • Before clearing, demarcate the extent of the orchards footprint and ensure that clearing impacts are contained within this area and do not affect areas of natural habitat. • Limit the removal of vegetation to the development footprint only.	
	• **Impact 3:** Erosion and siltation**.** • **Mitigation Description:** • **Vegetation Clearing**: Clearing and development should take place during the driest time of the year, however unexpected storm events can happen at any time. Clearing time should be kept as short as possible and planting or rehabilitation of cleared or excavated areas should commence as soon as the development activity is completed. • **Erosion and Run-off Protection**: Management actions should be implemented, i.e., the re-establishment of indigenous vegetation wherever possible, control of storm water run-off and ongoing repair and stabilisation of any erosion. Where steeper slopes are cleared of vegetation, stop-boards should be erected at the commencement of clearing to prevent wash-off down-slope. • **Sediment Control**: Strict measures must be taken to prevent erosion and sediment-laden water from entering the adjacent watercourses. Storm water management measures are to be included in roadways especially at water course crossings. The vegetated riparian buffer zone should remain intact along all watercourses to facilitate the containment of sediment-laden run-off from orchards. • Sediment basins (including debris basins, desilting basins or silt traps) shall be installed at the project site in conjunction with the initial grading operations and maintained through the development process to remove sediment from runoff waters. • Sediment traps are considered temporary structures and often placed at the site on an “as needed” basis by field personnel. Construct traps of rock (mixed with smaller stone), rock-filled fibre bags, or use approved commercial sediment trap products installed and spaced according to manufacturer’s instructions. Silt fences and straw bales are used to form silt traps and dykes to keep sediment from washing downstream during excavation and other activities that disturb soil at crossings and that could lead to temporary sediment flushing. • **Note:** The two low level crossings that were approved during the 2019 EIA process, were constructed successfully in 2022 taking into account all the conditions listed above. Both crossings were signed off during a final audit survey in November 2022.	

	• **Impact 4**: Habitat fragmentation. • **Mitigation Description**: • A network of corridors is provided by buffers on the Krokodilspruit Farm: • Buffers around rivers; • Buffers around drainage lines; • Buffers around wetlands; • Buffers around inselbergs; • Buffers around *Aloe simii* populations, • Forests utilised as buffers around valley drainage lines. • **Value of Buffers**: These corridors buffer all the CBA areas and connect most of the farm with the proposed Nature Reserve and other no-go areas. These buffers protect the Sandspruit River, Afrotemperate Forests, Floodplain wetlands, *Aloe simii* populations and Rocky outcrops. • This network will provide viable corridors and dwellings for animals undertaking a range of movements, including daily or regular movements, seasonal and migratory movements, dispersal movements, and range expansion. The network, which includes the Nature Reserve, will be a sanctuary for both animals and plants, which includes a number of potential Red data listed and protected species. • In the process of demarcating/delineating the agricultural land, larger areas were clumped together to refrain from creating unconnected spaces.	
	• **Impact 5:** Disturbance to Fauna. • **Mitigation Description:** • The disturbance factor will be high during the clearing activities. This will taper off during the operational phase. • During the operational phase of the project, fewer people participate in the farming activities in the orchards and thus the visual disturbance and noise is less. This also applies to the movement and noise factor of farming vehicles and other implements. • During all phases it is important to establish no-go zones for both workers and their vehicles, especially in the Nature Reserve area. • People presence and movement in the buffer areas will disturb animals, chances of interference (poaching and collecting) with both plants and animals, trampling of plants and pet dogs are all possible adverse influences that impact on the local ecology. • Unnecessary/unauthorised movement in the buffer areas is thus not allowed.	

	• **Impact 6:** Human interference impacting on biota. • **Mitigation Description:** • **No poaching**: The collection, hunting or harvesting of animals at the project site should be strictly forbidden. No animals should be intentionally killed or destroyed and poaching and hunting should not be permitted on the project site and adjacent areas. • There must be a stringent and dedicated control of collection, poaching, hunting or harvesting of animals. All personnel should be informed not to harm or collect species such as snakes and tortoises. • **Relocate Fauna**: Faunal species encountered during construction activities should be removed by the ECO from the immediate site and relocated to an adjacent, suitable area. • Any slow-moving fauna (particularly tortoises, hedgehogs, golden moles and subterranean species) disturbed during the clearing phase should be relocated to a suitable site and not harmed in any way. • **Control- and Monitor Movement**: Poaching could be a significant threat. If any external labour teams are used during soil preparation and planting, then these teams should preferably be accommodated off site; if this is not possible then teams must be carefully monitored to ensure that no unsupervised access to plant- and animal resources takes place. Site access to be controlled and no unauthorised persons should be allowed onto the site. • **Trenches**: Check open trenches daily for trapped animals (e.g., bullfrogs, hedgehogs and reptiles), which should be caught and relocated as per the specifications of a relevant specialist. • **Logs**: Place a log in all open trenches during the night to allow trapped animals to escape at their own pace. • **Demarcated Footprint**: Limit construction impacts to the development footprints only. • Ensure that unnecessary impacts on natural habitat do not occur, e.g., driving around in the grassland or wetland. • Highlight all prohibited activities to workers using training workshops and toolbox talks.	

