



SUSTAINABLE  
FUTURES ZA

P.O. Box 749 Rondebosch 7701 Cape Town South Africa

Tel: ++27(0)833259965 Fax 0865102537

E-mail: swjohnston@mweb.co.za

January 2012

Dear Stakeholder

**PROPOSED SOLAR ENERGY FACILITY ON HARTEBEESTPAN FARM,  
CHRISTIANA PV 2 (75MW), NORTH-WEST PROVINCE  
(DEA Ref No.: 14/12/16/3/3/2/259)**

---

**NOTICE OF ENVIRONMENTAL IMPACT ASSESSMENT PROCESS**

---

Solar Reserve South Africa (Pty) Ltd proposes the establishment of a commercial photovoltaic (PV) solar energy facility and associated infrastructure on a site located approximately 12 km south of Christiana in the North-West Province. The proposed facility is envisaged to make use of **photovoltaic (PV)** technology with a total generating capacity of **up to 75MW**.

The facility is proposed on Portion 2 of Farm Hartebeestpan 330 which is located approximately 12 kilometres south-west of Christiana in the North-West Province. The study area falls within the jurisdiction of the Lekwa-Teemane Local Municipality. The larger site under investigation for the proposed solar PV facility covers an approximate area of 428 hectares, although the actual development footprint of the proposed facility would be smaller in extent. The proposed facility is anticipated to accommodate up to 75MW of generating capacity, which would be accomplished through the installation of an array of **photovoltaic (PV) panels**.

**Infrastructure** associated with the facility will include:

- » An array of photovoltaic (PV) panels
- » Mounting structure to be either rammed steel piles or piles with pre-manufactured concrete footings to support the PV panels;
- » Cabling between the project components, to be lain underground where practical;

- » Internal access roads; fencing;
- » Workshop area for maintenance storage, office, toilets and small water treatment unit;
- » Upgrade of the Bloemheuwel Rural 132/22kV substation which is located on the site

It should be noted that Solar Reserve South Africa (Pty) Ltd. plans to also develop a 15 MW facility on Portion 2 of Farm Hartebeestpan 330. This project would be referred to as Christiana PV 1 (DEA Ref. No.: 14/12/16/3/3/1/424). A separate Basic Assessment report for this project would be undertaken; however one consolidated public participation process is being undertaken.

### **ENVIRONMENTAL IMPACT ASSESSMENT PROCESS**

In terms of the EIA Regulations published in terms of Section 24(5) of the National Environmental Management Act (NEMA, Act No. 107 of 1998), Solar Reserve South Africa (Pty) Ltd requires authorisation from the National Department of Environmental Affairs (DEA) (in consultation with the North West Province: Department of Economic Development, Environment, Conservation and Tourism: Directorate: Environmental Management and Protection (NW DEDECT)), for the undertaking of the proposed solar PV plant. In terms of sections 24 and 24D of NEMA, as read with the EIA Regulations of GNR543, a Scoping and an EIA Phase are required to be undertaken for the proposed project.

In order to obtain authorisation, comprehensive, independent environmental studies must be undertaken in accordance with the EIA Regulations. This project has been registered with the National DEA under application reference number 14/12/16/3/3/2/259.

Solar Reserve South Africa (Pty) Ltd has appointed **Savannah Environmental**, as the independent environmental consultants, to undertake the required EIA process to identify and assess potential environmental impacts associated with the proposed project, and propose appropriate mitigation and management measures as part of an Environmental Management Programme. As part of these environmental studies, I&APs will be actively involved through the public involvement process being undertaken by **Sustainable Futures ZA**.

You and/or the organisation/department which you represent have been identified as an Interested and Affected Party (I&AP). Should you have an interest in this project, please register yourself as an I&AP and note your formal comments by sending written correspondence in this regard. All comments received will form part of the Comments and Response Report that will be included in the EIA



Report which is submitted to the DEA. By submitting your details and comments to Sustainable Futures ZA, you are ensured that your comments, concerns or queries will be noted.

***INVITATION FOR PUBLIC REVIEW OF THE DRAFT EIA REPORT***

In accordance with the EIA Regulations, a Draft Scoping Report for the Christiana PV2 has been prepared by Savannah Environmental and is available for public review. The period for review is **20 January 2012 – 20 February 2012**. Please submit written comment by **20 February 2012**. You are invited to review the report at one of the following locations:

- Christiana Public Library
- Bloemhof Public Library
- Website: [www.savannahSA.com](http://www.savannahSA.com)

All comments received will be included in the Final Scoping Report, which will be submitted to DEA for their consideration and decision. Comments can be made as written submission via fax, post or e-mail to Shawn Johnston.

***PUBLIC MEETING***

In order to facilitate comments on the draft Scoping Report, a public meeting will be held during the public review period. All interested and affected parties are invited to attend a public meeting to be held as follows:

- **DATE: TUESDAY, 31 JANUARY 2012**
- **TIME: 17:30 -19:00**
- **VENUE: PROTEA HOTEL - CHRISTIANA (ON MAIN ROAD)**

The aim of the public meeting is to provide you with more information regarding the proposed project (including technical details, project process and timeframes etc.), to provide a summary of the findings of the EIA undertaken, to invite comment on the proposed project, and to further discuss possible issues of specific concern to you which may need to be investigated and managed through the EIA process.

Yours sincerely,

Shawn Johnston  
Process Facilitator

PROPOSED PHOTOVOLTAIC (PV) SOLAR ENERGY FACILITIES ON HARTEBEESTPAN FARM, NEAR  
CHRISTIANA, NORTH-WEST PROVINCE:

Christiana PV1 (DEA Ref No. 14/12/16/3/3/1/424) Christiana PV2 (DEA Ref No. 14/12/16/3/3/2/259)

PUBLIC INVOLVEMENT PROCESS REPLY FORM

Return completed reply form to: **Shawn Johnston** of **Sustainable Futures ZA**

Fax: **086 510 2537**

Phone: **083 325 9965**

E-mail: **swjohnston@mweb.co.za**

Postal Address: **PO Box 749, Rondebosch, Cape Town, 7701**

**Please provide your complete contact details:**

Name & Surname:

Organisation & Designation:

Postal Address:

Telephone:

Fax:

Cellphone:

E-mail:

**Would you like to register as an interested and affected party (I&AP)?** YES

(please tick the relevant box)

NO

Note: Please register as an I&AP to receive further correspondence regarding the EIA process for the project. Once registered on the project database, your contact details MAY be included in public documentation.

Which project would you like to register on? (please tick the relevant box)

Christiana PV1

Christiana PV2

**Please state your interest in the project** (add additional pages if necessary):

----------------------

**Please list your questions, views or concerns regarding the project** (add additional pages if necessary):

--

**Please provide contact details of other persons who you regard as a potential interested or affected party:**

Name & Surname:

Organisation & Designation:

Postal Address:

Telephone:

Fax:

Cellphone:

E-mail:

**What is your preferred language of correspondence?** (please tick the relevant box)

English

Afrikaans



**SOLARRESERVE®**

(Sien keersy vir Afrikaans)



VOORGESTELDE FOTOVOLTAÏESE (FV) SONKRAGANLEGTE OP DIE PLAAS HARTEBEESTPAN NABY  
CHRISTIANA, NOORDWESPROVINSIE

Christiana PV1 (DEA Verw No. 14/12/16/3/3/1/424) Christiana PV2 (DEA Verw No. 14/12/16/3/3/2/259)

OPENBARE DEELNAMEPROSES REGISTRASIE/KOMMENTAAR VORM

Stuur voltooide registrasie/kommentaar vorm aan: **Shawn Johnston** by **Sustainable Futures ZA**

Faks: **086 510 2537**

Telefoon: **083 325 9965**

E-pos: **swjohnston@mweb.co.za**

Posadres: **Posbus 749, Rondebosch, Kaapstad, 7701**

**Verskaf asseblief u persoonlike kontak besonderhede:**

Naam & Van:

Organisasie & Rol:

Posadres:

Telefoon:

Faks:

Selfoon:

Vonkpos:

**Stel u belang om te registreer as 'n belangstellende en/of geaffekteerde party (B&GP)?** (Merk met X) JA

NEE

Nota: Dit word van u vereis om te registreer as 'n B&GP om alle toekomstige inligting in verband met die Omgewingsimpakevalueringproses te ontvang.

Watter projek wil jou graag om te registreer? (Merk asseblief die toepaslike blokkie)

Christiana PV1

Christiana PV2

**Verduidelik u belangstelling in hierdie projek** (gebruik addisionele bladsye indien nodig):

--

**Lys u vrae, opinies of besorghede in verband met hierdie projek** (gebruik addisionele bladsye indien nodig):

--

**Verskaf bykommende kontak besonderhede van addisionele persoon/e wie u beskou as potensiële belangstellende en/of geaffekteerde partye:**

Naam & Van:

Organisasie & Rol:

Posadres:

Telefoon:

Faks:

Selfoon:

E-pos:

**Dui u taal van keuse en korrespondensie aan** (Merk met X)

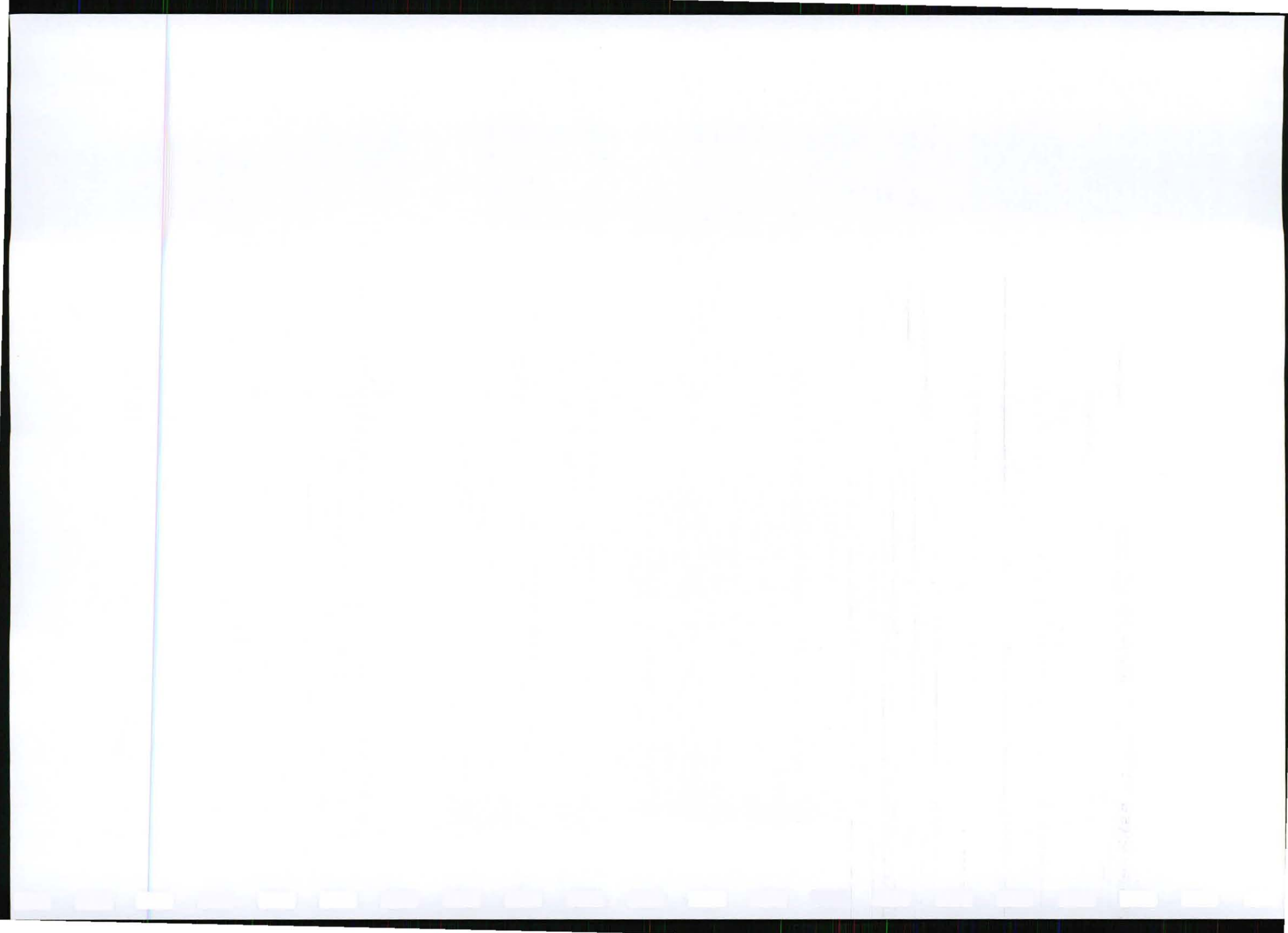
Engels

Afrikaans



**SOLARRESERVE®**

(Sien omkeer bladsy vir Engels)





**Appendix F:**  
Ecology Scoping Study





## **SCOPING REPORT:**

Specialist ecological study on the potential impacts of the proposed  
Solar Reserve Christiana PV 2 Solar Energy Facility, near Christiana,  
North-West Province

Prepared by

Dr David Hoare  
(Ph.D., Pr.Sci.Nat.)

David Hoare Consulting cc  
41 Soetdoring Ave  
Lynnwood Manor,  
Pretoria

for

Savannah Environmental (Pty) Ltd  
PO Box 148,  
Sunninghill,  
2197

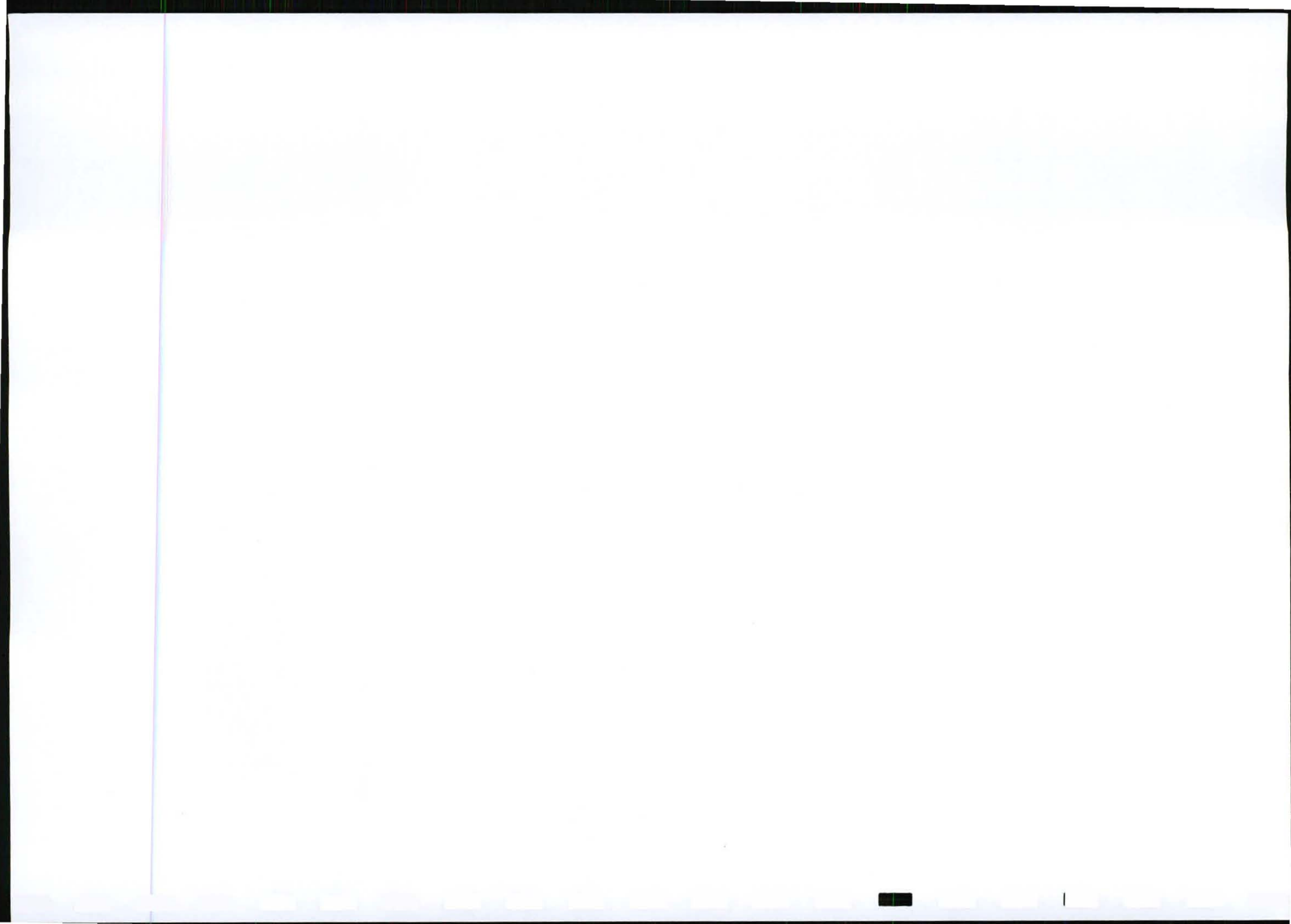
on behalf of  
Solar Reserve (Pty) Ltd

11 January 2012

**SCOPING REPORT: 1<sup>st</sup> Draft**



**David Hoare Consulting cc**  
**Biodiversity Assessments, Vegetation Description /**  
**Mapping, Species Surveys**





## **REGULATIONS GOVERNING THIS REPORT**

This report has been prepared in terms the EIA Regulations promulgated under the *National Environmental Management Act* No. 107 of 1998 (NEMA) and is compliant with Regulation 543 Section 32 - Specialist reports and reports on specialized processes under the Act. Relevant clauses of the above regulation are quoted below and reflect the required information in the "Control sheet for specialist report" given above.

Regulation 32. (1): An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialized process.

Regulation 32. (2): A person referred to in subregulation (1) must comply with the requirements of regulation (17) i.e. is independent

Regulation 33. (3): A specialist report or a report on a specialized process prepared in terms of these Regulations must contain:

- (a) details of (i) the person who prepared the report, and  
(ii) the expertise of that person to carry out the specialist study or specialized process;
- (b) declaration that the person is independent in a form as may be specified by the competent authority;
- (c) indication of the scope of, and the purpose for which, the report was prepared;
- (d) description of the methodology adopted in preparing the report or carrying out the specialized process;
- (e) description of any assumptions made and any uncertainties or gaps in knowledge;
- (f) description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
- (g) recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;
- (h) description of any consultation process that was undertaken during the course of carrying out the study;
- (i) summary and copies of any comments that were received during any consultation process;
- (j) any other information requested by the competent authority.

### **Appointment of specialist**

David Hoare of David Hoare Consulting cc was commissioned by Savannah Environmental (Pty) Ltd to provide specialist consulting services for the Environmental Impact Assessment for the proposed Solar Reserve Christiana PV 2 solar energy facility near Christiana in the North-West Province. The consulting services comprise an assessment of potential impacts on the flora, fauna, vegetation and ecology in the study area by the proposed project.

### **Details of specialist**

Dr David Hoare  
David Hoare Consulting cc  
Postnet Suite no. 116  
Private Bag X025  
Lynnwood Ridge, 0040

Telephone: 012 804 2281

Cell: 083 284 5111  
Fax: 086 550 2053  
Email: dhoare@lantic.net

### **Summary of expertise**

Dr David Hoare:

- Registered professional member of The South African Council for Natural Scientific Professions (Ecological Science, Botanical Science), registration number 400221/05.
- Founded David Hoare Consulting cc, an independent consultancy, in 2001.
- Ecological consultant since 1995.
- Conducted, or co-conducted, over 250 specialist ecological surveys as an ecological consultant.
- Published six technical scientific reports, 15 scientific conference presentations, seven book chapters and eight refereed scientific papers.
- Attended 15 national and international congresses & 5 expert workshops, lectured vegetation science / ecology at 2 universities and referee for 2 international journals.

### **Independence**

David Hoare Consulting cc and its Directors have no connection with Solar Reserve (Pty) Ltd. David Hoare Consulting cc is not a subsidiary, legally or financially, of the proponent. Remuneration for services by the proponent in relation to this project is not linked to approval by decision-making authorities responsible for authorising this proposed project and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project. David Hoare is an independent consultant to Savannah Environmental (Pty) Ltd and has no business, financial, personal or other interest in the activity, application or appeal in respect of which he was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of this specialist performing such work.

### **Scope and purpose of report**

The scope and purpose of the report are reflected in the "Terms of reference" section of this report.



**Conditions relating to this report**

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. David Hoare Consulting cc and its staff reserve the right to modify aspects of the report including the recommendations if and when new information may become available from on-going research or further work in this field, or pertaining to this investigation.

