

Anglo American Inyosi Coal (Pty) Ltd

ALEXANDER PROJECT

TERRESTRIAL ECOLOGY STUDY, BIODIVERSITY VALUE ASSESSMENT & IMPACT ASSESSMENT



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EXECUTIVE SUMMARY

ECOREX Consulting Ecologists CC conducted an assessment of the terrestrial ecology of the Anglo American Inyosi Coal (AAIC) Alexander Mine Project in Jan 2014 and April 2016. The study comprised flora and vertebrate fauna (mammals, birds, reptiles, frogs). The key objective of the 2016 study was to update the terrestrial ecology baseline and assessment of the biodiversity value of the terrestrial habitats represented, and to conduct an assessment of the potential impacts on terrestrial ecology.

The study area covers approximately 10 700 ha, of which only about 220 ha comprise surface infrastructure. The area is situated almost entirely within Eastern Highveld Grassland, which has a national ecosystem status of **Endangered**. About 8 300 ha, or 78% of the study area, has been transformed, mostly through commercial crop cultivation. The remaining 2 400 ha comprise five untransformed vegetation communities, which were identified within the study area on the basis of distinctive vegetation structure, floristic composition and position in the landscape:

- Untransformed Grassland on Rocky Ridges;
- Untransformed Grassland on Hillslopes and Plateaus;
- Untransformed Grassland on Plains;
- Evergreen Thicket on Rocky Scarps and Outcrops;
- Wetlands.

Two hundred and ninety-six plant species were recorded within the study area during fieldwork. Fifteen of these are protected under the Mpumalanga Nature Conservation Act (No. 10 of 1998). Five plant species of conservation concern were confirmed to occur in the study area, four of which have the status of Declining (*Boophone disticha*, *Crinum bulbispermum*, *Eucomis autumnalis subsp. clavata*, *Hypoxis hemerocallidea*). The fifth species is *Khadia beswickii*, which is classified as Vulnerable. An additional seven species of conservation concern have been recorded within the quarter-degree grid 2629 AD and surrounding grids with similar habitat, of which six species have a moderate or high likelihood of occurring because of the presence of suitable habitat and / or presence of known populations nearby.

Eight fauna species of conservation concern were confirmed during fieldwork, three of which are Vulnerable (Secretarybird, Southern Bald Ibis), and five of which are Near Threatened

(Brown Hyaena, Serval, Black-winged Pratincole, Maccoa Duck, Greater Flamingo). Two Near Threatened mammals (Highveld Golden Mole and Southern African Hedgehog) are considered to have a moderate likelihood of occurring in the study area. A number of mammals classified as Data Deficient have a moderate likelihood of occurring, particularly shrews and rodents. Fifteen bird species confirmed to occur in the general vicinity of the study area during the current South African Bird Atlas Project have Red Data status. Six of these have been confirmed and have been mentioned above. Five other species have a moderate likelihood of occurring, two of which are classified as Vulnerable (White-bellied Korhaan, African Grass Owl), and three are Near Threatened (Pallid Harrier, Red-footed Falcon and Lesser Flamingo). One reptile with Near Threatened status has a moderate likelihood of occurring in any untransformed grassland fragments (Transvaal Grass Lizard). No amphibian species of conservation concern were recorded within the study area, although habitat is present for the Giant Bullfrog, which is Near Threatened.

Five vegetation communities have High Biodiversity Value, namely the three Untransformed Grassland communities, Evergreen Thicket on Scarps and Rocky Outcrops and Wetlands. These are the key ecosystems that need to remain intact and functional. Impacts within these communities will have the highest significance levels and therefore the impact footprint should remain outside of these communities as much as possible.

Much of the untransformed vegetation within the study area falls within a Critical Biodiversity Area (CBA) within the new Mpumalanga Biodiversity Sector Plan (Lötter *et. al*, 2014). A portion of the untransformed vegetation is also classified as Other Natural Habitats, while the transformed areas are classified as Modified. Areas falling within the Modified category are the preferred areas for a wide variety of land-use types, which includes urban and business development. **Mining developments within CBAs are considered as inappropriate developments in conflict with the recommended land use guidelines.**

An assessment of potential impacts was compiled and is summarised in the table below.

Potential Impact	Project Activity	Environmental significance before mitigation					Mitigation	Environmental significance after mitigation						
		I	D	E	C	P		S	I	D	E	C	P	S
Construction Phase														
Destruction and / or fragmentation of natural habitat	Strip clearing vegetation	M	VH	VL	M	M	MEDIUM	Habitat restoration	M	M	VL	M	L	MEDIUM
Loss of plant species of conservation importance	Strip clearing vegetation	H	VH	VL	H	L	MEDIUM	Staff awareness	H	VH	VL	H	VL	MEDIUM
Increased illegal utilisation of natural resources	Increase in number of people	M	H	VL	M	M	MEDIUM	Security (patrolling adjacent natural vegetation for evidence of poaching, etc), Staff awareness, Relocation of protected flora	L	L	VL	L	L	LOW
Disturbance and displacement of fauna	Heavy vehicle activity; construction of conveyor line	H	H	L	H	M	HIGH	Traffic control (speed enforcement, working hours)	H	L	L	H	L	MEDIUM
Increased invasion by alien plant species	Strip clearing vegetation	H	VH	VL	H	H	HIGH	Invasive alien plant control	L	L	VL	L	L	LOW
Increase in mortalities of fauna through road collisions	Heavy vehicle activity	M	H	L	M	H	HIGH	Traffic control (speed enforcement, working hours)	L	H	L	M	L	MEDIUM
Operational Phase														
Increased invasion by alien plant species	Exposed areas of bare soil once construction completed	M	L	VL	L	M	MEDIUM	Invasive alien plant control, habitat restoration	L	L	VL	L	L	LOW
Increase in mortalities of fauna through road collisions	Heavy vehicle activity	M	H	L	M	H	HIGH	Traffic control (speed enforcement, working hours)	L	H	L	M	L	MEDIUM

M=Magnitude or Severity;
R=Reversibility; D=Duration;
E=Extent; C=Context;
P=Probability; S=Significance

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Abbreviations

BVA	Biodiversity Value Assessment
CBA	Critical Biodiversity Area
IBA	Important Bird Areas
mamsl	Metres Above Mean Sea Level
MBSP	Mpumalanga Biodiversity Sector Plan
MNCA	Mpumalanga Nature Conservation Act (No. 10 of 1998)
MTPA	Mpumalanga Tourism and Parks Agency
NFA	National Forest Act (No. 30 of 1998)
PRECIS	National Herbarium Pretoria (PRE) Computerised Information System

Terminology

Alien	Introduced from elsewhere: neither endemic nor indigenous.
Biodiversity	The structural, functional and compositional attributes of an area, ranging from genes to landscapes.
Degraded	An ecosystem that is in a poor ecological state, usually through impacts such as invasion by alien plants, severe overgrazing, poor burning regimes, etc. These systems still contain a moderate proportion of indigenous flora.
Geophyte	Plants that produce their growth points from organs stored below the ground, an adaption to survive frost, drought and / or fire.
Riparian	Pertaining to the river bank.
Transformed	Transformed ecosystems are no longer natural and contain little or no indigenous flora. Examples include agricultural lands, plantations, urban areas, etc.

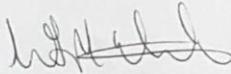
Declaration of Independence

The specialist appointed in terms of the Regulations

I, Warren Lee McClelland, declare that -

General declaration:

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in Regulation 8;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.



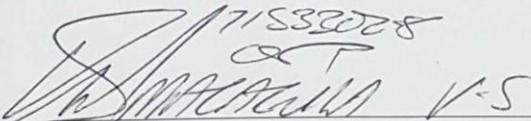
Signature of specialist:

ECOREX Consulting Ecologists

Name of company:

29/04/2016

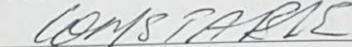
Date:



Signature of Commissioner of Oaths

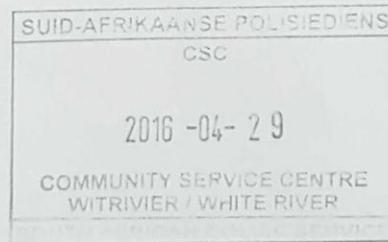
2016-04-29

Date:



Designation:

Official stamp (below)



Specialist Compliance Checklist

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

(a) details of-

<input checked="" type="checkbox"/>	(i) the specialist who prepared the report; and	section 1.3
<input checked="" type="checkbox"/>	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;	Appendix 8
<input checked="" type="checkbox"/>	(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	page 5
<input checked="" type="checkbox"/>	(c) an indication of the scope of, and the purpose for which, the report was prepared;	section 2
<input checked="" type="checkbox"/>	(d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	section 4.2
<input checked="" type="checkbox"/>	(e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	section 4
<input checked="" type="checkbox"/>	(f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	section 6
<input checked="" type="checkbox"/>	(g) an identification of any areas to be avoided, including buffers;	Fig 12-13
<input checked="" type="checkbox"/>	(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Fig 12-13
<input checked="" type="checkbox"/>	(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	section 4.5
<input checked="" type="checkbox"/>	(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;	section 7
<input checked="" type="checkbox"/>	(k) any mitigation measures for inclusion in the EMPr;	section 8
<input type="checkbox"/>	(l) any conditions for inclusion in the environmental authorisation;	n/a
<input type="checkbox"/>	(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	n/a
	(n) a reasoned opinion-	
<input checked="" type="checkbox"/>	(i) as to whether the proposed activity or portions thereof should be authorised; and	section 9
<input checked="" type="checkbox"/>	(ii) if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	section 9
<input type="checkbox"/>	(o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	n/a
<input type="checkbox"/>	(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	n/a
<input type="checkbox"/>	(q) any other information requested by the competent authority.	n/a

1. INTRODUCTION

1.1 Background

Anglo American Inyosi Coal (Pty) Ltd (AAIC) is proposing to establish a new underground coal mine (the Alexander Project) within the current AAIC prospecting right areas. Synergistics Environmental Services (Synergistics), an SLR Group Company, has been appointed as the independent environmental assessment practitioner (EAP) responsible for undertaking the necessary environmental assessment and public participation process for the project.

ECOREX Consulting Ecologists CC Enpact conducted a terrestrial ecology assessment (flora and vertebrate fauna) for the Alexander Project in January 2014. The key deliverables of that study were a baseline description of the terrestrial ecology (flora, mammals, birds, reptiles and frogs), an integrated Biodiversity Value Assessment (BVA) and an assessment of the potential impacts on terrestrial ecology associated with the project. The objective of the 2014 study was to provide a basis for assessing potential impacts of the proposed project on terrestrial ecology and guide the design and location of planned infrastructure. Studies were not completed in 2014 due to project delays and therefore the additional surveys were only completed as part of this 2016 study. In addition, specialist reports were needed to be adjusted to meet the requirements of Appendix 6 (Specialist Reports) of Government Gazette No. 38282 of 4 December 2014.

1.2 Brief Project Description

The proposed Alexander Project will involve the development of surface and underground facilities comprising an underground mine, a waste rock dump, topsoil stockpiles, mine related facilities such as workshops, stores and various support infrastructure and services. The proposed project will also require construction of an overland conveyor to transport coal from the proposed Alexander incline shaft to the stockpile area at Elders Colliery from where it will be transported via the Elders overland conveyor to Goedehoop Colliery for beneficiation purposes. More details regarding the project layout are provided in the Scoping Report.

1.3 Study Team

The study team for the 2014 and 2016 studies was as follows:

Warren McClelland (Terrestrial Ecologist). Warren is the owner and director of ECOREX Consulting Ecologists CC, a consultancy of flora and vertebrate fauna specialists based in White River, Mpumalanga. He has been involved in specialist biodiversity assessments for a wide range of developments, particularly mining, throughout sub-Saharan Africa over the past 16 years. These have included over 30 coal mining projects within Mpumalanga alone. Countries of work experience outside of South Africa include Angola, Democratic Republic of the Congo, Republic of Guinea, Sierra Leone, Tanzania, Zambia, Malawi, Mali, Mozambique, Namibia and Swaziland. Warren is the co-author of the acclaimed “Field Guide to the Trees & Shrubs of Mpumalanga & Kruger National Park” published by Jacana in 2002, and is currently working on a field guide to the Wildflowers of Kruger National Park. He received the Marloth Award in 2014 in recognition of his contribution to amateur botany through co-authorship of the Mpumalanga Tree Field Guide.

Duncan McKenzie (Terrestrial Ecologist). Duncan is a part of the ECOREX team and manages most of the Mpumalanga projects. He has been involved in biodiversity assessments for ECOREX for six years, particularly for coal mining projects on the Mpumalanga Highveld. Other countries of work experience include Lesotho, Swaziland, Mali, Mozambique, Sierra Leone, Tanzania and Democratic Republic of the Congo. Duncan has previously worked as a Regional Coordinator for the Mondi Wetlands Project where he gained considerable experience in wetland delineation and management. He is currently the Regional Co-ordinator for the South African Bird Atlas Project and is a co-author on the Wildflowers of the Kruger National Park project.

Linda McKenzie (GIS Specialist). Linda is a GIS Specialist/GIS Analyst with over 12 years experience in the industry. For the last 4 years she has operated her own GIS Consultancy (Digital Earth). She has extensive experience in both the private and public sector, as has worked on a wide variety of projects and GIS applications. These include vegetation and sensitivity mapping, landcover data capture, municipal roads master planning, hydroelectric scheme and wind farm feasibility mapping and town planning, land surveyor and engineering support services. Linda currently serves as treasurer for GISSA Mpumalanga and is a registered Professional GISc Practitioner (PGP0170).

2. TERMS OF REFERENCE

- A. Update the assessment of the terrestrial ecosystems within the project area (vertebrate fauna and flora), which will include the following:
- Updated description of vegetation communities;
 - Revised Vegetation Map (if necessary);
 - Updated description of faunal assemblages (mammals, birds, reptiles and frogs).
- B. Update the assessment of the Biodiversity Value of the vegetation units represented, which will comprise:
- Assessment of conservation importance and functional importance of each vegetation unit;
 - Revised Biodiversity Value Map (if necessary).
- C. Assess the potential impacts of the project on Terrestrial Ecology, using the methodology provided by Synergistics.

3. STUDY AREA

The study area is situated at the south-eastern boundary of the town of Kriel, and extends on either side of the R545 road between Kriel and Bethal, straddling the shared boundary of Nkangala and Gert Sibande Districts, Mpumalanga Province (Figure 1). The area that was surveyed covered approximately 10 700 hectares, of which only about 220 ha will comprise surface infrastructure. About 8 300 ha, or 78% of the study area, has been transformed, mostly through commercial crop cultivation. This report is relevant to the 2 400 ha of untransformed (natural) habitat, with the direct impacts dealt with in section 7 being specific to the area of above-ground infrastructure.

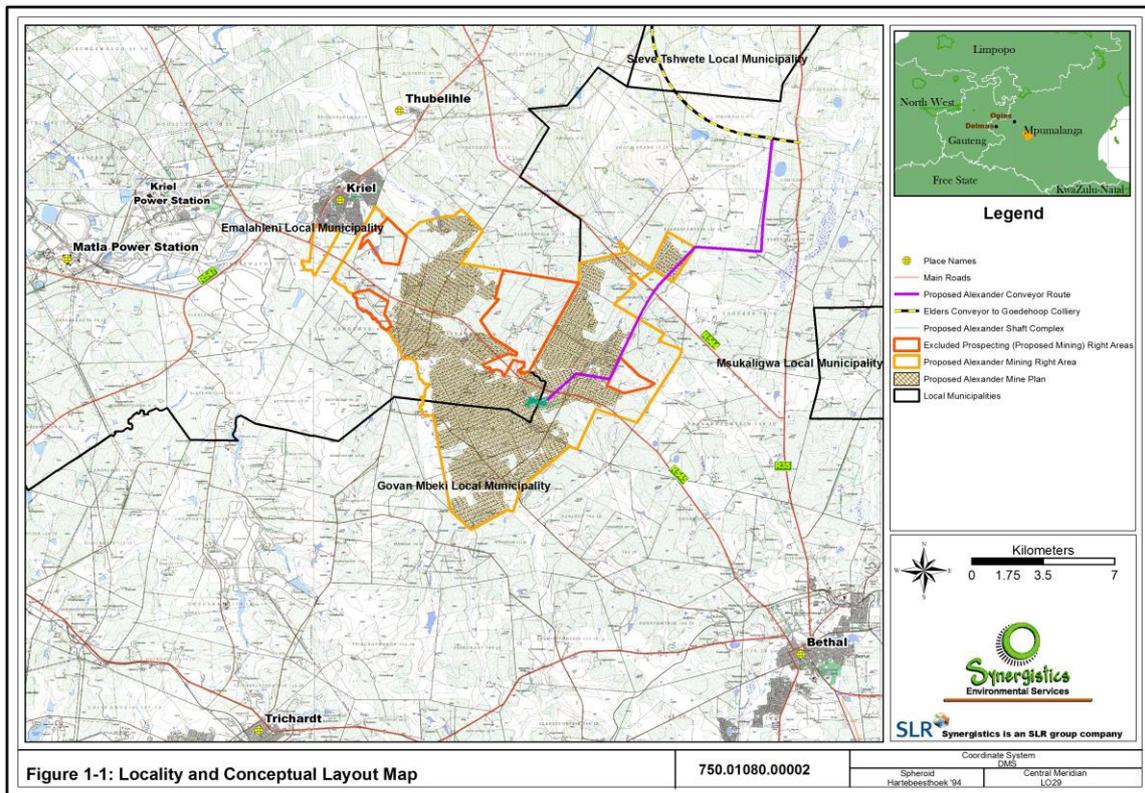


Figure 1. Location of Study Area

4. METHODS

4.1 Flora

Desktop

Vegetation communities were identified prior to fieldwork using satellite imagery. Red Data plant species listed for the quarter-degree grid 2629 AD in the Mpumalanga Tourism & Parks Agency's threatened species database, as well as PRECIS data from the South African National Biodiversity Institute (SANBI), were used to produce a list of the most likely threatened species, which were searched for during fieldwork.

Fieldwork

Vegetation was sampled by walking through all patches of natural habitat within the study area, ensuring that all vegetation communities identified during desktop imagery analysis were covered. The search focused on microhabitats for potentially occurring species of conservation concern. Specimens not identified to genus / species level were photographed and collected, dried in a plant press and identified through use of online herbaria and consultation with other experts. Quantitative sampling for determining species richness took place in 10 m x 10 m quadrats placed in each vegetation community. All plant species located in each quadrat were recorded and cover-abundance estimated according to the Braun-Blanquet cover scale (Kent & Coker, 1992).

Data Analysis

Similarity between different plant communities was determined using the Sørensen Coefficient of Similarity (Kent & Coker, 1992), defined as:

$$S_s = \frac{2a}{2a + b + c}$$

where

S_s	=	Sørensen Coefficient of Similarity
a	=	number of species common to both communities
b	=	number of species in community 1
c	=	number of species in community 2

4.2 Fauna

Desktop

Lists of potentially occurring conservation-important mammals, birds, reptiles and frogs were prepared using Friedmann & Daly (2004), Taylor et al. (2015), data from the second Southern African Bird Atlas Project (<http://sabap2.adu.org.za>), Minter *et.al* (2004), and data from the current South African Reptile Conservation Assessment (<http://vmus.adu.org.za>). The above data were mostly captured at a quarter-degree spatial resolution, but were refined by excluding species unlikely to occur within the footprint, either because of incorrect habitat or altitude. Bat species thought to only fly over the site and not actually utilize vegetation communities were not included in the assessment.

Fieldwork

Fieldwork for this study was conducted from 6-8 April 2016, which co-incided with the end of the wet season and the period of passage for a number of migrating bird species.

Mammals were recorded along the same transects and at the same points at which birds were sampled. Visual sightings were supplemented with indirect evidence such as spoor or dung, as well as limited audio confirmation. Birds were surveyed during the first four hours of daylight when bird activity was at its highest. Species heard calling only were also included. The sampling technique was Timed-Species Counts (Pomeroy & Tengecho, 1983), which involved spending an hour at each site and recording observations within ten minute segments. Additional incidental observations were made during the less productive time of the day while conducting the vegetation survey.

Reptiles and frogs were searched for during the day by visual scanning of likely habitat, investigating potential refuges such as under logs, beneath old bark on dead trees, leaf litter, etc. Frogs were also sampled through recording calls at acoustical monitoring points. No trapping exercise was undertaken.

4.3 Biodiversity Value Assessment

The biodiversity value of each vegetation community was based on a combination of Conservation Importance and Functional Importance, each of which were rated on a five-point scale, from Very Low to Very High, as indicated in Table 1. This method was based on Biodiversity Action Plan guidelines developed by Anglo American (Coombes, 2004).

Conservation Importance

The method of calculating conservation importance was based on six key parameters, which were each allocated a score that ranged between zero (Not Important) and twenty (Very Important) (Table 2). The overall conservation importance was based on the median value of the six parameters, namely:

1. *Protection Status*. The extent to which the vegetation community is currently formally protected (e.g. World Heritage Site; RAMSAR, National Park; Provincial Game Reserve; Private Conservancy etc);
2. *Size*. The extent to which the larger vegetation type of which the defined area is a representative sample, still exists; this incorporates the conservation status of threatened vegetation types in that vegetation types with the highest threat status are assumed to have the lowest extent of habitat remaining;
3. *Species Diversity*. The extent to which the vegetation community supports a high diversity of plants or animals;
4. *Species of Conservation Concern*. The extent to which the vegetation community supports threatened species and other species of conservation concern;
5. *Unique Habitat or Taxa*. Presence of range-restricted plants or animals or unusual natural feature;
6. *Present Ecological State*. The extent to which the vegetation community is modified from natural conditions.

Functional Importance

The method of calculating functional importance was based on four ecosystem service categories, which were each allocated a score that ranged between zero (Not Important) and twenty (Very Important) (Table 3). The overall functional importance was based on the median value of the four ecosystem service categories, namely:

1. *Provisioning Services*. The extent and frequency that the vegetation community provides consumable goods (e.g. food, freshwater, timber, fibre, medicinal plants, etc);
2. *Regulating Services*. The extent to which the vegetation community provides regulating services (e.g. flood attenuation, water purification, storage, climate regulation, carbon sequestration, etc);
3. *Cultural Services*. The extent to which the vegetation community provides cultural services (e.g. tourism attraction, spiritual attraction, aesthetic value, etc), and;
4. *Supporting Services*. The extent to which the vegetation community provides supporting ecological services, either positive (e.g. migration corridor, refuge area, primary production, pollination, pest control, nutrient cycling, soil formation), or negative (e.g. disease sources, pest outbreaks).

By integrating assessments of the conservation importance and functional importance of the different vegetation communities, an assessment of Biodiversity Value was made. This is indicated spatially in Figure 12.