	• **Impact 7:** Linear structures: Impacts of roads and pipelines. • **Mitigation Description:** • **Use Existing Routes**: Refrain from creating unnecessary new roads or tracks, make use of current routes as far as possible. • **Control Run-off**: Management actions should be implemented such as the re-establishment of indigenous vegetation wherever possible, control of storm water run-off and ongoing repair and stabilisation of any erosion. • Where steeper slopes are cleared of vegetation, stop-boards should be erected at the commencement of the clearing to prevent wash-off down-slope. • Refrain from incorporating continuous low solid barricades such as road curbs or steep-walled ditches that might act as barriers to smaller vertebrates moving or migrating through the area. • **Trenches**: Check open trenches daily for trapped animals (e.g., bullfrogs, hedgehogs and reptiles), which should be carefully caught and relocated as per the specifications of a relevant specialist. • **Alien Plants**: Weeds and alien plants may emerge along linear structures. • Develop and implement an alien plant control programme for the study area in order to prevent the further degradation of the faunal habitat. • **Note:** Alien plant control is currently an ongoing exercise on the farm.	
	• **Impact 8:** Alien invasive vegetation. • **Mitigation Description:** • An alien invasive plant management- and control plan should be put in place for both the construction- and operational phases on the farm. • A programme for the eradication, or at least control, of alien plants present within the project area must be developed. • The Contractor and Farm Manager, during orchard establishment and the various construction phases, should ensure that the immediate removal of alien invasive species (seedlings) is implemented as these species establish themselves rapidly within disturbed areas. • Mechanical removal is preferred and should follow the guidelines laid down in an alien plant management and control plan. • Alien plant removal should include the natural biotopes not impacted by the development. • The farmer indicated that he would remove the scattered alien trees in the Nature Reserve once the orchards are established.	

	• **Impact 9:** Loss of Red listed and protected fauna/flora species • **Mitigation Description:** • ***Aloe simii* versus New Project Areas:** The new areas earmarked for development consist mostly of Untransformed Grassland. Should the application to clear the additional 72.5 ha of land be granted, 70.9 ha of Untransformed North-eastern Mountain Grassland and 1.51 ha of secondary grassland will be affected. The 475 ha of Untransformed Grassland protected in 2018 will be reduced to 404 ha. However, more than 50 ha of grassland have been allocated to the *Aloe simii* buffers and thus the grassland in these protected patches will also be secured, resulting in approximately 458 ha of Untransformed Grassland being protected. • **Save Fauna**: Where total vegetation clearing is going to take place: • Specified faunal species must be captured and relocated to suitable habitat in the area. • The operations must be handled by specialists with expertise in the area of environmental concern (GIS Guideline document). • Species data (GIS point locality, species name and date) must be forwarded to the MTPA. • It is suggested that any species caught during the process, should be translocated to the grassland areas in the proposed Nature Reserve. • **Specialist Intervention**: Relocation plans of plants of conservation importance should be considered and this relocation should be undertaken by specialists that have expertise in the area of environmental concern.	
	• **Impact 10:** Impact of clearing activities on birds. • **Mitigation Description:** • **Breeding Season**: In order to lessen the disruption of the clearing activities on the birds, it is proposed that the clearing should take place when birds are not breeding and the migratory species (Palearctic breeding migrants and intra-African breeding migrants) have already left the grasslands, usually in autumn. Most local birds will breed in early summer through to late summer, thus the most appropriate time to start the bush clearing will be in the winter months. • **Useful Corridors**: A positive feature of the Krokodilspruit development is the fact that most of the landscape is covered with a network of corridors which interlink the different habitat types with little interruption to migration routes. Birds driven from these grassland areas will be able to reach other similar habitat types and also link into the Nature Reserve with its pristine grassland habitat. • **Respect Buffer Areas**: Corridors protecting *Aloe simii* colonies, will add to the diversity of potential habitat on the farm. It is essential to respect all natural areas and refrain from impacting on proposed buffers, no-go areas, corridors and the Nature Reserve. These areas will provide corridors for movement of migrating species as well as local movement. • Areas not suitable for agriculture should become part of the network of natural sanctuaries. Only by providing additional, appropriate habitat for displaced bird species, will a level of mitigation be achieved.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
3. Project Specifics and Excavation Management: Trenching; Backfilling and Levelling.	**1. Excavation**: During excavation topsoil has to be stockpiled as specified in low 1m heaps next to the trench in the ROW. • Excavation of soil to solid ground to be done carefully and to ensure proper drainage.	**Contractor or Debushing Agent and ECO where applicable.**
	• Remove soil/sand and debris and expose all rocky material.	
	• Excess (spoil) excavated rocky material (rock and boulders) to be used for erosion control/cladding where applicable or for purposes of landscaping.	
	2. Backfilling: The Contractor shall backfill according to the requirements of progressive reinstatement, i.e., reinstatement of disturbed areas to topsoil profile on an ongoing basis, immediately after selected construction activities are completed, which will allow for passive rehabilitation.	
	• All soils must be returned into the trench in the sequence in which they were excavated. Firstly, the C-horizon, then the B-horizon and finally the A-horizon (topsoil).	
	3. Levelling: Excess sand/soil (after construction) must be filled in and landscaped into natural sandbanks blending in with the topography of the surroundings.	
	• Excess stockpiled building material must be removed completely and all areas levelled to fit in with the surrounding lie of the land.	
	• Excess sand and soil resulting from levelling activities of the work area to be stored in low heaps on the access road/or already disturbed areas.	
	• Excess topsoil to be spread evenly over the area in a manner that blends in with the natural topography.	
	• When the bulk of material stockpiles have been cleared, the disturbed areas are to be levelled and cleared of any unnatural foreign material manually using shovels and rakes.	
	4. Trenching: This activity is limited to the pipeline installations to the new orchards. • Trenching will be minimised through the use of single trenches.	
	• Planning- and selection of trench routes will be indicated on the Site Development Plan.	
	• Trench routes with permitted working areas will be clearly defined and marked with painted stakes prior to excavation.	