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

**TABLE OF CONTENTS**

**REGULATIONS GOVERNING THIS REPORT..... 2**

    APPOINTMENT OF SPECIALIST.....2

    DETAILS OF SPECIALIST .....2

    SUMMARY OF EXPERTISE .....3

    INDEPENDENCE.....3

    SCOPE AND PURPOSE OF REPORT.....3

    CONDITIONS RELATING TO THIS REPORT .....4

**TABLE OF CONTENTS..... 5**

**INTRODUCTION..... 7**

    TERMS OF REFERENCE AND APPROACH.....7

    STUDY AREA LOCATION.....7

**METHODOLOGY ..... 8**

    ASSESSMENT PHILOSOPHY .....8

    PLANT AND ANIMAL SPECIES OF CONSERVATION CONCERN .....9

*Red List plant species* .....9

*Protected trees* ..... 10

*Other protected species*..... 10

*Red List animal species* ..... 10

*Species probability of occurrence*..... 10

    HABITAT SENSITIVITY ..... 11

    LIMITATIONS AND EXCLUSIONS..... 13

**DESCRIPTION OF STUDY AREA..... 14**

    LOCATION..... 14

    TOPOGRAPHY ..... 14

    LAND TYPES AND SOILS ..... 15

    CLIMATE ..... 15

    LANDUSE AND LANDCOVER OF THE STUDY AREA ..... 15

    BROAD VEGETATION TYPES OF THE REGION ..... 15

*Kimberley Thornveld*..... 15

    CONSERVATION STATUS OF BROAD VEGETATION TYPES ..... 16

    RED LIST PLANT SPECIES OF THE STUDY AREA..... 17

    PROTECTED PLANTS (NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT) ..... 18

    RED LIST AND PROTECTED ANIMAL SPECIES OF THE STUDY AREA ..... 18

    PROTECTED TREES ..... 19

    SENSITIVITY ASSESSMENT ..... 20

**RELEVANT LEGISLATIVE AND PERMIT REQUIREMENTS..... 22**

    LEGISLATION ..... 22

*National Environmental Management Act, Act No. 107 of 1998 (NEMA)* ..... 22

*Environment Conservation Act No 73 of 1989 Amendment Notice No R1183 of 1997*..... 22

*National Forests Act (Act no 84 of 1998)*..... 22

*National Environmental Management: Biodiversity Act (Act No 10 of 2004)*..... 22

*Government Notice No. 1477 of 2009: Draft National List of Threatened Ecosystems* .... 23

*GNR 151: Critically Endangered, Endangered, Vulnerable and Protected Species List*..... 23

*GNR 1187: Amendment of Critically Endangered, Endangered, Vulnerable and Protected Species List* ..... 23

*Conservation of Agricultural Resources (Act No. 43 of 1983) as amended in 2001*..... 23

*National Water Act (Act No. 36 of 1998)* ..... 24

*National Veld and Forest Fire Act (Act No. 101 of 1998)* ..... 24

*Other Acts*..... 24

**IDENTIFICATION OF RISKS AND POTENTIAL IMPACTS..... 25**



DESCRIPTION OF POTENTIAL IMPACTS .....	26
<i>Impact 1: Loss or fragmentation of indigenous natural vegetation (terrestrial)</i> .....	26
<i>Impact 2: Loss of individuals of threatened plants</i> .....	26
<i>Impact 3: Loss of individuals of protected tree species</i> .....	26
<i>Impact 4: Loss of individuals of protected plant species</i> .....	27
<i>Impact 5: Loss of habitat for threatened and protected animals and birds</i> .....	27
<i>Impact 6: Collisions of individuals of threatened birds with overhead power lines</i> .....	28
<i>Impact 7: Impacts on watercourses and drainage areas</i> .....	28
<i>Impact 8: Establishment and spread of declared weeds and alien invader plants</i> .....	28
<b>DISCUSSION AND CONCLUSIONS</b> .....	<b>29</b>
SUMMARY OF PROPOSED EIA METHODOLOGY.....	30
<b>REFERENCES:</b> .....	<b>31</b>
<b>APPENDICES:</b> .....	<b>33</b>
APPENDIX 1: PLANT SPECIES OF CONSERVATION IMPORTANCE (THREATENED, NEAR THREATENED AND DECLINING) THAT HAVE HISTORICALLY BEEN RECORDED IN THE STUDY AREA.....	33
APPENDIX 2: THREATENED VERTEBRATE SPECIES WITH A GEOGRAPHICAL DISTRIBUTION THAT INCLUDES THE CURRENT STUDY AREA. ....	34
APPENDIX 3: LIST OF PROTECTED TREE SPECIES (NATIONAL FORESTS ACT).....	37
APPENDIX 4: CHECKLIST OF PLANT SPECIES RECORDED DURING PREVIOUS BOTANICAL SURVEYS IN THE STUDY AREA AND SURROUNDS. ....	38
APPENDIX 5: ANIMAL SPECIES WITH A GEOGRAPHICAL DISTRIBUTION THAT INCLUDES THE STUDY AREA. ...	48
APPENDIX 6: SPECIES PROTECTED UNDER THE NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT 10 OF 2004) .....	53

## INTRODUCTION

### Terms of reference and approach

Savannah Environmental (Pty) Ltd. was appointed by Solar Reserve (Pty) Ltd to undertake an application for environmental authorisation through an Environmental Impact Assessment (EIA) for a proposed solar energy facility on a site near Christiana, North-West Province. The project involves the establishment of a renewable energy facility for power generation and its associated infrastructure, including an array of photovoltaic (PV) panels, power lines to connect to Eskom's existing power lines, on-site substation/s to facilitate the connection between the facility and the power lines, internal and external access roads, maintenance buildings, lay down areas, and a site office. The purpose of the EIA is to identify environmental impacts associated with the project.

On 2 December 2011 David Hoare Consulting cc was appointed by Savannah Environmental (Pty) Ltd to undertake an ecological assessment of the study area. The specific terms of reference for the ecological scoping study include:

- to provide a description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed project;
- to provide a description and evaluation of potential environmental issues and potential impacts (including direct, indirect and cumulative impacts) that have been identified;
- Direct, indirect and cumulative impacts of the identified issues must be evaluated within the Scoping Report in terms of the following criteria:
  - the **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected;
  - the **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development), regional, national or international;
- a statement regarding the potential significance of the identified issues based on the evaluation of the issue/impacts;
- A statement regarding the desk-top evaluation of full site, with high-level identification of potential areas of sensitivity (for input into a sensitivity map)
- identification of potentially significant impacts to be assessed within the EIA phase;
- to provide recommendations regarding the methodology to be adopted in assessing potentially significant impacts in the EIA phase (sufficiently detailed to be included within the Plan of Study for EIA and must include a description of the proposed method of assessing the potential environmental impacts associated with the project).

This report provides details of the results of the Scoping phase. The findings of the study are based on a desktop assessment of the study area, including mapping from aerial imagery.

### Study area location

At a regional level the study area falls within the North-West Province to the south-west of the town of Christiana. A more detailed description of the study area is provided in a section below.



## **METHODOLOGY**

The assessment is to be undertaken in two phases, a Scoping phase and an Environmental Impact Assessment phase. The objective of the Scoping phase study was to review fauna and flora patterns within the study area in order to identify any highly sensitive areas that should be avoided during development. It was therefore necessary to provide checklists of sensitive species that could potentially occur in the study area as well as habitats with high conservation value. For potential species, only those of high conservation concern are provided. It was also intended to provide a draft habitat map of the study area based on available maps and database information. The results of the Scoping phase study are provided in this report.

### **Assessment philosophy**

Many parts of South Africa contain high levels of biodiversity at species and ecosystem level. At any single site there may be large numbers of species or high ecological complexity. Sites also vary in their natural character and uniqueness and the level to which they have been previously disturbed. Assessing the potential impacts of a proposed development often requires evaluating the conservation value of a site relative to other natural areas and relative to the national importance of the site in terms of biodiversity conservation. A simple approach to evaluating the relative importance of a site includes assessing the following:

- Is the site unique in terms of natural or biodiversity features?
- Is the protection of biodiversity features on the site of national/provincial importance?
- Would development of the site lead to contravention of any international, national or provincial legislation, policy, convention or regulation?

Thus, the general approach adopted for this type of study is to identify any critical biodiversity issues that may lead to the decision that the proposed project cannot take place, i.e. to specifically focus on red flags and/or potential fatal flaws. Biodiversity issues are assessed by documenting whether any important biodiversity features occur on site, including species, ecosystems or processes that maintain ecosystems and/or species. These can be organised in a hierarchical fashion, as follows:

#### Species

1. threatened plant species
2. protected trees
3. threatened animal species

#### Ecosystems

1. threatened ecosystems
2. protected ecosystems
3. critical biodiversity areas
4. areas of high biodiversity
5. centres of endemism

#### Processes

1. corridors
2. mega-conservancy networks
3. rivers and wetlands
4. important topographical features



It is not the intention to provide comprehensive lists of all species that occur on site, since most of the species on these lists are usually common or widespread species. Rare, threatened, protected and conservation-worthy species and habitats are considered to be the highest priority, the presence of which are most likely to result in significant negative impacts on the ecological environment. The focus on national and provincial priorities and critical biodiversity issues is in line with National legislation protecting environmental and biodiversity resources, including, but not limited to the following which ensure protection of ecological processes, natural systems and natural beauty as well as the preservation of biotic diversity in the natural environment:

1. Environment Conservation Act (Act 73 of 1989)
2. National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998)
3. National Environmental Management Biodiversity Act, 2004. (Act 10 Of 2004)

### **Plant and animal species of conservation concern**

There are two types of species of concern for the site under investigation, (i) those listed by conservation authorities as being on a Red List and are therefore considered to be at risk of extinction, and (ii) those listed as protected according to National and/or Provincial legislation.

#### ***Red List plant species***

Determining the conservation status of a species is required in order to identify those species that are at greatest risk of extinction and, therefore, in most need of conservation action. South Africa has adopted the IUCN Red List Categories and Criteria to provide an objective, rigorous, scientifically founded system to identify Red List species. A published list of the Red List species of South African plants (Raimondo et al. 2009) contains a list of all species that are considered to be at risk of extinction. This list is updated regularly to take new information into account, but these are not published in book/paper format. Updated assessments are provided on the SANBI website (<http://redlist.sanbi.org/>). According to the website of the Red List of Southern African Plants (<http://redlist.sanbi.org/>), *the conservation status of plants indicated on the Red List of South African Plants Online represents the status of the species within South Africa's borders. This means that when a species is not endemic to South Africa, only the portion of the species population occurring within South Africa has been assessed. The global conservation status, which is a result of the assessment of the entire global range of a species, can be found on the International Union for the Conservation of Nature (IUCN) Red List of Threatened Species: <http://www.iucnredlist.org>.* The South African assessment is used in this study.

The purpose of listing Red List plant species is to provide information on the potential occurrence of species at risk of extinction in the study area that may be affected by the proposed infrastructure. Species appearing on these lists can then be assessed in terms of their habitat requirements in order to determine whether any of them have a likelihood of occurring in habitats that may be affected by the proposed infrastructure.

Lists were compiled specifically for any species at risk of extinction (Red List species) previously recorded in the area. Historical occurrences of threatened plant species were obtained from the South African National Biodiversity Institute (<http://posa.sanbi.org>) for the quarter degree square/s within which the study area is situated. Habitat information for each species was obtained from various published sources. The probability of finding any of these species will then be assessed by comparing the habitat requirements with those habitats that occur on site.



### **Protected trees**

Regulations published for the National Forests Act (Act 84 of 1998) as amended, provide a list of protected tree species for South Africa. The species on this list were assessed in order to determine which protected tree species have a geographical distribution that coincides with the study area and habitat requirements that may be met by available habitat in the study area. The distribution of species on this list were obtained from published sources (e.g. van Wyk & van Wyk 1997) and from the SANBI Biodiversity Information System website (<http://sibis.sanbi.org/>) for quarter degree grids in which species have been previously recorded. Species that have been recorded anywhere in proximity to the site (within 100 km), or where it is considered possible that they could occur there, were listed in the Scoping Report and were considered as being at risk of occurring there.

### **Other protected species**

National legislation was evaluated in order to provide lists of any plant or animal species that have protected status. The most important legislation is the following:

- *National Environmental Management: Biodiversity Act (Act No 10 of 2004)*

This legislation contains lists of species that are protected. These lists were scanned in order to identify any species that have a geographical range that includes the study area and habitat requirements that are met by those found on site. These species were searched for within suitable habitats on site or, where relevant, it was stated that it was considered possible that they could occur on site.

There is additional legislation that provides lists of protected species, but the legislation to which these are attached deal primarily with harvesting or trade in listed species and do not specifically address transformational threats to habitat or individuals. This includes the following legislation:

- *CITES: Convention on the Trade in Endangered Species of Wild Fauna and Flora.*

### **Red List animal species**

Lists of threatened animal species that have a geographical range that includes the study area were obtained from literature sources (for example, Alexander & Marais 2007, Branch 1988, 2001, du Preez & Carruthers 2009, Friedmann & Daly 2004, Mills & Hes 1997, Monadjem et al. 2010). The likelihood of any of them occurring was evaluated on the basis of habitat preference and habitats available at each of the proposed sites. The three parameters used to assess the probability of occurrence for each species were as follows:

- *Habitat requirements:* most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics within the study area were assessed;
- *Habitat status:* in the event that available habitat is considered suitable for these species, the status or ecological condition was assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Data species (especially wetland-related habitats where water-quality plays a major role); and
- *Habitat linkage:* movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the study area to these surrounding habitats and adequacy of these linkages are assessed for the ecological functioning Red Data species within the study area.

### **Species probability of occurrence**

Some species are highly mobile (e.g. many birds) or, in the case of plants, may be cryptic, difficult to find, rare, ephemeral or generally not easy to spot while undertaking a survey of a large area. An assessment of the possibility of these species occurring there was therefore provided. For all threatened or protected organisms (flora and fauna) that occur in the general



geographical area of the site, a rating of the likelihood of it occurring on site is given as follows:

- **LOW**: no suitable habitats occur on site / habitats on site do not match habitat description for species;
- **MEDIUM**: habitats on site match general habitat description for species (e.g. karoo shrubland), but detailed microhabitat requirements (e.g. mountain shrubland on shallow soils overlying sandstone) are absent on the site or are unknown from the descriptions given in the literature or from the authorities;
- **HIGH**: habitats found on site match very strongly the general and microhabitat description for the species (e.g. m mountain shrubland on shallow soils overlying sandstone);
- **DEFINITE**: species found in habitats on site.

### Habitat sensitivity

The purpose of producing a habitat sensitivity map is to provide information on the location of potentially sensitive features in the study area. This was compiled by taking the following into consideration:

1. The general status of the vegetation of the study area was derived by compiling a landcover data layer for the study area (*sensu* Fairbanks et al. 2000) using available satellite imagery and aerial photography. From this it can be seen which areas are transformed versus those that are still in a natural status.
2. Various provincial, regional or national level conservation planning studies have been undertaken in the area, e.g. the National Spatial Biodiversity Assessment (NSBA). The mapped results from these were taken into consideration in compiling the habitat sensitivity map.
3. Habitats in which various species of plants or animals occur that may be protected or are considered to have high conservation status are considered to be sensitive.

An explanation of the different sensitivity classes is given in Table 1. Areas containing untransformed natural vegetation of conservation concern, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered potentially sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to potentially have low sensitivity.

**Table 1: Explanation of sensitivity ratings.**

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
VERY HIGH	<p>Indigenous natural areas that are highly positive for <u>any</u> of the following:</p> <ul style="list-style-type: none"> <li>• presence of threatened species (Critically Endangered, Endangered, Vulnerable) and/or habitat critical for the survival of populations of threatened species.</li> <li>• <u>High</u> conservation status (low proportion remaining intact, highly fragmented, habitat for species that are at risk).</li> <li>• <u>Protected</u> habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain</li> </ul>	<ul style="list-style-type: none"> <li>• CBA 1 areas.</li> <li>• Remaining areas of vegetation type listed in Draft Ecosystem List of NEM:BA as Critically Endangered, Endangered or Vulnerable.</li> <li>• Protected forest patches.</li> <li>• Confirmed presence of populations of threatened species.</li> </ul>

Sensitivity	Factors contributing to sensitivity	Example of qualifying features
	Catchment Areas Act, Lake Areas Development Act) And may also be positive for the following: <ul style="list-style-type: none"> <li>• <u>High</u> intrinsic biodiversity value (<u>high</u> species richness and/or turnover, unique ecosystems)</li> <li>• <u>High</u> value ecological goods &amp; services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value)</li> <li>• <u>Low</u> ability to respond to disturbance (low resilience, dominant species very old).</li> </ul>	
HIGH	Indigenous natural areas that are positive for any of the following: <ul style="list-style-type: none"> <li>• <u>High</u> intrinsic biodiversity value (<u>moderate/high</u> species richness and/or turnover).</li> <li>• presence of habitat highly suitable for threatened species (Critically Endangered, Endangered, Vulnerable species).</li> <li>• <u>Moderate</u> ability to respond to disturbance (<u>moderate</u> resilience, dominant species of intermediate age).</li> <li>• <u>Moderate</u> conservation status (moderate proportion remaining intact, moderately fragmented, habitat for species that are at risk).</li> <li>• <u>Moderate to high</u> value ecological goods &amp; services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value).</li> </ul> And may also be positive for the following: <ul style="list-style-type: none"> <li>• <u>Protected</u> habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act)</li> </ul>	<ul style="list-style-type: none"> <li>• CBA 2 "critical biodiversity areas".</li> <li>• Habitat where a threatened species could potentially occur (habitat is suitable, but no confirmed records).</li> <li>• Confirmed habitat for species of lower threat status (near threatened, rare).</li> <li>• Habitat containing individuals of extreme age.</li> <li>• Habitat with low ability to recover from disturbance.</li> <li>• Habitat with exceptionally high diversity (richness or turnover).</li> <li>• Habitat with unique species composition and narrow distribution.</li> <li>• Ecosystem providing high value ecosystem goods and services.</li> </ul>
MEDIUM-HIGH	Indigenous natural areas that are positive for <u>one</u> or <u>two</u> of the factors listed above, but not a combination of factors.	<ul style="list-style-type: none"> <li>• CBA 2 "corridor areas".</li> <li>• Habitat with high diversity (richness or turnover).</li> <li>• Habitat where a species of lower threat status (e.g. (near threatened, rare) could potentially occur (habitat is suitable,</li> </ul>



Sensitivity	Factors contributing to sensitivity	Example of qualifying features
		but no confirmed records).
MEDIUM	Other indigenous natural areas in which factors listed above are of no particular concern. May also include natural buffers around ecologically sensitive areas and natural links or corridors in which natural habitat is still ecologically functional.	
MEDIUM-LOW	Degraded or disturbed indigenous natural vegetation.	
LOW	No natural habitat remaining.	

Any natural vegetation within which there are features of conservation concern will be classified into one of the high sensitivity classes (MEDIUM-HIGH, HIGH or VERY HIGH. The difference between these three high classes is based on a combination of factors and can be summarised as follows:

1. Areas classified into the VERY HIGH class are vital for the survival of species or ecosystems. They are either known sites for threatened species or are ecosystems that have been identified as being remaining areas of vegetation of critical conservation importance. CBA1 areas would qualify for inclusion into this class.
2. Areas classified into the HIGH class are of high biodiversity value, but do not necessarily contain features that would put them into the VERY HIGH class. For example, a site that is known to contain a population of a threatened species would be in the VERY HIGH class, but a site where a threatened species could potentially occur (habitat is suitable), but it is not known whether it does occur there or not, is classified into the HIGH sensitivity class. The class also includes any areas that are not specifically identified as having high conservation status, but have high local species richness, unique species composition, low resilience or provide very important ecosystem goods and services. CBA2 "irreplaceable biodiversity areas" would qualify for inclusion into this class, if there were no other factors that would put them into the highest class.
3. Areas classified into the MEDIUM-HIGH sensitivity class are natural vegetation in which there are one or two features that make them of biodiversity value, but not to the extent that they would be classified into one of the other two higher categories. CBA2 "corridor areas" would qualify for inclusion into this class.

### Limitations and exclusions

- Red List species are, by their nature, usually very rare and difficult to locate. Compiling the list of species that could potentially occur in an area is limited by the paucity of collection records that make it difficult to predict whether a species may occur in an area or not. The methodology used in this assessment is designed to reduce the risks of omitting any species, but it is always possible that a species that does not occur on a list may be unexpectedly located in an area.
- It is not the intention of this study to produce comprehensive lists of species occurring on site (see "Assessment philosophy" section above). This would require detailed site assessments that are not necessary for providing an assessment of impacts associated with the proposed project. No checklists of species occurring on site are, therefore, provided.



## DESCRIPTION OF STUDY AREA

### Location

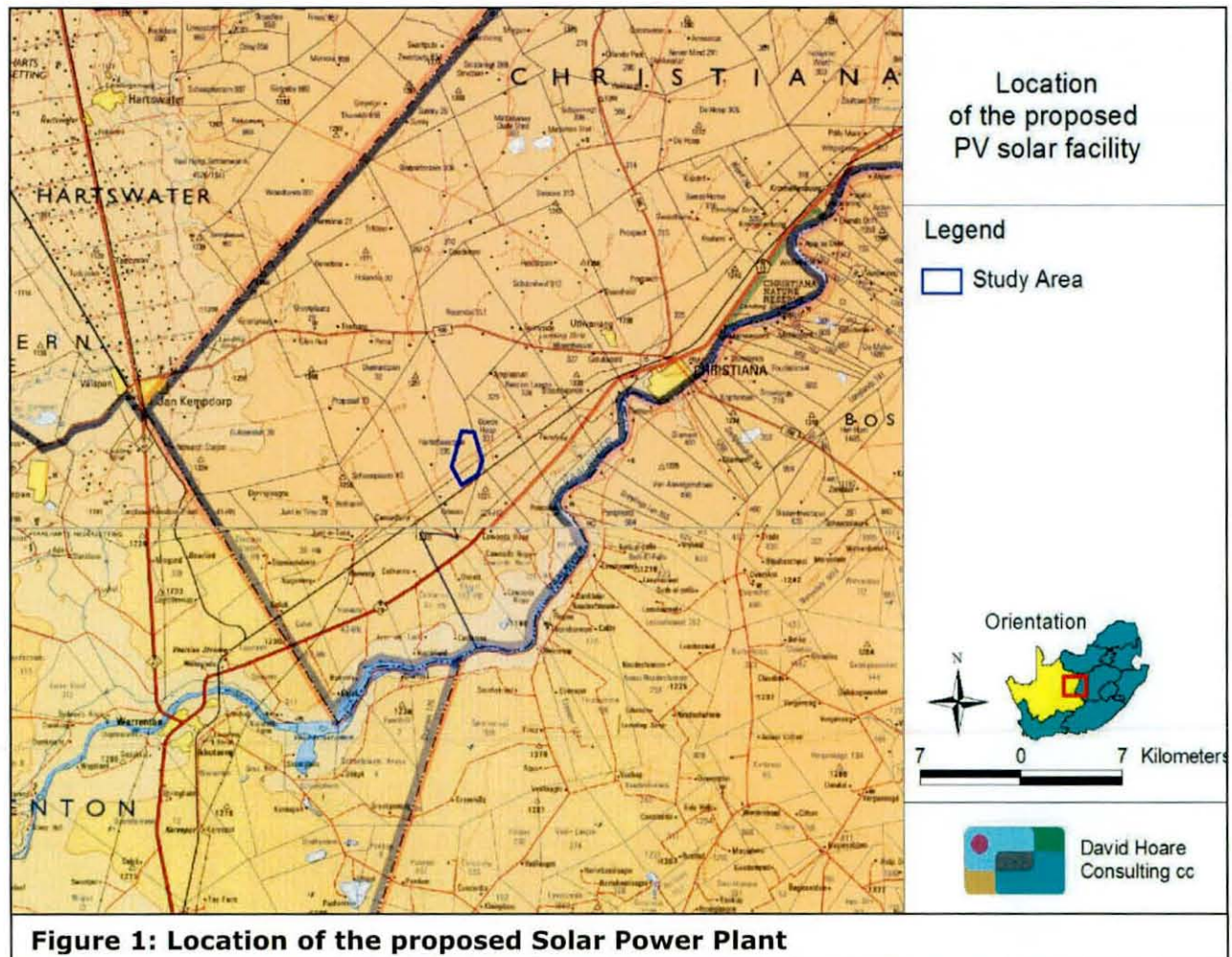
The study site is situated approximately 10 km west-south-west of Christiania within the North-West Province (Figure 1). The site falls within the quarter degree grid 2725CC. The proposed facility would occur on the Farm Heartebeest Pan.