Table 1. Method of calculating Biodiversity Value of vegetation communities

Conservation Importance	Functional Importance				
	Very High	High	Moderate	Low	Very Low
Very High	Very High	Very High	High	High	Moderate
High	Very High	High	High	Moderate	Moderate
Moderate	High	High	Moderate	Moderate	Low
Low	High	Moderate	Moderate	Low	Low
Very Low	Moderate	Moderate	Low	Low	Very Low

Table 2. Method of calculating Conservation Importance of vegetation communities

Parameter	Very High	High	Moderate	Low	Very Low
Protection Status	International	National	Regional	Local	None
	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Size / Length	Very small	Small	Moderate	Large	Very Large
	(<500km ²)	(500 to 1,000km ²)	(1,000 to 20,000km ²)	(20,000 to 50,000km ²)	(> 50,000km ²)
	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Species Diversity	Noticeably High		Moderate		Noticeably Low
	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Species of Conservation Concern	Noticeably High		Moderate		Noticeably Low
	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Unique Habitat or Taxa	Noticeably High		Moderate		Noticeably Low
	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Present Ecological State	Natural, largely Unmodified	Slightly modified	Moderately Modified	Considerably Modified	Severely Modified
	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0

Table 3. Method of calculating Functional Importance of vegetation communities

Parameter	Very High	High	Moderate	Low	Very Low
Provisioning Services	Constant	Regular	Frequent	Occasional	Intermittent
	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Regulating Services	Very High	High	Moderate	Low	Very Low
	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Cultural Services	Very High	High	Moderate	Low	Very Low
	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Supporting Services	Very High	High	Moderate	Low	Very Low
	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0

4.4 Impact Assessment

The method described below is that provided by Synergistics and is the method used in the Scoping Report.

PART A: DEFINITION AND CRITERIA*	
Definition of SIGNIFICANCE	Significance = consequence x probability
Definition of CONSEQUENCE	Consequence is a function of intensity, spatial extent and duration
Criteria for ranking of the INTENSITY of environmental impacts	VH Severe change, disturbance or degradation. Associated with severe consequences. May result in severe illness, injury or death. Targets, limits and thresholds of concern continually exceeded. Substantial intervention will be required. Vigorous/widespread community mobilization against project can be expected. May result in legal action if impact occurs.
	H Prominent change, disturbance or degradation. Associated with real and substantial consequences. May result in illness or injury. Targets, limits and thresholds of concern regularly exceeded. Will definitely require intervention. Threats of community action. Regular complaints can be expected when the impact takes place.
	M Moderate change, disturbance or discomfort. Associated with real but not substantial consequences. Targets, limits and thresholds of concern may occasionally be exceeded. Likely to require some intervention. Occasional complaints can be expected.
	L Minor (Slight) change, disturbance or nuisance. Associated with minor consequences or deterioration. Targets, limits and thresholds of concern rarely exceeded. Require only minor interventions or clean-up actions. Sporadic complaints could be expected.
	VL Negligible change, disturbance or nuisance. Associated with very minor consequences or deterioration. Targets, limits and thresholds of concern never exceeded. No interventions or clean-up actions required. No complaints anticipated.

	VL+	Negligible change or improvement. Almost no benefits. Change not measurable/will remain in the current range.
	L+	Minor change or improvement. Minor benefits. Change not measurable/will remain in the current range. Few people will experience benefits.
	M+	Moderate change or improvement. Real but not substantial benefits. Will be within or marginally better than the current conditions. Small number of people will experience benefits.
	H+	Prominent change or improvement. Real and substantial benefits. Will be better than current conditions. Many people will experience benefits. General community support.
	VH+	Substantial, large-scale change or improvement. Considerable and widespread benefit. Will be much better than the current conditions. Favourable publicity and/or widespread support expected.
Criteria for ranking of the DURATION of impacts	VL	Very short, always less than a year.
	L	Short-term, occurs for more than 1 but less than 5 years.
	M	Medium-term, 5 to 10 years.
	H	Long term, between 10 and 20 years. (Likely to cease at the end of the operational life of the activity)
	VH	Very long, permanent, +20 years (Irreversible. Beyond closure)
Criteria for ranking the EXTENT of impacts	VL	A portion of the site.
	L	Whole site.
	M	Beyond the site boundary, affecting immediate neighbours
	H	Local area, extending far beyond site boundary.
	V	Regional/National

PART B: DETERMINING CONSEQUENCE
--

SEVERITY = VL

DURATION	Very long	VH	Medium	Medium	Medium	High	High
	Long term	H	Low	Medium	Medium	Medium	High
	Medium term	M	Low	Low	Medium	Medium	Medium
	Short term	L	Very Low	Low	Low	Medium	Medium
	Very short	VL	Very Low	Low	Low	Low	Medium

SEVERITY = L

DURATION	Very long	VH	Medium	Medium	High	High	High
	Long term	H	Medium	Medium	Medium	High	High
	Medium term	M	Low	Medium	Medium	Medium	High
	Short term	L	Low	Low	Medium	Medium	Medium
	Very short	VL	Very Low	Low	Low	Medium	Medium

SEVERITY = M

DURATION	Very long	VH	Medium	High	High	High	Very High
	Long term	H	Medium	Medium	High	High	High
	Medium term	M	Medium	Medium	Medium	High	High

	Short term	L	Low	Medium	Medium	Medium	High
	Very short	VL	Very Low	Low	Medium	Medium	Medium

SEVERITY = H

DURATION	Very long	VH	High	High	High	Very High	Very High
	Long term	H	Medium	High	High	High	Very High
	Medium term	M	Medium	Medium	High	High	High
	Short term	L	Medium	Medium	Medium	High	High
	Very short	VL	Low	Medium	Medium	Medium	High

SEVERITY = VH

DURATION	Very long	VH	High	High	Very High	Very High	Very High
	Long term	H	High	High	High	Very High	Very High
	Medium term	M	Medium	High	High	High	Very High
	Short term	L	Medium	Medium	High	High	High
	Very short	VL	Low	Medium	Medium	High	High

	VL	L	M	H	VH
A portion of the site	Whole site	Beyond the site boundary, affecting immediate neighbours	Local area, extending far beyond site boundary.	Regional/ National	
EXTENT					

PART C: DETERMINING SIGNIFICANCE

PROBABILITY (of exposure to impacts)	Definite/ Continuous	VH	Medium	High	High	Very High	Very High
	Probable	H	Medium	Medium	High	High	Very High
	Possible / frequent	M	Low	Medium	Medium	High	High
	Conceivable	L	Low	Low	Medium	Medium	High
	Unlikely / Improbable	VL	Very Low	Low	Low	Medium	Medium
	VL	L	M	H	VH		
CONSEQUENCE							

PART D: INTERPRETATION OF SIGNIFICANCE

Significance	Decision guideline
Very High	Potential fatal flaw unless mitigated to lower significance.
High	It must have an influence on the decision. Substantial mitigation will be required.
Medium	It should have an influence on the decision. Mitigation will be required.
Low	Unlikely that it will have a real influence on the decision. Limited mitigation is likely to be required.
Very Low	It will not have an influence on the decision. Does not require any mitigation

4.5 Assumptions, Limitations and Knowledge Gaps

4.5.1 Seasonality

The 2014 study was conducted in the middle of the wet season (20-24 January) and coincided with the optimal flowering period for many plants, as well as as peak breeding activity for many bird species. The 2016 survey was undertaken at the end of the wet season and co-occurred with the period of passage for many migrating bird species. However, plants which flower in spring or early summer are likely to be underrepresented. An additional survey in September is recommended in order to supplement data with species flowering at that time of the year. However, since the biodiversity value assessment has highlighted all untransformed natural areas as having high value, this limitation is unlikely to have significant consequences on a record of decision.

4.5.2 Overlooked Species

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

4.5.3 Access Limitations

Access was restricted to portions of untransformed habitat that is potentially highly sensitive to development. This was particularly relevant along the western boundary of the study area. This is considered a significant limitation and as such, the precautionary principle has been applied and these areas have been allocated the highest sensitivity status.

5. BIODIVERSITY BASELINE DESCRIPTION

5.1 Flora

5.1.1 Regional Context

According to Mucina & Rutherford (2006), the study area is situated within Eastern Highveld Grassland, which has a national ecosystem status of **Endangered** and is a listed Threatened Ecosystem (Notice 1002 of Government Gazette 34809, 9 December 2011). This vegetation type is virtually endemic to Mpumalanga Province, marginally extending into Gauteng Province. It occurs on the Highveld from Belfast in the east to Johannesburg in the west, and south to a line joining Bethal, Ermelo and Piet Retief. About 44% of Eastern Highveld Grassland has already been transformed, mostly through cultivation, plantations, mines and urbanisation. Only small portions of the remaining untransformed grassland are formally protected. The south-western part of the study area is indicated as bordering on Soweto Highveld Grassland, another Endangered vegetation type, but the boundaries between different grassland vegetation types are vague and usually contain elements of both vegetation types, making it unlikely that Soweto Highveld Grassland is clearly represented in the study area.

The study area is not situated in any of Mpumalanga's floristic centres of endemism, which are areas that have an unusually high number of plants unique to that area (Van Wyk & Smith, 2001).

Much of the northern half of the study area has been disturbed or degraded, mostly through commercial irrigated cultivation, but rocky ridges and valley-bottom wetlands in the study area are mostly untransformed, although often heavily grazed and not in pristine state.

5.1.2 Local Vegetation Communities

Five untransformed vegetation communities were identified within the study area on the basis of distinctive vegetation structure (grassland, woodland, thicket, etc), floristic composition (dominant and diagnostic species) and position in the landscape (mid-slopes, terrace, crest, etc). Transformed areas make up 8 300 ha, or 66% of the study area. The untransformed vegetation communities are described in detail below:

5.1.2.1 Untransformed Grassland on Rocky Ridges

This small and fragmented vegetation community is found on sandstone ridges and scarps, which are concentrated along the western boundary and along the drainage system through the centre of the study area (Figure 2; Figure 9). The vegetation community covers 68 ha, or 5% of the study area. Vegetation structure is Low Closed Grassland or Herbland (*sensu* Edwards, 1983), with large areas of level sheetrock between vegetation patches. Dominant grasses in the vegetation patches are *Microchloa caffra*, *Eragrostis racemosa*, *Elionurus muticus*, *Harpochloa falx* and *Eragrostis curvula*. Creeping or mat-forming succulents are diagnostic for this community, particularly *Mossia intervallaris*, which is present at almost all sites, as well as at least one *Delosperma* species, and *Khadia beswickii*, which is classified as Vulnerable (Victor & Pfab, 2005). Small woody shrubs become established where soil accumulates in cracks in the rock, particularly *Diospyros lycioides* subsp. *guerkei*, *Diospyros austro-africana* and *Searsia magalismsontana*. Prominent herbaceous species occurring in the grassland on skeletal soils include *Commelina africana*, *Monsonia angustifolia*, *Ursinia nana*, *Chaenostoma leve* and *Helichrysum caespitium*.

A total of 139 species (47% of the entire list) was recorded from Untransformed Grassland on Rocky Ridges (Appendix 1), which is remarkably high considering how limited in size this community is. Median species richness for the 100m² sample quadrats was 34.5 (n=4) (Appendix 2). Species fidelity, which is closely linked to community uniqueness, is high, with 49 species (35% of the community list) occurring nowhere else in the study area. Sørensen's Coefficient of Similarity scores indicate that the highest affinity is with Untransformed Grassland on Hillslopes and Plateaus ($S_s = 0.29$) and Untransformed Grassland on Plains ($S_s = 0.24$) (Table 4).

Two conservation-important species were recorded (Table 5). Only one of these is considered to be of conservation concern as defined by Raimondo *et al.* (2009), namely *Khadia beswickii*, which is classified as **Vulnerable**. This species was previously thought to be endemic to Gauteng, but has recently been discovered in western Mpumalanga on an Ecorex survey (McClelland & McKenzie, 2012). *Crytanthus tuckii* is protected under the Mpumalanga Nature Conservation Act (No. 10 of 1998), although it is not considered to be of conservation concern.



Figure 2. Photos of Untransformed Grassland on Rocky Ridges

Untransformed Grassland on Rocky Ridges was assessed as having High Biodiversity Value through integration of High Conservation Importance and Moderate Functional Importance scores (Table 8). It was rated as having High Conservation Importance (Appendix 7A) because of a high rating in the following components:

- Protection Status – a High score was allocated because of provincial policy to avoid developing rocky ridges and outcrops;
- Size – sandstone outcrops and ridges are mostly small and fragmented and are embedded in an Endangered vegetation type;
- Unique Habitat or Taxa – numerous plant and animal species are restricted to these outcrops within the study area, e.g. *Mossia intervallaris*, *Crassula setulosa* and *Listia heterophylla*, while another species, *Khadia beswickii*, is Vulnerable;
- Present Ecological State – ridges and outcrops in the study area are largely untransformed.

Untransformed Grassland on Rocky Ridges was given a Moderate Functional Importance rating (Appendix 7A) because of low scores in Provisioning and Regulating Services and moderate scores in Cultural Services (aesthetic value) and Supporting Services (outcrops acting as refuge areas for flora and fauna).

5.1.2.2 Untransformed Grassland on Hillslopes and Plateaus

This grassland vegetation community is found mostly on hillslopes above and below scarps, while only a few small plateaus in the study area remain uncultivated. These grasslands are best represented around the sandstone ridges along the western boundary and along the ridges running through the centre of the study area (Figure 3; Figure 9). Untransformed

Grassland on Hillslopes and Plateaus was mapped together with Untransformed Grassland on Plains in Figure 9, representing a combined 3 216 ha, or 25% of the study area. Vegetation structure is Low Closed Grassland (*sensu* Edwards, 1983). Dominant grasses are *Tristachya leucothrix*, *Themeda triandra*, a number of *Eragrostis* species (including *E.curvula*, *E.plana*, *E. racemosa* and *E.chloromelas*), *Elionurus muticus*, *Harpochloa falx* and *Setaria sphacelata*. Diversity of the herbaceous understory varies significantly between sites, although the least degraded sites usually have the highest diversity. Forbs and fire-adapted dwarf shrubs (geoxylic suffrutices) are common under the grass canopy and include *Blepharis innocua*, *Pygmaeothamnus chamaedendrum*, *Senecio coronatus*, *Dicoma anomala*, *Pentanisia angustifolia*, *Rhynchosia adenodes*, *Pelargonium luridum*, *Helichrysum rugulosum*, various *Berkheya* species, *Salvia runcinata*, *Tephrosia capensis*, *Zornia milneana* and *Haplocarpha scaposa*. Fire-adapted bulbous plants that store most of their resources below the ground (geophytes) are also diagnostic for temperate grasslands such as this community, and include *Hypoxis* species, *Boophone disticha*, *Eucomis autumnalis*, *Gladiolus permeabilis*, *Cyrtanthus tuckii* and at least two *Chlorophytum* species. Numerous grassland patches have been heavily grazed and have unfavourable burning regimes, and have consequently been invaded by unpalatable shrubs such as *Berkheya rigida* and *Seriphium plumosum*. These grasslands are indicated in Figure 9 as Degraded Grassland.

A total of 136 species (46% of the entire list) was recorded from Untransformed Grassland on Hillslopes and Plateaus (Appendix 1). Median species richness for the 100m² sample quadrats was 32 (n=4) (Appendix 2). Species fidelity, which is closely linked to community uniqueness, is high, with 56 species (41% of the community list) occurring nowhere else in the study area. Sørensen's Coefficient of Similarity scores indicate that the highest affinity is with Untransformed Grassland on Rocky Ridges ($S_s = 0.29$) and Untransformed Grassland on Plains ($S_s = 0.29$), which makes sense since Untransformed Grassland on Rocky Ridges is embedded in this one, and Untransformed Grassland on Plains is usually contiguous with this one (Table 4).

Seven conservation-important species were recorded (Table 5). Three of these are considered to be of conservation concern as defined by Raimondo *et al.* (2009), namely *Boophone disticha*, *Eucomis autumnalis* subsp. *clavata* and *Hypoxis hemerocallidea*. All three are classified as **Declining** because of unsustainable collecting for the traditional medicine market. *Boophone* and *Eucomis* are also protected under the Mpumalanga Nature

Conservation Act (No. 10 of 1998), as well as *Cyrtanthus tuckii*, two *Gladiolus* species and *Eulophia nutans*.



Figure 3. Photos of Untransformed Grassland on Hillslopes and Plateaus

Untransformed Grassland on Hillslopes and Plateaus was assessed as having High Biodiversity Value through integration of High Conservation Importance and Moderate Functional Importance scores (Table 8). It was rated as having High Conservation Importance (Appendix 7B) because of a high rating in the following components:

- Protection Status – a High score was allocated because this vegetation community is representative of a gazetted Threatened Ecosystem;
- Size – grassland patches are mostly small and fragmented;
- Species Diversity – diversity of flora, relative to the small size of most grassland patches, is high;
- Present Ecological State – ecological state of grasslands in the study area is varied, with some being largely undisturbed, although others are overgrazed and invaded by shrubs such as *Berkheya rigida* and *Seriphium plumosum*.

Untransformed Grassland on Hillslopes and Plateaus was given a Moderate Functional Importance rating (Appendix 7B) because of low scores in Provisioning and Regulating Services and moderate scores in Cultural Services (aesthetic value) and Supporting Services (grassland fragments acting as refuge areas for flora and fauna).

5.1.2.3 Untransformed Grassland on Plains

This grassland vegetation community is found mostly on broad valley bottoms and is usually contiguous with Untransformed Grassland on Hillslopes and Plateaus (Figure 4; Figure 9). Vegetation structure is Low Closed Grassland (*sensu* Edwards, 1983). Dominant grasses are *Themeda triandra*, a number of *Eragrostis* species (including *E.curvula*, *E.plana* and *E.capensis*), *Bothriochloa insculpta*, *Cymbopogon* species, *Cynodon dactylon*, *Digitaria tricholaenoides*, *Heteropogon contortus*, *Pennisetum thunbergii* and *Setaria sphacelata*. *Paspalum urvillei* becomes dominant on moist floodplain grasslands that have been heavily grazed, while *Eragrostis curvula* and *E. plana* are prominent on drier overgrazed plains.

Diversity of the herbaceous understory is not as high as in Untransformed Grassland on Hillslopes and Plateaus. However, forbs and fire-adapted dwarf shrubs (geoxylic suffrutices) are present and include *Blepharis subvulabilis*, *Chaetacanthus setiger*, various *Berkheya* species, *Conyza* species, *Helichrysum aureonitens*, *Geigeria burkei*, *Senecio consanguineus* and *S.erubescens*, *Erythrina zeyheri*, *Indigofera hedyantha*, *Rhynchosia adenodes*, *Sphenostylis angustifolia*, *Salvia runcinata*, *Hermannia depressa*, *Hibiscus microcarpus* and *Striga bilabiata*. Fire-adapted bulbous plants that store most of their resources below the ground (geophytes) are prominent in this community, particularly on Portion 9 of Farm 79 IS, where fields of geophytes are dominated by *Nerine krigei*, *Haemanthus montanus* and *Gladiolus elliotii*, while elsewhere common geophytes include *Hypoxis* and *Chlorophytum* species. *Crinum bulbispermum* is relatively common on some moist floodplains in the study area. Numerous grassland patches have been heavily grazed and have unfavourable burning regimes, and have consequently been invaded by unpalatable shrubs such as *Berkheya rigida*, *Ulex europaeus* and *Seriphium plumosum*. These grasslands are indicated in Figure 9 as Degraded Grassland.

A total of 90 species (30% of the entire list) was recorded from Untransformed Grassland on Plains (Appendix 1). Median species richness for the 100m² sample quadrats was 23 (n=2) (Appendix 2). Species fidelity, which is closely linked to community uniqueness, is moderate, with 24 species (27% of the community list) occurring nowhere else in the study area. Sørensen's Coefficient of Similarity scores indicate that the highest affinity is with Untransformed Grassland on Hillslopes and Plateaus ($S_s = 0.29$) and Untransformed Grassland on Rocky Ridges ($S_s = 0.24$) (Table 4).

Seven conservation-important species were recorded (Table 5). Two of these are considered to be of conservation concern as defined by Raimondo *et al.* (2009), namely *Crinum bulbispermum* and *Hypoxis hemerocallidea*, both of which are classified as **Declining**. The *Crinum* is also protected under the Mpumalanga Nature Conservation Act (No. 10 of 1998), as well as *Haemanthus montanus*, *Nerine krigei*, *Aloe ecklonis*, *Gladiolus elliotii* and *Habenaria epipactidea*.



Figure 4. Photos of Untransformed Grassland on Plains

Untransformed Grassland on Plains was assessed as having High Biodiversity Value through integration of High Conservation Importance and Moderate Functional Importance scores (Table 8). It was rated as having High Conservation Importance (Appendix 7C) because of a high rating in the following components:

- Protection Status – a High score was allocated because this vegetation community is representative of a gazetted Threatened Ecosystem;
- Size – grassland patches are mostly small and fragmented;
- Species Diversity – diversity of flora, relative to the small size of most grassland patches, is high;
- Present Ecological State – ecological state of grasslands in the study area is varied, with some being largely undisturbed, although others are overgrazed and invaded by shrubs such as *Berkheya rigida* and *Seriphium plumosum*.

Untransformed Grassland on Plains was given a Moderate Functional Importance rating (Appendix 7C) because of moderate scores in Provisioning and Regulating Services and moderate scores in Cultural Services (aesthetic value) and Supporting Services (grassland fragments acting as refuge areas for flora and fauna).

5.1.2.4 Evergreen Thicket on Scarps and Rocky Outcrops

Small and highly fragmented evergreen to semi-deciduous thickets occur along most scarps and sandstone ridges or outcrops in the study area (Figure 5). The fragments are mostly too small to map accurately, and have not been included in Figure 9. Nor could area calculations be done for this community. Vegetation structure is Low to Tall Thicket (*sensu* Edwards, 1983). Woody shrubs and trees are the dominant life forms, with grasses and geophytes being conspicuously absent. A few large thickets have formed at the base of the highest scarps on Portion 9 of Farm 79 IS and Portion 1 of Witbank 80 IS that are entirely dominated by the invasive alien *Populus alba*, with smaller patches on Witbank 80 IS being dominated by alien species such as *Robinia pseudo-acacia*, *Ficus carica*, *Prunus persicus* and *Ligustrum sinensis*. Common trees and shrubs in the smaller, fragmented indigenous thickets are *Diospyros lycioides* subsp. *guerkei*, *Diospyros austro-africana*, *Celtis africana*, *Kiggelaria africana*, *Searsia dentata* and *Searsia magalismontana*. Two invasive alien species that are fairly frequent in these thickets are *Cotoneaster franchetii* and *Pyracantha coccinea*. Ferns present in shade of the canopy include *Adiantum capillus-veneris*, *Mohria vestita*, *Cheilanthes viridis* and *Pellaea calomelanos*. The sparse herbaceous understory has shade-loving species such as *Achyranthes aspera* and *Solanum retroflexum*, while the thicket edges have species such as *Leonotis ocymifolia* var. *raineriana*, *Senecio subrubriflorus*, *Agrimonia odorata* and *Mentha longifolia*.