	• All trenches must be clearly marked (Flags; coloured posts; reflective banners; lights) in order to alert people to the potential hazard thereof.	
	• All open trenches must be patrolled on a minimum of a daily basis to ensure that animals, e.g., lizards, small rodents, have not become trapped. • Such animals will be removed and released. • A log must be placed at strategic spots in the trench each afternoon to allow any animal that accidentally falls into the trench an opportunity to escape.	
	• Stripping and separation of topsoil will occur as stipulated in the EMPr above.	
	• Soil will be excavated and used for re-filling trenches using the **rollover method**, i.e., progressive re-instatement: This entails the following approach: • Soil from the first trench section will be stockpiled. • Soil excavated from subsequent trench lengths will be used to backfill once the pipelines have been laid on an ongoing basis. • The final trench length will be re-filled using the originally stockpiled soil.	
	• Trench lengths will be kept as short as practically possible.	
	• Trenches will be re-filled to the same level as, or slightly higher to allow for settlement of the surrounding land surface to minimise erosion. Excess soil will be stockpiled in an appropriate manner.	
	• Immediately after refilling, the disturbed areas will be stabilised.	
	• The Contractor will not pollute any eco-system as a result of construction activities. • All cement mixing activities must take place on an impermeable layer, e.g., metal sheet or plastic. • No mixing of cement may take place directly on the soil surface.	

	5.Irrigation Methods/Equipment: • The efficient use of water and the implementation of a site-specific irrigation system will go a long way towards the sustainable use of irrigation water on the new orchards.	
	• It is therefore essential that a cost-effective system is used which optimises the use of water and prevents run-off and erosion. For this reason, the **Low Flow Irrigation System (LFIS)** must be implemented:	
	Advantages of the LFIS: • **Broader water distribution:** As water enters the ground at a slow pace, it spreads around the sides of the plant rather than seeping downward. • **Better nutrient utilisation:** Since water stays closer to the area where the roots are most active, more nutrients are available to the plant with fewer ground pollutants. • **Larger and enhanced yields:** Since the in-ground air-water ratio at any given moment is higher, crop yields are larger and of a better quality. • **Lower nutrient usage:** As all the fertiliser is distributed at the active root-zone level, the plant receives a high percentage of the amount distributed, leading to lower quantities of applied fertiliser. • **Water saving:** Irrigation is placed underneath the agricultural fabric; the low flow drip ensures no over irrigation. Drip emitters have an ultra-low flow of 0.7 lt/hr each, spaced 1m apart.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
4. Waste Management: Solid Waste.	**1. Litter and Builders Waste**: All waste to be disposed of off-site at an approved landfill site. • Contractor not to dispose of any waste and/or construction debris through burning or by burying.	**Contractor or Debushing Agent.**
	• Contractor to supply tamper proof waste bins throughout the site at locations where construction workers are working.	
	• Tamper-proof refuse bins to be emptied on a daily basis. Refuse bins not to be used for any other purpose.	
	• Contractor has to designate specific areas for staff to enjoy their lunches and tea and he must provide for access to adequate refuse bins at these sites.	
	• All litter must be removed off site daily and deposited at the designated waste collection point near the Maintenance Yard (Business Unit Charlie).	
	• Waste includes cigarette boxes, cigarette butts, paper, plastic bags, tin, glass, wires, cable ties, and organic waste e.g., peels and bones.	
	• Under no circumstances will cigarette butts be discarded anywhere on the development site.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
5. Waste Management: Liquid Waste.	**1. Construction Water**: Construction water refers to all water affected by construction activities. • No River/Stream/Natural Drainage Line must be used for cleaning of tools and equipment. • This includes the washing of clothes and bathing/recreational purposes.	**Contractor or Debushing Agent.**
	• All washing of equipment to be undertaken at the designated facilities in the Site Yard/Business Unit Charlie.	
	• Water from any other cleaning operations in the Site Yard to be collected in a “conservancy” tank removed from site and disposed of in the agreed manner.	
	• Water and slurry to be contained to prevent the pollution of the ground surrounding the mixing and/or disposal points.	
	• No spills to be channelled into the natural environment. Contractor to take reasonable precautions to prevent pollution of the ground- and water resources.	
	• Contractor to ensure that no fuels (petrol/diesel), oils, lubricants and/or other chemicals are discarded onto the ground.	
	• Use drip trays in all potentially risky situations, e.g., refuelling a mobile generator.	