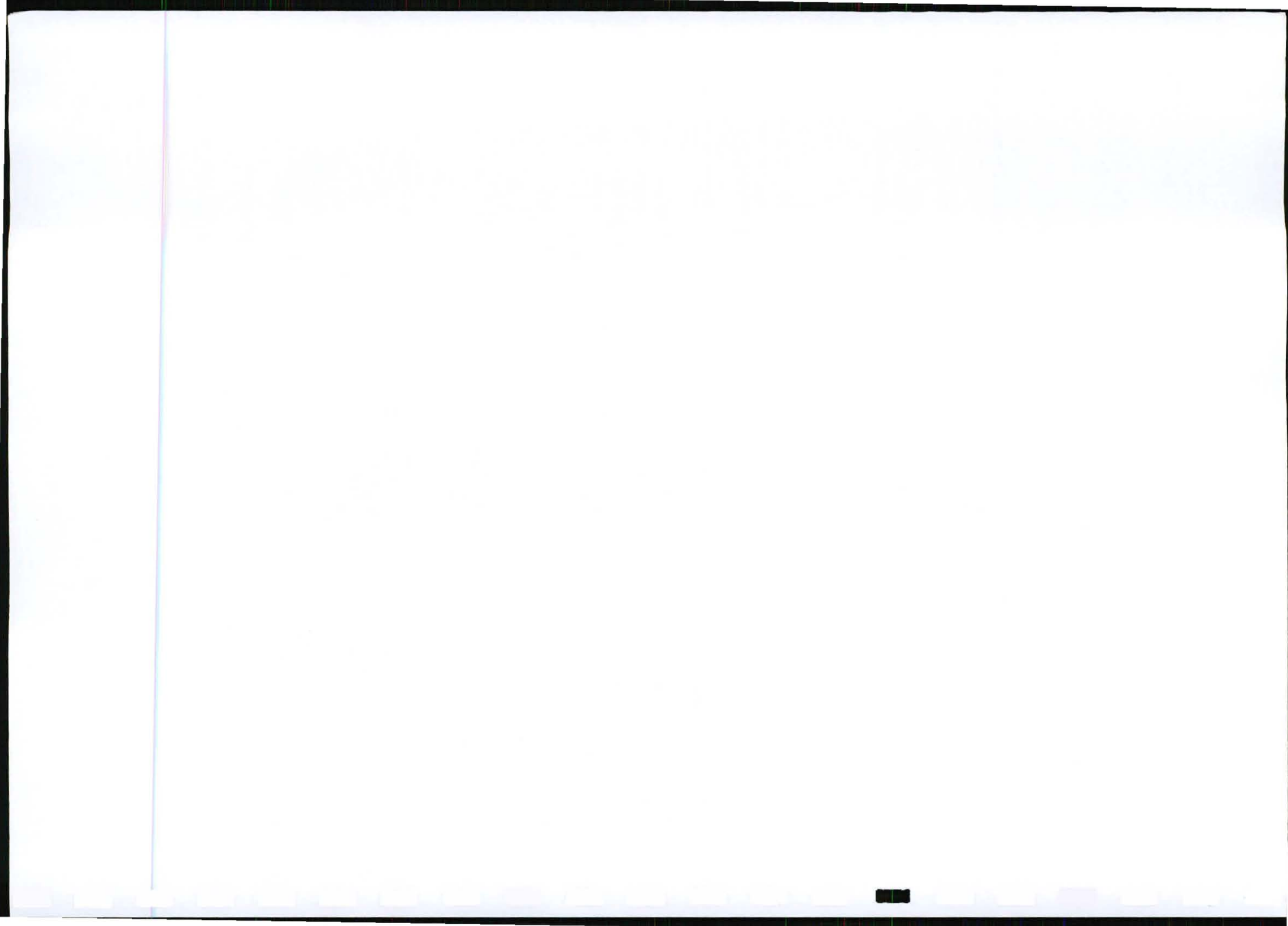
No alternative site is currently being considered for the proposed facility, but the current site is sufficiently large to allow placement of the facility in alternative positions within the site in order to avoid any identified environmental sensitivities. The site was selected based on the local topography, solar irradiation and access to the electricity grid.

The study area is accessible from Christiania via the N12, which runs to Christiania from Kimberley. There is a gravel farm access road that branches from the N12 and passes through the centre of the site. The site is therefore relatively accessible by means of existing roads.

### Topography

The topography of the study site is relatively flat. There is a dry pan on site. Other than this feature, there are no other topographic features of note on sight. The elevation on site varies from 1221 to 1230 m above sea level over a distance of almost 3 km, which is virtually flat.







## **Land types and soils**

Detailed soil information is not available for broad areas of the country. As a surrogate, landtype data was used to provide a general description of soils in the study area (landtypes are areas with largely uniform soils, topography and climate). There is one land type in the study area, namely the Ae land type (Land Type Survey Staff, 1987).

The A-group of land types refer to yellow and red soils without water tables belonging to one or more of the following soil forms: Inanda, Kranskop, Magwa, Hutton, Griffin, Clovelly. The Ae landtype consists of red, high base status, > 300 mm deep soils and no dunes (MacVicar et al. 1974).

## **Climate**

The climate is arid to semi-arid. Rainfall occurs from November to March, but peaks in mid- to late summer (February / March). Mean annual rainfall is 390 mm per year. All areas with less than 400 mm rainfall are considered to be arid. The study area can therefore be considered to be semi-arid to arid.

## **Landuse and landcover of the study area**

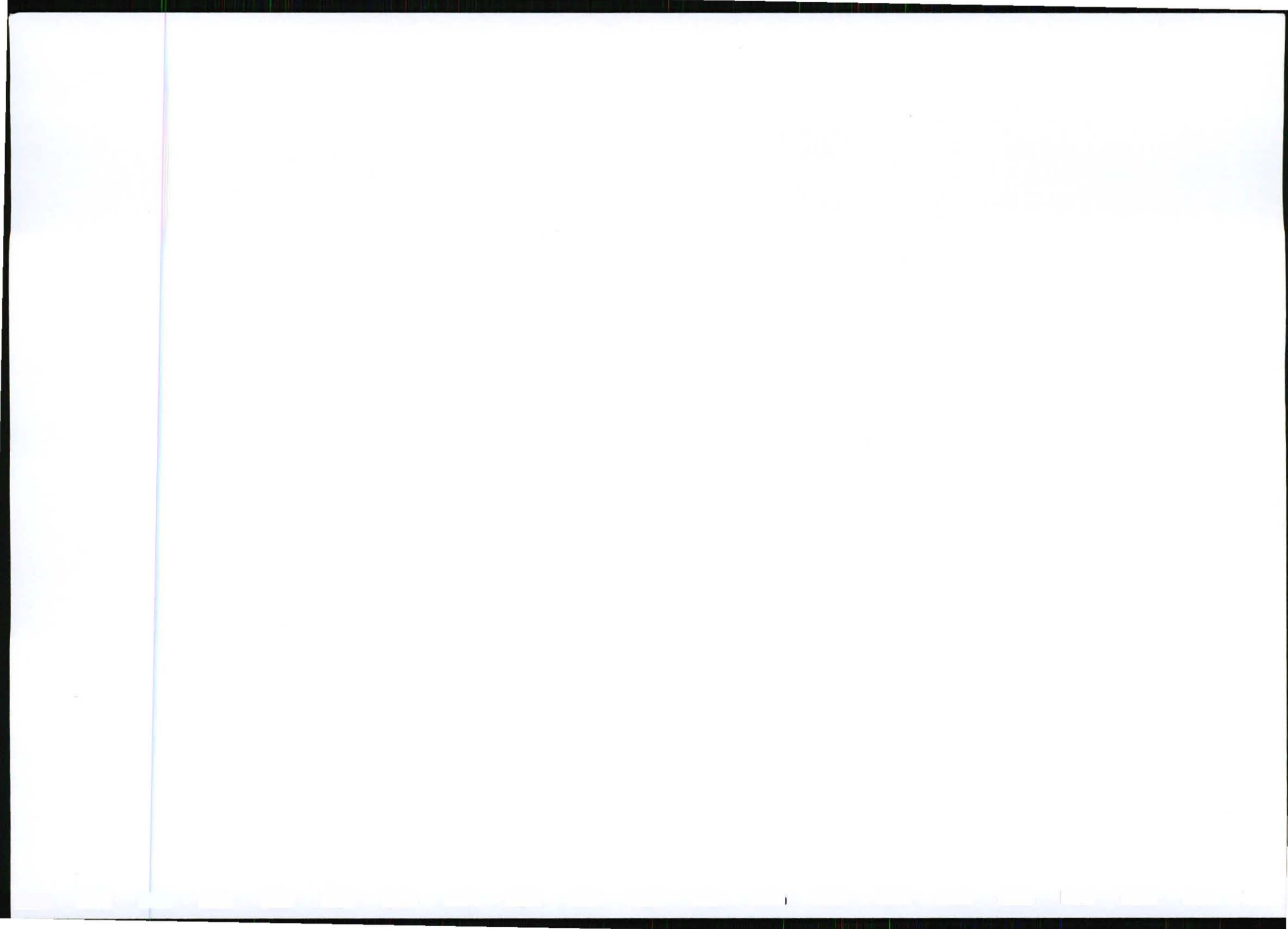
A landcover map of the study area (Fairbanks *et al.* 2000) indicates that the entire site consists of natural vegetation, except for a small patch of cultivation in the centre. The landcover on site is classified as "unimproved grassland" and "thicket and bushland". This is contrary to the 1:50 000 topo-cadastral maps, which show that large parts of the site have been previously cultivated. There are also farm buildings in the central part of the study area, roads, and Eskom substation and various power lines crossing the site. Google imagery for the site indicates that, except for a small patch in the north and another one in the south of the site, the entire site has been previously cultivated.

## **Broad vegetation types of the region**

The study area falls within the Savanna Biome (Rutherford & Westfall 1986, Mucina & Rutherford 2006). The most recent and detailed description of the vegetation of this region is part of a national map (Mucina, Rutherford & Powrie, 2005; Mucina *et al.* 2006). This map shows one vegetation type occurring within the study site, namely Kimberley Thornveld. There is a small area of azonal Highveld Salt Pans to the south-east of the site, but this does not fall within the study area. Further away is Highveld alluvial vegetation associated with the Vaal River. No other vegetation type occurs anywhere near to the site. The vegetation type is described in more detail below.

### ***Kimberley Thornveld***

This vegetation type occurs on the slightly irregular plains of parts of the North-West, Free State and Northern Cape Provinces. It has a well-developed tree layer with *Acacia erioloba*, *Acacia tortilis*, *Acacia karro* and *Boscia albitrunca* and a well-developed shrub-layer with occasional dense stands of *Tarchonanthus camphoratus* and *Acacia mellifera*. The grass layer is open with much uncovered soil. Overgrazing leads to encroachment of *Acacia mellifera*.





## Conservation status of broad vegetation types

On the basis of a recently established approach used at national level by SANBI (Driver *et al.* 2005), vegetation types can be categorised according to their conservation status which is, in turn, assessed according to the degree of transformation relative to the expected extent of each vegetation type. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. The original extent of a vegetation type is as presented in the most recent national vegetation map (Mucina, Rutherford & Powrie 2005) and is the extent of the vegetation type in the absence of any historical human impact. On a national scale the thresholds are as depicted in Table 1, as determined by best available scientific approaches (Driver *et al.* 2005).

The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% of the ecosystem still remaining in a natural state (Driver *et al.* 2005). The vegetation types occurring in the study area (Table 2) are classified as Least Threatened (Driver *et al.* 2005; Mucina *et al.*, 2006).

**Table 1: Determining ecosystem status (from Driver *et al.* 2005).** \*BT = biodiversity target (the minimum conservation requirement).

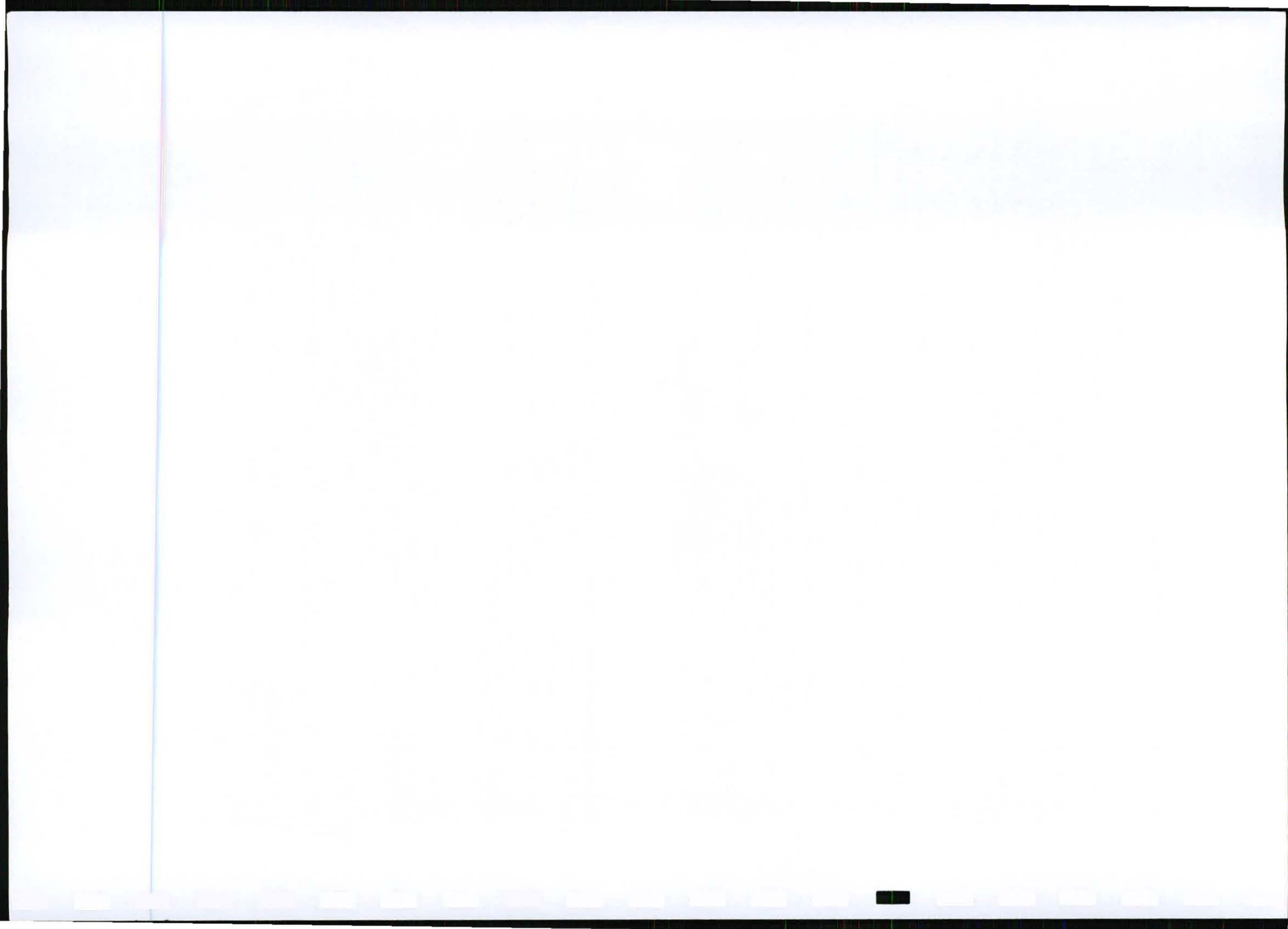
Habitat remaining (%)	80–100	least threatened	LT
	60–80	vulnerable	VU
	*BT–60	endangered	EN
	0–*BT	critically endangered	CR

The Draft National List of Threatened Ecosystems (GN1477 of 2009), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004), lists national vegetation types that are afforded protection on the basis of rates of transformation. The thresholds for listing in this legislation are higher than in the scientific literature, which means there are fewer ecosystems listed in the Draft Ecosystem List versus in the scientific literature. The vegetation types occurring on site are not listed in the Draft National List of Threatened Ecosystems (GN1477 of 2009).

**Table 2: Conservation status of different vegetation types occurring in the study area, according to Driver *et al.* 2005 and Mucina *et al.* 2005.**

Vegetation Type	Target (%)	Conserved (%)	Transformed (%)	Conservation status	
				Driver <i>et al.</i> 2005; Mucina <i>et al.</i> , 2006	Draft Ecosystem List (NEMBA)
Kimberley Thornveld	16	2	18	Least Threatened	Not listed

No Critical Biodiversity Areas have been identified for municipal areas of the North-West Province (bgis.sanbi.org). It is therefore not possible to identify areas of concern at a regional level in the current study area.





### Red List plant species of the study area

Lists of plant species of conservation concern previously recorded in the quarter degree grids in which the study area is situated were obtained from the South African National Biodiversity Institute. These are listed in Appendix 1. Additional species that could occur in similar habitats, as determined from database searches and literature sources, but have not been recorded in these grids are also listed.

There were three species on this list, one listed as Near Threatened and two listed as Declining. The conservation categories of "declining" and "rare" are of much lower importance than species classified as threatened (critically endangered, endangered or vulnerable) or near threatened.

One of these species, *Acacia erioloba* (declining), has a high probability of occurring on site. *Acacia erioloba* is also a protected tree. It usually occurs in deep sandy soils, along drainage lines and sometimes on rocky outcrops, but may also occur more widely in other habitats.

The species, *Lithops lesliei* subsp. *lesliei*, is listed as Near Threatened. Information from the SANBI website indicates that this species has not been previously listed in the grid in which the site is located, but occurs in neighbouring grids. The site is within its overall distribution range and is known (from other research) to potentially occur in the area. *Lithops lesliei* subsp. *lesliei* therefore has a high probability of occurring on site. This species is found primarily in arid grasslands, usually in rocky places, growing under the protection of forbs and grasses. The main threats to this species are muthi harvesting, which has recently become the biggest threat to its persistence, followed by succulent collectors and habitat destruction.

The bulb, *Crinum bulbispermum*, is listed as Declining. It is found near rivers and streams, in seasonal pans and in damp depressions. There is a moderate probability of it occurring in the pan on site.

The quantity and quality of floristic data for the study area is poor. There are few taxonomic collections and relatively little floristic information for the area. There may therefore be unknown species in this area or known species that have not been previously collected in this area. For this study, floristic information was collected for the quarter degree grid in which the site is located as well as in all eight surrounding grids and no additional species were identified of potential conservation concern.

On the basis of the information presented here, it is concluded that there are no threatened plant species that are likely to occur on site, but there is one near threatened species that could occur on site.

**Table 3: Explanation of IUCN Ver. 3.1 categories (IUCN, 2001), and Orange List categories (Victor & Keith, 2004).**

IUCN / Orange List category	Definition	Class
EX	Extinct	Extinct
CR	Critically Endangered	Red List
EN	Endangered	Red List
VU	Vulnerable	Red List
NT	Near Threatened	Orange List
Declining	Declining taxa	Orange List
Rare	Rare	Orange List
Critically Rare	Rare: only one subpopulation	Orange List
Rare-Sparse	Rare: widely distributed but rare	Orange List
DDD	Data Deficient: well known but not enough information for	Orange List



IUCN / Orange List category	Definition	Class
	assessment	
DDT	Data Deficient: taxonomic problems	Data Deficient
DDX	Data Deficient: unknown species	Data Deficient

### Protected plants (National Environmental Management: Biodiversity Act)

Plant species protected under the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004) are listed in Appendix 5. One plant species that appears on this list that could potentially occur in the region, although it has not previously been recorded in the grid, is *Hoodia gordonii*. This species is currently listed in Appendix II to the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), which includes species not currently considered endangered but are at risk if trade is not controlled. *Hoodia gordonii* has a wide tolerance of growing habitats and is found in deep Kalahari sands, on dry stony slopes or flats and under the protection of xerophytic bushes. It is considered possible that this species occurs on site, although the distribution of the species is near its eastern limit at the current site.

Another protected species that could potentially occur in the region, although it has not previously been recorded in the grid, is *Harpagophytum procumbens* (devil's claw). This species is associated mainly with dry sandveld on deep Kalahari sand. It usually occupies plains, dune bases and interdunes. Soils are usually sandy but can be rocky. They are generally nutrient poor, often with lime. It is considered highly possible that it occurs on site.

### Red List and protected animal species of the study area

All Red List vertebrates (mammals, birds, reptiles, amphibians) that could occur in the study area are listed in Appendix 2. Those vertebrate species with a geographical distribution that includes the study area, and habitat preference that includes habitats available in the study area are discussed further.

There are two mammal species of conservation concern that could occur in available habitats in the study area. This includes one species classified as Near Threatened (NT), the Brown Hyaena and one species classified in South Africa as Near Threatened, but globally as Least Concern (LC), the South African Hedgehog. There are an additional five mammal species that are not listed as of conservation concern, but which are protected. These are the White rhinoceros, Black Wildebeest, Black-footed Cat, Honey Badger and Cape Fox.

There are four threatened bird species (Blue Crane, Kori Bustard, Lesser Kestrel, Martial Eagle, all VU) and four Near Threatened bird species (Caspian Tern, Lanner Falcon, Secretarybird, White Pelican) that have a medium to high probability of utilising available habitats in the study area, either for foraging or breeding. The only species likely to use parts of the site for breeding are Kori Bustard. The other seven species, the Blue Crane, Caspian Tern, Lanner Falcon, Lesser Kestrel, Martial Eagle, White Pelican and Secretarybird, may use the site or parts of the site for foraging. Loss of a relatively small area of foraging will not affect these species significantly and the project is assessed as being unlikely to have an important impact on any these seven species.

The Giant Bullfrog is the only amphibian species with a distribution that includes the study area and which could occur on site. This species is classified as Least Concern globally and



Near threatened in South Africa. It is, however, protected under the National Environmental Management: Biodiversity Act and any impacts on a specimen of this species or that may negatively affect the survival of the species would require a permit. The Giant Bullfrog inhabits a variety of vegetation types where it breeds in seasonal, shallow, grassy pans in flat, open areas. It also utilises non-permanent vleis and shallow water on margins of waterholes and dams. It prefers sandy substrates although they sometimes inhabit clay soils. Habitats such as these occur on site. It was therefore assessed that there was a probability of it occurring on site.

There are no reptile species of conservation concern that have a distribution that includes the study area.

The threatened, near threatened and protected species of potential concern for the site are therefore as follows:

- White rhinoceros (protected),
- Brown Hyaena (NT, protected),
- South African Hedgehog (NT/LC, protected),
- Black Wildebeest (protected),
- Black-footed Cat (protected),
- Honey Badger (protected),
- Cape Fox (protected),
- Blue Crane (VU),
- Caspian Tern (NT),
- Kori Bustard (VU),
- Lanner Falcon (NT),
- Lesser Kestrel (VU),
- Martial Eagle (VU),
- Secretarybird (NT),
- White Pelican (NT)
- Giant Bullfrog (protected).

### **Protected trees**

Tree species protected under the National Forest Act are listed in Appendix 3. There are three that have a geographical distribution that includes the study area, *Boscia albitrunca* (Shepherd's Tree / Witgatboom / !Xhi), *Acacia haematoxylon* (Grey camel thorn) and *Acacia erioloba* (Camel Thorn, Kameeldoring).

*Boscia albitrunca* occurs in semi-desert areas and bushveld, often on termitaria, but is common on sandy to loamy soils and calcrete soils. It is usually quite common where it is found.

The tree, *Acacia erioloba*, occurs in dry woodland along watercourses in arid areas where underground water is present as well as on deep Kalahari sands. The site is at the very edge of it's distribution range.

The tree, *Acacia haematoxylon*, occurs on deep Kalahari sand between dunes or along dry watercourses. There is some confusion on the distribution of this species. This species has a geographic distribution that is indicated in the literature (van Wyk & van Wyk 1997) as not occurring in the area, but collection records for this species obtained from the SANBI website (<http://sibis.sanbi.org/>) indicate that this species does occur near to the site. The collection records are a more reliable indicator of distribution, since they are based on observation of



individual plants in the field. The SANBI distribution records also match the habitat preference for the species (Kalahari Basin).

### Sensitivity assessment

The sensitivity assessment identifies those parts of the study area that have high conservation value or that may be sensitive to disturbance. Areas of sensitivity are shown in Figure 2. An explanation of the different sensitivity classes is given in Table 4.