A total of 52 species (18% of the entire list) was recorded from Evergreen Thicket (Appendix 1). Species richness in the single 100m² sample quadrat was 22 (Appendix 2). Species fidelity, which is closely linked to community uniqueness, is moderate, with 20 species (39% of the community list) occurring nowhere else in the study area. Sørensen's Coefficient of Similarity scores indicate that the highest affinity is with Untransformed Grassland on Rocky Ridges ($S_s = 0.19$), but very low affinity with the other vegetation communities (Table 4).

Only one conservation-important species was recorded, namely *Zantedeschia albomaculata* (Table 5). This is not considered to be of conservation concern as defined by Raimondo *et al.* (2009), but is protected under the Mpumalanga Nature Conservation Act (No. 10 of 1998).



Figure 5. Photos of Evergreen Thicket on Scarps and Rocky Outcrops

Evergreen Thicket was assessed as having Moderate Biodiversity Value through integration of Moderate Conservation Importance and Moderate Functional Importance scores (Table 8). It was rated as having Moderate Conservation Importance (Appendix 7D) even though it scored high for Protection Status (because of provincial policy to avoid developing rocky ridges and outcrops) but had moderate rating in the other components. Evergreen Thicket was given a Moderate Functional Importance rating (Appendix 7D) because of high scores in Supporting Services (particularly regarding provision of resources for plant pollinators) and Provisioning Services (provision of food, timber, productive soils), but only moderate scores in Cultural and Regulating Services.

5.1.2.5 Wetlands

Wetlands are being covered in a separate report, so are included here as a biodiversity value assessment with some discussion on conservation-important species. Photos of some of the valley-bottom wetlands are included in Figure 6. Only one species of conservation concern was recorded from the wetland vegetation community, namely *Crinum bulbispermum*, which is classified as Declining and is protected under the Mpumalanga Nature Conservation Act (No. 10 of 1998). It was found to be fairly common in channelled and unchannelled valley-bottom wetlands.

Wetlands were assessed as having High Biodiversity Value through integration of Moderate Conservation Importance and High Functional Importance scores (Table 8). These were rated as having Moderate Conservation Importance (Appendix 7E) in spite of high ratings in the following components:

- Protection Status – a High score was allocated because of legislation and government policy preventing development on wetlands;
- Present Ecological State – Wetlands in the study area are only slightly modified, although a few have been invaded by the alien grass *Paspalum urvillei*.

However, moderate scores in the other Conservation Importance components reduced the overall score to Moderate. Wetlands were allocated a High Functional Importance rating (Appendix 7E) because of high scores in the following components:

- Provisioning Services – fibres, medicinal plants;
- Regulating Services - flood attenuation, water purification;
- Supporting Services – nutrient cycling, migration corridors.



Figure 6. Photos of Valley-bottom Wetlands in the Project Area

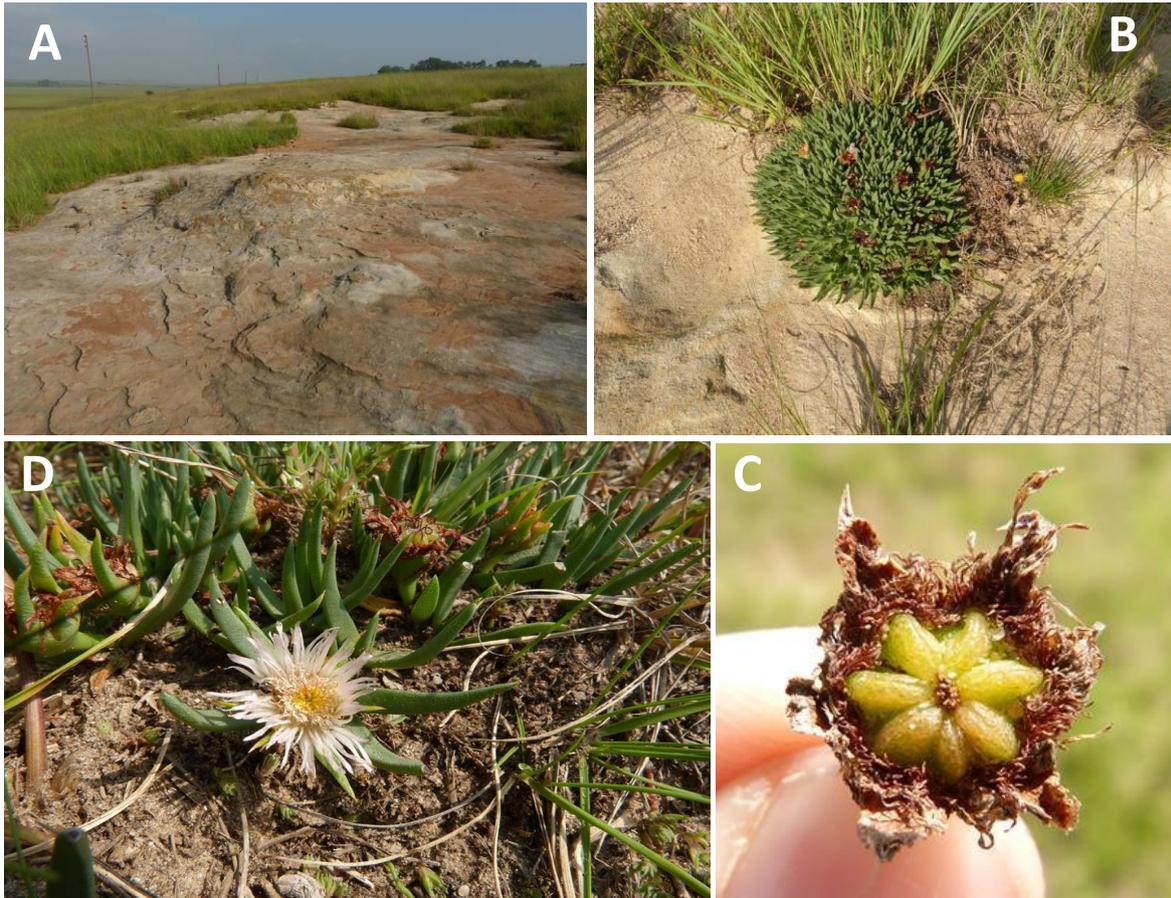
Table 4. Sørensen's Coefficient of Similarity Scores for Vegetation Communities

	Rocky Ridge Grassland	Rocky Ridge Thicket	Hillslope and Plateau Grassland	Plains Grassland	Wetlands	Transformed Habitats
Rocky Ridge Grassland	-	0.19	0.29	0.24	0.02	0.04
Rocky Ridge Thicket	0.19	-	0.07	0.04	0.02	0.08
Hillslope and Plateau Grassland	0.29	0.07	-	0.29	0.08	0.10
Plains Grassland	0.24	0.04	0.29	-	0.13	0.10
Wetlands	0.02	0.02	0.08	0.13	-	0.13
Transformed Habitats	0.04	0.08	0.10	0.10	0.13	-

5.1.3 Conservation-Important Flora

A total of 296 plant species was recorded within the study area during fieldwork (Appendix 1). Fifteen of these are protected under the Mpumalanga Nature Conservation Act (No. 10 of 1998) (Table 5). Five species are considered to be of conservation concern as defined by Raimondo *et al.* (2009) of which only one is threatened, namely *Khadia beswickii*, which is classified as **Vulnerable**. This species was previously thought to be endemic to Gauteng, but has recently been discovered in western Mpumalanga on an Ecorex survey (McClelland & McKenzie, 2012). A small population of ten plants were found on the edge of an area of sheetrock on a low sandstone ridge on Portion 6 of Witrand 103 IS (Figure 7). The four other species are all classified as Declining due to unsustainable illegal collecting for the traditional medicine market. *Boophone disticha* was only located at one site in the study area, in a fragment of untransformed grassland on Portion 6 of Witrand 103 IS. Several *Eucomis autumnalis* subsp. *clavata* plants were found on a hill slope on Portion 11 of Witbank 80 IS and above a scarp on Portion 9 of Farm 79 IS. *Crinum bulbispermum* was found at numerous localities in unchannelled and channelled valley-bottom wetlands and plains grassland on the farms Witbank 80 IS, Farm 79 IS and Witrand 103 IS. Small colonies of *Hypoxis hemerocallidea* were located in untransformed grassland on Portions 11 and 12 of Witbank 80 IS. Photographs of these four species are included in Figure 8.

An additional seven species of conservation concern have been recorded within the quarter-degree grid 2629 AD and surrounding grids with similar habitat, of which five species have a moderate or high likelihood of occurring because of the presence of suitable habitat and / or presence of known populations nearby (Table 6). One of these, *Nerine gracilis*, is threatened (Vulnerable). It potentially occurs at the edges of shallow pans or in untransformed grassland on plains, but was not located during early April fieldwork, which falls at the end of its flowering period when it is most visible. However, it is a small species that is easily overlooked, particularly when surveying large tracts of suitable habitat. The other four species are classified as Near Threatened. *Stenostelma umbelliferum* and *Gladiolus robertsoniae* are both species of undisturbed, untransformed grassland, while *Trachyandra erythrorrhiza* occurs in black turf marshes and *Kniphofia typhoides* in unchannelled valley-bottom wetlands. Although these species were not confirmed during fieldwork, they could have been overlooked because of the large size of the study area. However, the biodiversity value assessment in this report already classifies the potential habitat of these species as High so this is not seen as a significant limitation.



A = Typical *Khadia beswickii* habitat in the study area; B = Colony of *Khadia beswickii* plants at the edge of sheetrock; C = unripe fruit that hasn't yet opened; D = unusually pale pink flowers of *Khadia beswickii*

Figure 7. Selected photographs of *Khadia beswickii*, a Vulnerable species occurring in the study area



A - *Boophone disticha* (old inflorescence); B - *Hypoxis hemerocallidea*; C - *Crinum bulbispermum* (with fruit); D - *Eucomis autumnnalis* subsp. *clavata* (flowers)

Figure 8. Photos of some Declining species in the Project Area

Table 5. Conservation-important plant species confirmed during fieldwork

Species	Family	Cons Status	Protected Status	Rocky Ridge Grassland	Rocky Ridge Thicket	Hillslope and Plateau Grassland	Plains Grassland	Wetlands
<i>Boophone disticha</i>	Amaryllidaceae	Declining	MNCA			x		
<i>Crinum bulbispermum</i>	Amaryllidaceae	Declining	MNCA				x	x
<i>Cyrtanthus tuckii</i>	Amaryllidaceae		MNCA	x		x		
<i>Haemanthus montanus</i>	Amaryllidaceae		MNCA				x	
<i>Nerine krigei</i>	Amaryllidaceae		MNCA				x	
<i>Zantedeschia albomaculata</i>	Araceae		MNCA		x			
<i>Aloe ecklonis</i>	Asphodelaceae		MNCA				x	
<i>Eucomis autumnalis</i> subsp. <i>clavata</i>	Hyacinthaceae	Declining	MNCA			x		
<i>Hypoxis hemerocallidea</i>	Hypoxidaceae	Declining				x	x	
<i>Gladiolus elliotii</i>	Iridaceae		MNCA				x	
<i>Gladiolus permeabilis</i>	Iridaceae		MNCA			x		
<i>Gladiolus</i> sp. (no flowers)	Iridaceae		MNCA			x		
<i>Khadia beswickii</i>	Mesembryanthemaceae	VU		x				
<i>Eulophia nutans</i>	Orchidaceae		MNCA			x		
<i>Habenaria epipactidea</i>	Orchidaceae		MNCA				x	
TOTAL	15	5	13	2	1	7	7	1

Table 6. Potentially Occurring Plant Species of Conservation Concern

Species	Family	Red Data	Protected	Habitat	Likelihood	Reason
<i>Nerine gracilis</i>	Amaryllidaceae	Vulnerable	MNCA	Edge of pans	Moderate	Some suitable habitat available
<i>Stenostelma umbelluliferum</i>	Apocynaceae	Near Threatened		Grassland near drainage lines, on vertic soils with high clay content	Moderate	Some suitable habitat available
<i>Kniphofia typhoides</i>	Asphodelaceae	Near Threatened	MNCA	Valley-bottom wetlands	High	Much suitable habitat present
<i>Trachyandra erythrorrhiza</i>	Asphodelaceae	Near Threatened		Dark clay soils, wetlands	Moderate	Some suitable habitat available
<i>Gladiolus robertsoniae</i>	Iridaceae	Near Threatened	MNCA	Grassland at low rocky ridges	Moderate	Some suitable habitat available
<i>Frithia humilis</i>	Mesembryanthemaceae	Endangered		Level areas of sheetrock on rocky ridges	Low	While some apparently suitable habitat is present, all areas of habitat were carefully searched without success
<i>Brachycorythis conica subsp. transvaalensis</i>	Orchidaceae	Endangered	MNCA	Rocky ridges in grassland	Low	Very rare species with very few records. Nearest confirmed record is a farm about 19 km to the north of the study area

MNCA = Mpumalanga Nature Conservation Act

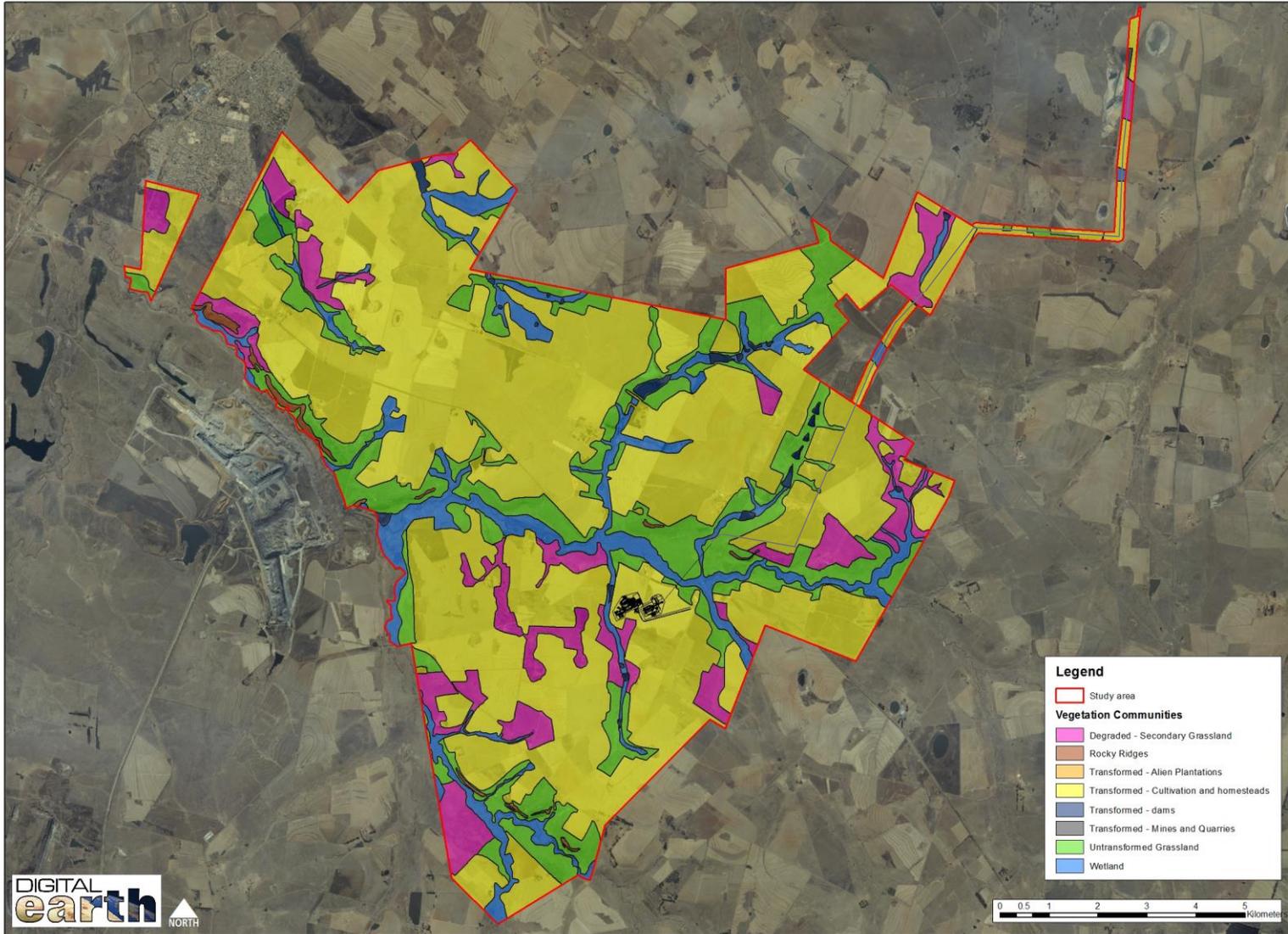


Figure 9. Vegetation communities identified within the Study Area

5.2 Terrestrial Fauna

5.2.1 Mammals

About 66% of the study area has been transformed, mostly through cropland agriculture. This habitat transformation, together with elevated human presence and concomitant impacts such as disturbance, hunting and persecution, has negatively impacted on large mammal occurrence, particularly ungulates and predators. However, several game farms have reintroduced species that occurred in the area in the past such as Blesbok, Springbok and Black Wildebeest, as well as species that were unlikely to have been present historically, such as Waterbuck, Buffalo and Gemsbok. Smaller antelope such as Common Duiker and Steenbok are still present in small numbers.

Important portions of intact indigenous vegetation exist in the western, southern and central parts of the study area. An estimated 10 mammals of conservation concern potentially occur within the area, none of which are threatened (Appendix 6). Two Near Threatened insectivores, Highveld Golden Mole and Southern African Hedgehog, potentially occur in untransformed grassland anywhere in the study area. Two Near Threatened carnivores, Brown Hyaena and Serval, were confirmed to occur through daytime sightings and indirect evidence. Most significantly, a pair of Brown Hyaenas was seen during the early morning at a large den on farm Witbank 80 IS, and a motion-triggered camera placed at the entrance to the den produced several hundred photographs of the hyaenas. Some of the photos confirmed that four hyaenas were present, two of which were younger and most likely were the previous season's juveniles (see photos in Figure 10). The property landowner confirmed that over the past two years several hyaenas had been caught in snares set by poachers for small game, so it appears that there is a viable population within the study area.

The rest of the potentially occurring mammals of conservation concern are classified as Data Deficient, meaning that not enough data were available in order to assess their Red Data status¹. It is probable that at least a few Data-Deficient species do occur, particularly shrews in the genera *Crocidura* and *Suncus* (Appendix 6).

Twenty-six mammal species were confirmed to occur during fieldwork (Appendix 4).

¹ Friedman & Daly, 2004



Figure 10. Selected Bushnell TrailCam photos at the Brown Hyaena den

5.2.2 Birds

The level of transformation of Highveld Grassland has had significant impacts on bird assemblages. Populations of seed-eating species such as Red-billed Quelea and Southern Red Bishop are most likely much higher and less nomadic than in the past because of the planting of crops, resulting in a more predictable and more plentiful food supply. More sensitive grassland specialists such as Botha's Lark, Denham's Bustard, White-bellied Korhaan and Blue Crane have declined dramatically in numbers as their habitat has been reduced. Thus, any sizeable fragment of untransformed grassland should be considered very valuable to populations of conservation-important birds.

Species Diversity and Assemblages

A total of 170 bird species has been reported from the quarter-degree grid 2629 AD, in which the study area falls, during the current second South African Bird Atlas Project (SABAP2), reflecting the moderately high species richness of this part of the Highveld. At a finer scale, data from SABAP2 indicate that 136 bird species have already been recorded from the pentad (mapping unit) in which the bulk of the study area is situated (2615_2915)¹. A pentad covers an area of approximately 72 km², which is considerably smaller than a quarter-degree grid and thus a better indication of which species occur in the study area. This puts into perspective the total of 145 bird species which was recorded during the 2014 and 2016 surveys (Appendix 4). Considering the limited time spent in the field, this is a high total that reflects sufficient sampling for assessing habitat suitability for potentially occurring threatened species, the primary objective of the ornithological component of this study, as well as determining the species composition of bird assemblages in the study area. Six broad assemblages or species-habitat associations were identified, each of which is briefly described below:

I. Grassland Assemblage

This is a prominent bird assemblage in the study area and contained 76 species during fieldwork (Appendix 4). The assemblage is closely linked to two of the Untransformed Grassland vegetation communities (Hillslopes and Plateaus, and Plains) in the study area. The most abundant species in this assemblage during the fieldwork period (Timed-Species Count scores in parentheses) were Cape Longclaw (6.0), Cape Turtle Dove (6.0), Zitting

¹ Data accessed from http://sabap2.adu.org.za/summary_pentad.php?pentad=2615_2915 on 23 Apr 2016

Cisticola (6.0), Barn Swallow (5.7), Laughing Dove (5.7) and Long-tailed Widowbird (5.7) (Appendix 5). Sørensen's Coefficient of Similarity scores indicate that the Grassland assemblage is most similar to the Rocky Outcrops and Cliffs assemblage ($S_s = 0.34$) and Cultivated Lands and Homesteads assemblage ($S_s = 0.34$), with considerable overlap with the Wetland assemblage as well ($S_s = 0.27$) (Table 7). The larger fragments of untransformed grassland in the study area were found to support numerous grassland specialists, such as Cloud Cisticola, Wing-snapping Cisticola, Pale-crowned Cisticola, Spike-heeled Lark, Amur Falcon, Mountain Wheatear, Malachite Sunbird and African Quailfinch. While the study area is situated in mesic Highveld grassland, it is near the edge of a transition zone between moist grassland and arid western grassland bird assemblages. Some typical arid grassland species recorded during fieldwork were Orange River Francolin, Black-chested Prinia, Red-headed Finch, Black-throated Canary and Yellow Canary.

II. Rocky Outcrops and Cliffs Assemblage

This is an assemblage which is confined to the Untransformed Grassland on Rocky Ridges vegetation community and is thus embedded within the Grassland assemblage. Twenty-seven species were recorded in this assemblage during fieldwork (Appendix 4). The habitat was too small and fragmented for the Timed-Species Count sampling method, so no comparative measures of abundance were recorded. Sørensen's Coefficient of Similarity scores indicate that the Rocky Outcrops and Cliffs assemblage is most similar to the Grassland assemblage ($S_s = 0.34$), with some overlap in species composition with the Cultivated Lands and Homesteads assemblage ($S_s = 0.23$) (Table 7). The only diagnostic species that were confined to this assemblage were Mountain Wheatear and Malachite Sunbird, while Cape Longclaw, Orange River Francolin and Wailing Cisticola were shared only with the Grassland assemblage.