	2. Sewerage Management: Adequate temporary (e.g., Enviro-loos) ablution facilities to be put in place on sites located near to working areas. • 1 Enviro-loo per 10 workers.	
	• Toilet paper must be provided by the contractor/developer.	
	• All toilets must be checked daily and serviced accordingly by an accredited service provider.	
	• No spillages into the surrounding environment will be allowed.	
	• The entrances to the toilets must be adequately screened from public view.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
6. Waste Management: Hazardous Waste (The use of hazardous materials are not envisaged during the development phase, however unforeseen events may occur which are not known to the EAP at this stage of the process. This aspect is therefore included as a precautionary measure).	**1. Hazardous Waste Process**: The EAP has not been made aware of any hazardous substances that may be used during the development construction process. To ensure that the EMPr maximises the implications of the precautionary approach the following conditions are included in the event that substances such as fuel (mobile generator); paints; varnishes; chemicals for alien plant control etc. are used at any stage of the development. • A Contractor staff member must be designated to manage this process.	**Contractor or Debushing Agent.**
	• Contractor to comply to all national, regional, and local legislation with regards to the storage, transport, use and disposal of petroleum, chemicals, harmful and hazardous materials and substances.	
	• Contractor to provide the ECO with a list of all petroleum, chemical, harmful and hazardous materials and substances on site, together with all the storage, handling and disposal procedures for these materials. A register must be kept at the site office containing all the written/prescribed handling procedures.	
	• Contractor to be responsible for training and education of workers that will be working with these materials. Training to include the proper use, handling and disposal of the substances.	
	• Storage of chemicals to be safe, tamper proof and under strict control.	
	• Storage and handling of fuels, lubricants, chemicals and other hazardous substances to be protected by placing an impermeable liner, e.g., bund beneath the above ground storage containers in order to prevent accidental contamination of the soil.	
	• The contractor will ensure that there is a supply of absorbent material (or absorption blankets) readily available on site to absorb, break down and where possible control any spillages that may occur. The amount and type of absorbent material must be appropriate to the volumes of hazardous liquids on site.	
	• Any accidental chemical/fuel spills to be addressed and reported immediately to the ECO. The ECO will inform the applicable authorities and initiate a containment- and control programme as applicable.	
	• Contractor to be responsible for establishing an emergency procedure for dealing with spills/releases of fuels, chemicals, hazardous substances and medical emergencies.	

	• All spills/accidents to be recorded (in the Incident Register) and reported to the ECO. The cleanup of spills and any damage caused shall be for the Contractor's account.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
7. Access Roads and Causeways (Low Level Crossings).	**1. Existing Roads**: The farm is well serviced with all-weather farm roads to the various sections and facilities on the property. The proposed project and all deliveries will make use of these access routes.	**Contractor or Debushing Agent.**
	• Adhere to the local speed limit on the farm (40km/h) at all times.	
	• Contractors to limit the number of deliveries where possible through appropriate advance planning.	
	• Contractors will be required to submit a delivery timetable to the ECO.	
	• Construction personnel should only use authorised paths and roads.	
	• Any damage caused by the construction activities to any access or public roads must be rehabilitated thoroughly upon completion of the construction.	
	2. New Roads (Less than 3.5m wide): • All orchard roads created for the purposes of the development must be designed and planned in advance with the ECO. • Access will be required to each orchard. Orchard roads must be designed to incorporate adequate drainage and water attenuation structures.	
	• Where applicable the road must be stabilised with all-weather gravel (patch gravelling).	
	• A **designated roads contractor** must oversee this aspect of the development process.	
	• **Stabilise/All Weather Access**: Although these farm roads will not carry significant loads of traffic on a daily basis access to the orchards will be required during the harvesting process. The road surfaces must thus be stabilised for all weather use.	
	• **Prevention of Erosion**: Erosion problems on roads must be addressed immediately as and when these occur. This must be done by installing humps across the roads at regular intervals, in order to redirect the water away from the road or track.	
	• **Humps** must be large enough to withstand storm water events. They must be constructed across the entire width of the road (from side to side and into the adjoining vegetation). The humps must be at least 50cm higher than the surrounding ground level. This will ensure that run-off of water is directed out of the road and not down the road.	
	• **Mitre Drain**: All water run-off from the roads must be channelled into mitre drains. These drains must be kept open (free of vegetation and blockages). All drains must be opened by end of September annually.	