**Table 4: Explanation of sensitivity ratings.**

<b>Sensitivity</b>	<b>Factors contributing to sensitivity</b>
VERY HIGH	Indigenous natural areas that are highly positive for the following: <ul style="list-style-type: none"> <li>• <u>High</u> intrinsic biodiversity value (<u>high</u> species richness and/or turnover, presence of species of concern, unique ecosystems).</li> <li>• <u>Low</u> ability to respond to disturbance (low resilience, dominant species very old).</li> <li>• <u>High</u> conservation status (low proportion remaining intact, highly fragmented, habitat for species that are at risk).</li> <li>• <u>High</u> value ecological goods &amp; services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value)</li> <li>• <u>Protected</u> habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act)</li> </ul>
HIGH	Indigenous natural areas that are moderately positive for the following: <ul style="list-style-type: none"> <li>• <u>Moderate</u> intrinsic biodiversity value (<u>moderate</u> species richness and/or turnover, presence of species of concern).</li> <li>• <u>Moderate</u> ability to respond to disturbance (<u>moderate</u> resilience, dominant species of intermediate age).</li> <li>• <u>Moderate</u> conservation status (low proportion remaining intact, moderately fragmented, habitat for species that are at risk).</li> <li>• <u>Moderate</u> value ecological goods &amp; services (e.g. water supply, erosion control, soil formation, carbon storage, pollination, refugia, food production, raw materials, genetic resources, cultural value).</li> </ul> And may also be positive for the following: <ul style="list-style-type: none"> <li>• <u>Protected</u> habitats (areas protected according to national / provincial legislation, e.g. National Forests Act, Draft Ecosystem List of NEM:BA, Integrated Coastal Zone Management Act, Mountain Catchment Areas Act, Lake Areas Development Act)</li> </ul>
MEDIUM-HIGH	Indigenous natural areas that are positive for <u>one</u> or <u>two</u> of the factors listed above.
MEDIUM	Other indigenous natural areas in which factors listed above are of no particular concern. May also include natural buffers around ecologically sensitive areas and natural links or corridors in which natural habitat is still ecologically functional.
MEDIUM-LOW	Degraded or disturbed indigenous natural vegetation.
LOW	No natural habitat remaining.

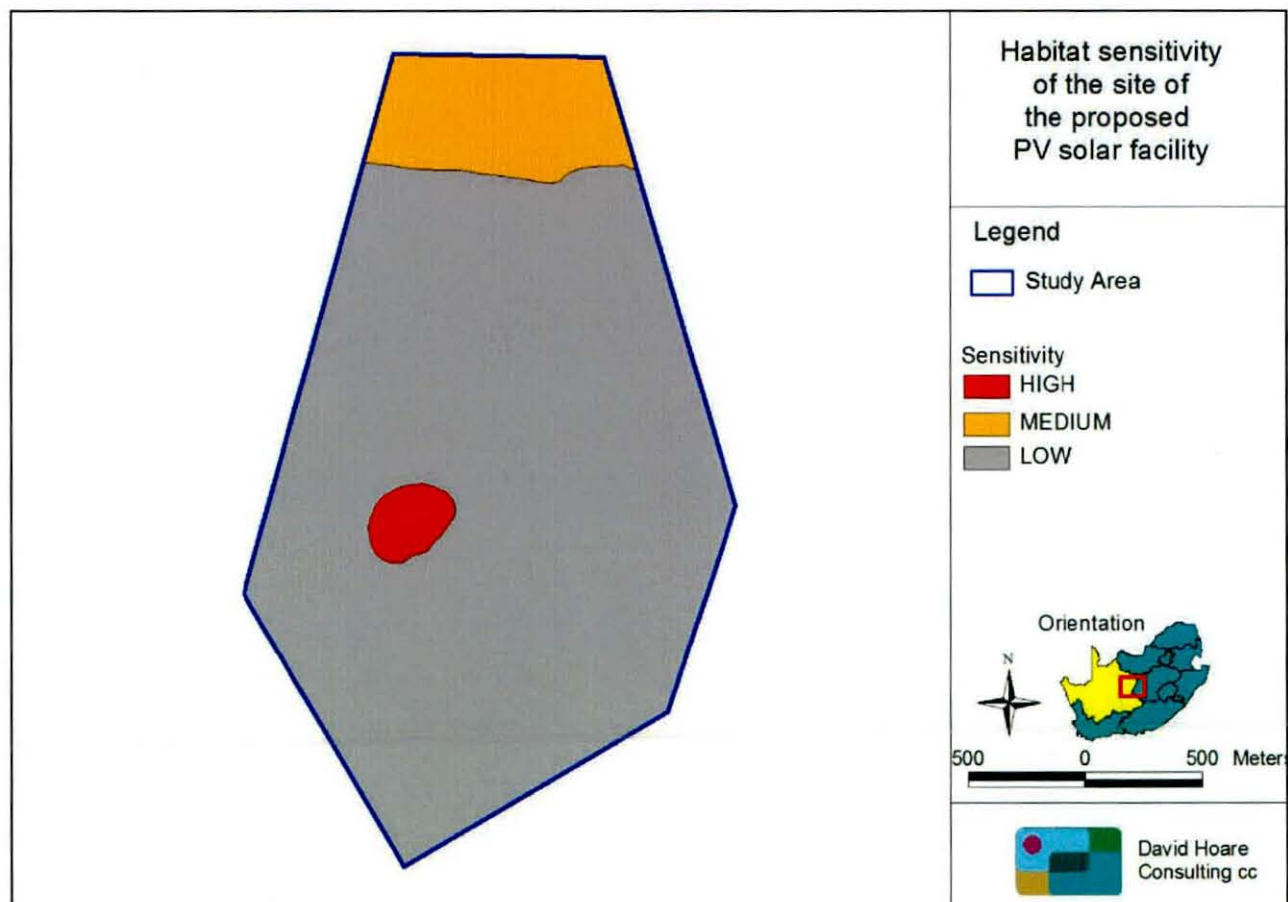
Areas containing untransformed natural vegetation of conservation concern, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered potentially sensitive. In contrast, any transformed area that has no importance for the functioning of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

provided in the preceding sections was used to compile a map of remaining natural habitats and areas important for maintaining ecological processes in the study area. Broad scale mapping was used to provide information on the location of sensitive features. There are a number of features that need to be taken into account in order to evaluate sensitivity in the study area. These include the following:

1. Pan: this represents a number of ecological processes including groundwater dynamics, hydrological processes, nutrient cycling and wildlife dispersal. Wetlands are protected according to the National Water Act and the National Environmental Management Act.
2. Potential occurrence of populations of Red List or protected organisms, including flora and fauna, that have been evaluated as having a probability of occurring within natural habitats within the study area. The threatened species of potential concern for the site are listed in a section above.

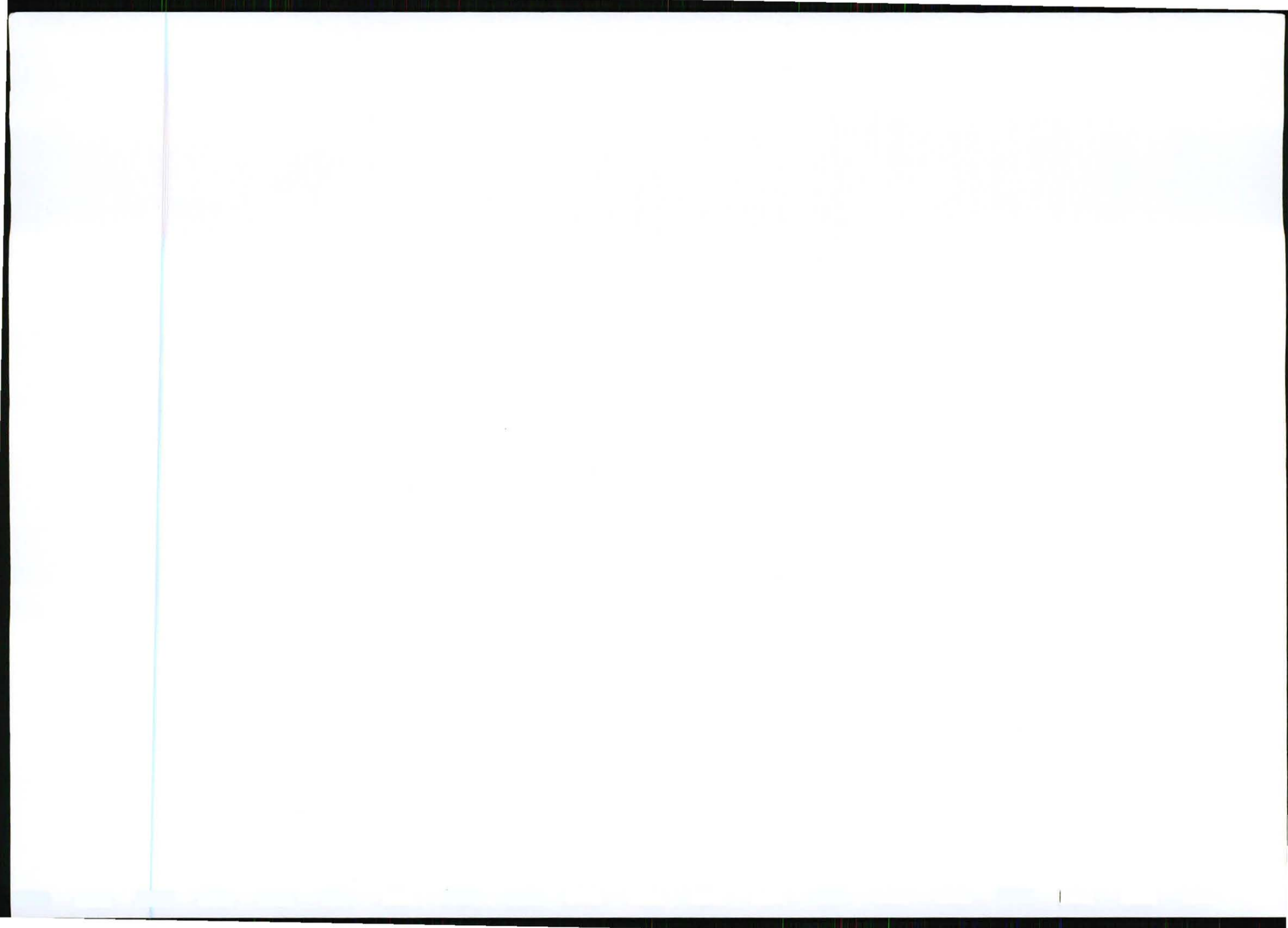
These factors have been taken into account in evaluating sensitivity within the study area (Figure 2). The sensitivity classification is as follows:

1. HIGH: Pan on site is classified as having high sensitivity (see Table 3 and Figure 2). They are protected according to the National Water Act (Act 36 of 1998). Ecologically, they are areas that provide moderate value ecosystem goods and services.
2. MEDIUM: Remaining patches of natural vegetation in the study area are classified as having medium sensitivity (see Table 4 and Figure 2). These are areas of natural vegetation which are potential habitat for various animal species of conservation concern.



**Figure 2: Potentially sensitive areas of the study area.**





## RELEVANT LEGISLATIVE AND PERMIT REQUIREMENTS

Relevant legislation is provided in this section to provide a description of the key legal considerations of importance to the proposed project. The applicable legislation is listed below.

### Legislation

#### **National Environmental Management Act, Act No. 107 of 1998 (NEMA)**

NEMA requires, inter alia, that:

- "development must be socially, environmentally, and economically sustainable",
- "disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied.",
- "a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions",

NEMA states that "the environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people's common heritage."

#### **Environment Conservation Act No 73 of 1989 Amendment Notice No R1183 of 1997**

The ECA states that:

Development must be environmentally, socially and economically sustainable. Sustainable development requires the consideration of inter alia the following factors:

- that pollution and degradation of the environment is avoided, or, where they cannot be altogether avoided, are minimised and remedied;
- that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;
- that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised; and
- that negative impacts on the environment and on peoples' environmental rights be anticipated and prevented, and where they cannot be altogether prevented are minimised and remedied.

The developer is required to undertake Environmental Impact Assessments (EIA) for all projects listed as a Schedule 1 activity in the EIA regulations in order to control activities which might have a detrimental effect on the environment. Such activities will only be permitted with written authorisation from a competent authority.

#### **National Forests Act (Act no 84 of 1998)**

##### *Protected trees*

According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that 'no person may cut, damage, disturb, destroy or remove any *protected tree*, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'.

##### *Forests*

Prohibits the destruction of indigenous trees in any natural forest without a licence.

#### **National Environmental Management: Biodiversity Act (Act No 10 of 2004)**

In terms of the Biodiversity Act, the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).



- Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

Chapter 4 of the Act relates to threatened or protected ecosystems or species. According to Section 57 of the Act, "Restricted activities involving listed threatened or protected species":

- (1) A person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7.

Such activities include any that are "of a nature that may negatively impact on the survival of a listed threatened or protected species".

Chapter 5 of the Act relates to species and organisms posing a potential threat to biodiversity. According to Section 75 of the Act, "Control and eradication of listed invasive species":

- (1) Control and eradication of a listed invasive species must be carried out by means of methods that are appropriate for the species concerned and the environment in which it occurs.
- (2) Any action taken to control and eradicate a listed invasive species must be executed with caution and in a manner that may cause the least possible harm to biodiversity and damage to the environment.
- (3) The methods employed to control and eradicate a listed invasive species must also be directed at the offspring, propagating material and re-growth of such invasive species in order to prevent such species from producing offspring, forming seed, regenerating or re-establishing itself in any manner.

**Government Notice No. 1477 of 2009: Draft National List of Threatened Ecosystems**

Published under Section 52(1)(a) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004). This Act provides for the listing of threatened or protected ecosystems based on national criteria. The list of threatened terrestrial ecosystems supersedes the information regarding terrestrial ecosystem status in the National Spatial Biodiversity Assessment (2004).

**GNR 151: Critically Endangered, Endangered, Vulnerable and Protected Species List**

Published under Section 56(1) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).

**GNR 1187: Amendment of Critically Endangered, Endangered, Vulnerable and Protected Species List**

Published under Section 56(1) of the National Environmental Management: Biodiversity Act (Act No. 10 of 2004).

**Conservation of Agricultural Resources (Act No. 43 of 1983) as amended in 2001**

Declared Weeds and Invaders in South Africa are categorised according to one of the following categories:

- Category 1 plants: are prohibited and must be controlled.
- Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread.
- Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to

prevent the spreading thereof, except within the floodline of watercourses and wetlands.

***National Water Act (Act No. 36 of 1998)***

Wetlands, riparian zones and watercourses are defined in the Water Act as a water resource and any activities that are contemplated that could affect the wetlands requires authorisation (Section 21 of the National Water Act of 1998). A "watercourse" in terms of the National Water Act (Act 36 of 1998) means:

- River or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and

Any collection of water which the Minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

***National Veld and Forest Fire Act (Act No. 101 of 1998)***

Provides requirements for veldfire prevention through firebreaks and required measures for fire-fighting. Chapter 4 of the Act places a duty on landowners to prepare and maintain firebreaks. Chapter 5 of the Act places a duty on all landowners to acquire equipment and have available personnel to fight fires.

***Other Acts***

Other Acts that may apply to biodiversity issues, but which are considered to not apply to the current site are as follows:

- National Environmental Management Protected Areas Act (Act No. 57 of 2003)
- Marine Living Resources Act (Act No. 18 of 1998)
- Sea Birds and Seals Protection Act (Act No. 46 of 1973)
- Lake Areas Development Act (Act No. 39 of 1975)
- Mountain Catchment Areas Act (Act No. 63 of 1970)
- Integrated Coastal Zone Management Act (Act No. 24 of 2008)



## IDENTIFICATION OF RISKS AND POTENTIAL IMPACTS

Potential issues relevant to potential impacts on the ecology of the study area include the following:

- Impacts on biodiversity: this includes any impacts on populations of individual species of concern (flora and fauna), including protected species, and on overall species richness. This includes impacts on genetic variability, population dynamics, overall species existence or health and on habitats important for species of concern.
- Impacts on sensitive habitats: this includes impacts on any sensitive or protected habitats, including indigenous forest, fynbos and wetland vegetation that leads to direct or indirect loss of such habitat.
- Impacts on ecosystem function: this includes impacts on any processes or factors that maintain ecosystem health and character, including the following:
  - Disruption to nutrient-flow dynamics;
  - Impedance of movement of material or water;
  - Habitat fragmentation;
  - Changes to abiotic environmental conditions;
  - Changes to disturbance regimes, e.g. Increased or decreased incidence of fire;
  - Changes to successional processes;
  - Effects on pollinators;
  - Increased invasion by alien plants.

Changes to factors such as these may lead to a reduction in the resilience of plant communities and ecosystems or loss or change in ecosystem function.

- Secondary and cumulative impacts on ecology: this includes an assessment of the impacts of the proposed project taken in combination with the impacts of other known projects for the area or secondary impacts that may arise from changes in the social, economic or ecological environment.
- Impacts on the economic use of vegetation: this includes any impacts that affect the productivity or function of ecosystems in such a way as to reduce the economic value to users, e.g. reduction in grazing capacity, loss of harvestable products. It is a general consideration of the impact of a project on the supply of so-called ecosystem goods and services.

A number of direct risks to ecosystems that would result from **construction** of the proposed solar energy facility are as follows:

- Clearing of land for construction.
- Construction of access roads.
- Placement of power lines, cables and water pipelines (if applicable).
- Establishment of borrow and spoil areas.
- Chemical contamination of the soil by construction vehicles and machinery.
- Operation of construction camps.
- Storage of materials required for construction.

## **Description of potential impacts**

Major potential impacts are described briefly below. These are compiled from a generic list of possible impacts derived from previous projects of this nature and from a literature review of the potential impacts of solar energy facilities on the ecological environment. The major expected negative impact will be due to loss of habitat which may have direct or indirect impacts on individual organisms.

### ***Impact 1: Loss or fragmentation of indigenous natural vegetation (terrestrial)***

Nature: Construction of infrastructure may lead to direct loss of vegetation. This may lead to localised or more extensive reduction in the overall extent of vegetation. There are factors that may aggravate this potential impact. For example, where this vegetation has already been stressed due to degradation and transformation at a regional level, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat and a change in the conservation status (current conservation situation). Consequences of the potential impact of loss of indigenous natural vegetation occurring may include:

1. Negative change in conservation status of habitat (Driver et al. 2005);
2. Increased vulnerability of remaining portions to future disturbance;
3. General loss of habitat for sensitive species;
4. Loss in variation within sensitive habitats due to loss of portions of it;
5. General reduction in biodiversity;
6. Increased fragmentation (depending on location of impact);
7. Disturbance to processes maintaining biodiversity and ecosystem goods and services; and
8. Loss of ecosystem goods and services.

The vegetation types on site is Kimberley Thornveld, which is classified as Least Threatened.

### ***Impact 2: Loss of individuals of threatened plants***

Nature: Plant species are especially vulnerable to infrastructure development due to the fact that they cannot move out of the path of the construction activities, but are also affected by overall loss of habitat.

Threatened species include those classified as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened plant species, loss of a population or individuals could lead to a direct change in the conservation status of the species, possibly extinction. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations. Consequences may include:

1. Fragmentation of populations of affected species;
2. Reduction in area of occupancy of affected species; and
3. Loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chance of survival of the species.

There is the potential for one Near threatened and two Declining plant species to occur on site.

### ***Impact 3: Loss of individuals of protected tree species***

There are a number of tree species that are protected according to Government Notice no. 1012 under section 12(I)(d) of the National Forests Act, 1998 (Act No. 84 of 1998). In terms of section 15(1) of the National Forests Act, 1998 "no person may cut, disturb, damage or



destroy any protected tree or possess, collect, remove, transport, export, purchase, sell donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license granted by the Minister to an (applicant and subject to such period and conditions as may be stipulated".

Three species have a geographic distribution that includes the study area, *Boscia albitrunca*, *Acacia haematoxylon* and *Acacia erioloba*.

**Impact 4: Loss of individuals of protected plant species**

There is one plant species that is protected according to National Environmental Management: Biodiversity Act (Act No. 10 of 2004). According to this Act, "a person may not carry out a restricted activity involving a specimen of a listed threatened or protected species without a permit issued in terms of Chapter 7". Such activities include any that are "of a nature that may negatively impact on the survival of a listed threatened or protected species". This implies that any negative impacts on habitats in which populations of protected species occur or are dependent upon would be restricted according to this Act.

Two species have a geographic distribution that includes the study area, *Hoodia gordonii* and *Harpagophytum procumbens*.

**Impact 5: Loss of habitat for threatened and protected animals and birds**

Nature: Threatened animal species are indirectly affected primarily by the overall loss of habitat, since direct construction impacts can often be avoided due to movement of individuals from the path of construction. Animals are generally mobile and, in most cases, can move away from a potential threat.

Threatened species include those classified as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localised populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened animal species, loss of a population or individuals could lead to a direct change in the conservation status of the species. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations or the habitat that they depend on. Consequences may include:

1. Fragmentation of populations of affected species;
2. Reduction in area of occupancy of affected species; and
3. Loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species overall survival chances.

There are two mammal species of conservation concern that could occur in available habitats in the study area (Brown Hyaena and South African Hedgehog) and five protected mammal species that could occur there (White rhinoceros, Black Wildebeest, Black-footed Cat, Honey Badger, Cape Fox. The Brown Hyaena and South African Hedgehog are also protected.

There are four threatened bird species (Blue Crane, Kori Bustard, Lesser Kestrel, Martial Eagle, all VU) and four Near Threatened bird species (Caspian Tern, Lanner Falcon, Secretarybird, White Pelican) that have a medium to high probability of utilising available habitats in the study area, either for foraging or breeding.

There are no threatened, near threatened or protected reptile species that could occur in available habitats in the proposed study area.



The protected Giant Bullfrog (not listed as threatened) could occur on site.

**Impact 6: Collisions of individuals of threatened birds with overhead power lines**

Nature: Threatened bird species may be directly affected by collisions with overhead powerlines. Cranes, bustards, flamingos, waterfowl, shorebirds, gamebirds and falcons are among the most frequently affected (Jenkins et al. 2010). Ludwig's Bustard is especially affected by collisions with overhead power lines.

There are four threatened bird species (Blue Crane, Kori Bustard, Lesser Kestrel, Martial Eagle, all VU) and four Near Threatened bird species (Caspian Tern, Lanner Falcon, Secretarybird, White Pelican) that have a medium to high probability of utilising available habitats in the study area, either for foraging or breeding. The species most likely to use parts of the site for breeding (and could occur there regularly) are the Kori Bustard (listed globally as Least Concern and nationally as Vulnerable).

**Impact 7: Impacts on watercourses and drainage areas**

Nature: The site is in a very arid area. There is a pan on site. According to the National Water Act, these are classified as wetlands or water resources. Construction, if it occurred within any of these areas, would lead to some direct or indirect loss of or damage to some of these areas or changes to the catchment of these areas. This may affect the hydrology of the landscape or lead to loss of habitat for species that depend on this habitat type. No major infrastructure is proposed to be located within these areas.

**Impact 8: Establishment and spread of declared weeds and alien invader plants**

Major factors contributing to invasion by alien invader plants includes *inter alia* high disturbance (such as clearing for construction activities) and negative grazing practices (Zachariades et al. 2005). Exotic species are often more prominent near infrastructural disturbances than further away (Gelbard & Belnap 2003, Watkins et al. 2003). Consequences of this may include:

1. Loss of indigenous vegetation;
2. Change in vegetation structure leading to change in various habitat characteristics;
3. Change in plant species composition;
4. Change in soil chemical properties;
5. Loss of sensitive habitats;
6. Loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
7. Fragmentation of sensitive habitats;
8. Change in flammability of vegetation, depending on alien species;
9. Hydrological impacts due to increased transpiration and runoff; and
10. Impairment of wetland function.