III. Wetland Assemblage

This was another prominent assemblage in the study area during fieldwork and contained at least 59 species (Appendix 4). The assemblage is closely linked to the Untransformed Grassland on Plains and Wetlands vegetation communities. The most abundant species in this assemblage (all of which had mean Timed-Species Count scores of 6.0) were African Sacred Ibis, Blacksmith Lapwing, Cattle Egret, Glossy Ibis, Great Egret, Hadedda Ibis, Wood Sandpiper, Yellow-billed Duck and Yellow-crowned Bishop (Appendix 5). Sørensen's Coefficient of Similarity scores indicate that the Wetland assemblage is most similar to the Rivers and Dams ($S_s = 0.40$), Grassland ($S_s = 0.27$) and Cultivated Lands and Homesteads

assemblages ($S_s = 0.27$) (Table 7). A number of species were confined to this assemblage, including African Snipe, Cuckoo Finch, Dark-capped Yellow Warbler, Marsh Owl and Squacco Heron. A small, shallow wetland on Dorstfontein 71 IS had small numbers of two out-of-range tropical wetland birds in January 2014, namely African Crake and Lesser Moorhen, neither of which had previously been recorded in the vicinity of Kriel in SABAP2.

IV. Rivers and Dams Assemblage

This is an assemblage which is confined to open waterbodies such as perennial rivers and farm dams. Sixty-six species were recorded in this assemblage during fieldwork (Appendix 4), which was the second highest total for any assemblage in the study area. This reflects the diversity of habitats associated with rivers and dams, including exposed sandbanks or mudflats. The habitat was too small and fragmented for the Timed-Species Count sampling method, so no comparative measures of abundance were recorded. Sørensen's Coefficient of Similarity scores indicate that the Rivers and Dams assemblage is most similar to the Wetlands assemblage ($S_s = 0.40$), with some overlap in species composition with the Cultivated Lands and Homesteads assemblage ($S_s = 0.23$) (Table 7). Numerous waterbird species were confined to this assemblage, including African Darter, African Spoonbill, Cape Shoveler, Common Sandpiper, Greater Flamingo, Great Crested Grebe, Macco Duck and South African Shelduck. A number of smaller species more typical of the Wetlands assemblage occurred in the vegetated fringes of rivers and dams, including Levillant's Cisticola, Malachite Kingfisher and Common Waxbill.

V. Thickets and Plantations Assemblage

The Thickets and Plantations assemblage is confined to small and fragmented evergreen thickets and plantations of alien trees that are closely associated with scarps and rocky outcrops in the study area. Thirty-five species were recorded in this assemblage during fieldwork (Appendix 4). The habitat was too small and fragmented for the Timed-Species Count sampling method, so no comparative measures of abundance were recorded. Sørensen's Coefficient of Similarity scores indicate that the Thickets and Plantations assemblage is most similar to the Cultivated Lands and Homesteads assemblage ($S_s = 0.23$), with little overlap in species composition with the other bird assemblages in the study area (Table 7). African Paradise Flycatcher and Fiscal Flycatcher were both confined to this assemblage, while numerous typical thicket species were shared with the Cultivated Lands and Homesteads assemblage because of the similarity between wooded gardens of homesteads and evergreen thickets.

VI. Cultivated Lands and Homesteads Assemblage

This is an artificial assemblage consisting of many grassland species such as Amur Falcon, Black-headed Heron, Black-shouldered Kite, Common Fiscal and Red-capped Lark which also forage in recently harvested fields, and also typical thicket species that also occur in wooded gardens of homesteads, such as Black-collared Barbet, Cape Robin-Chat and Cape White-eye. This habitat diversity resulted in a high total of 52 species recorded during fieldwork (Appendix 4). Sørensen's Coefficient of Similarity scores indicate that the Cultivated Lands and Homesteads assemblage had relatively high affinity with all the other bird assemblages in the study area (Table 7).

Table 7. Sørensen's Coefficient of Similarity Scores for Bird Assemblages

	Grassland	Rocky Outcrops and Cliffs	Thickets, Plantations	Wetlands	Rivers, Dams	Cultivated Lands, Homesteads
Grassland	-	0.34	0.11	0.27	0.15	0.34
Rocky Outcrops and Cliffs	0.34	-	0.14	0.17	0.15	0.23
Thickets, Plantations	0.11	0.14	-	0.08	0.11	0.24
Wetlands	0.27	0.17	0.08	-	0.40	0.27
Rivers, Dams	0.15	0.15	0.11	0.40	-	0.23
Cultivated Lands, Homesteads	0.34	0.23	0.24	0.27	0.23	-

Species of Conservation Concern

Sixteen bird species of conservation concern have been confirmed to occur in the general vicinity of the study area during the current South African Bird Atlas Project (Appendix 6). Six of these were confirmed to occur during fieldwork, three of which are threatened and three of which are Near Threatened. The three threatened species, Southern Bald Ibis, Lanner Falcon and Secretarybird, are classified as Vulnerable. Each is dealt with in more detail below and selected photos shown in Figure 11.

Southern Bald Ibis

This threatened species is endemic to the temperate grasslands of South Africa, Lesotho and western Swaziland, with the distribution core in north-eastern Free State, Mpumalanga Highveld and KwaZulu-Natal Drakensberg (Barnes, 2000). Preferred breeding habitat is on inaccessible cliffs, often near waterfalls, although birds have been known to nest in trees in

the Wakkerstroom area (Tarboton, 2001), in disused mine shafts near Belfast, and a colony has occupied an active granite quarry near Belfast since 2008 (Henderson *et al.*, 2013). Preferred foraging habitat is recently burnt grassland, but the birds also feed in heavily grazed unburnt grassland, cultivated fields and open fields such as sport fields. Southern Bald Ibis has been assessed as Vulnerable because of the small population size, restricted extent of occurrence and being confined to a restricted habitat, i.e. high altitude grasslands. The key threat to this species is loss of grassland habitat, primarily through commercial afforestation, intensive crop farming, open-cast mining and urbanisation. This species is currently the most frequently reported threatened species from the pentad within which the bulk of the study area lies (2615_2915), with a 40% reporting rate¹. A small flock of Southern Bald Ibis was seen flying over cultivated lands in the direction of Kriel town and most likely forage on sports fields or recently burnt lands in the vicinity of town.

Secretarybird

Secretarybird is a widespread species in sub-Saharan Africa, occurring in a wide variety of woodland and grassland habitats. Within South Africa its distribution is centred in the eastern half of the country and the highest reporting rates in the Nama Karoo biome in the Eastern Cape and the Grassland biome in the Free State, Mpumalanga and KwaZulu-Natal². Very few records have been reported for the Kriel area during SABAP2 and it has not yet been reported from the pentad 2615_2915. However, the landowner of the farm Witbank 80 IS confirmed that the species does occur occasionally on his property, while one bird was seen flying overhead during fieldwork in January 2014.

Lanner Falcon

Lanner Falcon is another species occurring throughout Africa in a wide variety of habitats. It is also widespread throughout South Africa, with strongholds in Lesotho, Eastern Cape and Kwazulu-Natal; within Mpumalanga, the highest reporting rates are from parts of the Highveld, Escarpment and north-western Bushveld regions³. While the reporting rate for the study area pentad is low (incidental records only), adjacent pentads have high reporting rates and the species is probably a fairly regular visitor. A Lanner Falcon was observed flying over grassland on the farm Kafferstad 79 IS in January 2014, where suitable breeding habitat is present for a breeding pair of this species.

¹ http://sabap2.adu.org.za/pentad_info.php?pentad=2615_2915. Downloaded 24 April 2016.

² http://sabap2.adu.org.za/species_info.php?spp=105#menu_left. Downloaded 24 April 2016.

³ http://sabap2.adu.org.za/species_info.php?spp=114#menu_left. Downloaded 24 April 2016.



A – Secretarybird (© D.McKenzie); B – Southern Bald Ibis (© W.McClelland); C – Lanner Falcon (© W.McClelland)

Figure 11. Selected photographs of threatened species occurring in the study area

The three Near Threatened species that were confirmed to occur are Black-winged Pratincole, Greater Flamingo and Maccoa Duck. Black-winged Pratincole is a non-breeding migrant from Europe and Asia, and is likely to be a regular visitor to grassland, recently harvested fields and wetlands; a loose flock of this species was seen foraging over grassland before an approaching storm in January 2014. Greater Flamingo and Maccoa Duck are confined to the few large shallow pans and dams in the area and are unlikely to be breeding residents, but rather regular visitors to these habitats.

Five bird species of conservation concern have a low likelihood of occurring because of a lack of suitable habitat and are not dealt with any further here. Five species have a moderate likelihood of occurring, two of which are classified as Vulnerable (White-bellied Korhaan and African Grass Owl), while three are Near Threatened (Pallid Harrier, Red-footed Falcon and Lesser Flamingo). Untransformed grassland is the most important habitat in the study area for the first four species, and it is imperative that sufficiently large tracts of this habitat remain untransformed and unfragmented in the study area for these species. Large, shallow pans are the preferred habitat for Lesser Flamingo, although this habitat is sparse in the study area.

5.2.3 Reptiles

Bates *et al.* (2014) provided a recent assessment of reptile conservation status for South Africa, which was conducted at a spatial resolution of quarter-degree grid. The quarter-degree grid in which the study area is situated (2629AD) is indicated as being in an area of moderate reptile diversity (12-14 species per grid) and moderate diversity of endemic reptiles (5 species). Only three reptile species were recorded during fieldwork (Appendix 4),

although a dedicated reptile trapping exercise and nocturnal surveys would have yielded further species. However, the very low number of reptile species of conservation concern in the area makes it unlikely that further reptile surveys would have yielded data with consequences for a record of decision on the project.

Only one of the species indicated as occurring in 2629AD is considered a species of conservation concern, namely Coppery Grass Lizard, which is classified as Near Threatened. This species is endemic to the Grassland Biome in South Africa, occurring marginally in to Lesotho and north-western Swaziland. It has a moderate likelihood of occurrence in any large patches of untransformed grassland in the Alexander project area.

5.2.4 Frogs

Minter *et al.* (2004) indicate ten frog species for the quarter-degree grid within which the Alexander project area is situated (2629AD), none of which are species of conservation concern. Three frog species were recorded in the project area during fieldwork (Appendix 4), although a dedicated frog trapping exercise and nocturnal surveys would have yielded further species. However, the absence of frog species of conservation concern in the area makes it unlikely that further surveys would have yielded data with consequences for a record of decision on the project. While some suitable wetland habitat is present for a Near Threatened frog species, namely Giant Bullfrog, it was not recorded from the grid 2629 AD and surrounding grids during the South African Frog Atlas Project (SAFAP) (Minter *et al.*, 2004), and it is possibly not present in the study area. No other frog species of conservation concern are likely to occur in the study area.

6. BIODIVERSITY VALUE ASSESSMENT

A qualitative integration of conservation importance and functional importance values for the untransformed vegetation communities and the transformed areas represented in the study area provides an indication of the biodiversity values of these communities. The data sheets for conservation importance and functional importance calculations for each community are presented in Appendix 7, and are dealt with in more detail under each vegetation community description. The integrated biodiversity values are summarised in Table 8 and presented spatially in Figure 12.

Five communities / habitats have High Biodiversity Value, namely Untransformed Grassland on Rocky Ridges, Untransformed Grassland on Hillslopes and Plateaus, Untransformed Grassland on Plains, Evergreen Thickets on Scarps and Wetlands. These are the key ecosystems that need to remain intact and functional. Impacts within these communities will have the highest significance levels and therefore the impact footprint should remain outside of these communities as much as possible.

Table 8. Conservation Importance, Functional Importance and Biodiversity Values for vegetation communities in the Study Area

Vegetation Communities	Conservation Importance	Functional Importance	Biodiversity Value
Untransformed Grassland on Rocky Ridges	High	Moderate	High
Untransformed Grassland on Hillslopes and Plateaus	High	Moderate	High
Untransformed Grassland on Plains	High	Moderate	High
Evergreen Thickets on Scarps and Rocky Outcrops	High	Moderate	High
Wetlands	High	High	High
Transformed	Very Low	Low	Low

Most of the untransformed vegetation within the study area falls within **Critical Biodiversity Areas (CBAs)** according to the Mpumalanga Biodiversity Sector Plan (MBSP) (Lötter *et al*, 2014). The main river systems and associated rocky ridges that cross the central part of the study area and follow the western boundary are classified as **CBA: Irreplaceable**, while some of the tributaries of these systems are classified as **CBA: Optimal**. These same river systems are also regarded as Ecological Support Areas in the MBSP, while other areas of untransformed vegetation within the study area are classified as Other Natural Habitats. All the transformed areas are classified as either Modified or Modified: Old Lands. Areas falling

within the Modified category are the preferred areas for a wide variety of land-use types, which includes mining development.

Critical Biodiversity Areas are areas that are essential for meeting biodiversity targets for species, ecosystems or ecological processes. The desired management objectives for CBAs are that they be kept in a natural or near-natural state, with no further loss of habitat or species. Only low-impact, biodiversity-sensitive land-uses such as low-intensity livestock grazing are considered appropriate, while land-uses such as any form of mining or prospecting, conversion of natural habitat for agriculture or plantation forestry, expansion of existing settlements or infrastructure, and the building of new infrastructure or linear developments such as roads, railways, pipelines, etc., **are considered inappropriate.**

Other Natural Areas refer to areas that have not been identified as a priority in the current systematic biodiversity plan but retain most of their natural character, while performing a range of biodiversity and ecological functions. While not considered priority areas for biodiversity conservation at present, they are still an important part of the natural ecosystem. Other Natural Areas offer much more flexibility in terms of permissible land uses, but the desired management objective should be to minimise habitat and species loss and ensure ecosystem functionality through strategic landscape planning.

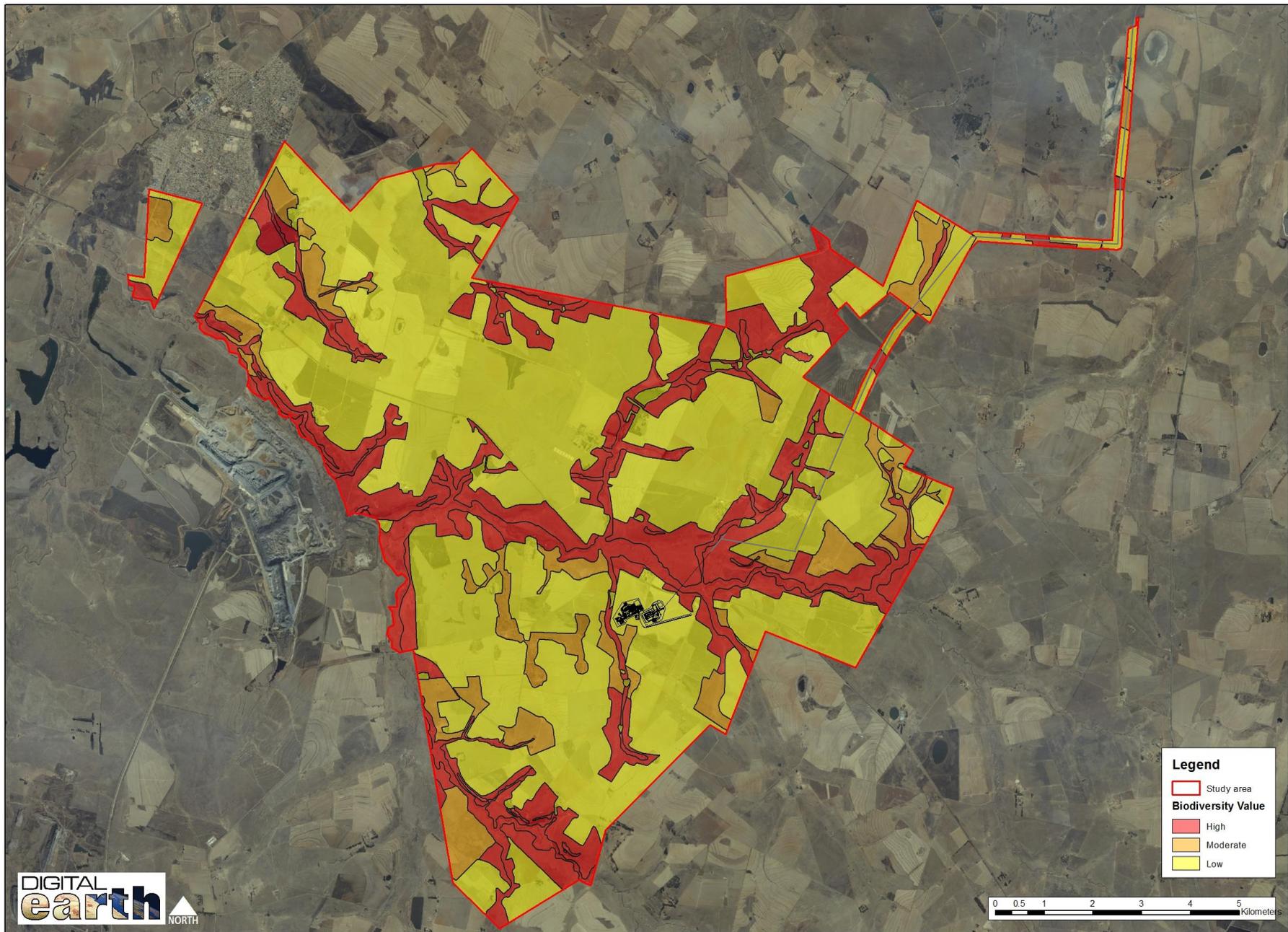


Figure 12. Biodiversity Values of Vegetation Communities in the Study Area

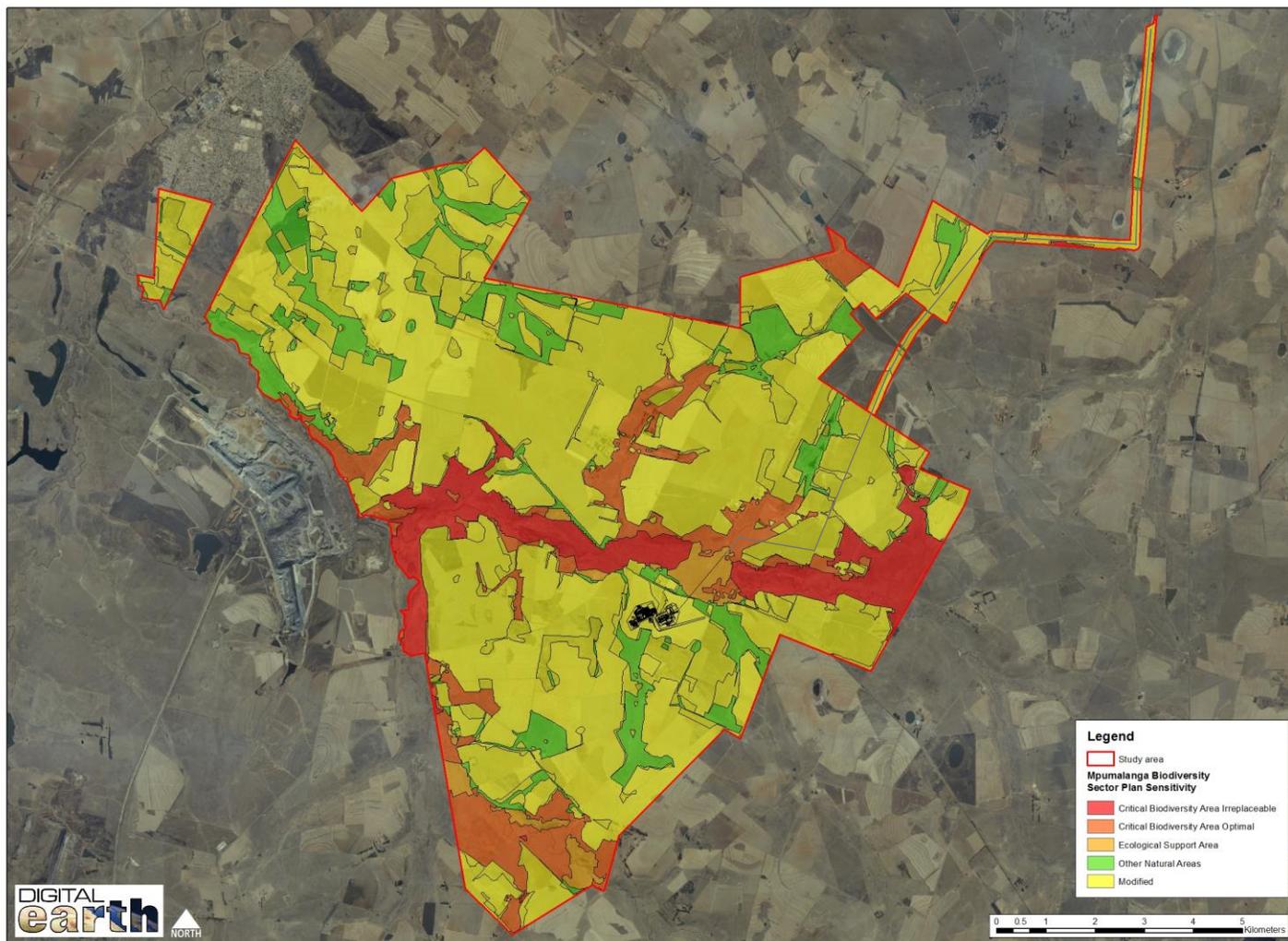


Figure 13. Mpumalanga Biodiversity Sector Plan classification of the Study Area

7. IMPACT ASSESSMENT

This section deals with the potential impacts of the proposed Alexander project on terrestrial ecosystems. Impacts are arranged in order of decreasing overall significance per project phase, and are summarised in Table 9.

7.1 Construction Phase

7.1.1 Destruction or fragmentation of natural habitat

While most of the Alexander mine is located below the ground surface, the current location of the preferred shaft / adit is adjacent to a riparian wetland system, as well as approximately 12 hectares of seep wetland and disturbed grassland.

Site preparation for the shaft area will involve clearing of vegetation and digging of the shaft entrance, where care will need to be taken that the above habitats are not impacted. It is assumed that the conveyor line will be raised above ground and will involve limited habitat loss during construction. The above-ground infrastructure footprint has been shifted away from untransformed (natural) habitat, the intensity / severity of the impact is rated as Medium. The extent of the impact is Very Low, the duration of impact without mitigation is permanent and the consequence is Medium. Since no untransformed (natural) habitat is likely to be impacted by the revised shaft site, the significance of the impact is rated as **Medium**.

Potential Impact	Project Activity	Impact significance before mitigation					
		I	D	E	C	P	SIGNIFICANCE
Destruction or fragmentation of natural habitat	Strip-clearing of vegetation for shaft construction	M	VH	VL	M	M	MEDIUM
		Impact significance after mitigation					
		I	D	E	C	P	SIGNIFICANCE
		M	M	VL	M	L	MEDIUM

7.1.2 Loss of plant species of conservation concern

One Threatened plant species and four Declining species have been confirmed within the Alexander project area, while one Threatened and four Near Threatened species have a moderate to high likelihood of occurring. However, none of these species have been confirmed to occur within the proposed above ground infrastructure and shaft entrance

footprint. The relocation of the infrastructure footprint away from untransformed habitat makes it unlikely that any of these species could occur within the footprint.