3. Low Level Crossings: A low level river crossing will be developed to accommodate equipment and vehicles during harvesting- and general farming operations. This structure will be a basic, low level concrete crossing with concrete pipes or culverts. Two previous examples of low-level crossings have been completed recently and a similar *modus operandi* and or design will be implemented/followed.

- Due to the fact that the construction of the low-level river crossing is planned to accommodate equipment and vehicles during harvesting- and general farming operations, it was decided to undertake a DWS Risk assessment protocol for these activities.
- The relevant risks identified for this concern are summarised as following from the DWS risk assessment **(Table 50): Appendix 4.5.2:**
- **Site Specific Mitigation Measures**: Erosion control should be implemented in the bank cuttings towards the crossing. During clearing, the Contractor shall protect all areas susceptible to erosion by installing necessary temporary- and permanent drainage works as soon as possible and by taking any other measures necessary to prevent storm water from concentrating in streams and scouring slopes, banks, etc. The use of silt fences, turbidity barriers, sedimentation ponds, cofferdams, and the timely mulching and seeding or sodding of roadway slopes and other exposed areas will reduce run-off and siltation.
- Work should be undertaken during the dry winter months when there is low flow in these systems; thus, low impact on flow of water or any biota utilising the system.
- A small working area will be confined to the terrestrial area above the macro-channel bank and must be rehabilitated after construction. Storage of all components will be at the farmyard, away from the rivers.
- Clearing of natural vegetation shall be kept to a minimum. The removal, damage and disturbance of natural vegetation without the written approval of the ECO are prohibited. Removal of any vegetation should be mitigated by replanting the original species where possible.
- The Contractor shall be responsible for informing all employees about the need to prevent any harmful effects on natural vegetation on or around the construction site as a result of their activities.
- Farm roads already exist. The crossing sites are directly aligned with existing roads and very little vegetation clearing will be required for the road connection.
- The Contractor shall not work within river floodlines, watercourses and wetlands without written approval from the ECO as required for the execution of the work. Actual in-river construction for any structure would stir up bottom sediment. Re-suspension of the sediments would increase turbidity, release nutrients, and increase the oxygen demand on the river. This type of sedimentation is difficult to control and is an unavoidable impact of bridge construction. However, minimising the use of in-river construction techniques and through the use of cofferdams and silt screens including turbidity barriers the sedimentation will be reduced.
- The use of coffer dams should be avoided, where practical, and if necessary, should only be considered in consultation with a riverine specialist. During construction, flow-diversion is necessary to ensure the delivery of flows to the downstream channel. If a cofferdam is required and this is constructed from sandbags, the entire structure must be covered with bidum or a suitable geo-textile to prevent the breakage of bags in the event of unanticipated high run-off events. The cofferdam can serve to trap any sediments which may wash towards the downstream channel. Any such sediments must be physically removed from the channel before the cofferdam is removed.