Potential weeds with a distribution centred on arid regions of the country include *Salsola kali*, *Atriplex lindleyi*, *Opuntia ficus-indica*, *Opuntia imbricata*, *Prosopis glandulosa*, *Prosopis velutina*, *Atriplex numularia*, and *Nicotiana glauca*. The shrub, *Prosopis glandulosa*, is potentially the most problematic and is widely distributed in the Northern Upper Karoo vegetation type. This species invades riverbeds, riverbanks and drainage lines in semi-arid and arid regions. There is therefore the potential for alien plants to spread or invade following disturbance on site.



## DISCUSSION AND CONCLUSIONS

There is one major vegetation types that occur in the study area, namely Kimberley Thornveld, classified as Least Threatened and also has a wide distribution and extent. The natural vegetation across most of the site is therefore not considered, from this perspective, to have high conservation status. The site does not occur within any Centre of Floristic Endemism.

Local factors that may lead to parts of the study area having elevated ecological sensitivity are watercourses and drainage areas, the potential presence of some animal species of conservation concern, three species of protected tree and two species of protected plant that occur in this geographical area and one near threatened plant species.

There are a number of animal species of conservation concern and protected animal species that may occur in habitats within the broad study area. This includes two mammal species of conservation concern (Brown Hyaena and South African Hedgehog) and five protected mammal species (White rhinoceros, Black Wildebeest, Black-footed Cat, Honey Badger, Cape Fox), four threatened bird species (Blue Crane, Kori Bustard, Lesser Kestrel, Martial Eagle, all VU) and four Near Threatened bird species (Caspian Tern, Lanner Falcon, Secretarybird, White Pelican) of which one species may use the site for breeding purposes (Kori Bustard). The protected Giant Bullfrog could also occur on site. Habitat requirements for these species are provided in the appendices to this report.

There are three protected tree species that have a geographical distribution that includes the study area, *Boscia albitrunca* (Shepherd's Tree / Witgatboom / !Xhi), *Acacia haematoxylon* (Grey camel thorn) and *Acacia erioloba* (Camel Thorn, Kameeldoring).

There are three plant species of conservation concern that have a likelihood of occurring in available habitats in the study area. One of these is listed as Near Threatened (*Lithops lesliei* subsp. *lesliei*) and two as Declining (*Acacia erioloba* and *Crinum bulbispermum*). There are also two plant species protected according to the National Environmental Management: Biodiversity Act (Act No 10 of 2004) that are likely to occur on site, *Hoodia gordonii* and *Harpagophytum procumbens* subsp. *procumbens*.

The study area is in a mostly transformed condition. Except for two small patches, it appears from aerial imagery that most of the site has been previously cultivated. The pan on site is, however, classified as having high sensitivity. The majority of the study area is classified as having low sensitivity. Two small area of vegetation are classified as having medium sensitivity.

A risk assessment was undertaken which identified eight main potential negative impacts on the ecological receiving environment. The identified potential impacts are the following:

1. Loss or fragmentation of indigenous natural vegetation
2. Loss of individuals of threatened plants
3. Loss of individuals of protected tree species
4. Loss of individuals of other protected plants
5. Loss of habitat for threatened animals
6. Collisions of individuals of threatened bird species with overhead power lines
7. Damage to watercourses and drainage areas
8. Establishment and spread of declared weeds and alien invader plants.

The significance of these impacts will be assessed during the EIA phase after collection of relevant field data. An initial assessment indicates that some of these impacts may be significant or that there is a legislative benefit to establishing whether they will occur or not.

### **Summary of proposed EIA methodology**

The following assessments will be done during the EIA phase in order to properly assess potential impacts on the ecological receiving environment by the proposed solar thermal facility:

- A detailed sensitivity map of the entire site will be produced from aerial photography and on-site observation during the EIA phase. This will include mapping and incorporation of any sensitive features that may occur on site.
- The presence and distribution of drainage lines on site will be confirmed. This will be done primarily using aerial photograph interpretation, but will be confirmed in the field.
- The presence of species of concern will be evaluated during the EIA phase. For plant species this will be done by searching for populations that could occur in the study area based on habitat requirements and historical collection records. For animal species this will be done by assessing habitat suitability for those species that have been assessed as potentially occurring in the area. The lists provided in this Scoping Report will form the basis for those assessments and surveys. Particular attention will be paid to those species classified as threatened (VU, EN or CR), Near Threatened or Critically rare, including the following:
  - Two plant species of conservation concern (*Lithops lesliei* subsp. *lesliei* and *Acacia erioloba*)
  - three protected tree species (*Boscia albitrunca*, *Acacia erioloba* and *Acacia haematoxylon*),
  - Two protected plant species (*Hoodia gordonii* and *Harpagophytum procumbens*),
  - Four Vulnerable bird species (Blue Crane, Kori Bustard, Lesser Kestrel, Martial Eagle) and four Near Threatened bird species (Caspian Tern, Lanner Falcon, Secretarybird, White Pelican), of which one potentially has a likelihood of using the site for breeding there (Kori Bustard),
  - It will be confirmed during the survey whether habitat suitable for the protected Giant Bullfrog occurs on site.



## REFERENCES:

- ALEXANDER, G. & MARAIS, J. 2007. A guide to the reptiles of southern Africa. Struik, Cape Town.
- BARNES, K.N. (ed.) (2000) The Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland. Birdlife South Africa, Johannesburg.
- BRANCH, W.R. (1988) South African Red Data Book—Reptiles and Amphibians. South African National Scientific Programmes Report No. 151.
- CHITTENDEN, H. 2007. Roberts bird guide: a comprehensive field guide to over 950 bird species in southern Africa. John Voelcker Bird Book Fund, Cape Town.
- DENT, M.C., LYNCH, S.D. & SCHULZE, R.E. 1989. Mapping mean annual and other rainfall statistics in southern Africa. Department of Agricultural Engineering, University of Natal. ACRU Report No. 27. Massachusetts: Clark University.
- DRIVER, A., MAZE, K., ROUGET, M., LOMBARD, A.T., NEL, J., TURPIE, J.K., COWLING, R.M., DESMET, P., GOODMAN, P., HARRIS, J., JONAS, Z., REYERS, B., SINK, K and STRAUSS, T. 2005. National Spatial Biodiversity Assessment 2004: priorities for biodiversity conservation in South Africa. *Strelitzia* 17. South African National Biodiversity Institute, Pretoria.
- DU PREEZ, L. & CARRUTHERS, V. 2009. A complete guide to the frogs of southern Africa. Random House Struik, Cape Town.
- FAIRBANKS, D.H.K., THOMPSON, M.W., VINK, D.E., NEWBY, T.S., VAN DEN BERG, H.M & EVERARD, D.A. 2000. The South African Land-Cover Characteristics Database: a synopsis of the landscape. *S.Afr.J.Science* 96: 69-82.
- FRIEDMANN, Y. & DALY, B. (eds.) 2004. The Red Data Book of the Mammals of South Africa: A Conservation Assessment: CBSG Southern Africa, Conservation Breeding Specialist Group (SSC/IUCN), Endangered Wildlife Trust, South Africa.
- GERMISHUIZEN, G., MEYER, N.L., STEENKAMP, Y and KEITH, M. (eds.) (2006). A checklist of South African plants. Southern African Botanical Diversity Network Report No. 41, SABONET, Pretoria.
- IUCN (2001). *IUCN Red Data List categories and criteria: Version 3.1*. IUCN Species Survival Commission: Gland, Switzerland.
- JENKINS, A.R., SMALLIE, J.J. & DIAMOND, M. 2010. Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. *Bird Conservation International* 1-16.
- MACVICAR, C. N., SCOTNEY, D. M. SKINNER, T. E. NIEHAUS, H. S. & LOUBSER, J. H., 1974. A classification of land (climate, terrain form, soil) primarily for rainfed agriculture. *S. Afr. J. Agric. Extension*, 3(3): 1-4.
- MARAIS, J. 2004. A complete guide to the snakes of southern Africa. Struik Publishers, Cape Town.
- MILLS, G. & HES, L. 1997. The complete book of southern African mammals. Struik Publishers, Cape Town.
- MINTER, L.R., BURGER, M., HARRISON, J.A., BRAACK, H.H., BISHOP, P.J. and KLOEPFER, D. (eds.) 2004. Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland. SI/MAB Series #9. Smithsonian Institution, Washington, DC.
- MONADJEM, A., TAYLOR, P.J., COTTERILL, E.P.D. & SCHOEMAN, M.C. 2010. Bats of southern and central Africa. Wits University Press, Johannesburg.
- MUCINA, L, BREDEKAMP, G.J., **HOARE, D.B** & MCDONALD, D.J. 2000. A National Vegetation Database for South Africa *South African Journal of Science* 96: 1-2.
- MUCINA, L. AND RUTHERFORD, M.C. (editors) 2006. Vegetation map of South Africa, Lesotho and Swaziland: an illustrated guide. *Strelitzia* 19, South African National Biodiversity Institute, Pretoria.

- MUCINA, L., RUTHERFORD, M.C. AND POWRIE, I.W. (editors) 2005. Vegetation map of South Africa, Lesotho and Swaziland, 1:1 000 000 SCALE SHEET MAPS South African National Biodiversity Institute, Pretoria.
- MUCINA, L., RUTHERFORD, M.C., **HOARE, D.B.** & POWRIE, L.W. 2003. VegMap: The new vegetation map of South Africa, Lesotho and Swaziland. In: Pedrotti, F. (ed.) Abstracts: Water Resources and Vegetation, 46<sup>th</sup> Symposium of the International Association for Vegetation Science, June 8 to 14 – Napoli, Italy.
- MUCINA, L., RUTHERFORD, M.C., PALMER, A.R., MILTON, S.J., SCOTT, L., VAN DER MERWE, B., **HOARE, D.B.**, BEZUIDENHOUT, H., VLOK, J.H.J., EUSTON-BROWN, D.I.W., POWRIE, L.W. & DOLD, A.P. 2006. *Nama-Karoo Biome*. In: Mucina, L. & Rutherford, M.C. (eds.) The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.
- RUTHERFORD, M.C., MUCINA, L., LÖTTER, M.C., BREDEKAMP, G.J., SMIT, J.H.L., SCOTT-SHAW, C.R., **HOARE, D.B.**, GOODMAN, P.S., BEZUIDENHOUT, H., SCOTT, L. & ELLIS, F., POWRIE, L.W., SIEBERT, F., MOSTERT, T.H., HENNING, B.J., VENTER, C.E., CAMP, K.G.T., SIEBERT, S.J., MATTHEWS, W.S., BURROWS, J.E., DOBSON, L., VAN ROOYEN, N., SCHMIDT, E., WINTER, P.J.D., DU PREEZ, P.J., WARD, R.A., WILLIAMSON, S. and HURTER, P.J.H. 2006. *Savanna Biome*. In: Mucina, L. & Rutherford, M.C. (eds.) The vegetation of South Africa, Lesotho and Swaziland. *Strelitzia* 19. South African National Biodiversity Institute, Pretoria.
- PASSMORE, N.I. & CARRUTHERS, V.C. (1995) South African Frogs; a complete guide. Southern Book Publishers and Witwatersrand University Press. Johannesburg.
- RUTHERFORD, M.C. & WESTFALL, R.H. (1994). Biomes of southern Africa: an objective categorization. *Memoirs of the Botanical Survey of South Africa* No. 63.
- SKELTON, P. 2001. A complete guide to the freshwater fishes of southern Africa. Struik Publishers, Cape Town.
- TOLLEY, K. & BURGER, M. 2007. Chameleons of southern Africa. Struik Publishers, Cape Town.
- VAN WYK, A.E. & SMITH, G.F. 2001. Regions of floristic endemism in southern Africa. Umदाus press, Hatfield.



**APPENDICES:****Appendix 1: Plant species of conservation importance (Threatened, Near Threatened and Declining) that have historically been recorded in the study area.**

Sources: South African National Biodiversity Institute in Pretoria.

Family	Taxon	Status	Habitat	Likelihood of occurrence on site
FABACEAE	Acacia erioloba	Declining	Savanna, semi-desert and desert areas, deep sandy soils and along drainage lines in very arid areas, sometimes in rocky outcrops.	HIGH
AMARYLLIDACEAE	Crinum bulbispermum	Declining	Near rivers, streams, seasonal pans and in damp depressions.	HIGH
MESEMBRYANTHEMACEAE	Lithops lesliei subsp. lesliei	Near Threatened	Arid grasslands, usually in rocky places, growing under the protection of forbs and grasses	MEDIUM

\* Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001), as evaluated by the Threatened Species Programme of the South African National Biodiversity Institute in Pretoria. \*IUCN (3.1) Categories: VU = Vulnerable, EN = Endangered, CR = Critically Endangered, NT = Near Threatened.

**Appendix 2: Threatened vertebrate species with a geographical distribution that includes the current study area.**

**MAMMALS**

Common name	Taxon	Habitat	National status	Global status <sup>2</sup>	Likelihood of occurrence
Black rhinoceros	<i>Diceros bicornis bicornis</i>	Wide variety of habitats, but currently only occurs in game reserves.	CR	CR	<b>NONE</b> , only occurs in game reserves
Brown hyena	<i>Hyaena brunnea</i>	Savanna, urban areas, scavenger	NT	NT	<b>MEDIUM</b> , overall geographical distribution includes this area, habitat is suitable.
Spotted-necked otter	<i>Lutra maculicollis</i>	Permanent, unsilted, unpolluted rivers, streams and freshwater lakes where sufficient numbers of its prey occur.	NT	NT	<b>LOW</b> , no suitable permanent water on site or nearby
Natal long-fingered bat	<i>Miniopterus natalensis</i>	Caves and sub-terranean habitats in Fynbos, savanna, woodland, succulent and Nama Karoo, grassland; cave-dwelling aerial insectivore.	NT	NT	<b>LOW</b> , overall geographical distribution includes this area, no suitable roosting habitat on site
South African hedgehog	<i>Aterelix frontalis</i>	Wide variety of habitats where there is ample ground cover. Avoids mesic habitats.	NT	LC	<b>HIGH</b> , within known distribution and suitable habitat on site.

<sup>1</sup>Distribution and national status according to Friedmann & Daly 2004.

<sup>2</sup>Global status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. ([www.iucnredlist.org](http://www.iucnredlist.org)). Downloaded on 10 January 2012.

**AMPHIBIANS**

Common name	Species	Habitat	Status	Likelihood of occurrence
Giant Bullfrog	<i>Pyxicephalus adspersus</i>	Widely distributed in southern Africa, mainly at higher elevations. Inhabits a variety of vegetation types where it breeds in seasonal, shallow, grassy pans in flat, open areas; also utilises non-permanent vleis and shallow water on margins of waterholes and dams. Prefer sandy substrates although they sometimes inhabit clay soils.	NT <sup>1</sup> LC <sup>2</sup> Protected (NEMBA)	<b>HIGH</b> , within distribution range and suitable habitat (pans) occur on site.

<sup>1</sup>Status according to Minter et al. 2004.

<sup>2</sup>Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. ([www.iucnredlist.org](http://www.iucnredlist.org)). Downloaded on 10 January 2012.

**REPTILES**

Common name	Species	Habitat	Status <sup>3</sup>	Likelihood of occurrence
None				

<sup>3</sup>Distribution according to Alexander & Marais 2007.

<sup>4</sup>Status according to Alexander & Marais 2007.

**BIRDS**

Common name	Species	Habitat	Status	Importance of site for species
African Marsh Harrier	<i>Circus ranivorus</i>	Marsh, vlei, grassland (usually near water); may hunt over grassland, cultivated lands and open savanna. Roosts in dense grass or reeds, sometimes communally when not breeding. Uncommon resident in study area.	VU Protected (NEMBA)	ZERO, breeding, LOW, foraging
Black harrier	<i>Circus maurus</i>	Grassveld, karoo scrub, mountain fynbos, cultivated lands, subalpine vegetation, semidesert. Uncommon, non-breeding migrant in study area.	VU	ZERO, breeding, LOW, foraging
Black Stork	<i>Ciconia nigra</i>	Feeds in or around marshes, dams, rivers and	NT	ZERO,



Common name	Species	Habitat	Status	Importance of site for species
		estuaries; breeds in mountainous regions. Forages by walking slowly, usually in shallow water, and stabbing at prey. Roosts in trees or on cliffs or power pylons. Nests on cliff ledge, in cave or pothole, rarely on nest of Hamerkop or Black Eagle. Uncommon resident.	Protected (NEMBA)	breeding, ZERO, foraging
Blackwinged pratincole	<i>Glareola nordmannii</i>	Open grassland. Uncommon non-breeding migrant in study area.	NT	ZERO, breeding, LOW, foraging
Blue Crane	<i>Anthropoides paradisea</i>	Midland and highland grassveld, edge of karoo, cultivated land, edges of vleis. Roosts on ground or in shallow water. Nest: Scrape on bare ground or rock (klipplaat) in open grassveld, often in moist places; sometimes thinly lined or ringed with pebbles, sheep droppings or bits of plant material. Uncommon resident.	VU Protected (NEMBA)	MEDIUM, breeding, MEDIUM, foraging
Cape vulture	<i>Gyps coprotheres</i>	Mostly mountainous country, or open country with inselbergs and escarpments; less commonly in savanna or desert. Uncommon resident.	VU Protected (NEMBA)	ZERO, breeding, LOW, foraging
Caspian tern	<i>Sterna caspia</i>	Estuaries, marine shores, larger inland dams and pans. Uncommon resident.	NT	LOW, breeding, MEDIUM, foraging
Chestnut-banded Plover	<i>Charadrius pallidus</i>	Saline lagoons, saline and brackish pans, saltworks; occasionally estuaries and sandy lagoons.	NT	LOW, breeding, LOW, foraging
Greater Flamingo	<i>Phoenicopterus ruber</i>	Large bodies of shallow water, both inland and coastal; saline and brackish waters preferred.	NT	LOW, breeding, LOW, foraging
Kori Bustard	<i>Ardeotis kori</i>	Semi-arid regions, within the 100 - 600 mm rainfall isohyet. Also occurs throughout dryer west, particularly in the Nama-Karoo. Diet consists of insects, reptiles, rodents and vegetable matter. Breeding peaks from October to January. In the semi-arid western parts of South Africa, favours tree-lined watercourses. Common resident.	VU <sup>1</sup> LC <sup>2</sup> Protected (NEMBA)	MEDIUM, breeding, MEDIUM, foraging
Lanner Falcon	<i>Falco biarmicus</i>	Widespread species, occurring in Afrotropics, Middle East and western Palearctic. Occurs in mountains or open country from semidesert to woodland and agricultural land; also cities (Durban, Harare). Common resident.	NT	LOW, breeding, MEDIUM, foraging
Lappetfaced vulture	<i>Torgos tracheliotus</i>	Savanna to desert. Breeds in flat-topped trees. Roosts in trees (usually pair together) at night; flies with difficulty in absence of thermals.	VU Protected (NEMBA)	LOW, breeding, LOW, foraging
Lesser Flamingo	<i>Phoenicopterus minor</i>	Larger brackish or saline inland and coastal waters.	NT	LOW, breeding, LOW, foraging
Lesser Kestrel	<i>Falco naumanni</i>	Open grassveld, mainly on highveld, usually near towns or farms. Highly gregarious; roosts communally in thousands in tall trees, usually around human habitations, especially in towns. Common non-breeding migrant in study area.	VU Protected (NEMBA)	ZERO, breeding, MEDIUM, foraging
Marabou stork	<i>Leptoptilos crumeniferus</i>	Open to semi-arid woodland, bushveld, fishing villages, rubbish tips, lake shores. Nest above ground, in trees, villages or on cliffs	NT	LOW, breeding, LOW, foraging
Martial Eagle	<i>Polemaetus bellicosus</i>	The Martial Eagle is widespread but uncommon throughout South Africa and neighbouring countries. It tolerates a wide range of vegetation types, being found in open grassland, scrub, Karoo and woodland. It relies on large trees (and electricity pylons) to	VU <sup>1</sup> NT <sup>2</sup> Protected (NEMBA)	LOW, breeding, MEDIUM, foraging



Common name	Species	Habitat	Status	Importance of site for species
		provide nest sites. It is found typically in flat country and is rarer in mountains and forests. One of the main reason it is declining is because of persecution on private land.		
Old world painted snipe	<i>Rostratula benghalensis</i>	Marshes, swamps, edges of lakes, dams, ponds and streams, with marginal vegetation.	NT	LOW, breeding, LOW, foraging
Pallid Harrier	<i>Circus macrourus</i>	Open grassveld, cultivated fields; less commonly in open to semi-arid savanna (but more likely in arid areas than Montagu's Harrier).	NT	ZERO, breeding, LOW, foraging
Peregrine Falcon	<i>Falco peregrinus</i>	Cliffs, mountains, steep gorges; may hunt over open grassland, farmland and forests; rarely enters cities to hunt pigeons.	NT Protected (NEMBA)	LOW, breeding, LOW, foraging
Pinkbacked Pelican	<i>Pelecanus rufescens</i>	Coastal bays and estuaries, seldom inland on larger rivers, marshes and floodplains.	VU	LOW, breeding, LOW, foraging
Secretarybird	<i>Sagittarius serpentarius</i>	Widespread across South Africa, occurring in savanna and open grassland from coastal regions to high altitudes, but avoids thick bush and forest. Sensitive to disturbance and high human population numbers - higher numbers usually found in conservation areas.	NT	MEDIUM, breeding, MEDIUM, foraging
Tawny Eagle	<i>Aquila rapax</i>	Woodland and savanna to semi-arid savanna or grassland with scattered Acacia trees. Site on edge of range.	VU <sup>1</sup> NT <sup>2</sup> Protected (NEMBA)	LOW, breeding, LOW, foraging
Whitebacked vulture	<i>Gyps africanus</i>	Savanna and bushveld. Edge of distribution range.	VU Protected (NEMBA)	ZERO, breeding, LOW, foraging
White Pelican	<i>Pelecanus onocrotalus</i>	Coastal bays, estuaries, lakes, larger pans and dams.	NT	LOW, breeding, MEDIUM, foraging
Yellow-billed Stork	<i>Mycteria ibis</i>	Mainly inland waters; rivers, dams, pans, floodplains, marshes; less often estuaries. Uncommon non-breeding migrant in study area.	NT	ZERO, breeding, LOW, foraging

<sup>1</sup>Status according to Barnes 2000.

<sup>2</sup>Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. ([www.iucnredlist.org](http://www.iucnredlist.org)).  
Downloaded on **10 January 2012**.