However, if construction machinery were to leave the infrastructure footprint and impact adjacent natural habitat, the intensity and duration of the impact would be High and Very High respectively. However, the extent of the impact is Very Low and the probability of the impact occurring is Low, resulting in a significance of **Medium**.

Potential Impact	Project Activity	Impact significance before mitigation					
		I	D	E	C	P	SIGNIFICANCE
Loss of plant species of conservation concern	Strip-clearing of vegetation for shaft construction	H	VH	VL	H	L	MEDIUM
		Impact significance after mitigation					
		I	D	E	C	P	SIGNIFICANCE
		H	VH	VL	H	VL	MEDIUM

7.1.3 Disturbance and displacement of fauna

The project area supports relatively high faunal diversity, considering the high proportion of modified habitat present and the high level of fragmentation of natural habitat. Untransformed grassland (101 spp), wetlands (71 spp) and open water habitats such as rivers and dams (66 spp) support the highest faunal diversity. Two Near Threatened mammals (Serval, Brown Hyaena), one Near Threatened bird species (Black-winged Pratincole) and three Vulnerable birds (Southern Bald Ibis, Secretarybird and Lanner Falcon) have been confirmed to occur in the project area. Untransformed grassland supports far more of these species (6 spp) than any other habitat.

While the loss of faunal habitat is likely to be very small, the intensity of the disturbance to fauna, particularly during construction of the conveyor belt, is likely to be High for the duration of the construction phase. The unmitigated consequence of the impact is High, as well as the probability of the impact occurring, and thus the significance of the impact prior to mitigation is **High**. Effective implementation of suggested mitigation measures could reduce the impact significance to **Medium**.

Potential Impact	Project Activity	Impact significance before mitigation					
		I	D	E	C	P	SIGNIFICANCE
Disturbance and displacement of fauna	Strip-clearing of vegetation for shaft construction; construction of conveyor line	H	H	L	H	H	HIGH
		Impact significance after mitigation					
		I	D	E	C	P	SIGNIFICANCE

				H	L	L	H	L	MEDIUM
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7.1.4 Increased invasion by alien plant species

Fifty-two species of alien plants have been confirmed to occur in the project area, representing 18% of the plant species list. Woody species such as *Acacia mearnsii*, *Populus cf. alba*, *Cotoneaster franchetii* and *Pyracantha coccinea* are declared invasive species and are most likely to invade natural habitat in the project area. The high proportion of alien species indicates that a significant seed bank is already present in the project area. Site preparation activities such as strip-clearing of vegetation will result in areas of bare soil that will be vulnerable to colonization by aggressive invasive species until these bare areas are once again vegetated. Without any mitigation measures being implemented, the intensity of this impact is likely to be High and the duration permanent. Even though the extent of the impact is limited to only a small part of the overall project area, the unmitigated consequence is still High and the probability of occurring is High, resulting in an impact significance of **High**. Mitigation measures are well known and relatively easy to implement (see section 8). Effective implementation of these measures could reduce the impact consequence to Low and the impact significance to **Low**.

Potential Impact	Project Activity	Impact significance before mitigation					
		I	D	E	C	P	SIGNIFICANCE
Increased invasion by alien plant species	Strip-clearing of vegetation for shaft construction	H	VH	V L	H	H	HIGH
		Impact significance after mitigation					
		I	D	E	C	P	SIGNIFICANCE
		L	L	V L	L	L	LOW

7.1.5 Increased illegal utilisation of natural resources

While most of the properties within the project area are privately owned and suitably fenced, many areas do not have resident landowners and illegal utilization of natural resources, such as poaching, does take place (local landowners *pers. comm*). The increase in numbers of people present in the vicinity of the construction footprint could result in an increase in such illegal utilization. It is assumed that any labour teams will be accommodated in Kriel and not on site, lowering this risk considerably. Given that opportunities are likely to be limited to daylight hours, the intensity of this impact is rated as Medium without mitigation. Consequence and probability are both Medium, resulting in a pre-mitigation impact

significance of Medium. Implementation of recommended mitigation measures (see section 8) could reduce the consequence, probability and significance of the impact to **Low**.

Potential Impact	Project Activity	Impact significance before mitigation					
		I	D	E	C	P	SIGNIFICANCE
Increased illegal utilisation of natural resources	Strip-clearing of vegetation for shaft construction; construction of conveyor line	M	H	VL	M	M	MEDIUM
		Impact significance after mitigation					
		I	D	E	C	P	SIGNIFICANCE
		L	L	VL	L	L	LOW

7.1.6 Increased mortalities of fauna through collisions with vehicles

Large antelope such as Eland, Gemsbok and Waterbuck, as well as carnivores such as Brown Hyaena and Serval, are present in the project area. These are species that would be vulnerable to collisions with vehicles at night. Even though most properties are well fenced, species such as Eland frequently jump over game fences and the carnivores crawl under them, making it possible to encounter these species on roads at night. During the Construction Phase it is likely that there will be an increase in vehicles using the roads, particularly at night. The intensity / severity of the impact is rated as Medium. Combined with a Low extent of impact and a potential permanent duration of impact, the unmitigated consequence is Medium and the significance of the impact is rated as **High**. The implementation of recommended mitigation measures (see section 8) could reduce the intensity, consequence and probability of the impact, resulting in a significance of **Medium**.

Potential Impact	Project Activity	Impact significance before mitigation					
		I	D	E	C	P	SIGNIFICANCE
Increased mortalities of fauna through collisions with vehicles	Vehicle activity during construction	M	H	L	M	H	HIGH
		Impact significance after mitigation					
		I	D	E	C	P	SIGNIFICANCE
		L	H	L	M	L	MEDIUM

7.2 Operational Phase

7.2.1 Continued invasion by alien plant species

While the highest risk of this impact is in the Construction Phase, the areas of bare soil within the operations footprint could still be at risk to being colonized by alien plants. However, the intensity of this impact is likely to be Medium and the duration short-term.

Given the limited extent of the potential impact, the unmitigated consequence is Low, while the probability of occurring is Medium, resulting in an impact significance of **Medium**. Mitigation measures are well known and relatively easy to implement (see section 8). Effective implementation of these measures could reduce the impact consequence to Low and the impact significance to **Low**.

Potential Impact	Project Activity	Impact significance before mitigation					
		I	D	E	C	P	SIGNIFICANCE
Increased invasion by alien plant species	Heavy vehicle activity in operations footprint	M	L	V L	L	M	MEDIUM
		Impact significance after mitigation					
		I	D	E	C	P	SIGNIFICANCE
		L	L	V L	L	L	LOW

7.2.2 Increased mortalities of fauna through collisions with vehicles

While the period of highest risk of this impact will be during the Construction Phase, it is likely that there will still be a moderate number of vehicles using the roads during the Operational Phase, possibly even at night. The intensity / severity of the impact is rated as Medium. Combined with a Low extent of impact and a potential permanent duration of impact, the unmitigated consequence is Medium and the significance of the impact is rated as **High**. The implementation of recommended mitigation measures (see section 8) could reduce the intensity, consequence and probability of the impact, resulting in a significance of **Medium**.

Potential Impact	Project Activity	Impact significance before mitigation					
		I	D	E	C	P	SIGNIFICANCE
Increased mortalities of fauna through collisions with vehicles	Vehicle activity in operations footprint	M	H	L	M	H	HIGH
		Impact significance after mitigation					
		I	D	E	C	P	SIGNIFICANCE
		L	H	L	M	L	MEDIUM

Table 9. Summary of Impacts and Mitigations

Potential Impact	Project Activity	Environmental significance before mitigation						Mitigation	Environmental significance after mitigation					
		I	D	E	C	P	S		I	D	E	C	P	S
Construction Phase														
Destruction and / or fragmentation of natural habitat	Strip clearing vegetation	M	VH	VL	M	M	MEDIUM	Habitat restoration	M	M	VL	M	L	MEDIUM
Loss of plant species of conservation importance	Strip clearing vegetation	H	VH	VL	H	L	MEDIUM	Staff awareness	H	VH	VL	H	VL	MEDIUM
Increased illegal utilisation of natural resources	Increase in number of people	M	H	VL	M	M	MEDIUM	Security (patrolling adjacent natural vegetation for evidence of poaching, etc), Staff awareness, Relocation of protected flora	L	L	VL	L	L	LOW
Disturbance and displacement of fauna	Heavy vehicle activity; construction of conveyor line	H	H	L	H	M	HIGH	Traffic control (speed enforcement, working hours)	H	L	L	H	L	MEDIUM
Increased invasion by alien plant species	Strip clearing vegetation	H	VH	VL	H	H	HIGH	Invasive alien plant control	L	L	VL	L	L	LOW
Increase in mortalities of fauna through road collisions	Heavy vehicle activity	M	H	L	M	H	HIGH	Traffic control (speed enforcement, working hours)	L	H	L	M	L	MEDIUM
Operational Phase														
Increased invasion by alien plant species	Exposed areas of bare soil once construction completed	M	L	VL	L	M	MEDIUM	Invasive alien plant control, habitat restoration	L	L	VL	L	L	LOW
Increase in mortalities of fauna through road collisions	Heavy vehicle activity	M	H	L	M	H	HIGH	Traffic control (speed enforcement, working hours)	L	H	L	M	L	MEDIUM

*M=Magnitude or Severity;
R=Reversibility; D=Duration;
E=Extent; C=Context;
P=Probability; S=Significance*

8. IMPACT MITIGATION

8.1 Pre-Construction Mitigation Measures

8.1.1 Locate plant species of conservation concern in infrastructure footprint

A suitably experienced botanist should search the conveyor line impact footprint for any plant species of conservation concern and protected species, so that a decision can be made regarding the potential relocation or destruction of those populations, or modifications to the route to avoid such populations.

8.1.2 Compile an invasive alien plant management plan

An invasive plant control management plan for the above-ground infrastructure footprint should be compiled, which should include a strategy for which species to target and where. The plan should also have a monitoring component to ensure that controlled areas are not re-infested. A small team of labourers should be trained in the safe and efficient handling of the appropriate herbicides and provided with suitable equipment.

8.1.3 Increase staff awareness

All employees and contractors involved with the development should be made aware of the requirements of the Environmental Management Plan and the relevant prohibitions (e.g. no hunting, no collection of firewood or any other plant resources, no collection of medical plants, no indiscriminate burning).

8.2 Construction Phase Mitigation Measures

8.2.1 Rescue plant species of conservation concern and protected species

Threatened and protected species occurring in the area of impact that have been identified and marked by the botanist prior to the Construction Phase will need to be translocated to suitable adjacent habitat if possible; this should be under the supervision of a botanist with

horticultural experience. Priority should be given to relocating species to habitat as close to their original location as possible.

8.2.2 Implement invasive alien plant management program

An alien plant control team that has been trained in the safe and efficient handling of the appropriate herbicides will need to regularly check areas of soil disturbed during construction activities. During the construction phase it is important that safety and precautionary considerations for herbicide choice, storage, application and equipment maintenance are strictly adhered to so as to avoid contamination of surface water or groundwater. Herbicides should be stored in a locked area that is dedicated for storage of hazardous substances. Equipment used for alien plant control must be washed in a specific area dedicated for this purpose, and all wash-water must be appropriately treated. An ECO should check the construction area at least once a month to ensure that the team is successfully controlling any invasive species.

8.2.3 Security

Security personnel should regularly patrol adjacent natural vegetation looking for evidence of poaching, fences being cut, plants being harvested, etc. A staff awareness programme initiated in the Planning Phase should continue through to Operational Phase, including signage on site warning against trespassing on adjacent property.

8.2.4 Traffic Control

While it will be difficult to enforce a traffic control plan on public roads, a speed restriction should be placed on all construction vehicles. Vehicles capable of driving at high speeds should be fitted with GPS units that monitor travel speed. Construction staff should be informed of the consequences of traffic infringements and fined accordingly if speed restrictions are ignored. Use of construction vehicles at night should be prohibited or severely restricted, particularly on dirt roads where nocturnal fauna are more likely to occur.

8.3 Operational Phase Mitigation Measures

8.3.1. Continue control of invasive alien plants

An alien plant control team should undertake regular monitoring and removal of alien invasive plant species in all areas of disturbed soil. This should take place during the first year of the Operational Phase. An audit at the end of that year should determine whether further monitoring and / or control is needed.

8.3.2 Security

Security personell should regularly patrol adjacent natural vegetation looking for evidence of poaching, fences being cut, plants being harvested, etc. A staff awareness programme initiated in the Planning Phase should continue through the life of the mine, and should include signage on site warning against trespassing on adjacent property.

8.3.3 Traffic Control

Vehicles capable of driving at high speeds should be fitted with GPS units that monitor travel speed. Construction staff should be informed of the consequences of traffic infringements and fined accordingly if speed restrictions are ignored. Use of construction vehicles at night should be prohibited or severely restricted, particularly on dirt roads where nocturnal fauna are more likely to occur.

8.3.4 Rehabilitate disturbed areas

Areas of bare soil where construction has taken place should be rehabilitated as soon as practically possible. Rehabilitation of disturbed areas can be facilitated, for example, by preparation of soils and, where necessary, and feasible, revegetation with indigenous plants.

9. CONCLUSIONS

The proposed Alexander project poses no fatal flaws in terms of potential impacts on terrestrial ecology as it pertains to the relevant legislation, and authorisation is recommended with the proviso that the mitigation measures recommended in section 8 be implemented and adhered to.

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11. APPENDICES

Appendix 1. Detailed Data: Checklist of Flora recorded during fieldwork

Species	Growth Form	Cons Status	Protected Status	Rocky Ridge Grassland	Rocky Ridge Thicket	Hillslope and Plateau Grassland	Plains Grassland	Wetlands	Transformed Habitats
PTERIDOPHYTES - FERNS AND FERN ALLIES									
Adiantaceae									
<i>Adiantum capillus-veneris</i>	Fern				x				
Anemiaceae									
<i>Mohria vestita</i>	Fern			x	x				
Marsileaceae									
<i>Marsilea macrocarpa</i>	Hydrophyte							x	
Sinopteridaceae									
<i>Cheilanthes quadripinnata</i>	Fern			x	x				
<i>Cheilanthes viridis</i>	Fern			x	x				
<i>Pellaea calomelanos</i>	Fern			x	x				
ANGIOSPERMS - FLOWERING PLANTS									
DICOTYLEDONS									
Acanthaceae									
<i>Blepharis innocua</i>	Herb			x		x			
<i>Blepharis subvolubilis</i>	Herb						x		
<i>Chaetacanthus setiger</i>	Herb					x	x		
<i>Crabbea acaulis</i>	Herb					x			
<i>Justicia anagaloides</i>	Herb			x		x	x		
Achariaceae									
<i>Kiggelaria africana</i>	Tree				x				
Amaranthaceae									
<i>Achyranthes aspera</i> *	Herb				x				
<i>Amaranthus hybridus</i> *	Herb								x
<i>Gomphrena celosioides</i> *	Herb			x		x	x		x
Anacardiaceae									
<i>Searsia dentata</i>	Shrub			x	x				

<i>Searsia discolor</i>	Dwarf Shrub	x							x
<i>Searsia magalismontana</i>	Shrub	x		x					
<i>Searsia pyroides</i>	Shrub	x		x					
<i>Searsia rigida</i>	Shrub	x		x					
Apiaceae									
<i>Afroscidium magalimontanum</i>	Herb								x
<i>Centella asiatica</i> *	Herb								x
Apocynaceae									
<i>Araujia sericifera</i> *	Climber				x				
<i>Asclepias aurea</i>	Herb								x
<i>Asclepias gibba</i>	Herb								x
<i>Gomphocarpus fruticosus</i>	Shrub	x							
<i>Gomphocarpus physocarpus</i>	Shrub								x
<i>Pachycarpus rigidus</i>	Succulent								x
<i>Xysmalobium cf. undulatum</i> (old fruit)	Succulent								x
Asteraceae									
<i>Artemisia afra</i> *	Herb							x	
<i>Berkheya echinacea</i>	Herb	x							x
	Dwarf Shrub								
<i>Berkheya rigida</i>	Shrub	x							x
<i>Berkheya setifera</i>	Herb	x							x
<i>Berkheya speciosa</i>	Herb	x							x
<i>Bidens bipinnata</i> *	Herb	x		x				x	
<i>Bidens pilosa</i> *	Herb	x		x					x
<i>Cirsium vulgare</i> *	Herb							x	x
<i>Conyza bonariensis</i> *	Herb	x		x					x
<i>Conyza canadensis</i> *	Herb	x							x
<i>Conyza podocephala</i>	Herb	x						x	x
<i>Conyza sp. (no flowers)</i>	Herb	x						x	
<i>Cosmos bipinnatus</i> *	Herb								x
<i>Crepis hypochaeridea</i> *	Herb	x							
<i>Dicoma anomala</i>	Herb	x							x
<i>Euryops transvaalensis</i>	Herb								x
<i>Felicia muricata</i>	Herb	x							x
<i>Galinsoga parviflora</i> *	Herb				x				
<i>Gazania krebsiana</i>	Herb								x
<i>Geigeria burkei</i>	Dwarf Shrub								x

<i>Haplocarpha lyrata</i>	Herb			x	x		
<i>Haplocarpha scaposa</i>	Herb	x		x	x		
<i>Helianthus annuus</i> *	Herb						x
<i>Helichrysum aureonitens</i>	Herb			x	x	x	
<i>Helichrysum caespititium</i>	Herb	x					
<i>Helichrysum callicomum</i>	Herb	x					
<i>Helichrysum chionosphaerum</i>	Herb	x					
<i>Helichrysum nudifolium</i>	Herb			x	x		
<i>Helichrysum oreophilum</i>	Herb	x		x			
<i>Helichrysum pilosellum</i>	Herb	x					
<i>Helichrysum rugulosum</i>	Herb	x		x	x		
<i>Helichrysum setosum</i>	Herb	x					
<i>Hilliardiella aristata</i>	Herb			x			
<i>Hilliardiella oligocephala</i>	Herb	x		x	x		
<i>Hypochaeris radicata</i> *	Herb	x		x	x		
<i>Lactuca capensis</i>	Herb					x	
<i>Pseudognaphalium sp. (photo)</i>	Herb		x				
<i>Schkuhria pinnata</i> *	Herb	x				x	
<i>Senecio bupleuroides</i>	Herb			x			
<i>Senecio consanguineus</i>	Herb					x	
<i>Senecio coronatus</i>	Herb			x			
<i>Senecio erubescens</i>	Herb	x		x	x		
<i>Senecio inornatus</i>	Herb			x	x		
<i>Senecio othonniflorus</i>	Herb	x	x				
<i>Senecio sp. (old flowers)</i>	Herb			x			
<i>Senecio subrubriflorus</i>	Herb	x	x	x			
<i>Seriphium plumosum</i>	Shrub	x		x			
<i>Sonchus sp. (no flowers)</i>	Herb			x			
<i>Ursinia nana</i>	Herb	x		x			
<i>Tagetes minuta</i> *	Herb			x			x
<i>Tolpis capensis</i>	Herb	x		x			
<i>Tragopogon dubius</i> *	Herb			x	x		
<i>Xanthium spinosum</i> *	Herb					x	x
<i>Xanthium strumarium</i> *	Herb					x	x
Buddlejaceae							
<i>Gomphostigma virgatum</i>	Shrub					x	
Campanulaceae							

<i>Wahlenbergia cf. undulata</i>	Herb				x
<i>Wahlenbergia sp.</i>	Herb				x
Caryophyllaceae					
<i>Dianthus mooiensis</i>	Herb		x		x
<i>Pollichia campestris</i>	Herb				x
<i>Silene burchellii</i>	Herb		x		
<i>Silene undulata</i>	Herb		x		x
Celtidaceae					
<i>Celtis africana</i>	Tree			x	
Chenopodiaceae					
<i>Chenopodium sp. (no flowers)</i>	Herb			x	x
Convolvulaceae					
<i>Convolvulus sagittatus</i>	Creepers				x
<i>Cuscuta campestris</i> *	Climber		x		
<i>Ipomoea bathycolpos</i>	Creepers		x		x
<i>Ipomoea oblongata</i>	Creepers		x		x
<i>Seddera sp. (no flowers)</i>	Creepers		x		x
Crassulaceae					
<i>Crassula alba</i>	Succulent		x		
<i>Crassula capitella</i> subsp. <i>nodulosa</i>	Succulent		x		
<i>Crassula lanceolata</i>	Succulent		x		
<i>Crassula setulosa</i>	Succulent		x		
Dipsacaceae					
<i>Cephalaria pungens</i>	Herb				x
<i>Scabiosa columbaria</i>	Herb		x		x
Ebenaceae					
<i>Diospyros austro-africana</i>	Shrub		x	x	
<i>Diospyros lycioides</i> subsp. <i>guerkei</i>	Shrub		x	x	
Ericaceae					
<i>Erica drakensbergensis</i>	Shrub				x
Euphorbiaceae					
<i>Acalypha caperonioides</i>	Herb		x		
<i>Acalypha sp.</i>	Herb				x
Fabaceae: Caesalpinioideae					
<i>Chamaecrista capensis</i>	Dwarf Shrub				x
Fabaceae: Papilionoideae					

<i>Eriosema cf. cordata</i>	Dwarf Shrub			x			
<i>Erythrina zeyheri</i>	Dwarf Shrub					x	
<i>Indigofera hedyantha</i>	Dwarf Shrub			x		x	
<i>Indigofera melanadenia</i>	Dwarf Shrub	x					
<i>Indigofera sp. (no flowers)</i>	Dwarf Shrub	x		x			
<i>Indigofera sp. (photos)</i>	Dwarf Shrub					x	
<i>Leobordea divaricata</i>	Dwarf Shrub	x		x			
<i>Leobordea eriantha</i>	Dwarf Shrub	x		x			
<i>Listia heterophylla</i>	Dwarf Shrub	x					
<i>Medicago sativa</i> *	Herb					x	
<i>Pearsonia cajanifolia</i>	Dwarf Shrub	x					
<i>Rhynchosia adenodes</i>	Herb			x		x	
<i>Rhynchosia totta</i>	Creeper			x			
<i>Robinia pseudo-acacia</i> *	Tree		x				
<i>Sesbania punicea</i> *	Shrub					x	
<i>Sphenostylis angustifolia</i>	Creeper					x	
<i>Tephrosia capensis</i>	Herb	x					
<i>Tephrosia elongata</i>	Herb			x			
<i>Tephrosia macropoda</i>	Herb			x			
<i>Trifolium pratense</i> *	Herb			x		x	
<i>Ulex europaeus</i> *	Dwarf Shrub					x	
<i>Vigna unguiculata</i>	Creeper			x			
<i>Zornia milneana</i>	Herb	x		x			
Geraniaceae							
<i>Monsonia angustifolia</i>	Herb	x					
<i>Pelargonium luridum</i>	Herb			x			
Lamiaceae							
<i>Ajuga ophridis</i>	Herb			x		x	
<i>Leonotis ocymifolia</i> var. <i>raineriana</i>	Dwarf Shrub	x	x				
<i>Mentha longifolia</i>	Herb		x	x		x	