	• Should alien plants be observed, these will be removed/controlled immediately by the management team of the farm. • The pipes underneath the crossing must be large enough to allow free flow through. Debris obstructing free flow must be actively removed. • The pipes underneath the crossings must be wide enough to prevent a damming effect and to allow medium floods through. • Prevent road run-off from entering watercourse using cut off drains. • The project area is small and will be used regularly. The erosion probability is moderate but contained in a small area. Any erosion detected must be rehabilitated.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
8. Construction Staff	**1. Staff Management**: The Code of Conduct for Contractors as described in the Tender Document will apply to all Construction Staff. • The EMPr will be included as a condition of the Tender Document.	**Contractor or Debushing Agent.**
	• Contractor must adhere to all conditions of the Occupational Health and Safety Act.	
	• A Safety Plan must be submitted to the ECO prior to the commencement of construction.	
	• No contractor staff will be housed on the development site.	
	• All contractor staff will abide with the Rules and Regulations of the Krokodilspruit Farm. This includes all aspects to gain entrance and to exit the property.	
	• All staff must use the water- and sewerage facilities judiciously and keep these facilities neat and clean.	
	• All staff must remain within the development footprint and behind the demarcated boundaries.	
	• No open fires will be allowed for cooking and or heating purposes.	
	• Staff must supply their own lunches and refreshments. No cooking will be allowed on site.	
	• Staff must respect the surrounding environment and prevent all littering and damage to fauna and flora.	
	• **Site Specifics: Induction Courses**: All staff will undergo an intensive induction course on worker safety and safety procedures for the various sections of the site.	
	• **EMPr**: The conditions of the Environmental Management Programme must be explained to all workers and staff on site. • These conditions must be repeated during regular toolbox talks.	
	• All staff on site must sign an acceptance of understanding the EMPr form prior to being allowed on site.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
9. Fire.	**1. Fire Management**: Contractor to take all the necessary precautions to ensure that no fires are caused as a result of development activities on site. • A Contractor staff member must be designated to manage this process. • Contractor to supply all facilities, site offices, workshop areas, storage areas, with approved fire-fighting equipment. • All staff on site will be made aware of general fire prevention and control methods and the name of the responsible person to alert to the presence of a fire. • The Contractor will advise the relevant authority of a fire outside of a demarcated area as soon as it starts and will not wait until he can no longer control it. • All fire-fighting equipment to be maintained in good operating order. • No open fires for heating or cooking are allowed on site.	**Contractor or Debushing Agent.**
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
10. Accidents.	**1. Staff Safety**: Contractor to comply with the Occupational Health and Safety Act (OHASA) and any other labour regulations with regard to safety on site. • Contractor to provide an Occupational Health and Safety Management Plan to the ECO for approval prior to the commencement of works in terms of the Construction Regulations. • A Contractor staff member must be designated to manage this OHASA process. • Fencing and barriers will be in place in accordance with the Occupational Health and Safety Act (Act No. 85 of 1993). • Applicable notice boards and hazard warning notices will be put in place and secured. Night hazards, e.g., open trenches, will be suitably indicated (e.g., reflectors, lighting, and traffic signage). • No unauthorised firearms or weapons of any kind will be permitted on the site. • Contractor to ensure that all staff are familiar with all the emergency procedures. • All staff must undergo a basic First Aid Course. • Contractor to ensure that lists of all emergency telephone numbers/contact people are available and are posted at relevant locations, e.g., Site Office/Business Unit Charlie, at all times and that they are updated regularly. • Contractor to be responsible for establishing an emergency procedure for dealing with medical emergencies. All incidents to be recorded (in the Incident Register) and reported to the ECO.	**Contractor or Debushing Agent.**

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
11. Adverse Weather Conditions and Erosion Protection.	**1. Wet Weather: Overflows and Erosion Protection**: Development on these project sites will preferably take place during the period March-September.	**Contractor or Debushing Agent.**
	• Contractor to set up a procedure for rapidly emptying any collection points to prevent them filling with rainwater.	
	• Contractor to ensure that no sumps (where applicable) are emptied unnecessarily. Special care to be taken during rainy periods/adverse weather conditions to prevent contents from overflowing.	
	• Contractor to ensure that a procedure is established for dealing with potentially polluted rainwater. Procedures/method statements must be filed in the register in the site office.	
	• Stockpiles of fine material such as sand, topsoil, etc. to be protected from rain run-off and wind.	
	• During construction, Contractor to protect all areas susceptible to erosion by installing all the necessary temporary and permanent drainage works ASAP. • Contractor must also prevent water scouring of the slopes, embankments (where applicable) and any other areas.	
	• Correct any cause of erosion at the onset thereof through the most appropriate mechanism. Discuss any remedial actions with the resident ECO.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
12. Noise, Visual and Dust Impacts.	**1. Noise Impacts**: Contractor to use the equipment that is appropriate to the task in order to minimise the extent of damage to the environment and minimise the noise levels.	**Contractor or Debushing Agent.**
	• The provisions of SABS 1200A will apply to all areas within audible distance of the site.	
	• Noise levels to be kept within acceptable limits for a conservation/agricultural area and not to be of such a nature as to detract from the experience of persons in the area.	
	• No amplified music will be allowed.	
	• Construction activities generating output levels of 85dB or more will be confined to the hours 07h00 to 17h00 Mondays to Fridays.	
	2. Dust: Dust to be controlled on site at all times.	
	• Dust emissions may occur during the clearing of vegetation and delivery of equipment and supplies on the farm roads to the project area.	
	• Contractor must control dust emissions using a water tanker as and when the impact arises.	