### Appendix 3: List of protected tree species (National Forests Act).

<i>Acacia erioloba</i>	<i>Acacia haematoxylon</i>
<i>Adansonia digitata</i>	<i>Azelia quanzensis</i>
<i>Balanites</i> subsp. <i>maughamii</i>	<i>Barringtonia racemosa</i>
<i>Boscia albitrunca</i>	<i>Brachystegia spiciformis</i>
<i>Breonadia salicina</i>	<i>Bruguiera gymnorhiza</i>
<i>Cassipourea swaziensis</i>	<i>Catha edulis</i>
<i>Ceriops tagal</i>	<i>Cleistanthus schlechteri</i> var. <i>schlechteri</i>
<i>Colubrina nicholsonii</i>	<i>Combretum imberbe</i>
<i>Curtisia dentata</i>	<i>Elaeodendron (Cassine) transvaalensis</i>
<i>Erythrophysa transvaalensis</i>	<i>Euclea pseudebenus</i>
<i>Ficus trichopoda</i>	<i>Leucadendron argenteum</i>
<i>Lumnitzera racemosa</i> var. <i>racemosa</i>	<i>Lydenburgia abottii</i>
<i>Lydenburgia cassinoides</i>	<i>Mimusops caffra</i>
<i>Newtonia hildebrandtii</i> var. <i>hildebrandtii</i>	<i>Ocotea bullata</i>
<i>Ozoroa namaensis</i>	<i>Philenoptera violacea (Lonchocarpus capassa)</i>
<i>Pittosporum viridiflorum</i>	<i>Podocarpus elongatus</i>
<i>Podocarpus falcatus</i>	<i>Podocarpus henkelii</i>
<i>Podocarpus latifolius</i>	<i>Protea comptonii</i>
<i>Protea curvata</i>	<i>Prunus africana</i>
<i>Pterocarpus angolensis</i>	<i>Rhizophora mucronata</i>
<i>Sclerocarya birrea</i> subsp. <i>caffra</i>	<i>Securidaca longependunculata</i>
<i>Sideroxylon inerme</i> subsp. <i>inerme</i>	<i>Tephrosia pondoensis</i>
<i>Warburgia salutaris</i>	<i>Widdringtonia cedarbergensis</i>
<i>Widdringtonia schwarzii</i>	

*Acacia erioloba*, *Acacia haematoxylon* and *Boscia albitrunca* have a geographical distribution that coincides with the study area.

**Appendix 4: Checklist of plant species recorded during previous botanical surveys in the study area and surrounds.**

(Species from quarter degree grid in which the site is located as well as surrounding grids in which similar vegetation is found)

Acacia erioloba E.Mey.  
Acacia hebeclada DC. subsp. hebeclada  
Acacia karroo Hayne  
Acacia robusta Burch. subsp. robusta  
Acacia tortilis (Forssk.) Hayne subsp. heteracantha (Burch.) Brenan  
Acanthosicyos naudinianus (Sond.) C.Jeffrey  
Achyranthes aspera L. var. aspera  
Acrotome inflata Benth.  
Aerva leucura Moq.  
Agrostis lachnantha Nees var. lachnantha  
Albuca fastigiata Dryand. var. fastigiata  
Alectra welwitschii (Hiern) Hemsl.  
Alternanthera nodiflora R.Br.  
Alternanthera pungens Kunth  
Amaranthus dinteri Schinz subsp. dinteri var. a  
Amaranthus hybridus L. subsp. cruentus (L.) Thell.  
Amaranthus hybridus L. subsp. hybridus var. hybridus  
Amaranthus thunbergii Moq.  
Ambrosia artemisiifolia L.  
Ammocharis coranica (Ker Gawl.) Herb.  
Andropogon appendiculatus Nees  
Andropogon eucomus Nees  
Antheophora pubescens Nees  
Anthospermum rigidum Eckl. & Zeyh. subsp. rigidum  
Aponogeton rehmannii Oliv.  
Aptosimum elongatum Engl.  
Aptosimum indivisum Burch. ex Benth.  
Aptosimum lineare Marloth & Engl. var. lineare  
Aptosimum procumbens (Lehm.) Steud.  
Arctotis arctotoides (L.f.) O.Hoffm.  
Arctotis microcephala (DC.) Beauverd  
Arctotis venusta Norl.  
Argemone ochroleuca Sweet subsp. ochroleuca  
Aristida adscensionis L.  
Aristida canescens Henrard subsp. canescens  
Aristida congesta Roem. & Schult. subsp. barbicollis (Trin. & Rupr.) De Winter  
Aristida congesta Roem. & Schult. subsp. congesta  
Aristida meridionalis Henrard  
Aristida mollissima Pilg. subsp. mollissima  
Aristida scabrivalvis Hack. subsp. scabrivalvis  
Aristida stipitata Hack. subsp. graciliflora (Pilg.) Melderis  
Aristida vestita Thunb.  
Asclepias meyeriana (Schltr.) Schltr.  
Asparagus cooperi Baker  
Asparagus laricinus Burch.  
Asparagus suaveolens Burch.  
Asplenium phillipsianum (Kümmerle) S.S.Bir, Fraser-Jenk. & J.D.Lovis  
Atriplex semibaccata R.Br. var. appendiculata Aellen



*Babiana hypogaea* Burch.  
*Barleria macrostegia* Nees  
*Berkheya onopordifolia* (DC.) O.Hoffm. ex Burt Davy var. *onopordifolia*  
*Berkheya pinnatifida* (Thunb.) Thell. subsp. *stobaeoides* (Harv.) Roessler  
*Berkheya radula* (Harv.) De Wild.  
*Bidens bipinnata* L.  
*Bidens pilosa* L.  
*Blepharis integrifolia* (L.f.) E.Mey. ex Schinz var. *integrifolia*  
*Brachiaria brizantha* (A.Rich.) Stapf  
*Brachiaria eruciformis* (Sm.) Griseb.  
*Brachiaria marlothii* (Hack.) Stent  
*Brachiaria nigropedata* (Ficalho & Hiern) Stapf  
*Brachiaria serrata* (Thunb.) Stapf  
*Brachystelma foetidum* Schltr.  
*Briza minor* L.  
*Bromus pectinatus* Thunb.  
*Bulbine abyssinica* A.Rich.  
*Bulbine narcissifolia* Salm-Dyck  
*Bulbostylis burchellii* (Ficalho & Hiern) C.B.Clarke  
*Caesalpinia gilliesii* (Wall. ex Hook.) D.Dietr.  
*Capsella bursa-pastoris* (L.) Medik.  
*Ceropegia crassifolia* Schltr. var. *crassifolia*  
*Chamaecrista biensis* (Steyaert) Lock  
*Chamaecrista mimosoides* (L.) Greene  
*Chascanum adenostachyum* (Schauer) Moldenke  
*Chascanum hederaceum* (Sond.) Moldenke var. *hederaceum*  
*Chascanum pinnatifidum* (L.f.) E.Mey. var. *pinnatifidum*  
*Chenopodium album* L.  
*Chenopodium carinatum* R.Br.  
*Chenopodium murale* L. var. *murale*  
*Chenopodium phillipsianum* Aellen  
*Chenopodium schraderianum* Roem. & Schult.  
*Chloris virgata* Sw.  
*Chloris virgata* Sw.  
*Chlorophytum angulicaule* (Baker) Kativu  
*Chlorophytum fasciculatum* (Baker) Kativu  
*Chortolirion angolense* (Baker) A.Berger  
*Chrysocoma obtusata* (Thunb.) Ehr.Bayer  
*Chrysopogon serrulatus* Trin.  
*Cirsium vulgare* (Savi) Ten.  
*Citrullus lanatus* (Thunb.) Matsum. & Nakai  
*Cleome gynandra* L.  
*Cleome monophylla* L.  
*Cleome rubella* Burch.  
*Clusia pulchella* L. var. *pulchella*  
*Coccinia sessilifolia* (Sond.) Cogn.  
*Colchicum burkei* (Baker) J.C.Manning & Vinn.  
*Colchicum melanthoides* (Willd.) J.C.Manning & Vinn. subsp. *melanthoides*  
*Commelina africana* L. var. *africana*  
*Commelina africana* L. var. *barberae* (C.B.Clarke) C.B.Clarke  
*Commelina africana* L. var. *krebsiana* (Kunth) C.B.Clarke  
*Commelina benghalensis* L.  
*Commelina livingstonii* C.B.Clarke

Commicarpus pentandrus (Burch.) Heimerl  
 Convolvulus ocellatus Hook.f. var. ocellatus  
 Convolvulus sagittatus Thunb.  
 Conyza bonariensis (L.) Cronquist  
 Corchorus asplenifolius Burch.  
 Coronopus integrifolius (DC.) Spreng.  
 Crinum bulbispermum (Burm.f.) Milne-Redh. & Schweick.  
 Crotalaria burkeana Benth.  
 Crotalaria griquensis L.Bolus  
 Crotalaria lotoides Benth.  
 Crotalaria sphaerocarpa Perr. ex DC. subsp. sphaerocarpa  
 Cucumis heptadactylus Naudin  
 Cucumis myriocarpus Naudin subsp. myriocarpus  
 Cullen tomentosum (Thunb.) J.W.Grimes  
 Cyanotis speciosa (L.f.) Hassk.  
 Cymbopogon pospischilii (K.Schum.) C.E.Hubb.  
 Cynanchum orangeanum (Schltr.) N.E.Br.  
 Cynanchum virens (E.Mey.) D.Dietr.  
 Cynodon bradleyi Stent  
 Cynodon dactylon (L.) Pers.  
 Cynodon decipiens Caro & E.A.Sánchez  
 Cynodon incompletus Nees  
 Cyperus bellus Kunth  
 Cyperus congestus Vahl  
 Cyperus difformis L.  
 Cyperus eragrostis Lam.  
 Cyperus esculentus L. var. esculentus  
 Cyperus fastigiatus Rottb.  
 Cyperus indecorus Kunth var. decurvatus (C.B.Clarke) Kük.  
 Cyperus longus L. var. tenuiflorus (Rottb.) Boeck.  
 Cyperus margaritaceus Vahl var. margaritaceus  
 Cyperus marginatus Thunb.  
 Cyperus marlothii Boeck.  
 Cyperus obtusiflorus Vahl var. obtusiflorus  
 Cyperus rupestris Kunth var. rupestris  
 Cyperus sexangularis Nees  
 Cyperus sphaerospermus Schrad.  
 Cyperus squarrosus L.  
 Cyperus usitatus Burch.  
 Cyphostemma hereroense (Schinz) Desc. ex Wild & R.B.Drumm.  
 Daubenya comata (Burch. ex Baker) J.C.Manning & A.van der Merwe  
 Deverra burchellii (DC.) Eckl. & Zeyh.  
 Dianthus micropetalus Ser.  
 Dicliptera leistneri K.Balkwill  
 Dicoma anomala Sond. subsp. anomala  
 Dicoma anomala Sond. subsp. gerrardii (Harv. ex F.C.Wilson) S.Ortíz & Rodr.Oubiña  
 Dicoma macrocephala DC.  
 Dicoma schinzii O.Hoffm.  
 Digitaria argyrograpta (Nees) Stapf  
 Digitaria eriantha Steud.  
 Dimorphotheca zeyheri Sond.  
 Diospyros austro-africana De Winter var. microphylla (Burch.) De Winter  
 Diospyros lycioides Desf. subsp. lycioides



*Dipcadi crispum* Baker  
*Dipcadi marlothii* Engl.  
*Dipcadi papillatum* Oberm.  
*Dipcadi viride* (L.) Moench  
*Duthieastrum linifolium* (E.Phillips) M.P.de Vos  
*Dyschoriste transvaalensis* C.B.Clarke  
*Echinochloa crus-galli* (L.) P.Beauv.  
*Echinochloa holubii* (Stapf) Stapf  
*Ehretia rigida* (Thunb.) Druce subsp. *rigida*  
*Eleocharis dregeana* Steud.  
*Elephantorrhiza elephantina* (Burch.) Skeels  
*Eleusine coracana* (L.) Gaertn. subsp. *africana* (Kenn.-O'Byrne) Hilu & de Wet  
*Elionurus muticus* (Spreng.) Kunth  
*Emex australis* Steinh.  
*Enneapogon cenchroides* (Licht. ex Roem. & Schult.) C.E.Hubb.  
*Enneapogon desvauxii* P.Beauv.  
*Enneapogon scoparius* Stapf  
*Equisetum ramosissimum* Desf. subsp. *ramosissimum*  
*Eragrostis bicolor* Nees  
*Eragrostis biflora* Hack. ex Schinz  
*Eragrostis chloromelas* Steud.  
*Eragrostis cilianensis* (All.) Vignolo ex Janch.  
*Eragrostis curvula* (Schrad.) Nees  
*Eragrostis echinochloidea* Stapf  
*Eragrostis gummiflua* Nees  
*Eragrostis homomalla* Nees  
*Eragrostis lehmanniana* Nees var. *chaunantha* (Pilg.) De Winter  
*Eragrostis lehmanniana* Nees var. *lehmanniana*  
*Eragrostis micrantha* Hack.  
*Eragrostis nindensis* Ficalho & Hiern  
*Eragrostis obtusa* Munro ex Ficalho & Hiern  
*Eragrostis pallens* Hack.  
*Eragrostis planiculmis* Nees  
*Eragrostis porosa* Nees  
*Eragrostis remotiflora* De Winter  
*Eragrostis rigidior* Pilg.  
*Eragrostis rotifer* Rendle  
*Eragrostis superba* Peyr.  
*Eragrostis tef* (Zuccagni) Trotter  
*Eragrostis trichophora* Coss. & Durieu  
*Eragrostis truncata* Hack.  
*Eragrostis x pseud-obtusa* De Winter  
*Eriocephalus karooicus* M.A.N.Müll.  
*Eriochloa fatmensis* (Hochst. & Steud.) Clayton  
*Eriospermum cooperi* Baker var. *cooperi*  
*Eriospermum flagelliforme* (Baker) J.C.Manning  
*Eriospermum porphyrium* Archibald  
*Eriospermum schinzii* Baker  
*Erucastrum griquense* (N.E.Br.) O.E.Schulz  
*Euphorbia duseimata* R.A.Dyer  
*Euphorbia inaequilatera* Sond. var. *inaequilatera*  
*Euphorbia prostrata* Aiton  
*Euphorbia pseudotuberosa* Pax

*Euphorbia rectirama* N.E.Br.  
*Euphorbia rhombifolia* Boiss.  
*Eustachys paspaloides* (Vahl) Lanza & Mattei  
*Fagopyrum esculentum* Moench  
*Felicia fascicularis* DC.  
*Felicia muricata* (Thunb.) Nees subsp. *muricata*  
*Felicia muricata* (Thunb.) Nees subsp. *strictifolia* Grau  
*Fingerhuthia africana* Lehm.  
*Flaveria bidentis* (L.) Kuntze  
*Gazania krebsiana* Less. subsp. *serrulata* (DC.) Roessler  
*Geigeria brevifolia* (DC.) Harv.  
*Geigeria burkei* Harv. subsp. *fruticulosa* Merxm.  
*Geigeria filifolia* Mattf.  
*Geigeria obtusifolia* L.Bolus  
*Geigeria ornativa* O.Hoffm. subsp. *ornativa*  
*Gisekia pharnacioides* L. var. *pharnacioides*  
*Gladiolus permeabilis* D.Delaroche subsp. *edulis* (Burch. ex Ker Gawl.) Oberm.  
*Gnaphalium filagopsis* Hilliard & B.L.Burt  
*Gomphocarpus fruticosus* (L.) Aiton f. subsp. *fruticosus*  
*Gomphrena celosioides* Mart.  
*Grewia flava* DC.  
*Grielim cuneifolium* Schinz  
*Guilleminea densa* (Willd. ex Roem. & Schult.) Moq.  
*Gymnosporia buxifolia* (L.) Szyszyl.  
*Haemanthus montanus* Baker  
*Haplocarpha scaposa* Harv.  
*Haworthia venosa* (Lam.) Haw. subsp. *tessellata* (Haw.) M.B.Bayer  
*Helianthus debilis* Nutt. subsp. *cucumerifolius* (Torr. & A.Gray) Heiser  
*Helichrysum argyrosphaerum* DC.  
*Helichrysum caespititium* (DC.) Harv.  
*Helichrysum callicomum* Harv.  
*Helichrysum cerastioides* DC. var. *cerastioides*  
*Helichrysum dregeanum* Sond. & Harv.  
*Helichrysum paronychioides* DC.  
*Helichrysum zeyheri* Less.  
*Heliotropium ciliatum* Kaplan  
*Heliotropium lineare* (A.DC.) Gürke  
*Heliotropium nelsonii* C.H.Wright  
*Heliotropium zeylanicum* (Burm.f.) Lam.  
*Hemarthria altissima* (Poir.) Stapf & C.E.Hubb.  
*Hermannia bicolor* Engl. & Dinter  
*Hermannia comosa* Burch. ex DC.  
*Hermannia erodioides* (Burch. ex DC.) Kuntze  
*Hermannia linearifolia* Harv.  
*Hermannia linnaeoides* (Burch.) K.Schum.  
*Hermannia modesta* (Ehrenb.) Mast.  
*Hermannia quartiniana* A.Rich.  
*Hermannia tomentosa* (Turcz.) Schinz ex Engl.  
*Hermbstaedia odorata* (Burch.) T.Cooke var. *odorata*  
*Herniaria erckertii* Herm. subsp. *erckertii*  
*Heteropogon contortus* (L.) Roem. & Schult.  
*Hibiscus marlothianus* K.Schum.  
*Hibiscus microcarpus* Garcke



*Hibiscus pusillus* Thunb.  
*Hibiscus trionum* L.  
*Hirpicium bechuanense* (S.Moore) Roessler  
*Hypertelis salsoloides* (Burch.) Adamson var. *salsoloides*  
*Hypoxis angustifolia* Lam. var. *angustifolia*  
*Hypoxis iridifolia* Baker  
*Indigofera alternans* DC. var. *alternans*  
*Indigofera commixta* N.E.Br.  
*Indigofera cryptantha* Benth. ex Harv. var. *cryptantha*  
*Indigofera daleoides* Benth. ex Harv. var. *daleoides*  
*Indigofera daleoides* Benth. ex Harv. var. *gossweileri* Baker f.  
*Indigofera dimidiata* Vogel ex Walp.  
*Indigofera filipes* Benth. ex Harv.  
*Indigofera flavicans* Baker  
*Indigofera heterotricha* DC.  
*Indigofera rhytidocarpa* Benth. ex Harv. subsp. *rhytidocarpa*  
*Indigofera sessilifolia* DC.  
*Indigofera subcorymbosa* Baker var. *subcorymbosa*  
*Ipomoea bathycolpos* Hallier f.  
*Ipomoea bolusiana* Schinz  
*Ipomoea obscura* (L.) Ker Gawl. var. *obscura*  
*Ipomoea ommanneyi* Rendle  
*Jamesbrittenia albiflora* (I.Verd.) Hilliard  
*Jamesbrittenia atropurpurea* (Benth.) Hilliard subsp. *atropurpurea*  
*Jamesbrittenia aurantiaca* (Burch.) Hilliard  
*Juncus oxycarpus* E.Mey. ex Kunth  
*Juncus punctorius* L.f.  
*Juncus rigidus* Desf.  
*Justicia orchioides* L.f. subsp. *glabrata* Immelman  
*Kalanchoe rotundifolia* (Haw.) Haw.  
*Kedrostis crassirostrata* Bremek.  
*Kohautia caespitosa* Schnizl. subsp. *brachyloba* (Sond.) D.Mantell  
*Kohautia cynanchica* DC.  
*Kyllinga alba* Nees  
*Kyllinga erecta* Schumach. var. *erecta*  
*Kyphocarpa angustifolia* (Moq.) Lopr.  
*Lactuca inermis* Forssk.  
*Lagarosiphon major* (Ridl.) Moss ex Wager  
*Lagarosiphon muscoides* Harv.  
*Laggera decurrens* (Vahl) Hepper & J.R.I.Wood  
*Lantana rugosa* Thunb.  
*Lapeirousia plicata* (Jacq.) Diels subsp. *plicata*  
*Lappula heteracantha* Ledeb.  
*Ledebouria revoluta* (L.f.) Jessop  
*Lepidium africanum* (Burm.f.) DC. subsp. *africanum*  
*Lepidium bonariense* L.  
*Leptochloa fusca* (L.) Kunth  
*Lessertia depressa* Harv.  
*Leucas capensis* (Benth.) Engl.  
*Leucas sexdentata* Skan  
*Limeum pterocarpum* (J.Gay) Heimerl var. *pterocarpum*  
*Limeum viscosum* (J.Gay) Fenzl subsp. *transvaalense* Friedrich  
*Limeum viscosum* (J.Gay) Fenzl subsp. *viscosum* var. *kraussii* Friedrich

*Limeum viscosum* (J.Gay) Fenzl subsp. *viscosum* var. *macrocarpum* Friedrich  
*Lippia scaberrima* Sond.  
*Lithospermum cinereum* A.DC.  
*Litogyne gariiepina* (DC.) Anderb.  
*Lobelia erinus* L.  
*Lobelia thermalis* Thunb.  
*Lolium temulentum* L.  
*Lotononis bainesii* Baker  
*Lotononis brachyantha* Harms  
*Lotononis calycina* (E.Mey.) Benth.  
*Lotononis listii* Polhill  
*Lotononis marlothii* Engl.  
*Lycium arenicola* Miers  
*Lycium cinereum* Thunb.  
*Lycium horridum* Thunb.  
*Lycium pilifolium* C.H.Wright  
*Malva parviflora* L. var. *parviflora*  
*Manulea parviflora* Benth. var. *parviflora*  
*Marsilea capensis* A.Braun  
*Marsilea macrocarpa* C.Presl  
*Medicago laciniata* (L.) Mill. var. *laciniata*  
*Melia azedarach* L.  
*Melinis repens* (Willd.) Zizka subsp. *repens*  
*Menodora africana* Hook.  
*Mentha longifolia* (L.) Huds. subsp. *capensis* (Thunb.) Briq.  
*Merremia verecunda* Rendle  
*Mestoklema arboriforme* (Burch.) N.E.Br. ex Glen  
*Microchloa caffra* Nees  
*Microchloa kunthii* Desv.  
*Mollugo cerviana* (L.) Ser. ex DC. var. *cerviana*  
*Momordica balsamina* L.  
*Monsonia angustifolia* E.Mey. ex A.Rich.  
*Moraea natalensis* Baker  
*Moraea pallida* (Baker) Goldblatt  
*Moraea polystachya* (Thunb.) Ker Gawl.  
*Nananthus vittatus* (N.E.Br.) Schwantes  
*Nerine frithii* L.Bolus  
*Nerine hesseoides* L.Bolus  
*Nerine laticoma* (Ker Gawl.) T.Durand & Schinz  
*Nidorella resedifolia* DC. subsp. *resedifolia*  
*Nolletia ciliaris* (DC.) Steetz  
*Nuxia gracilis* Engl.  
*Oenothera rosea* L'Hér. ex Aiton  
*Oenothera tetraptera* Cav.  
*Orbea lutea* (N.E.Br.) Bruyns subsp. *lutea*  
*Ornithogalum flexuosum* (Thunb.) U. & D.Müll.-Doblies  
*Ornithoglossum dinteri* K.Krause  
*Ornithoglossum vulgare* B.Nord.  
*Oropetium capense* Stapf  
*Orthanthera jasminiflora* (Decne.) Schinz  
*Osteospermum muricatum* E.Mey. ex DC. subsp. *muricatum*  
*Oxalis depressa* Eckl. & Zeyh.  
*Oxygonum dregeanum* Meisn. subsp. *canescens* (Sond.) Germish. var. *canescens*