<i>Ocimum obovatum</i> subsp. <i>obovatum</i>	Herb		x			
<i>Salvia runcinata</i>	Herb				x	x
Lobeliaceae						
<i>Monopsis decipiens</i>	Herb		x		x	x
Malvaceae						
<i>Hermannia coccocarpa</i>	Herb					x
<i>Hermannia depressa</i>	Herb		x		x	x
<i>Hermannia transvaalensis</i>	Herb				x	
<i>Hibiscus aethiopicus</i> var. <i>ovatus</i>	Herb				x	
<i>Hibiscus microcarpus</i>	Herb		x		x	x
<i>Hibiscus trionum</i> *	Herb				x	x
Mesembryanthemaceae						
<i>Delosperma</i> cf. <i>sutherlandii</i> (photos)	Succulent		x			
<i>Delosperma</i> sp. (photos)	Succulent		x			
<i>Khadia beswickii</i>	Succulent	Vulnerable	x			
<i>Mossia intervallaris</i>	Succulent		x			
Moraceae						
<i>Ficus carica</i> *	Tree				x	
Oleaceae						
<i>Ligustrum sinensis</i> *	Tree				x	
Onagraceae						
<i>Oenothera rosea</i> *	Herb		x		x	x
<i>Oenothera tetraptera</i> *	Herb		x			x
Orobanchaceae						
<i>Striga bilabiata</i>	Herb				x	x
<i>Striga elegans</i>	Herb				x	
Oxalidaceae						
<i>Oxalis depressa</i>	Herb					x
<i>Oxalis obliquifolia</i>	Herb				x	
Papaveraceae						
<i>Papaver argemone</i> *	Herb					x
Plantaginaceae						
<i>Plantago lanceolata</i>	Herb		x			x
Polygalaceae						
<i>Polygala gracilentia</i>	Herb		x			
<i>Polygala hottentota</i>	Herb				x	
<i>Polygala transvaalensis</i>	Herb				x	

Polygonaceae						
<i>Persicaria decipiens</i>	Herb					x
<i>Rumex lanceolatus</i>	Herb				x	
Portulacaceae						
<i>Portulaca kermesina</i>	Herb		x			
Ranunculaceae						
<i>Ranunculus multifidus</i>	Herb					x
Rosaceae						
<i>Agrimonia odorata</i> *	Herb		x	x		
<i>Cotoneaster franchetii</i> *	Tree				x	
<i>Prunus persicus</i> *	Tree				x	
<i>Prunus sp.</i> *	Tree				x	x
<i>Pyracantha coccinea</i> *	Tree		x	x		
<i>Rubus ludwigii</i>	Shrub				x	
<i>Rubus rigidus</i>	Shrub				x	
Rubiaceae						
<i>Anthospermum rigidum</i>	Herb		x			x
<i>Pentanisia angustifolia</i>	Herb				x	
<i>Pentanisia prunelloides</i>	Herb				x	
<i>Pygmaeothamnus chamaedendrum</i>	Dwarf Shrub		x		x	
<i>Richardia brasiliense</i> *	Herb					x
Salicaceae						
<i>Populus cf. alba</i>	Tree			x		x
Scrophulariaceae						
<i>Chaenostoma leve</i>	Herb		x		x	
<i>Jamesbrittenia aurantiaca</i>	Herb				x	
<i>Nemesia fruticans</i>	Herb		x			
<i>Selago densiflora</i>	Herb		x			
<i>Veronica anagallis-aquatica</i>	Hydrophyte					x
<i>Zaluzianskya cf. elongata</i>	Herb		x			
Solanaceae						
<i>Solanum cf. capense</i>	Dwarf Shrub				x	
<i>Solanum lichtensteinii</i>	Dwarf Shrub					x
<i>Solanum nigrum</i> *	Herb			x		
<i>Solanum panduriforme</i> *	Dwarf Shrub		x		x	

<i>Aristida bipartita</i>	Grass			x			
<i>Aristida junciformis</i>	Grass	x		x			
<i>Bothriochloa insculpta</i>	Grass					x	
<i>Brachiaria serrata</i>	Grass	x		x		x	
<i>Ctenium concinnum</i>	Grass	x					
<i>Cymbopogon cf. dieterlenii</i>	Grass					x	
<i>Cymbopogon pospischilii</i> *	Grass	x				x	
<i>Cynodon dactylon</i>	Grass	x		x		x	x
<i>Digitaria eriantha</i>	Grass			x			
<i>Digitaria tricholaenoides</i>	Grass	x		x		x	
<i>Diheteropogon amplexens</i>	Grass	x		x			
<i>Diheteropogon filifolius</i>	Grass	x					
<i>Echinochloa sp.</i>	Grass						x
<i>Elionurus muticus</i>	Grass	x		x		x	
<i>Eragrostis capensis</i>	Grass	x				x	
<i>Eragrostis cf. viscosa</i>	Grass	x					
<i>Eragrostis chloromelas</i>	Grass	x					
<i>Eragrostis curvula</i>	Grass		x	x		x	
<i>Eragrostis gummiflua</i>	Grass	x					
<i>Eragrostis plana</i>	Grass	x				x	
<i>Eragrostis racemosa</i>	Grass	x		x			
<i>Eragrostis sp.1 (photo, specimen)</i>	Grass	x		x			
<i>Eragrostis superba</i>	Grass			x			
<i>Festuca cf. scabra</i>	Grass			x			
<i>Harpochloa falx</i>	Grass	x		x			
<i>Hemarthria altissima</i>	Grass						x
<i>Heteropogon contortus</i>	Grass	x		x		x	
<i>Hyparrhenia cf. anamesa</i>	Grass	x					
<i>Hyparrhenia dregeana</i>	Grass			x			
<i>Imperata cylindrica</i>	Grass						x
<i>Leersia hexandra</i>	Grass						x
<i>Loudetia simplex</i>	Grass	x					
<i>Melinis nerviglumis</i>	Grass	x					
<i>Microchloa caffra</i>	Grass	x					
<i>Panicum natalense</i>	Grass	x		x			
<i>Paspalum dilatatum</i> *	Grass		x				
<i>Paspalum distichum</i>	Grass						x
<i>Paspalum urvillei</i> *	Grass			x		x	x

<i>Pennisetum sphacelatum</i>	Grass							x	
<i>Pennisetum thunbergii</i>	Grass					x			
<i>Phragmites australis</i>	Reed							x	x
<i>Setaria cf. pumila</i>	Grass	x							
<i>Setaria sphacelata</i>	Grass					x	x		
<i>Setaria verticillata</i>	Grass				x				
<i>Sporobolus africanus</i>	Grass				x	x			
<i>Themeda triandra</i>	Grass	x				x	x		
<i>Tragus berteronianus</i>	Grass						x		
<i>Trichoneura grandiglumyx</i>	Grass					x			
<i>Tristachya leucothrix</i>	Grass	x				x			
<i>Zea mays</i> *	Grass								x
TOTAL		5	13	135	47	136	90	32	23

MNCA = Mpumalanga Nature Conservation Act

Appendix 2. Detailed Data: Flora Quadrats (A)

Species	Family	Quadra t 1	Quadra t 2	Quadra t 3	Quadra t 4	Quadra t 5	Quadra t 6	Quadra t 7	Quadra t 8	Quadra t 9	Quadra t 10	Quadra t 11
<i>Blepharis innocua</i>	Acanthaceae					+	+					
<i>Chaetacanthus setiger</i>	Acanthaceae				+							+
<i>Crabbea acaulis</i>	Acanthaceae					+		+				
<i>Achyranthes aspera</i> *	Amaranthaceae		1									
<i>Gomphrena celosioides</i> *	Amaranthaceae									1		
<i>Cyrtanthus tuckii</i>	Amaryllidaceae			+								
<i>Searsia dentata</i>	Anacardiaceae		+									
<i>Searsia discolor</i>	Anacardiaceae						+					
<i>Searsia magalismontana</i>	Anacardiaceae						2					
<i>Searsia pyroides</i>	Anacardiaceae		+									
<i>Chlorophytum sp. 1</i>	Anthericaceae	+		1								
<i>Chlorophytum sp. 2</i>	Anthericaceae						+	+				
<i>Centella asiatica</i> *	Apiaceae			1							1	
<i>Xysmalobium cf. undulatum (old fruit)</i>	Apocynaceae					+					+	
<i>Asparagus cooperi</i>	Asparagaceae		+									
<i>Berkheya echinacea</i>	Asteraceae				1						+	
<i>Berkheya rigida</i>	Asteraceae				+				3		+	+
<i>Berkheya setifera</i>	Asteraceae							+				
<i>Berkheya speciosa</i>	Asteraceae					+	1					
<i>Bidens bipinnata</i> *	Asteraceae		+		+		1					
<i>Bidens pilosa</i> *	Asteraceae		3									
<i>Conyza bonariensis</i> *	Asteraceae		1		+							
<i>Conyza canadensis</i> *	Asteraceae						+					
<i>Conyza podocephala</i>	Asteraceae				+	+	1					
<i>Conyza sp. (no flowers)</i>	Asteraceae			1								
<i>Crepis hypochaeridea</i> *	Asteraceae									+		
<i>Dicoma anomala</i>	Asteraceae					+	+	2				
<i>Euryops transvaalensis</i>	Asteraceae					+				1		
<i>Felicia muricata</i>	Asteraceae	1					1					
<i>Galinsoga parviflora</i> *	Asteraceae		+									
<i>Haplocarpha lyrata</i>	Asteraceae					1					1	
<i>Haplocarpha nervosa</i>	Asteraceae											1
<i>Haplocarpha scaposa</i>	Asteraceae			1	1		1	+			+	

<i>Helichrysum aureonitens</i>	Asteraceae					+				+		
<i>Helichrysum caespitium</i>	Asteraceae						+					
<i>Helichrysum callicomum</i>	Asteraceae							+				
<i>Helichrysum nudifolium</i>	Asteraceae					1						
<i>Helichrysum rugulosum</i>	Asteraceae			1	2	2	1					2
<i>Hilliardiella oligocephala</i>	Asteraceae						+					
<i>Hypochaeris radicata</i> *	Asteraceae			+	1	+		1		1	1	
<i>Pseudognaphalium sp.</i>	Asteraceae		+									
<i>Schkuhria pinnata</i> *	Asteraceae	+				+		1	1			
<i>Senecio consanguineus</i>	Asteraceae							1			+	+
<i>Senecio coronatus</i>	Asteraceae			1		+						
<i>Senecio erubescens</i>	Asteraceae	+						1		1	1	
<i>Senecio inornatus</i>	Asteraceae										+	
<i>Senecio othonniflorus</i>	Asteraceae						+					
<i>Senecio sp. (old flowers)</i>	Asteraceae					+		+				
<i>Senecio subrubriflorus</i>	Asteraceae			1	1	+	+					
<i>Seriphium plumosum</i>	Asteraceae			+			1	2				
<i>Sonchus sp. (no flowers)</i>	Asteraceae			+								
<i>Tagetes minuta</i> *	Asteraceae			1		+						
<i>Tragopogon dubius</i> *	Asteraceae					+						
<i>Ursinia nana</i>	Asteraceae	1										
<i>Dianthus mooiensis</i>	Caryophyllaceae					+	+					
<i>Pollichia campestris</i>	Caryophyllaceae				+							
<i>Silene undulata</i>	Caryophyllaceae			+								
<i>Chenopodium sp. (no flowers)</i>	Chenopodiaceae		+									
<i>Commelina africana</i>	Commelinaceae	1		1	1	+	1	1		1		
<i>Convolvulus sagittatus</i>	Convolvulaceae								+			
<i>Seddera sp. (no flowers)</i>	Convolvulaceae						1					
<i>Crassula alba</i>	Crassulaceae						+					
<i>Bulbostylis sp.</i>	Cyperaceae				+			+				
<i>Cyperus obtusiflorus</i>	Cyperaceae			+		1						
<i>Cyperus rupestris</i>	Cyperaceae	1				+			+	+		
<i>Kyllinga erecta</i>	Cyperaceae			+		2		2			+	
<i>Scabiosa columbaria</i>	Dipsacaceae			+	1						1	
<i>Diospyros austro-africana</i>	Ebenaceae						1					
<i>Diospyros lycioides subsp. guerkei</i>	Ebenaceae		+				2					

<i>Chamaecrista capensis</i>	Fabaceae: Caesalpinioideae					+						
<i>Indigofera sp. (no flowers)</i>	Fabaceae: Papilionoideae				+							
<i>Indigofera sp.</i>	Fabaceae: Papilionoideae									+		
<i>Leobordea divaricata</i>	Fabaceae: Papilionoideae									+		
<i>Leobordea eriantha</i>	Fabaceae: Papilionoideae								+			
<i>Rhynchosia adenodes</i>	Fabaceae: Papilionoideae				+		+					
<i>Robinia pseudo-acacia</i> *	Fabaceae: Papilionoideae		4									
<i>Tephrosia capensis</i>	Fabaceae: Papilionoideae						1			+		
<i>Tephrosia elongata</i>	Fabaceae: Papilionoideae									+		
<i>Trifolium pratense</i> *	Fabaceae: Papilionoideae											1
<i>Vigna unguiculata</i>	Fabaceae: Papilionoideae						+					
<i>Zornia milneana</i>	Fabaceae: Papilionoideae						1			+		
<i>Monsonia angustifolia</i>	Geraniaceae		+							+		
<i>Pelargonium luridum</i>	Geraniaceae						+					
<i>Dipcadi sp. (no flowers)</i>	Hyacinthaceae										+	
<i>Dipcadi viride</i>	Hyacinthaceae											1
<i>Drimia multisetosa</i>	Hyacinthaceae											+
<i>Ledebouria ovatifolia</i>	Hyacinthaceae										+	+
<i>Hypoxis hemerocallidea</i>	Hypoxidaceae						+	+				
<i>Hypoxis obtusa</i>	Hypoxidaceae							1				
<i>Hypoxis rigidula</i>	Hypoxidaceae											+
<i>Ajuga ophridis</i>	Lamiaceae			1		+	1			1		
<i>Leonotis ocymifolia</i> var. <i>raineriana</i>	Lamiaceae								1			
<i>Ocimum obovatum</i> subsp. <i>obovatum</i>	Lamiaceae									1		
<i>Salvia runcinata</i>	Lamiaceae				1						2	
<i>Hermannia coccocarpa</i>	Malvaceae										+	
<i>Hibiscus aethiopicus</i> var. <i>ovatus</i>	Malvaceae							+				
<i>Hibiscus trionum</i> *	Malvaceae										1	
<i>Delosperma</i> cf. <i>sutherlandii</i>	Mesembryanthemaceae									+		
<i>Khadia</i> cf. <i>beswickii</i>	Mesembryanthemaceae											1
<i>Mossia intervallaris</i>	Mesembryanthemaceae		2									1
<i>Ligustrum sinensis</i> *	Oleaceae				+							
<i>Oenothera rosea</i> *	Onagraceae						+					1
<i>Oxalis depressa</i>	Oxalidaceae											1
<i>Oxalis obliquifolia</i>	Oxalidaceae											

<i>Plantago lanceolata</i>	Plantaginaceae									+	1	
<i>Agrostis eriantha</i>	Poaceae									+		
<i>Alloteriopsis semialata</i>	Poaceae							+				
<i>Andropogon appendiculatus</i>	Poaceae										1	
<i>Andropogon eucomus</i>	Poaceae										+	
<i>Aristida adscensionis</i>	Poaceae				1					+		
<i>Aristida junciformis</i>	Poaceae			+				1				
<i>Bothriochloa insculpta</i>	Poaceae										+	
<i>Brachiaria serrata</i>	Poaceae							+				
<i>Cymbopogon cf. dieterlenii</i>	Poaceae										+	+
<i>Cynodon dactylon</i>	Poaceae									1		1
<i>Digitaria eriantha</i>	Poaceae				1							
<i>Digitaria tricholaenoides</i>	Poaceae	1		1							+	
<i>Diheteropogon amplexens</i>	Poaceae						+	1				
<i>Diheteropogon filifolius</i>	Poaceae								+			
<i>Elionurus muticus</i>	Poaceae			+		2	2		+		+	1
<i>Eragrostis capensis</i>	Poaceae										+	
<i>Eragrostis cf. viscosa</i>	Poaceae	+										
<i>Eragrostis chloromelas</i>	Poaceae									2	2	2
<i>Eragrostis curvula</i>	Poaceae		1	2	2			2	+	2		
<i>Eragrostis gummiflua</i>	Poaceae						+	1				
<i>Eragrostis plana</i>	Poaceae	1								2	2	2
<i>Eragrostis racemosa</i>	Poaceae			1		2	2	1				1
<i>Eragrostis sp.1</i>	Poaceae	+				1						
<i>Eragrostis superba</i>	Poaceae				1		+					
<i>Festuca cf. scabra</i>	Poaceae			+								
<i>Harporchloa falx</i>	Poaceae			2				1		2		
<i>Heteropogon contortus</i>	Poaceae			1	1	1	1			1		
<i>Hyparrhenia cf. anamesa</i>	Poaceae									1		
<i>Loudetia simplex</i>	Poaceae									+		
<i>Melinis nerviglumis</i>	Poaceae									+		
<i>Microchloa caffra</i>	Poaceae	2										
<i>Panicum natalense</i>	Poaceae			1			+	1				
<i>Paspalum dilatatum</i> *	Poaceae		1									
<i>Paspalum urvillei</i> *	Poaceae										1	
<i>Pennisetum thunbergii</i>	Poaceae								1			

<i>Setaria cf. pumila</i>	Poaceae	1						1					
<i>Setaria sphacelata</i>	Poaceae			1	2	1	+			1	+		
<i>Sporobolus africanus</i>	Poaceae		1	+									
<i>Themeda triandra</i>	Poaceae				2	3	1	1	1	1	3	2	
<i>Tristachya leucothrix</i>	Poaceae			3				1		+			
<i>Polygala gracilenta</i>	Polygalaceae						+						
<i>Rumex lanceolatus</i>	Polygonaceae										1		
<i>Agrimonia odorata</i> *	Rosaceae		+										
<i>Pyracantha coccinea</i> *	Rosaceae						+						
<i>Anthospermum rigidum</i>	Rubiaceae						+	1		1		+	
<i>Pentanisia angustifolia</i>	Rubiaceae			+		+		1					
<i>Pentanisia prunelloides</i>	Rubiaceae			+									
<i>Pygmaeothamnus chamaedendrum</i>	Rubiaceae			1	1								
<i>Populus cf. alba</i>	Salicaceae		1										
<i>Chaenostoma leve</i>	Scrophulariaceae									+			
<i>Nemesia fruticans</i>	Scrophulariaceae						+						
<i>Selago densiflora</i>	Scrophulariaceae						+						
<i>Zaluzianskya cf. elongata</i>	Scrophulariaceae									1			
<i>Cheilanthes viridis</i>	Sinopteridaceae		1										
<i>Solanum nigrum</i> *	Solanaceae		1										
<i>Solanum panduriforme</i> *	Solanaceae	+			+	+		+		+		1	
<i>Solanum sisymbriifolium</i> *	Solanaceae						+						
<i>Gnidia burchellii</i>	Thymelaeaceae		+							1			
<i>Gnidia caffra</i>	Thymelaeaceae							+		+			
<i>Verbena bonariensis</i> *	Verbenaceae		1		1	+					+		
TOTAL		165	16	22	36	28	45	40	36	15	33	31	16

Appendix 3. Detailed Data: Flora Quadrats (B)

Quadrat 1	
Location	S26.32543 E29.29052
Topography	Upper slopes
Elevation	1579 masl
Soil	Coarse sand between sandstone sheetrock
Vegetation	Low Open to Closed Herbland
Total Species	16
Dominant Species	<i>Mossia intervallaris</i> , <i>Microchloa caffra</i> , <i>Digitaria tricholaenoides</i>



Quadrat 2	
Location	S26.32572 E29.29119
Topography	Low scarp
Elevation	1565 masl
Soil	Brown sandy loam at base of scarp
Vegetation	Low to Tall Closed Woodland
Total Species	22
Dominant Species	<i>Robinia pseudo-acacia</i> *, <i>Bidens pilosa</i> *, <i>Sporobolus africanus</i>



Quadrat 3	
Location	S26.32591 E29.28999
Topography	Upper slopes
Elevation	1580 masl
Soil	Grey-brown coarse sand
Vegetation	Low Closed Grassland
Total Species	36
Dominant Species	<i>Tristachya leucothrix</i> , <i>Harporchloa falx</i> , <i>Eragrostis curvula</i> , <i>Senecio coronatus</i>



Quadrat 4	
Location	S26.32520 E29.29347
Topography	Upper slopes
Elevation	1586 masl
Soil	Grey-brown coarse sand
Vegetation	Low Closed Grassland
Total Species	28
Dominant Species	<i>Themeda triandra</i> , <i>Helichrysum rugulosum</i> , <i>Setaria sphacelata</i> , <i>Berkheya echinacea</i>
	
Quadrat 5	
Location	S26.32482 E29.32323
Topography	Upper slopes
Elevation	1619 masl
Soil	Grey-brown sandy loam
Vegetation	Low Closed Grassland
Total Species	45
Dominant Species	<i>Themeda triandra</i> , <i>Helichrysum rugulosum</i> , <i>Eragrostis racemosa</i> , <i>Elionurus muticus</i>
	
Quadrat 6	
Location	S26.32591 E29.32311
Topography	Low sandstone ridge
Elevation	1595 masl
Soil	Coarse sand between sandstone sheetrock
Vegetation	Low Closed Grassland
Total Species	40
Dominant Species	<i>Diospyros lycioides</i> subsp. <i>guerkei</i> , <i>Searsia magalismontana</i> , <i>Eragrostis racemosa</i> , <i>Elionurus muticus</i>
	

Quadrat 7	
Location	S26.33481 E29.36722
Topography	Top of scarp
Elevation	1622 masl
Soil	Coarse sand betw een sandstone sheetrock
Vegetation	Low Closed Grassland
Total Species	36
Dominant Species	<i>Eragrostis curvula</i> , <i>Dicoma anomala</i> , <i>Seriphium plumosum</i> , <i>Kyllinga erecta</i> , <i>Aristida junciformis</i>



Quadrat 8	
Location	S26.33756 E29.36948
Topography	Plains
Elevation	1508 masl
Soil	Deep grey-brown sandy loam
Vegetation	Low Closed Grassland or Herbland
Total Species	15
Dominant Species	<i>Berkheya rigida</i> , <i>Salvia runcinata</i> , <i>Senecio erubescens</i> , <i>Pennisetum thunbergii</i>