ACTIVITY	MANAGEMENT/MITIGATION ACTION	RESPONSIBLE PERSON
13. Cultural Artefacts.	**1. Handling of Unexpected Cultural Finds**: The proposed project does not traverse, impact and or influence aspects of historical value, however the following conditions are listed in the event that an unexpected find or artefact is unearthed. • An accredited archaeologist must oversee the debushing process.	**Contractor or Debushing Agent.**
	• Sensitise the Contractor/labourers to be aware of the importance of cultural artefacts/fossils and implement the recommended procedure below in the event that such a discovery is made accidentally during construction.	
	• Should any artefact, historical site or fossil be discovered during excavations for irrigation trenches as well as in future, all works must cease with immediate effect. • A buffer of 30m must be established around the find.	
	• The find must be reported to the ECO and the Project Manager for the project. • These representatives will initiate an Action Plan in conjunction with an accredited archaeologist/palaeontologist (Contact SAHRA) to address the management and handling of the find.	
ACTIVITY	**MANAGEMENT/MITIGATION ACTION**	**RESPONSIBLE PERSON**
14. Site Clean Up and Closure.	**1. Removal and Clearance**: Contractor to ensure that all temporary structures, materials, water and waste facilities used for construction activities are removed upon completion of the project.	**Contractor or Debushing Agent and the ECO.**
	• All signs of disturbance and contractor activity must be rehabilitated to a state as on day of site handover.	
	• All toilets must be removed.	
	• All left over stock and bits and pieces of materials must be removed.	
	• All waste bags must be deposited at the waste management facility (site yard).	
	2.Rehabilitation: It is not envisaged that major rehabilitation efforts will be required, however applying the precautionary approach the following conditions are placed on record:	
	• All re-seeding activities will be undertaken at the end of the dry season to ensure optimal conditions for germination and rapid vegetation establishment.	
	• When ripping for rehabilitation the contractor will rip to refusal or a minimum of 300 mm.	
	• The rehabilitated and seeded areas must be harrowed after spreading the topsoil and fertiliser uniformly.	
	• Inspect rehabilitated area at three monthly intervals during the first and second growing season to determine the efficacy of rehabilitation measures.	

	• Take appropriate remedial action where vegetation establishment has not been successful or erosion is evident.	
	• Only indigenous vegetation commensurate with the Krokodilspruit landscape is to be used in any landscaping/reseeding which may be undertaken.	
	3. Project Sign Off: The ECO must sign off the works and the site during a Final Audit Assessment. The Final Audit Report will be submitted to DARDLEA for approval and verification.	

PROTECTION OF THE ENVIRONMENT:
DECLARATION OF UNDERSTANDING: CONTRACTOR TO SIGN:

The Contractor will not be given right of access to the Site until this form has been signed.

I / we, _____ {Contractor} record as follows:

I / we, the undersigned, do hereby declare that I / we am / are aware of the increasing requirement by society that construction activities shall be carried out with due regard to their impact on the environment.

In view of this requirement of society and a corresponding requirement by the Employer with regard to this Contract, I / we will, in addition to complying with the letter of the terms of the Contract dealing with protection of the environment, also take into consideration the spirit of such requirements and will, in selecting appropriate employees, plant, materials and methods of construction, in-so-far as I / we have the choice, include in the analysis not only the technical and economic (both financial and with regard to time) aspects but also the impact on the environment of the options.