*Panicum coloratum* L. var. *coloratum*  
*Panicum kalahareense* Mez  
*Panicum maximum* Jacq.  
*Panicum schinzii* Hack.  
*Panicum stapfianum* Fourc.  
*Papaver aculeatum* Thunb.  
*Paraparmelia prolata* (Hale) Elix & J.Johnst.  
*Paraparmelia tortula* (Kurok.) Elix & J.Johnst.  
*Paspalum dilatatum* Poir.  
*Pavonia burchellii* (DC.) R.A.Dyer  
*Pentzia calcarea* Kies  
*Pentzia globosa* Less.  
*Persicaria hystricula* (J.Schust.) Soják  
*Persicaria lapathifolia* (L.) Gray  
*Pharnaceum brevicaule* (DC.) Bartl.  
*Phragmites australis* (Cav.) Steud.  
*Phyllanthus maderaspatensis* L.  
*Platycarphella parvifolia* (S.Moore) V.A.Funk & H.Rob.  
*Plinthus sericeus* Pax  
*Pogonarthria squarrosa* (Roem. & Schult.) Pilg.  
*Pollichia campestris* Aiton  
*Polygala hottentotta* C.Presl  
*Polygonum aviculare* L.  
*Polygonum plebeium* R.Br.  
*Polypogon monspeliensis* (L.) Desf.  
*Portulaca oleracea* L.  
*Portulaca quadrifida* L.  
*Potamogeton crispus* L.  
*Potamogeton pectinatus* L.  
*Pseudognaphalium luteo-album* (L.) Hilliard & B.L.Burt  
*Pseudognaphalium oligandrum* (DC.) Hilliard & B.L.Burt  
*Psilocaulon coriarium* (Burch. ex N.E.Br.) N.E.Br.  
*Psora decipiens* (Hedw.) Hoffm.  
*Pterodiscus speciosus* Hook.  
*Pycreus chrysanthus* (Boeck.) C.B.Clarke  
*Ranunculus multifidus* Forssk.  
*Rhynchosia confusa* Burt Davy  
*Riccia atropurpurea* Sim  
*Ruellia setosa* (Nees) C.B.Clarke  
*Rumex lanceolatus* Thunb.  
*Salix mucronata* Thunb. subsp. *mucronata*  
*Salvia disermas* L.  
*Salvia runcinata* L.f.  
*Salvia stenophylla* Burch. ex Benth.  
*Scabiosa columbaria* L.  
*Schismus barbatus* (Loefl. ex L.) Thell.  
*Schizocarphus nervosus* (Burch.) Van der Merwe  
*Schkuhria pinnata* (Lam.) Kuntze ex Thell.  
*Schmidtia pappophoroides* Steud.  
*Schoenoplectus decipiens* (Nees) J.Raynal  
*Schoenoplectus leucanthus* (Boeck.) J.Raynal  
*Schoenoplectus muricinux* (C.B.Clarke) J.Raynal  
*Schoenoplectus tabernaemontani* (C.C.Gmel.) Palla

*Scirpoides burkei* (C.B.Clarke) Goetgh., Muasya & D.A.Simpson  
*Scirpoides dioecus* (Kunth) Browning  
*Searsia dentata* (Thunb.) F.A.Barkley  
*Searsia lancea* (L.f.) F.A.Barkley  
*Searsia leptodictya* (Diels) T.S.Yi, A.J.Mill. & J.Wen forma *leptodictya*  
*Searsia pyroides* (Burch.) Moffett var. *pyroides*  
*Seddera capensis* (E.Mey. ex Choisy) Hallier f.  
*Selago densiflora* Rolfe  
*Selago welwitschii* Rolfe var. *australis* Hilliard  
*Senecio arenarius* Thunb.  
*Senecio burchellii* DC.  
*Senecio consanguineus* DC.  
*Senecio coronatus* (Thunb.) Harv.  
*Senecio oxyriifolius* DC. subsp. *oxyriifolius*  
*Senna italica* Mill. subsp. *arachoides* (Burch.) Lock  
*Sericorema remotiflora* (Hook.f.) Lopr.  
*Sesamum capense* Burm.f.  
*Sesuvium hydaspicum* (Edgew.) Gongç.  
*Setaria incrassata* (Hochst.) Hack.  
*Setaria sphacelata* (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. *sphacelata*  
*Setaria sphacelata* (Schumach.) Stapf & C.E.Hubb. ex M.B.Moss var. *torta* (Stapf) Clayton  
*Sida chrysantha* Ulbr.  
*Sida cordifolia* L. subsp. *cordifolia*  
*Silene gallica* L.  
*Silene undulata* Aiton  
*Solanum lichtensteinii* Willd.  
*Solanum supinum* Dunal var. *supinum*  
*Sonchus dregeanus* DC.  
*Sporobolus albicans* (Nees ex Trin.) Nees  
*Sporobolus discosporus* Nees  
*Sporobolus fimbriatus* (Trin.) Nees  
*Sporobolus ludwigii* Hochst.  
*Stachys spathulata* Burch. ex Benth.  
*Stipagrostis uniplumis* (Licht.) De Winter var. *neesii* (Trin. & Rupr.) De Winter  
*Stipagrostis uniplumis* (Licht.) De Winter var. *uniplumis*  
*Talinum caffrum* (Thunb.) Eckl. & Zeyh.  
*Tarchonanthus camphoratus* L.  
*Tephrosia burchellii* Burt Davy  
*Tephrosia longipes* Meisn. subsp. *longipes* var. *longipes*  
*Tephrosia lupinifolia* DC.  
*Teucrium trifidum* Retz.  
*Themeda triandra* Forssk.  
*Titanopsis calcarea* (Marloth) Schwantes  
*Trachyandra burkei* (Baker) Oberm.  
*Trachyandra laxa* (N.E.Br.) Oberm. var. *rigida* (Suess.) Roessler  
*Trachyandra saltii* (Baker) Oberm. var. *saltii*  
*Tragus berteronianus* Schult.  
*Tragus koelerioides* Asch.  
*Tragus racemosus* (L.) All.  
*Trianthema salsoloides* Fenzl ex Oliv. var. *salsoloides*  
*Tribulus terrestris* L.  
*Trichodesma angustifolium* Harv. subsp. *angustifolium*  
*Trichodiadema pomeridianum* L.Bolus



Trichoneura grandiglumis (Nees) Ekman  
Tripteris aghillana DC. var. aghillana  
Triraphis andropogonoides (Steud.) E. Phillips  
Trochomeria macrocarpa (Sond.) Hook.f. subsp. macrocarpa  
Tulbaghia acutiloba Harv.  
Tulbaghia leucantha Baker  
Urochloa brachyura (Hack.) Stapf  
Urochloa panicoides P. Beauv.  
Utricularia gibba L.  
Vahlia capensis (L.f.) Thunb. subsp. capensis  
Vahlia capensis (L.f.) Thunb. subsp. vulgaris Bridson var. linearis E. Mey. ex Bridson  
Verbena bonariensis L.  
Verbena officinalis L.  
Verbesina encelioides (Cav.) Benth. & Hook. var. encelioides  
Vigna unguiculata (L.) Walp. subsp. stenophylla (Harv.) Maréchal, Mascherpa & Stainier  
Vigna vexillata (L.) A. Rich. var. vexillata  
Viscum rotundifolium L.f.  
Wahlenbergia androsacea A. DC.  
Wahlenbergia denticulata (Burch.) A. DC. var. denticulata  
Wahlenbergia denticulata (Burch.) A. DC. var. transvaalensis (Adamson) W. G. Welman  
Wahlenbergia paniculata (Thunb.) A. DC.  
Wahlenbergia undulata (L.f.) A. DC.  
Withania somnifera (L.) Dunal  
Xanthium spinosum L.  
Xenostegia tridentata (L.) D. F. Austin & Staples subsp. angustifolia (Jacq.) Lejoly & Lisowski  
Ziziphus mucronata Willd. subsp. mucronata  
Ziziphus zeyheriana Sond.  
Zornia milneana Mohlenbr.

## Appendix 5: Animal species with a geographical distribution that includes the study area.

### Notes:

1. Species of conservation concern are in red lettering.
2. Species protected according to the Western Cape Nature Conservation Laws Amendment Act of 2000 (Act 3 of 2000) marked with "P"
3. Species protected according to the National Environmental Management: Biodiversity Act of 2004 (Act 10 of 2000) marked with "N"

### Mammals:

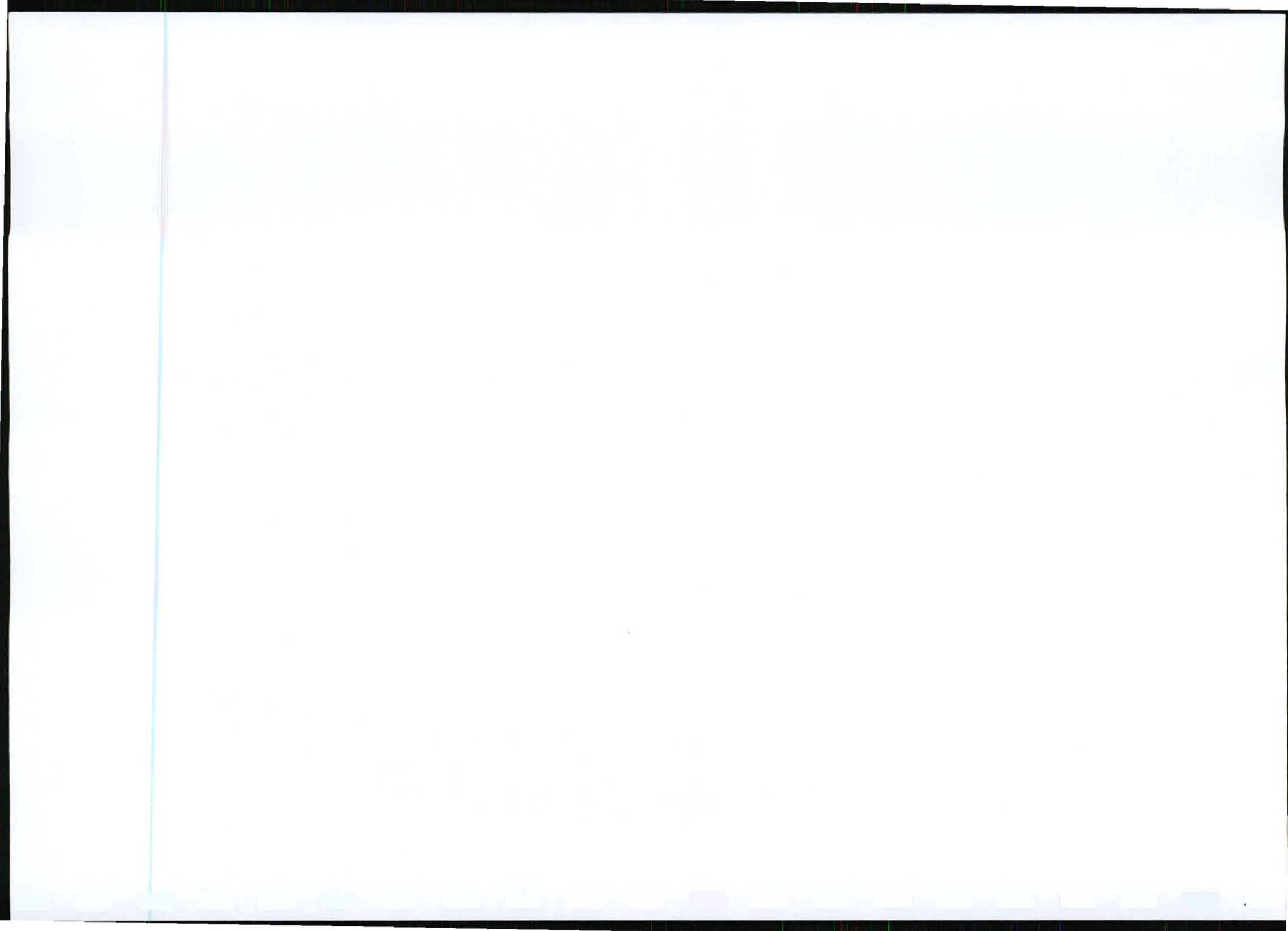
Red hartebeest  
Springbok  
<sup>N</sup>White rhinoceros  
<sup>N</sup>Black wildebeest  
Blue wildebeest  
Blesbok  
**<sup>N</sup>Black rhinoceros – arid ecotype (CR)**  
Klipspringer  
Gemsbok  
Warthog  
Steenbok  
Common duiker  
Eland  
Kudu  
Rock hyrax  
Cape clawless otter  
Water mongoose  
Black-backed jackal  
Caracal  
Yellow mongoose  
<sup>N</sup>Black-footed cat  
African wild cat  
Slender mongoose  
Small-spotted genet  
Large-spotted genet  
**<sup>N</sup>Brown hyaena (NT)**  
Striped polecat  
**<sup>N</sup>Spotted-necked otter (NT, global LC)**  
<sup>N</sup>Honey badger (NT)  
Bat-eared fox  
African weasel  
Aardwolf  
Suricate  
<sup>N</sup>Cape fox  
Long-tailed serotine bat  
**Natal long-fingered bat (NT, global LC)**  
Cape serotine bat  
Egyptian slit-faced bat  
Geoffroy's horseshoe bat  
Darling's horseshoe bat  
Egyptian free-tailed bat  
Mauritian tomb bat  
**<sup>N</sup>South African hedgehog (NT, global LC)**  
Reddish-grey musk shrew  
Tiny musk shrew  
Lesser dwarf shrew

Cape/Desert hare  
Scrub/Savannah hare  
Smith's red rock rabbit  
Red veld rat  
Tete veld rat  
Namaqua rock mouse  
Common mole-rat  
Short-tailed gerbil  
Woodland dormouse  
Porcupine  
Large-eared mouse  
Multimammate mouse  
Vlei rat  
Springhare  
Striped mouse  
Pouched mouse  
Kreb's fat mouse  
Highveld gerbil  
Bushveld gerbil  
Cape ground squirrel  
Rock elephant shrew  
Aardvark

### Reptiles:

Puff adder  
Horned adder  
Cape cobra  
Rinkhals  
Highveld garter snake  
Spotted harlequin snake  
Boomslang  
Kalahari sand snake  
Crossed whip snake  
Striped skaapsteker  
Common tiger snake  
Herald snake  
Brown house snake  
Aurora house snake  
Common brown water snake  
Mole snake  
Two-striped shovel-snout  
Common slug-eater  
Common wolf snake  
Common egg-eater  
Delalande's beaked blind snake  
Peter's worm snake  
Southern rock agama  
Common flap-necked chameleon





Rock monitor  
Holub's sandveld lizard  
Spotted sandveld lizard  
Namaqua sand lizard  
Spotted sand lizard  
Common rough-scaled lizard  
Cape spade-snouted worm lizard  
Thin-tailed legless skink  
Cape skink  
Eastern coastal skink  
Montane speckled skink  
Variable skink  
Variegated skink  
Karoo girdled lizard  
Yellow-throated plated lizard  
Cape dwarf gecko  
Cape gecko  
Marsh terrapin  
Greater padloper  
Leopard tortoise  
Kalahari tent tortoise

#### **Amphibians**

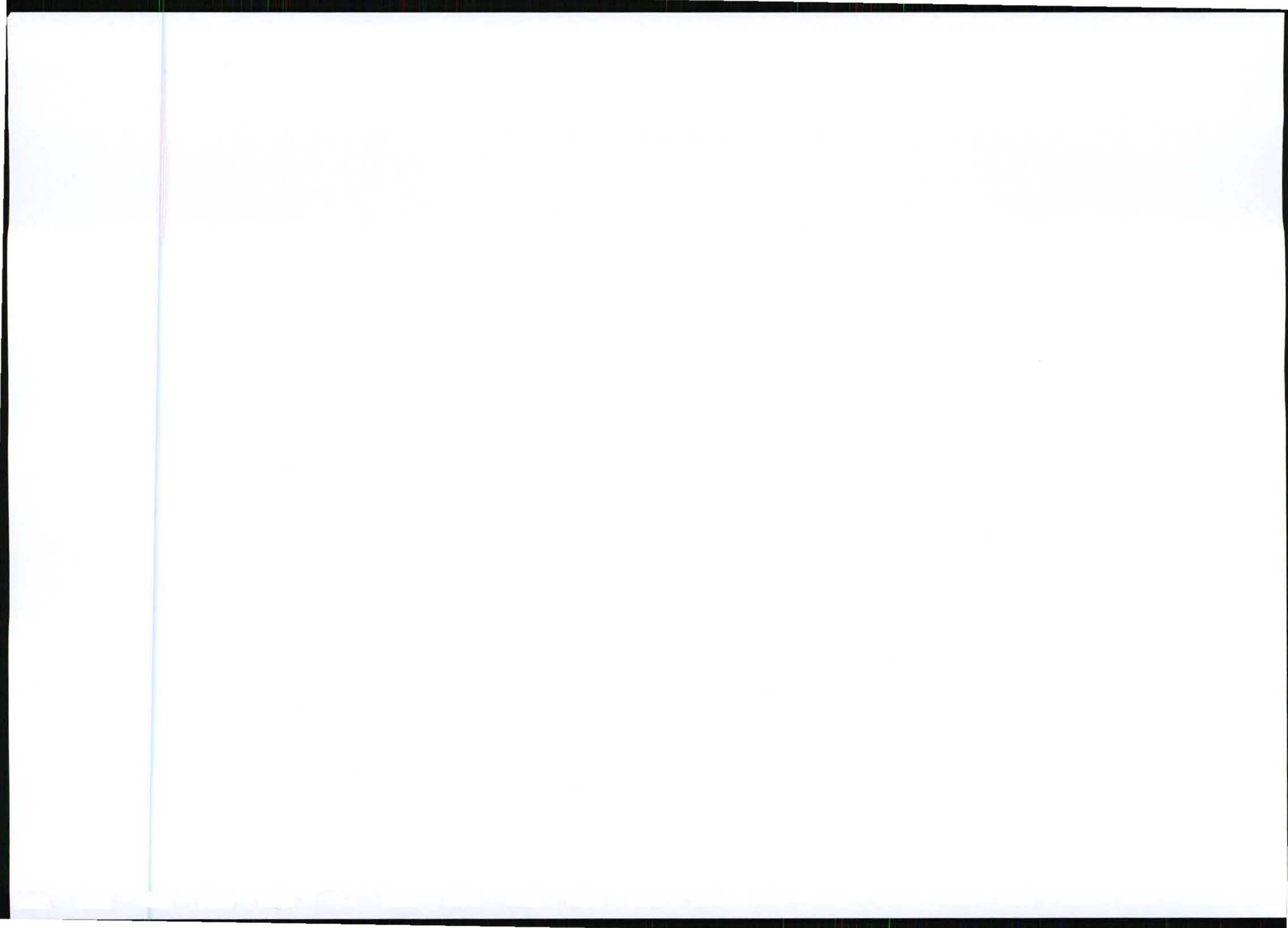
Eastern olive toad  
Guttural toad  
Western olive toad  
Raucous toad  
Southern pygmy toad  
Bubbling kassina  
Snoring puddle frog (not Chris)  
Common platanna  
Boettger's caco  
Common river frog  
Cape river frog  
<sup>N</sup>Giant bullfrog  
Tremolo sand frog  
Tandy's sand frog

#### **Birds:**

Abdim's Stork  
African Black Duck  
African Cuckoo  
African Fish Eagle  
African Hoopoe  
African Jacana  
**African Marsh Harrier (VU)**  
African Marsh Warbler  
African Pied Wagtail  
African Rail  
African Spoonbill  
Anteating Chat  
Ashy Tit  
Baillon's Crake  
Banded Martin

Barn Owl  
Black Crake  
Black Crow  
Black Egret  
**Black Harrier (VU)**  
Black Kite  
**Black Stork (NT)**  
Black Swift  
Blackbreasted Snake Eagle  
Blackcheeked Waxbill  
Blackchested Prinia  
Blackcrowned Night Heron  
Blackheaded Heron  
Blacknecked Grebe  
Blackshouldered Kite  
Blacksmith Plover  
Blacktailed Godwit  
Blackthroated Canary  
**Blackwinged Pratincole (NT)**  
Blackwinged Stilt  
**Blue Crane (VU)**  
Blue Waxbill  
Bluecheeked Bee-eater  
Bokmakierie  
Booted Eagle  
Bradfield's Swift  
Brownhooded Kingfisher  
Brownthroated Martin  
Brubru  
Buffy Pipit  
Burchell's Coucal  
Burchell's Courser  
Cape Bunting  
Cape Penduline Tit  
Cape Reed Warbler  
Cape Robin  
Cape Shoveller  
Cape Sparrow  
Cape Teal  
Cape Turtle Dove  
**Cape Vulture (VU)**  
Cape Wagtail  
Capped Wheatear  
Cardinal Woodpecker  
Caspian Plover  
**Caspian Tern (NT)**  
Cattle Egret  
Chat Flycatcher  
Chestnutbacked Finchlark  
**Chestnutbanded Plover (NT)**  
Cloud Cisticola  
Common Moorhen  
Common Quail