Quadrat 9	
Location	S26.37541 E29.31185
Topography	Low sandstone ridge
Elevation	1581 masl
Soil	Coarse sand betw een sandstone sheetrock
Vegetation	Low Closed Grassland or Herbland
Total Species	33
Dominant Species	<i>Eragrostis curvula</i> , <i>Eragrostis plana</i> , <i>Eragrostis chloromelas</i> , <i>Harpochloa falx</i>



Quadrat 10	
Location	S26.37908 E29.31500
Topography	Plains
Elevation	1567 masl
Soil	Deep sandy loam
Vegetation	Low Closed Grassland
Total Species	31
Dominant Species	<i>Themeda triandra</i> , <i>Eragrostis plana</i> , <i>Eragrostis chloromelas</i> , <i>Senecio erubescens</i>
	

Quadrat 11	
Location	S26.36547 E29.32573
Topography	Upper slopes
Elevation	1622 masl
Soil	Brown sandy loam
Vegetation	Low Closed Grassland
Total Species	16
Dominant Species	<i>Themeda triandra</i> , <i>Eragrostis plana</i> , <i>Eragrostis chloromelas</i> , <i>Helichrysum rugulosum</i>
	

Appendix 4. Detailed Data: Checklist of Fauna recorded during fieldwork

Species	Family	Protected	Endemic	Red Data	Assemblages					
					Thicket	Grassland	Wetland	Rivers, Dams	Transformed	Rocky Outcrop
Mammals										
ORDER LAGOMORPHA										
Family: Leporidae (rabbits & hares)										
Scrub Hare	<i>Lepus saxatilis</i>					X				X
ORDER: RODENTIA										
Family: Hystricidae (porcupines)										
Cape Porcupine	<i>Hystrix africaeaustralis</i>				X	X			X	X
Family Pedetidae (springhare)										
Springhare	<i>Pedetes capensis</i>					X				
ORDER: CARNIVORA										
Family: Canidae (dogs, jackals, wolves)										
Black-backed Jackal	<i>Canis mesomelas</i>				X	X	X			X
Family: Felidae (cats)										
Serval	<i>Leptailurus serval</i>	NEMBA		NT		X	X			
Family: Herpestidae (mongooses)										
Slender Mongoose	<i>Galerella sanguinea</i>				X					X
Water Mongoose	<i>Atilax paludinosus</i>				X		X	X		
Yellow Mongoose	<i>Cynictis penicillata</i>					X				
Suricate	<i>Suricata suricatta</i>					X				
Family: Hyaenidae (hyaenas)										
Aardwolf *	<i>Proteles cristatus</i>			MNCA		X				
Brown Hyaena	<i>Parahyaena brunnea</i>	NEMBA		NT	X	X	X			X
ORDER HYRACOIDEA										
Family Procaviidae (hyraxes)										
Rock Hyrax	<i>Procavia capensis</i>				X					X

African Black Duck	<i>Anas sparsa</i>									X	
Red-billed Teal	<i>Anas erythrorhyncha</i>							X		X	
Southern Pochard	<i>Netta erythrophthalma</i>									X	
Maccoa Duck	<i>Oxyura maccoa</i>									X	
ORDER: GALLIFORMES											
Family: Numididae (guineafowl)											
Helmeted Guineafowl	<i>Numida meleagris</i>					X	X			X	X
Family Phasianidae (pheasants, francolins, spurfowl)											
Orange River Francolin	<i>Scleroptila levallantoides</i>							X			
Swainson's Spurfowl	<i>Pternistis swainsonii</i>							X		X	X
Common Quail	<i>Coturnix coturnix</i>							X			
ORDER PODICIPEDIFORMES											
Family Podicipedidae (grebes)											
Little Grebe	<i>Tachybaptus ruficollis</i>									X	
Great Crested Grebe	<i>Podiceps cristatus</i>									X	
ORDER PHOENICOPTERIFORMES											
Family Phoenicopteridae (flamingos)											
Greater Flamingo	<i>Phoenicopterus ruber</i>									NT	X
ORDER CICONIIFORMES											
Family Ciconiidae (storks)											
White Stork	<i>Ciconia ciconia</i>									X	
ORDER: PELECANIFORMES											
Family Threskiornithidae (ibises, spoonbills)											
African Sacred Ibis	<i>Threskiornis aethiopicus</i>							X		X	
Southern Bald Ibis	<i>Geronticus calvus</i>				NEMBA	E	VU				X
Hadedda Ibis	<i>Bostrychia hagedash</i>							X	X		X
Glossy Ibis	<i>Plegadis falcinellus</i>								X		
African Spoonbill	<i>Platalea alba</i>										X
Family Ardeidae (herons, egrets, bitterns)											
Black-crowned Night-Heron	<i>Nycticorax nycticorax</i>									X	
Squacco Heron	<i>Ardeola ralloides</i>									X	
Western Cattle Egret	<i>Bubulcus ibis</i>							X	X	X	X
Grey Heron	<i>Ardea cinerea</i>										X

Black-headed Heron	<i>Ardea melanocephala</i>		x	x	
Purple Heron	<i>Ardea purpurea</i>			x	
Great Egret	<i>Egretta alba</i>			x	x
Yellow-billed Egret	<i>Egretta intermedia</i>			x	x
Little Egret	<i>Egretta garzetta</i>			x	x
Family Scopidae (Hamerkop)					
Hamerkop	<i>Scopus umbretta</i>				x
ORDER SULIFORMES					
Family Phalacrocoracidae (cormorants)					
Reed Cormorant	<i>Phalacrocorax africanus</i>				x
White-breasted Cormorant	<i>Phalacrocorax carbo</i>				x
Family Anhingidae (darters)					
African Darter	<i>Anhinga rufa</i>				x
ORDER: ACCIPITRIFORMES					
Family Sagittariidae (Secretarybird)					
Secretarybird	<i>Sagittarius serpentarius</i>	VU	x		x
Family Accipitridae (kites, hawks & eagles)					
Black Sparrowhawk	<i>Accipiter melanoleucus</i>		x		x
Black-shouldered Kite	<i>Elanus caeruleus</i>		x		
Common Buzzard	<i>Buteo vulpinus</i>		x		
ORDER OTIDIFORMES					
Family Otididae (bustards & korhaans)					
Blue Korhaan	<i>Eupodotis caerulescens</i>	E	x		
ORDER GRUIFORMES					
Family Rallidae (crakes, rails, moorhens)					
African Crake	<i>Creccopsis egregia</i>			x	
African Purple Swamphen	<i>Porphyrio madagascariensis</i>			x	
Lesser Moorhen	<i>Gallinula angulata</i>			x	
Red-knobbed Coot	<i>Fulica cristata</i>				x
Common Moorhen	<i>Gallinula chloropus</i>				x
ORDER: CHARADRIIFORMES					
Family Burhinidae (thick-knees)					
Spotted Thick-knee	<i>Burhinus capensis</i>		x		

Family Recurvirostridae (stilts & avocet)						
Black-winged Stilt	<i>Himantopus himantopus</i>			x	x	
Family Charadriidae (plovers)						
Blacksmith Lapwing	<i>Vanellus armatus</i>			x	x	
Crowned Lapwing	<i>Vanellus coronatus</i>		x			x
African Wattled Lapwing	<i>Vanellus senegallus</i>		x	x	x	
Three-banded Plover	<i>Charadrius tricollaris</i>			x	x	
Family Scolopacidae (sandpipers)						
African Snipe	<i>Gallinago nigripennis</i>			x		
Common Sandpiper	<i>Actitis hypoleucos</i>			x	x	
Common Greenshank	<i>Tringa nebularia</i>			x	x	
Wood Sandpiper	<i>Tringa glareola</i>			x	x	
Little Stint	<i>Calidris minuta</i>					x
Ruff	<i>Philomachus pugnax</i>			x	x	
Family Glareolidae (coursers & pratincoles)						
Black-winged Pratincole	<i>Glareola nordmanni</i>	NT		x		
Family Laridae (gulls & terns)						
Grey-headed Gull	<i>Larus cirrocephalus</i>				x	x
Whiskered Tern	<i>Chlidonias hybrida</i>				x	
ORDER: COLUMBIFORMES						
Family Columbidae (pigeons, doves)						
Speckled Pigeon	<i>Columba guinea</i>			x		x x
Rock Dove	<i>Columba livia</i>					x
Cape Turtle-Dove	<i>Streptopelia capicola</i>		x x		x	x x
Red-eyed Dove	<i>Streptopelia semitorquata</i>		x x		x	x x
Laughing Dove	<i>Streptopelia senegalensis</i>		x x		x	x x
ORDER: CUCULIFORMES						
Family Cuculidae (cuckoos & coucals)						
Diderick Cuckoo	<i>Chrysococcyx caprius</i>		x x	x	x	x
Family Strigidae (owls)						
Marsh Owl	<i>Asio capensis</i>				x	
Spotted Eagle-Owl	<i>Bubo africanus</i>		x			
ORDER: APODIFORMES						

Family Apodidae (swifts)

Little Swift	<i>Apus affinis</i>	over	over	over	over	over	over
African Black Swift	<i>Apus barbatus</i>	over	over	over	over	over	over
White-rumped Swift	<i>Apus caffer</i>	over	over	over	over	over	over
Horus Swift	<i>Apus horus</i>	over	over	over	over	over	over
African Palm-Swift	<i>Cypsiurus parvus</i>	over	over	over	over	over	over

ORDER: COLIIFORMES**Family Coliidae (mousebirds)**

Speckled Mousebird	<i>Colius striatus</i>	x					x
Red-faced Mousebird	<i>Urocolius indicus</i>						x

ORDER: CORACIIFORMES**Family Alcedinidae (kingfishers)**

Malachite Kingfisher	<i>Alcedo cristata</i>			x		x	
Giant Kingfisher	<i>Megaceryle maximus</i>					x	
Pied Kingfisher	<i>Ceryle rudis</i>					x	

Family Meropidae (bee-eaters)

European Bee-eater	<i>Merops apiaster</i>	x	x				
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ORDER: PICIFORMES**Family Lybiidae (African barbets)**

Crested Barbet	<i>Trachyphonus vaillantii</i>	x					x
Black-collared Barbet	<i>Lybius torquatus</i>	x					x

Family Picidae (woodpeckers)

Red-throated Wryneck	<i>Jynx ruficollis</i>	x					x
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ORDER: FALCONIFORMES**Family Falconidae (falcons)**

Amur Falcon	<i>Falco amurensis</i>			x	x		x
Lanner Falcon	<i>Falco biarmicus</i>	VU		x			

ORDER: PASSERIFORMES**Family Laniidae (shrikes)**

Southern Fiscal	<i>Lanius collaris</i>			x	x		x x
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Family Monarchidae (monarchs)

African Paradise Flycatcher	<i>Terpsiphone viridis</i>	x					
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Family Alaudidae (larks)

Common Myna	<i>Acridotheres tristis</i>									X
Cape Glossy Starling	<i>Lamprotornis nitens</i>									X
Family Turdidae (thrushes)										
Karoo Thrush	<i>Turdus smithi</i>									X
Family Muscicapidae (chats & Old World flycatchers)										
Fiscal Flycatcher	<i>Sigelus silens</i>	X								
Cape Robin-Chat	<i>Cossypha caffra</i>	X								X
African Stonechat	<i>Saxicola torquatus</i>			X	X					
Anteater Chat	<i>Myrmecocichla formicivora</i>			X						
Mountain Wheatear	<i>Oenanthe monticola</i>								X	X
Family Nectariniidae (sunbirds)										
Amethyst Sunbird	<i>Chalcomitra amethystina</i>									X
Malachite Sunbird	<i>Nectarinia famosa</i>	X	X							
Family Passeridae (Old World sparrows)										
House Sparrow	<i>Passer domesticus</i>									X
Cape Sparrow	<i>Passer melanurus</i>			X			X		X	
Southern Grey-headed Sparrow	<i>Passer diffusus</i>	X	X				X	X	X	X
Family Ploceidae (weavers & widowbirds)										
Southern Masked-Weaver	<i>Ploceus velatus</i>	X	X	X	X	X	X	X	X	X
Red-billed Quelea	<i>Quelea quelea</i>	X	X	X	X	X	X	X	X	X
Yellow-crowned Bishop	<i>Euplectes afer</i>			X	X				X	
Southern Red Bishop	<i>Euplectes orix</i>			X	X	X			X	
Fan-tailed Widowbird	<i>Euplectes axillaris</i>			X	X				X	
White-winged Widowbird	<i>Euplectes albonotatus</i>			X					X	
Long-tailed Widowbird	<i>Euplectes progne</i>			X						
Family Estrildidae (waxbills, mannikins)										
Red-headed Finch	<i>Amadina erythrocephala</i>			X			X		X	
Common Waxbill	<i>Estrilda astrild</i>			X	X	X				
Orange-breasted Waxbill	<i>Amandava subflava</i>				X					
African Quailfinch	<i>Ortygospiza atricollis</i>			X			X			
Family Viduidae (indigobirds & whydahs)										
Pin-tailed Whydah	<i>Vidua macroura</i>			X	X				X	
Cuckoo Finch	<i>Anomalospiza imberbis</i>			X						

Family Motacillidae (wagtails & pipits)												
Cape Wagtail	<i>Motacilla capensis</i>						x	x	x			
Cape Longclaw	<i>Macronyx capensis</i>					x	x					
African Pipit	<i>Anthus cinnamomeus</i>					x		x	x			
Family Fringillidae (finches, canaries & allies)												
Black-throated Canary	<i>Crithagra atrogularis</i>				x	x	x			x		
Yellow Canary	<i>Crithagra flaviventris</i>				x	x				x		
Cape Canary	<i>Serinus canicollis</i>				x	x	x	x	x	x		
Subtotal		146		1	4	5	35	76	59	66	52	27
Reptiles												
ORDER: SQUAMATA												
Family: Elapidae (cobras & mambas)												
Rinkhals *	<i>Hemachatus haemachatus</i>							x				
Family: Scincidae (skinks)												
Speckled Rock Skink	<i>Trachylepis punctatissima</i>											x
Family: Varanidae (monitor lizards)												
Water Monitor	<i>Varanus niloticus</i>								x			
Subtotal		3		0	0	0	0	1	1		0	1
Amphibians												
ORDER: ANURA												
Family: Pyxicephalidae (African frogs)												
Comon River Frog	<i>Amietia angolensis</i>								x			
Boettger's Caco	<i>Cacosternum boettgeri</i>							x	x			
Family: Pipidae (platannas)												
Common Platanna	<i>Xenopus laevis</i>								x			
Subtotal		3		0	0	0	0	1	3		0	0
TOTAL		178		13	6	7	44	101	71		56	35

E = Endemic

BE = Breeding Endemic

NT = Near Threatened

VU = Vulnerable

MNCA = Mpumalanga Nature Conservation Act

NEMBA = National Environmental Management
Biodiversity Act

* Landowner Record

Appendix 5. Detailed Data: Timed-Species Counts

Species	Grassland				
	TSC1	TSC2	TSC3	Total score	Average TSC
Cape Longclaw	6	6	6	18	6.00
Cape Turtle-Dove	6	6	6	18	6.00
Zitting Cisticola	6	6	6	18	6.00
Barn Swallow	6	5	6	17	5.67
Laughing Dove	6	6	5	17	5.67
Long-tailed Widowbird	6	5	6	17	5.67
African Pipit	4	6	6	16	5.33
Greater-striped Swallow	5	6	5	16	5.33
Helmeted Guineafowl	6	3	6	15	5.00
Common Waxbill	5	5	4	14	4.67
Diderick Cuckoo	6	2	5	13	4.33
Levaillant's Cisticola	2	5	6	13	4.33
African Quailfinch	6	3	3	12	4.00
Hadeda Ibis		6	6	12	4.00
South African Cliff-Swallow	6	6		12	4.00
African Stonechat	6		5	11	3.67
Amur Falcon	6		5	11	3.67
Cattle Egret	3	2	6	11	3.67
Fan-tailed Widowbird	2	4	5	11	3.67
Southern Masked Weaver	5	6		11	3.67
Swainson's Spurfowl	6		5	11	3.67
Common House Martin		4	6	10	3.33
Southern Red Bishop	5	5		10	3.33
White-rumped Swift	6	1	3	10	3.33
Wing-snapping Cisticola	5	5		10	3.33
Yellow-crowned Bishop		4	6	10	3.33
African Wattled Lapwing		5	4	9	3.00
Banded Martin		6	3	9	3.00
Black-throated Canary	1	6	2	9	3.00
Cape Canary	6		3	9	3.00
Pale-crowned Cisticola		3	6	9	3.00
Red-capped Lark		5	4	9	3.00
White-winged Widowbird	4		5	9	3.00
Yellow Canary	5	4		9	3.00
Red-billed Quelea	5	1	2	8	2.67
African Sacred Ibis			6	6	2.00
Anteater Chat		6		6	2.00
Common Quail			6	6	2.00
Glossy Ibis			6	6	2.00
African Snipe			5	5	1.67
Blacksmith Lapwing			5	5	1.67
Pin-tailed Whydah	1		4	5	1.67
Red-eyed Dove	5			5	1.67
White Stork			5	5	1.67
Black-chested Prinia	3		1	4	1.33

Black-headed Heron		4		4	1.33
Blue Korhaan			4	4	1.33
Cape Wagtail			4	4	1.33
Cloud Cisticola	4			4	1.33
Horus Swift	4			4	1.33
Pied Starling		4		4	1.33
Three-banded Plover			4	4	1.33
White-throated Swallow		4		4	1.33
Little Swift	3			3	1.00
Orange River Francolin	3			3	1.00
Spike-heeled Lark	3			3	1.00
Common Fiscal	1		1	2	0.67
Malachite Sunbird			2	2	0.67
Rock Martin		2		2	0.67
Spotted Thick-knee			2	2	0.67
Cape Sparrow	1			1	0.33
Crowned Lapwing			1	1	0.33
Southern Grey-headed Sparrow	1			1	0.33

Species	Wetland			
	TSC1	TSC2	Total score	Average TSC
African Sacred Ibis	6	6	12	6
Blacksmith Lapwing	6	6	12	6
Cattle Egret	6	6	12	6
Glossy Ibis	6	6	12	6
Great Egret	6	6	12	6
Hadeda Ibis	6	6	12	6
Wood Sandpiper	6	6	12	6
Yellow-billed Duck	6	6	12	6
Yellow-crowned Bishop	6	6	12	6
African Wattled Lapwing	5	6	11	5.5
Brown-throated Martin	6	5	11	5.5
Common Waxbill	5	6	11	5.5
Egyptian Goose	6	5	11	5.5
Fan-tailed Widowbird	5	6	11	5.5
Red-knobbed Coot	6	5	11	5.5
Southern Red Bishop	5	6	11	5.5
White-throated Swallow	6	5	11	5.5
Levaillant's Cisticola	4	6	10	5
Little Grebe	6	4	10	5
Southern Pochard	6	4	10	5
African Reed Warbler	3	6	9	4.5
African Snipe	3	6	9	4.5
Cape Shoveller	6	3	9	4.5
Reed Cormorant	6	3	9	4.5
Ruff	3	6	9	4.5
Southern Masked	3	6	9	4.5

Weaver				
African Darter	6	2	8	4
Barn Swallow	2	6	8	4
Pale-crowned Cisticola	3	5	8	4
Red-billed Teal	6	2	8	4
Purple Heron	1	6	7	3.5
Black-winged Stilt	6		6	3
Common Greenshank	6		6	3
Common Moorhen	4	2	6	3
Three-banded Plover		6	6	3
Whiskered Tern		6	6	3
Grey Heron		5	5	2.5
Marsh Owl		5	5	2.5
Spur-winged Goose		5	5	2.5
Squacco Heron	5		5	2.5
Yellow-billed Egret	5		5	2.5
Cape Wagtail	4		4	2
Malachite Kingfisher		4	4	2
Black-crowned Night Heron		3	3	1.5
Great Crested Grebe		3	3	1.5
Little Egret	3		3	1.5
Pied Kingfisher		1	1	0.5

Appendix 6. Potentially occurring fauna of conservation concern in the study area

Species	Scientific Name	Red Data	Protected	Habitat	Likelihood	Reason
Mammals						
Red Hartebeest	<i>Alcelaphus buselaphus</i>		NEMBA	Grassland	Confirmed	
Highveld Golden Mole	<i>Amblysomus septentrionalis</i>	NT		Grassland	Moderate	Some suitable habitat present
Cape Clawless Otter	<i>Aonyx capensis</i>	NT		Rivers, streams, dams	Moderate	Some suitable habitat present
Southern African Hedgehog	<i>Atelerix frontalis</i>	NT		Wide variety of habitats	Moderate	Some suitable habitat present
Black Wildebeest	<i>Connochaetes gnou</i>		NEMBA	Grassland	Confirmed	Re-introduced on certain farms
Reddish-grey Musk Shrew	<i>Crocidura cyanea</i>	DD		Wide variety of habitats	Moderate	Some suitable habitat present
Swamp Musk Shrew	<i>Crocidura mariquensis</i>	DD		Wide variety of habitats	Moderate	Some suitable habitat present
Peters' Musk Shrew	<i>Crocidura silacea</i>	DD		Wide variety of habitats	Moderate	Some suitable habitat present
Blesbok	<i>Damaliscus pygargus</i>		NEMBA	Grassland	Confirmed	
African Marsh Rat	<i>Dasymys incomtus</i>	NT		Wetlands, rivers, streams	Moderate	Some suitable habitat present
Burchell Zebra	<i>Equus quagga burchelli</i>		NEMBA	Grassland	Confirmed	
Black-footed Cat	<i>Felis nigripes</i>		NEMBA	Grassland	Low	Edge of range
Rock Dormouse	<i>Graphiurus platyops</i>	DD		Rocky outcrops in grassland	Moderate	Some suitable habitat present
Single-striped Grass-Mouse	<i>Lemniscomys rosalia</i>	DD		Grassland	Moderate	Some suitable habitat present
Serval	<i>Leptailurus serval</i>	NT	NEMBA	Grassland, wetlands	Confirmed	
Spotted-necked Otter #	<i>Lutra maculicollis</i>	NT		Rivers, streams, dams	Moderate	Some suitable habitat present
Brown Hyaena	<i>Parahyaena brunnea</i>	NT		Wide variety of habitats	Confirmed	
African Weasel	<i>Poecilogale albinucha</i>	DD		Wide variety of habitats	Moderate	Some suitable habitat

						present
Geoffroy's Horseshoe Bat	<i>Rhinolophus clivosus</i>	NT		Wide variety of habitats	Moderate	Some suitable habitat present
Least Dwarf Shrew	<i>Suncus infinitesimus</i>	DD		Wide variety of habitats	Moderate	Some suitable habitat present
Lesser Dwarf Shrew	<i>Suncus varilla</i>	DD		Wide variety of habitats	Moderate	Some suitable habitat present
Cape Fox #	<i>Vulpes chama</i>		NEMBA	Wide variety of habitats	Moderate	Some suitable habitat present
Subtotal	22	16	7			
Birds						
Half-collared Kingfisher	<i>Alcedo semitorquata</i>	NT		Wooded rivers and streams	Low	Limited suitable habitat
Blue Crane	<i>Anthropoides paradiseus</i>	NT	NEMBA	Grassland	Low	Some suitable habitat present, but very rare in Mpumalanga
Pallid Harrier	<i>Circus macrourus</i>	NT		Grassland	Moderate	Some suitable habitat present
African Marsh Harrier	<i>Circus ranivorus</i>	EN		Large wetlands, grasslands	Low	Limited suitable habitat
White-bellied Korhaan	<i>Eupodotis senegalensis</i>	VU		Tall grassland	Moderate	Some suitable habitat present
Lanner Falcon	<i>Falco biarmicus</i>	VU		Wide variety of habitats	Confirmed	
Red-footed Falcon	<i>Falco vespertinus</i>	NT		Grassland, plantations	Moderate	Some suitable habitat present
Southern Bald Ibis	<i>Geronticus calvus</i>	VU	NEMBA	Grasslands, burnt fields	Confirmed	
Black-winged Pratincole	<i>Glareola nordmanni</i>	NT		Large wetlands, grasslands	Confirmed	
Yellow-billed Stork	<i>Mycteria ibis</i>	EN		Large pans	Low	Limited suitable habitat present
Maccoa Duck	<i>Oxyura maccoa</i>	NT		Shallow pans, dams	Confirmed	
Greater Flamingo	<i>Phoenicopterus ruber</i>	NT		Pans, artificial dams	Confirmed	
Lesser Flamingo	<i>Phoenicopterus minor</i>	NT		Pans, artificial dams	Moderate	Some suitable habitat present
Secretarybird	<i>Sagittarius serpentarius</i>	VU		Wide variety of habitats	Confirmed	
Caspian Tern	<i>Sterna caspia</i>	VU		Large pans	Low	Limited suitable habitat
African Grass-Owl	<i>Tyto capensis</i>	VU		Large wetlands, grasslands	Moderate	Some suitable habitat

						present
Subtotal	15	15	2			
Reptiles & Frogs						
Transvaal Grass Lizard	<i>Chamaesaura aenea</i>	NT*		Grassland	Moderate	Some suitable habitat present
Spotted Harlequin Snake	<i>Homoroselaps lacteus</i>	NT		Variety of grassland types	Moderate	Some suitable habitat present
Giant Bullfrog	<i>Pyxicephalus edulis</i>	NT		Pans, wetlands in grassland	Moderate	Some suitable habitat present
Subtotal	3	3	0			
TOTAL	40	34	9			