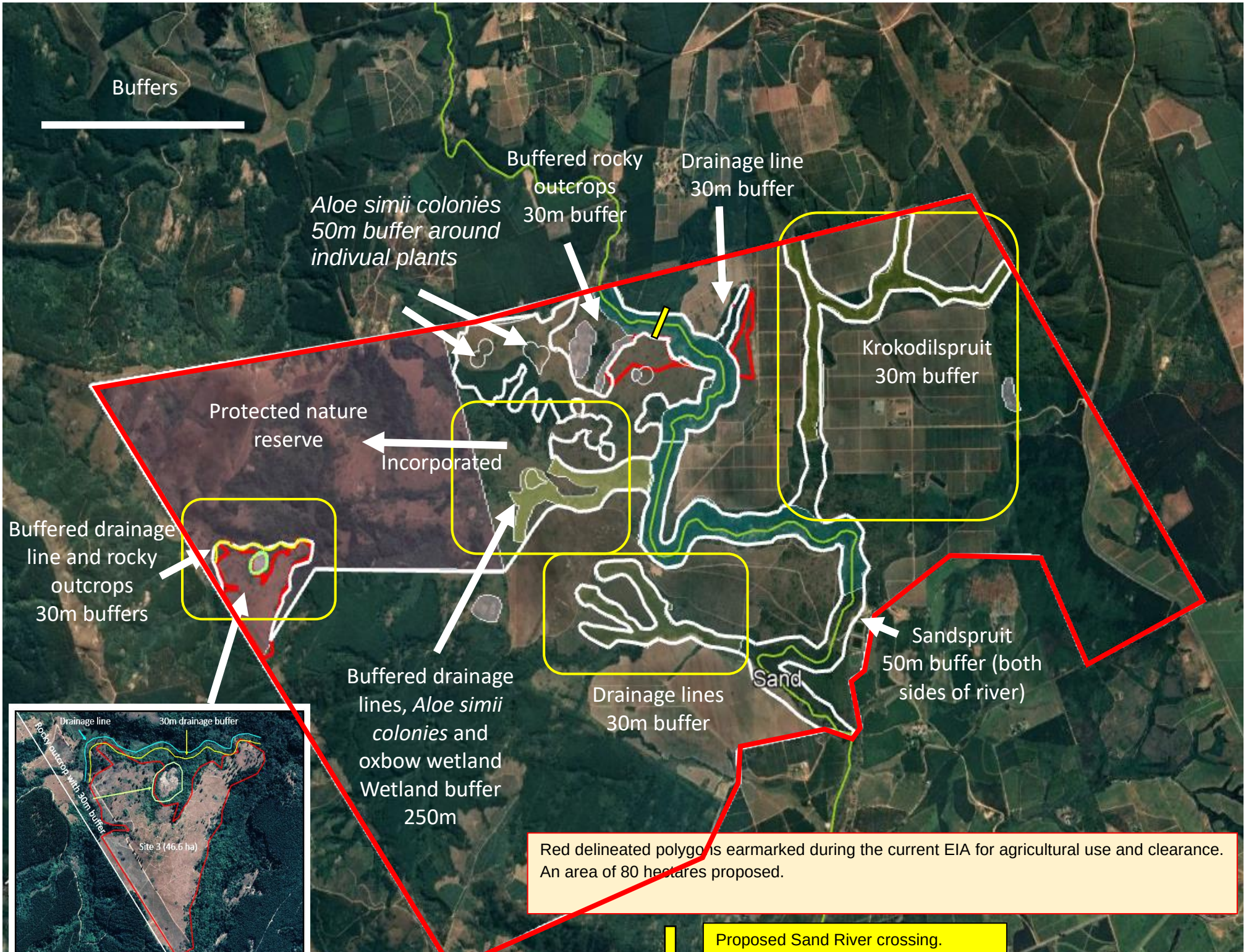
In this regard, I / we recognize and accept the need to abide by the “precautionary principle” which aims to ensure the protection of the environment by the adoption of the most environmentally sensitive construction approach in the face of uncertainty with regard to the environmental implications of construction.

I / we have signed the Declaration of Understanding with respect to the Environmental Management Programme.

I / we acknowledge and accept the right of the Employer to deduct, should they so wish, from any amounts due to me / us, such amounts (hereinafter referred to as fines) as the Construction Manager shall certify as being warranted in view of my / our failure to comply with the terms of the Contract dealing with protection of the environment, subject to the following:

The Project Manager, in determining the amount of such fine, shall take into account inter alia, the nature of the offence, the seriousness of its impact on the environment, the degree of prior compliance / non-compliance, the extent of the Contractor's overall compliance with environmental protection requirements and, in particular, the extent to which he/she considers it necessary to impose a sanction in order to eliminate / reduce future occurrences.
The Construction Manager shall, with respect to any fine imposed, provide me / us with a written statement giving details of the offence, the facts on which the Construction Manager has based their assessment and the terms of the Contract (by reference to the specific clause) which has been contravened.

Signed _____
Date _____


Buffers
Buffered rocky outcrops 30m buffer
Drainage line 30m buffer
Aloe simii colonies 50m buffer around indivual plants
Krokodilspruit 30m buffer
Protected nature reserve
Incorporated
Buffered drainage line and rocky outcrops 30m buffers
Buffered drainage lines, Aloe simii colonies and oxbow wetland Wetland buffer 250m
Drainage lines 30m buffer
Sand
Sandspruit 50m buffer (both sides of river)
Drainage line
30m drainage buffer
Rocky outcrop with 30m buffer
Site 3 (46.6 ha)
Red delineated polygons earmarked during the current EIA for agricultural use and clearance. An area of 80 hectares proposed.
Proposed Sand River crossing.

RHENGU ENVIRONMENTAL SERVICES
P O Box 1046 Cell: 082 414 7088
MALELANE Fax: 086 685 8003
1320 E–mail: rhengu@mweb.co.za

ACCEPTANCE OF EMPr:
KROKODILSPRUIT AGRICULTURE PROJECT:
PROJECT NR.: 1/3/1/16/1E-405.

DECLARATION

I/We, the undersigned as the proponent/s/person/s responsible for the above-proposed activity undertake to abide by the above-designated EMPr and associated conditions.

Name: _____

Signature: _____

Date: _____

Name: _____

Signature: _____

Date: _____

CHECKED BY ENVIRONMENTAL CONTROL OFFICER

Name: _____

Signature: _____

Date: _____