EN = Endangered
VU = Vulnerable
NT = Near-threatened
DD = Data Deficient
MNCA = Mpumalanga Nature Conservation Act
NEMBA = National Environmental Management: Biodiversity Act

Appendix 7. Biodiversity Values of vegetation communities represented within the study area

Untransformed Grassland on Rocky Ridges

Conservation Importance

Parameter	Score	Very High	High	Moderate	Low	Very Low
Protection Status		International	National	Regional	Local	None
	15	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Size / Length		Very small (<500km ²)	Small (500 to 1,000km ²)	Moderate (1,000 to 20,000km ²)	Large (20,000 to 50,000km ²)	Very Large (> 50,000km ²)
	15	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Species Diversity		Noticeably High		Moderate		Noticeably Low
	12	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Threatened Species		Noticeably High		Moderate		Noticeably Low
	12	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Unique Habitat or Taxa		Noticeably High		Moderate		Noticeably Low
	15	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Present Ecological State		Natural, largely Unmodified	Slightly modified	Moderately Modified	Considerably Modified	Severely Modified
	16	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
MEDIAN Score	15.0	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0

Functional Importance

Parameter	Score	Very High	High	Moderate	Low	Very Low
Provisioning Services		Constant	Regular	Frequent	Occasional	Intermittent
	8	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Regulating Services		Very High	High	Moderate	Low	Very Low
	8	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Cultural Services		Very High	High	Moderate	Low	Very Low
	14	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Supporting Services		Very High	High	Moderate	Low	Very Low
	12	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
MEDIAN Score	10.0	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0

Untransformed Grassland on Hillslopes and Plateaus**Conservation Importance**

Parameter	Score	Very High	High	Moderate	Low	Very Low
Protection Status		International	National	Regional	Local	None
	15	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Size / Length		Very small (<500km ²)	Small (500 to 1,000km ²)	Moderate (1,000 to 20,000km ²)	Large (20,000 to 50,000km ²)	Very Large (> 50,000km ²)
	13	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Species Diversity		Noticeably High		Moderate		Noticeably Low
	14	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Threatened Species		Noticeably High		Moderate		Noticeably Low
	12	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Unique Habitat or Taxa		Noticeably High		Moderate		Noticeably Low
	14	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Present Ecological State		Natural, largely Unmodified	Slightly modified	Moderately Modified	Considerably Modified	Severely Modified
	13	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
MEDIAN Score	13.5	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0

Functional Importance

Parameter	Score	Very High	High	Moderate	Low	Very Low
Provisioning Services		Constant	Regular	Frequent	Occassional	Intermittent
	12	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Regulating Services		Very High	High	Moderate	Low	Very Low
	8	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Cultural Services		Very High	High	Moderate	Low	Very Low
	12	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Supporting Services		Very High	High	Moderate	Low	Very Low
	12	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
MEDIAN Score	12.0	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0

Untransformed Grassland on Plains**Conservation Importance**

Parameter	Score	Very High	High	Moderate	Low	Very Low
Protection Status		International	National	Regional	Local	None
	15	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Size / Length		Very small (<500km ²)	Small (500 to 1,000km ²)	Moderate (1,000 to 20,000km ²)	Large (20,000 to 50,000km ²)	Very Large (> 50,000km ²)
	13	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Species Diversity		Noticeably High		Moderate		Noticeably Low
	14	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Threatened Species		Noticeably High		Moderate		Noticeably Low
	12	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Unique Habitat or Taxa		Noticeably High		Moderate		Noticeably Low
	14	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Present Ecological State		Natural, largely Unmodified	Slightly modified	Moderately Modified	Considerably Modified	Severely Modified
	13	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
MEDIAN Score	13.5	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0

Functional Importance

Parameter	Score	Very High	High	Moderate	Low	Very Low
Provisioning Services		Constant	Regular	Frequent	Occassional	Intermittent
	12	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Regulating Services		Very High	High	Moderate	Low	Very Low
	8	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Cultural Services		Very High	High	Moderate	Low	Very Low
	12	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Supporting Services		Very High	High	Moderate	Low	Very Low
	12	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
MEDIAN Score	12.0	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0

Evergreen Thickets on Scarps and Rocky Outcrops

Conservation Importance

Parameter	Score	Very High	High	Moderate	Low	Very Low
Protection Status		International	National	Regional	Local	None
	15	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Size / Length		Very small (<500km ²)	Small (500 to 1,000km ²)	Moderate (1,000 to 20,000km ²)	Large (20,000 to 50,000km ²)	Very Large (> 50,000km ²)
	15	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Species Diversity		Noticeably High		Moderate		Noticeably Low
	10	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Threatened Species		Noticeably High		Moderate		Noticeably Low
	8	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Unique Habitat or Taxa		Noticeably High		Moderate		Noticeably Low
	13	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Present Ecological State		Natural, largely Unmodified	Slightly modified	Moderately Modified	Considerably Modified	Severely Modified
	14	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
MEDIAN Score	13.5	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0

Functional Importance

Parameter	Score	Very High	High	Moderate	Low	Very Low
Provisioning Services		Constant	Regular	Frequent	Occassional	Intermittent
	12	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Regulating Services		Very High	High	Moderate	Low	Very Low
	8	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Cultural Services		Very High	High	Moderate	Low	Very Low
	12	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Supporting Services		Very High	High	Moderate	Low	Very Low
	12	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
MEDIAN Score	12.0	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0

Wetlands**Conservation Importance**

Parameter	Score	Very High	High	Moderate	Low	Very Low
Protection Status		International	National	Regional	Local	None
	15	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Size / Length		Very small (<500km ²)	Small (500 to 1,000km ²)	Moderate (1,000 to 20,000km ²)	Large (20,000 to 50,000km ²)	Very Large (> 50,000km ²)
	15	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Species Diversity		Noticeably High		Moderate		Noticeably Low
	8	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Threatened Species		Noticeably High		Moderate		Noticeably Low
	9	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Unique Habitat or Taxa		Noticeably High		Moderate		Noticeably Low
	13	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Present Ecological State		Natural, largely Unmodified	Slightly modified	Moderately Modified	Considerably Modified	Severely Modified
	13	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
MEDIAN Score	13.0	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0

Functional Importance

Parameter	Score	Very High	High	Moderate	Low	Very Low
Provisioning Services		Constant	Regular	Frequent	Occassional	Intermittent
	12	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Regulating Services		Very High	High	Moderate	Low	Very Low
	13	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Cultural Services		Very High	High	Moderate	Low	Very Low
	9	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Supporting Services		Very High	High	Moderate	Low	Very Low
	14	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
MEDIAN Score	12.5	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0

Transformed Areas

Conservation Importance

Parameter	Score	Very High	High	Moderate	Low	Very Low
Protection Status		International	National	Regional	Local	None
	4	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Size / Length		Very small (<500km ²)	Small (500 to 1,000km ²)	Moderate (1,000 to 20,000km ²)	Large (20,000 to 50,000km ²)	Very Large (> 50,000km ²)
	12	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Species Diversity		Noticeably High		Moderate		Noticeably Low
	2	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Threatened Species		Noticeably High		Moderate		Noticeably Low
	4	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Unique Habitat or Taxa		Noticeably High		Moderate		Noticeably Low
	4	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Present Ecological State		Natural, largely Unmodified	Slightly modified	Moderately Modified	Considerably Modified	Severely Modified
	4	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
MEDIAN Score	4.0	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0

Functional Importance

Parameter	Score	Very High	High	Moderate	Low	Very Low
Provisioning Services		Constant	Regular	Frequent	Occasional	Intermittent
	15	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Regulating Services		Very High	High	Moderate	Low	Very Low
	6	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Cultural Services		Very High	High	Moderate	Low	Very Low
	4	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
Supporting Services		Very High	High	Moderate	Low	Very Low
	4	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0
MEDIAN Score	5.0	20 19 18 17	16 15 14 13	12 11 10 9	8 7 6 5	4 3 2 1 0

Appendix 8. Curriculum Vitae of Specialists

Name : Warren Lee McClelland
Profession : Terrestrial Ecologist
Date of Birth : 7 Sep 1972
Name of Firm : Ecorex Consulting Ecologists cc
Position in Firm : Sole Member
Years with firm : 10
Nationality : South African



Qualifications :

- N.Dip. [Nature Conservation] Cape Peninsula University of Technology 1993

Membership in Professional Societies:

- Herpetological Association of Africa
- South African Association of Botanists
- International Association for Impact Assessment (SA)

Languages :

	<u>Speaking</u>	<u>Reading</u>	<u>Writing</u>
English (home):	Excellent	Excellent	Excellent
Afrikaans:	Good	Good	Good
isiZulu:	Good	Fair	Fair
siSwati:	Fair	Poor	Poor

Countries of Work Experience : Angola, Botswana, Democratic Republic of the Congo, Malawi, Mali, Mozambique, Namibia, Republic of Guinea, Sierra Leone, South Africa, Swaziland, Tanzania, Zambia, Zimbabwe.

OVERVIEW OF EXPERIENCE

- 15 years experience in conducting baseline surveys, data analysis and report writing in various biomes in southern and tropical Africa, particularly savannah, forest and grassland biomes
- 5 years experience game reserve management (KwaZulu-Natal, Mpumalanga)
- **Co-author of acclaimed Field Guide to Trees and Woody Shrubs of Mpumalanga & Kruger National Park, Jacana Publishers, 2002;**
- Specialist knowledge of identification of plants, mammals, birds, reptiles and frogs;
- Experience in reporting according to IFC Performance Standards for numerous international projects in Sierra Leone, Angola, Democratic Republic of the Congo, Republic of Guinea, Tanzania, Malawi, Mali, Mozambique and Zambia.
- Accredited with the discovery of three new plant species: *Gladiolus diluvialis* Goldblatt & Manning (Fish River Canyon, Namibia), *Streptocarpus sekhukhuniensis* ms (Stoffberg, Mpumalanga) and *Asclepias* sp.nov. (Steenkampsberg Mts, Mpumalanga).
- **2014 Recipient of the Marloth Medal** from the Botanical Society of South Africa for co-authoring the Kruger tree field guide.

Employment Record:

2005 - present	ECOREX Consulting Ecologists CC	Ecologist; Sole Member
2001 - 2005	Lawson's Birding Tours	Specialist Guide
2000 - 2001	Escarpment Ecological Consultants cc	Founder Director
1996 – 2000	Crystal Springs Game Reserve	Reserve Manager
1995	Mutemwa Lodge, western Zambia	Lodge manager, guide
1993 - 1994	Natal Parks Board	Cadet field ranger

SELECTED RECENT PROJECTS & EXPERIENCE

West Africa			
Mali	2014	Biodiversity Baseline Study and Impact Assessment for Kalana Gold Mine, Yanfolila	Epoch Resources – Fanie Coetzee (fanie@epochresources.co.za)
	2013	Biodiversity Baseline Study and Impact Assessment for Fekola Gold Mine, Fedougou	Epoch Resources – Fanie Coetzee (fanie@epochresources.co.za)
Republic of Guinea	2012	Review of Specialist Studies conducted for an EIA for an aluminium mine near Bel-Air, in Bofa Prefecture.	Epoch Resources – Fanie Coetzee (fanie@epochresources.co.za)
Sierra Leone	2011	Biodiversity Baseline Study and Impact Assessment for Marampa Iron Ore Mine, Lunsar	SRK (U.K.) - Nicola Rump (nrump@srk.co.uk)
East Africa			
Tanzania	2011	Biodiversity Baseline Study and Impact Assessment for Mkuju River Uranium Project, Selous Game Reserve, Songea	Epoch Resources – Fanie Coetzee (fanie@epochresources.co.za)
Southern and South-central Africa			
Angola	2013	Biodiversity Management Plan for the raising of the Cambambe Dam wall, Kwanza River, Dondo	ERM – Jessica Hughes (jessica.hughes@erm.com)
Democratic Republic of the Congo	2014	Biodiversity Baseline Study and Impact Assessment for Pumpi Copper Mine, Kolwezi	Epoch Resources – Fanie Coetzee (fanie@epochresources.co.za)
	2013	Biodiversity Assessment of selected wetland habitats, Kamo Copper Mine, Kolwezi	Wetland Consulting Services – Gary Mameweck (GaryM@wetcs.co.za)
	2009-2011	Biodiversity Baseline Study and Impact Assessment for Kinsevere Copper Mine, Lubumbashi	Knight Piesold - Amelia Briel (abriel@knightpiesold.com)
	2008	Biodiversity Baseline Study for Ulindi Hydropower Scheme, Itombwe Mts, Kivu South	Knight Piesold - Amelia Briel (abriel@knightpiesold.com)
Malawi	2015	Terrestrial Ecology Survey of sugar mill site, Ethco, Dwangwa	ERM - Rachel Conti (Rachel.Conti@erm.com)
	2010	Terrestrial Ecology Survey of Kanyika Uranium Mine, Kasungu	Synergistics - Bronwyn Williams (bronwyn@synergistics.co.za)
Mozambique	2016	Biodiversity Baseline Study and Impact Assessment for an onshore gas pipeline, Inhassoro, Inhambane province	ERM – Jessica Hughes (jessica.hughes@erm.com)
	2015	Critical Habitat Assessment for coastal dry forest in Palma District, Cabo Delgado province	Enviro-Insight - Luke Verburgt (luke@enviro-insight.co.za)
	2015	Biodiversity Baseline Study for a Regional ESIA of Seismic Exploration blocks, SASOL, Inhassoro	Golder - Warren Aken (waken@golder.co.za)
	2014	Biodiversity Baseline Study and Impact Assessment for a coastal road between Pemba and Palma, Cabo Delgado province	ERM – Jessica Hughes (jessica.hughes@erm.com)
	2013	Biodiversity Monitoring Plan for Benga Coal Mine, Moatize	Rio Tinto - Isaac Ndlovu (Isaac.ndlovu@riotinto.com)
	2012	Biodiversity Baseline Study and Action Plan for the Muanza Quarry, Gorongosa NP, Sofala province	Nepid Consultants - Dr Rob Palmer (rob@nepid.co.za)
	2011	Terrestrial Ecology component of the Biodiversity Study for the Four Dams Project (Corumana Dam, Gorongosa Dam, Metuchira Weir, Ressano Weir), Maputo and Sofala provinces	Austral-CowI - Jacob Ulrich (jacob.ulrich@australcowi.co.mz)
Namibia	2009	Biodiversity Baseline Study and Impact Assessment for Neckartal Dam, Keetmanshoop	Knight Piesold - Amelia Briel (abriel@knightpiesold.com)
South Africa	2013	Faunal Baseline Study and Impact Assessment for Riemvasmaak Hydro-electric Scheme, Augrabies Falls NP	Aurecon - Nelis Bezuidenhout (Nelis.Bezuidenhout@aurecongroup.com)
	2010	Biodiversity Baseline Study and Impact Assessment for Hoogland Chrome Mine, Steenkampsberg Mts, Mpumalanga	Metago Environmental Engineers - Hylton Allison (hallison@slrconsulting.com)
	2010	Assessment of the status of <i>Pelargonium sidoides</i> and harvesting potential in Lesotho and South Africa	South African National Biodiversity Institute - Domitilla Raimondo (Raimondo@sanbi.org)
Swaziland	2014	Biodiversity Baseline Study and Impact Assessment for Ehemba Dam, Hlatikulu	Knight Piesold - Neal Neervoort (nneervoort@knightpiesold.com)
		Biodiversity Value Assessment for the Mhlumeni Community Conservation land, Siteki	Rod de Vletter (devletter@gmail.com)
Zambia	2015	Botanical survey for ESIA for Ngonye Falls Hydropower Project, Zambezi River, Senanga	Ecotone - Michiel Jonker (michiel@ecotone-sa.co.za)
	2013	Biodiversity Baseline Study and Impact Assessment for Mulungushi Hydropower Project, Kabwe	ERM – Zoe Daniels (Zoe.Daniel@erm.com)
	2008	Biodiversity Baseline Study and Impact Assessment for Lumwana Copper Mine, Solwezi	Knight Piesold - Amelia Briel (abriel@knightpiesold.com)
Zimbabwe	2011	Biodiversity Baseline Study and Impact Assessment for Bokai Platinum Mine, Gweru	Epoch Resources - Fanie Coetzee (fanie.coetzee@epochresources.co.za)

Name: : **Duncan Robert McKenzie**
Profession : Terrestrial Ecologist
Date of Birth : 9 Nov 1977
Name of Firm : ECOREX Consulting Ecologists cc
Position in Firm : Ecologist
Years with firm : 8
Nationality : South African



Qualifications :

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

Membership in Professional Societies:

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

Languages :

	<u>Speaking</u>	<u>Reading</u>	<u>Writing</u>
English (home):	Excellent	Excellent	Excellent
Afrikaans:	Good	Good	Good
isiZulu:	Good	Fair	Fair
Spanish:	Fair	Fair	Fair

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

OVERVIEW OF EXPERIENCE

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

Employment Record:

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

SELECTED REPORTS AND EXPERIENCE

West Africa			
Sierra Leone	2011	Biodiversity Baseline Study and Impact Assessment for Marampa Iron Ore Mine, Lunsar	SRK (U.K.) - Nicola Rump (nrump@srk.co.uk)
Mali	2014	Biodiversity Baseline Study and Impact Assessment for Kalana Gold Mine, Yanfolila	Epoch Resources - Fanie Coetzee (fanie@epochresources.co.za)
	2013	Biodiversity Baseline Study and Impact Assessment for Fekola Gold Mine, Fedougou	Epoch Resources - Fanie Coetzee (fanie@epochresources.co.za)
East Africa			
Tanzania	2011	Biodiversity Baseline Study and Impact Assessment for Mkuju River Uranium Project, Selous Game Reserve, Songea	Epoch Resources - Fanie Coetzee (fanie@epochresources.co.za)
Southern and South-central Africa			
Democratic Republic of Congo	2014	Biodiversity Baseline Study and Impact Assessment for Pumpi Copper Mine, Kolwezi	Epoch Resources - Fanie Coetzee (fanie@epochresources.co.za)
	2011	Biodiversity Baseline Study and Impact Assessment for Kinsevere Copper Mine, Lubumbashi	Knight Piesold - Amelia Briel (abriel@knightpiesold.com)
Mozambique	2015	Biodiversity Baseline Study for a SASOL Gas Pipeline, Inhassoro	ERM - Jessica Hughes (jessica.hughes@erm.com)
	2014	Terrestrial Fauna Survey of the Terrestrial Fauna Survey of the Quirimbas Palma-Pemba Coastal Road	ERM - Jessica Hughes (jessica.hughes@erm.com)
	2013	Biodiversity Baseline Study and Impact Assessment for Benga Coal Mine, Tete	Nepid Consultants - Dr Rob Palmer rob@nepid.co.za)
	2008	Terrestrial Ecology Study for Chinhanganine Sugar Expansion Project, Maputo Province	ACER (Africa) Environmental Managment Consultants
South Africa	2015	Survey of the current status, population dynamics and distribution of <i>Aloe simii</i> (Pole-Evans) in Mpumalanga	Tommie Steyn - Mpumalanga Tourism and Parks Agency (tommie.mtpa@telkomsa.net)
	2014	Terrestrial Ecology Study for Alexander Mine Coal Project for Anglo	WCS - Dieter Kassier (dieter@wcs.co.za)
	2010	Biodiversity Baseline Study and Impact Assessment for Hoogland Chrome Mine, Steenkampsberg Mts	Metago Environmental Engineers - Hylton Allison (hallison@slrconsulting.com)
	2010	Assessment of the status of <i>Pelargonium sidoides</i> and harvesting potential in Lesotho and South Africa	South African National Biodiversity Institute - Domitilla Raimondo (Raimondo@sanbi.org)
	2009	Terrestrial Ecology Study for SASOL Block 2 North Coal Project	De Castro & brits - Tony De Castro (mwdcandb@iafrica.com)
	2007	Terrestrial Ecology Study for the Groot Letaba Water Resource Development Scheme, Tzaneen	Iliso Consulting - Terry Baker (terry@iliso.com)
Swaziland	2014	Ekhutuleni Sugar Farms Plant Rescue Report	Linda Loffler (lindad@realnet.co.sz)
	2009	Biodiversity Baseline Study for Siphofaneni Road Developments	Aurecon Nelspruit (mbombela@aurecongroup.com)