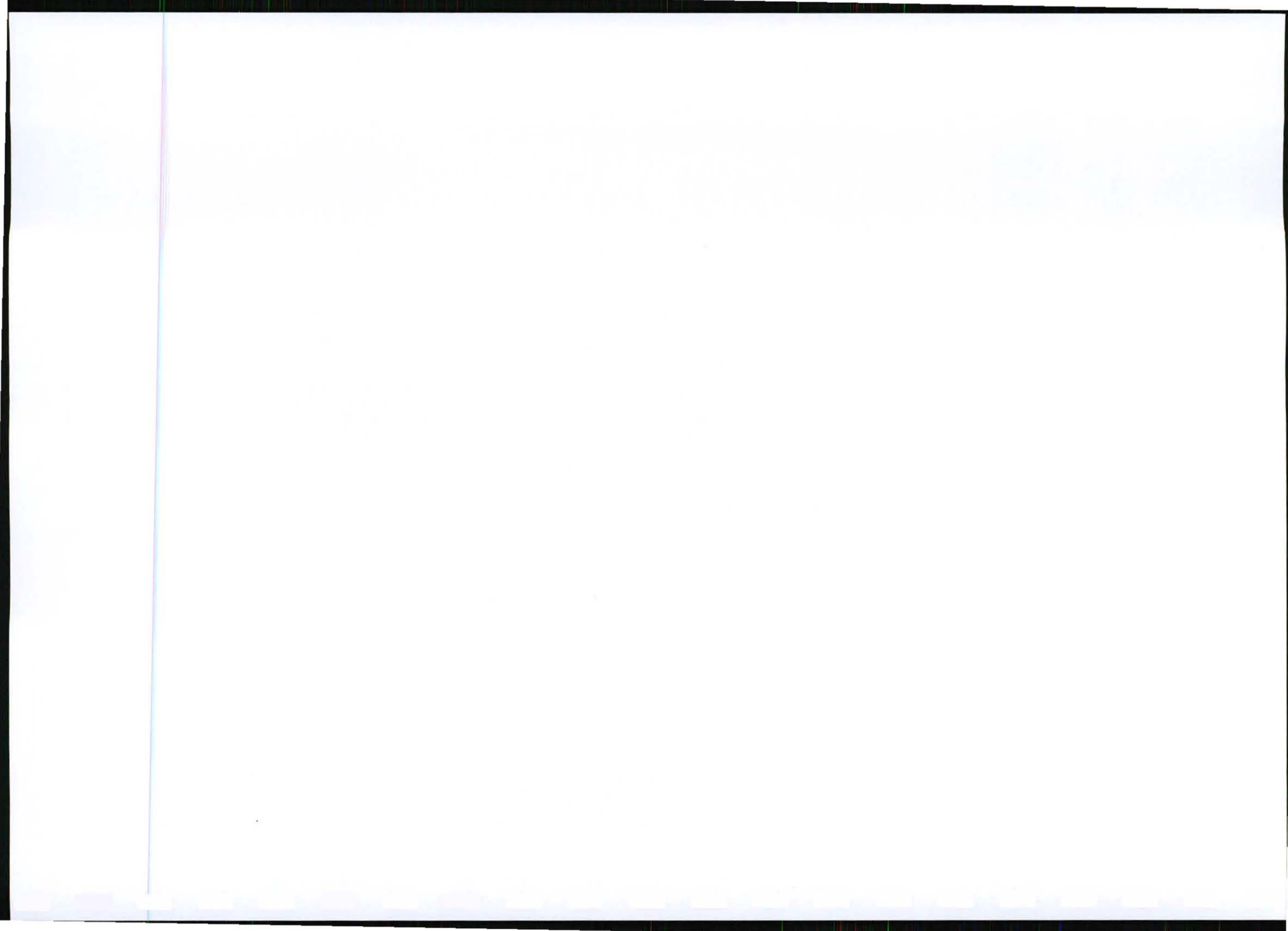




Common Sandpiper  
Common Waxbill  
Crested Barbet  
Crimsonbreasted Shrike  
Crowned Plover  
Curlew  
Curlew Sandpiper  
Dabchick  
Darter  
Desert Barred Warbler  
Desert Cisticola  
Diederik Cuckoo  
Doublebanded Courser  
Dusky Sunbird  
Eastern Clapper Lark  
Egyptian Goose  
Ethiopian Snipe  
Eurasian Bee-eater  
Eurasian Golden Oriole  
Eurasian Marsh Harrier  
Eurasian Nightjar  
Eurasian Roller  
Eurasian Sedge Warbler  
Eurasian Swallow  
Eurasian Swift  
Fairy Flycatcher  
Familiar Chat  
Fantailed Cisticola  
Fawncoloured Lark  
Feral Pigeon  
Fiscal Flycatcher  
Fiscal Shrike  
Forktailed Drongo  
Fulvous Duck  
Gabar Goshawk  
Garden Warbler  
Giant Eagle Owl  
Giant Kingfisher  
Glossy Ibis  
Glossy Starling  
Golden Bishop  
Goldenbreasted Bunting  
Goldentailed Woodpecker  
Goliath Heron  
Grassveld Pipit  
Great Crested Grebe  
Great Reed Warbler  
Great Sparrow  
Great Spotted Cuckoo  
Great White Egret  
**Greater Flamingo (NT)**  
Greater Honeyguide  
Greater Kestrel

Greater Striped Swallow  
Greenbacked Heron  
Greenshank  
Grey Heron  
Grey Hornbill  
Grey Lourie  
Greybacked Finchlark  
Greyheaded Gull  
Groundscraper Thrush  
Gymnogene  
Hadedda Ibis  
Hamerkop  
Helmeted Guineafowl  
Horus Swift  
Hottentot Teal  
House Martin  
House Sparrow  
Icterine Warbler  
Jackal Buzzard  
Jacobin Cuckoo  
Kalahari Robin  
Karoo Robin  
Karoo Thrush  
Kittlitz's Plover  
Knobbilled Duck  
**NKori Bustard (VU)**  
Kurrichane Buttonquail  
**Lanner Falcon (NT)**  
**Lappetfaced Vulture (VU)**  
Larklike Bunting  
Laughing Dove  
**Lesser Flamingo (NT)**  
Lesser Grey Shrike  
Lesser Honeyguide  
**NLesser Kestrel (VU)**  
Levaillant's Cisticola  
Lilacbreasted Roller  
Little Bittern  
Little Egret  
Little Stint  
Little Swift  
Longbilled Crombec  
Longtailed Widow  
Maccoa Duck  
Malachite Kingfisher  
**Marabou Stork (NT)**  
Marico Flycatcher  
Marsh Owl  
Marsh Sandpiper  
**NMartial Eagle (VU)**  
Masked Weaver  
Melba Finch  
Melodious Lark

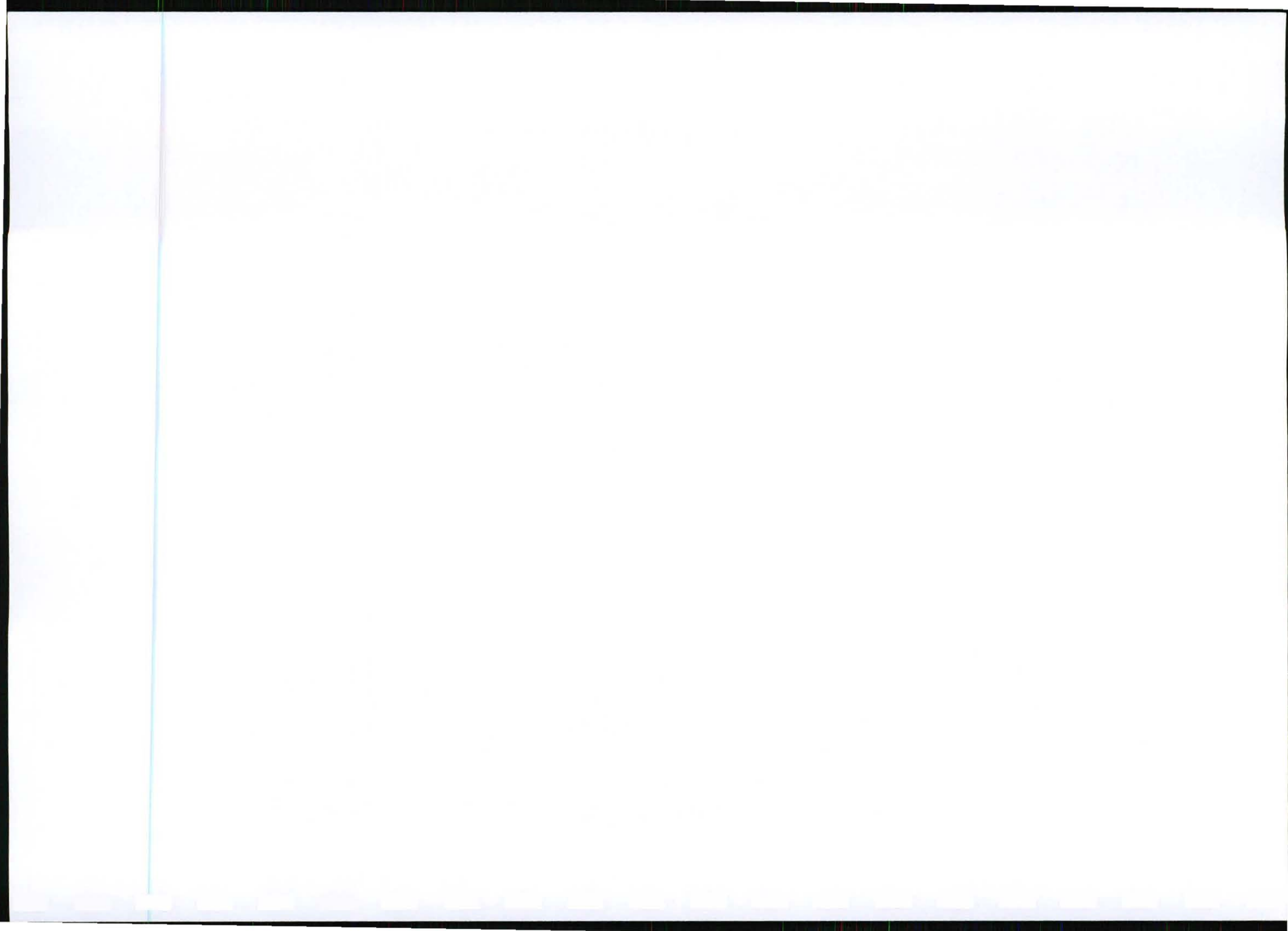




Montagu's Harrier  
Mountain Chat  
Namaqua Dove  
Namaqua Sandgrouse  
Natal Francolin  
Neddicky  
**Old World Painted Snipe (NT)**  
Orange River Francolin  
Orange River White-eye  
Orangebreasted Waxbill  
Orangethroated Longclaw  
Osprey  
Ostrich  
Pale Chanting Goshawk  
Palewinged Starling  
Pallid Harrier  
Palm Swift  
Paradise Flycatcher  
Paradise Whydah  
Pearlbreasted Swallow  
**<sup>N</sup>Peregrine Falcon (NT)**  
Pied Avocet  
Pied Barbet  
Pied Crow  
Pied Kingfisher  
Pied Starling  
**Pinkbacked Pelican (VU)**  
Pinkbilled Lark  
Pintailed Whydah  
Plainbacked Pipit  
Pririt Batis  
Purple Gallinule  
Purple Heron  
Purple Roller  
Pygmy Falcon  
Rattling Cisticola  
Red Bishop  
Redbacked Shrike  
Redbilled Firefinch  
Redbilled Quelea  
Redbilled Teal  
Redbilled Woodhoopoe  
Redbreasted Swallow  
Redcapped Lark  
Redchested Cuckoo  
Redcrested Korhaan  
Redeyed Bulbul  
Redeyed Dove  
Redfaced Mousebird  
Redheaded Finch  
Redknobbed Coot  
Reed Cormorant  
Ringed Plover

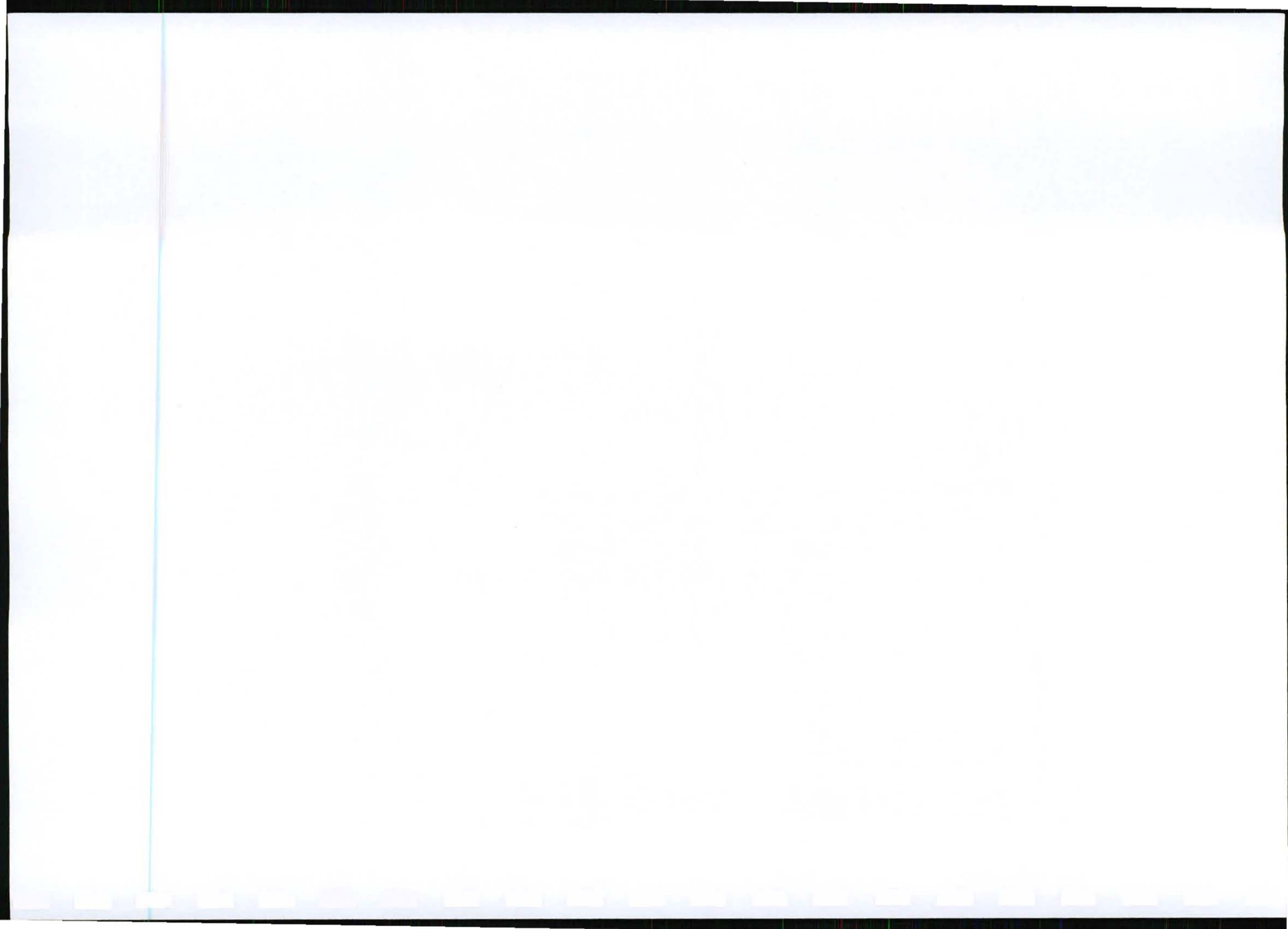
Rock Bunting  
Rock Kestrel  
Rock Martin  
Rock Pigeon  
Ruddy Turnstone  
Ruff  
Rufouscheeked Nightjar  
Rufouseared Warbler  
Rufousnaped Lark  
Sabota Lark  
Sacred Ibis  
Sand Martin  
Sanderling  
Scalyfeathered Finch  
Scimitar billed Woodhoopoe  
**Secretarybird (NT)**  
Shafttailed Whydah  
Shorttoed Rockthrush  
Sociable Weaver  
South African Cliff Swallow  
South African Shelduck  
Southern Greyheaded Sparrow  
Southern Pochard  
Southern Yellowbilled Hornbill  
Spikeheeled Lark  
Spotted Dikkop  
Spotted Eagle Owl  
Spotted Flycatcher  
Spurwinged Goose  
Squacco Heron  
Steelblue Widowfinch  
Steppe Buzzard  
Stonechat  
Swainson's Francolin  
Swallowtailed Bee-eater  
**Tawny Eagle (VU)**  
Temminck's Courser  
Threebanded Plover  
Threestreaked Tchagra  
Tinkling Cisticola  
Titbabbler  
Violeteared Waxbill  
Wattled Starling  
Western Redfooted Kestrel  
Whimbrel  
Whiskered Tern  
**White Pelican (NT)**  
White Stork  
Whitebacked Duck  
Whitebacked Mousebird  
**Whitebacked Vulture (VU)**  
Whitebellied Sunbird  
Whitebreasted Cormorant





Whitebrowed Sparrowweaver  
Whitefaced Duck  
Whitefaced Owl  
Whitefronted Bee-eater  
Whiterumped Swift  
Whitethroat  
Whitethroated Canary  
Whitethroated Swallow  
Whitewinged Korhaan  
Whitewinged Tern  
Willow Warbler  
Wood Sandpiper  
Yellow Canary  
Yellow Wagtail  
Yellowbellied Eremomela  
Yellowbilled Duck  
Yellowbilled Egret  
Yellowbilled Kite  
**Yellowbilled Stork (NT)**





**Appendix 6: Species protected under the National Environmental Management:  
Biodiversity Act, 2004 (Act 10 of 2004)**

(as updated in R. 1187, 14 December 2007)

**CRITICALLY ENDANGERED SPECIES**

**Reptilia**

Loggerhead sea turtle  
Leatherback sea turtle  
Hawksbill sea turtle

**Aves**

Wattled crane  
Blue swallow  
Egyptian vulture  
Cape parrot

**Mammalia**

Riverine rabbit  
Rough-haired golden mole

**Flora**

Adenium swazicum  
Aloe pillansii  
Diaphanathe millarii  
Dioscorea ebutsniorum  
Encephalartos aemulans  
Encephalartos brevifoliolatus  
Encephalartos cerinus  
Encephalartos dolomiticus  
Encephalartos heenanii  
Encephalartos hirsutus  
Encephalartos inopinus  
Encephalartos latifrons  
Encephalartos middelburgensis  
Encephalartos nubimontanus  
Encephalartos woodii

**ENDANGERED SPECIES**

**Reptilia**

Green turtle  
Giant girdled lizard  
Olive ridley turtle  
Geometric tortoise

**Aves**

Blue crane  
Grey crowned crane  
Saddle-billed stork  
Bearded vulture  
White-backed vulture  
Cape vulture  
Hooded vulture



Pink-backed pelican  
Pel's fishing owl  
Lappet-faced vulture

**Mammalia**

Robust golden mole  
Tsessebe  
Black rhinoceros  
Mountain zebra  
African wild dog  
Gunning's golden mole  
Oribi  
Red squirrel  
Four-toed elephant-shrew

**Flora**

Angraecum africanae  
Encephalartos arenarius  
Encephalartos cupidus  
Encephalartos horridus  
Encephalartos laevifolius  
Encephalartos lebomboensis  
Encephalartos msinganus  
Jubaeopsis caffra  
Siphonochilus aethiopicus  
Warburgia salutaris  
Newtonia hilderbrandi

**VULNERABLE SPECIES**

**Aves**

White-headed vulture  
Tawny eagle  
Kori bustard  
Black stork  
Southern banded snake eagle  
Blue korhaan  
Taita falcon  
Lesser kestrel  
Peregrine falcon  
Bald ibis  
Ludwig's bustard  
Martial eagle  
Bataleur  
Grass owl

**Mammalia**

Cheetah  
Samango monkey  
Giant golden mole  
Giant rat  
Bontebok  
Tree hyrax

Roan antelope  
Pangolin  
Juliana's golden mole  
Suni  
Large-eared free-tailed bat  
Lion  
Leopard  
Blue duiker

**Flora**

Aloe albida  
Encephalartos cycadifolius  
Encephalartos Eugene-maraisii  
Encephalartos ngovanus  
Merwillia plumbea  
Zantedeschia jucunda

**PROTECTED SPECIES**

**Amphibia**

Giant bullfrog  
African bullfrog

**Reptilia**

Gaboon adder  
Namaqua dwarf adder  
Smith's dwarf chameleon  
Armadillo girdled lizard  
Nile crocodile  
African rock python

**Aves**

Southern ground hornbill  
African marsh harrier  
Denham's bustard  
Jackass penguin

**Mammalia**

Cape clawless otter  
South African hedgehog  
White rhinoceros  
Black wildebeest  
Spotted hyaena  
Black-footed cat  
Brown hyaena  
Serval  
African elephant  
Spotted-necked otter  
Honey badger  
Sharpe's grysbok  
Reedbuck  
Cape fox

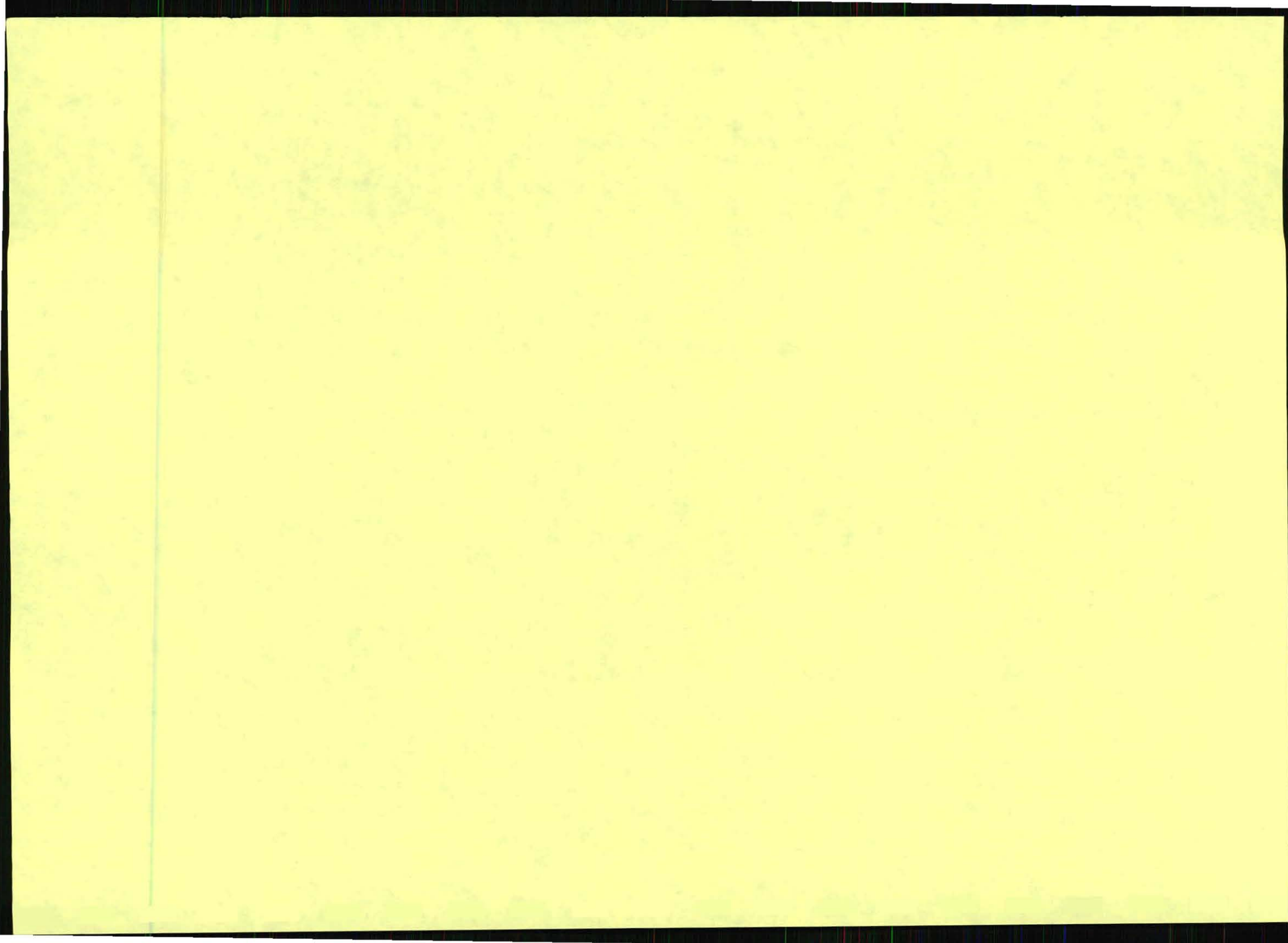


## **Flora**

Adenia wilmsii  
Aloe simii  
Clivia mirabilis  
Disa macrostachya  
Disa nubigena  
Disa physodes  
Disa procera  
Disa sabulosa  
Encephelartos altensteinii  
Encephelartos caffer  
Encephelartos dyerianus  
Encephelartos frederici-guilielmi  
Encephelartos ghellinckii  
Encephelartos humilis  
Encephelartos lanatus  
Encephelartos lehmannii  
Encephelartos longifolius  
Encephelartos natalensis  
Encephelartos paucidentatus  
Encephelartos princeps  
Encephelartos senticosus  
Encephelartos transvenosus  
Encephelartos trispinosus  
Encephelartos umbeluziensis  
Encephelartos villosus  
Euphorbia clivicola  
Euphorbia meloformis  
Euphorbia obesa  
Harpagophytum procumbens  
Harpagophytum zeyherii  
Hoodia gordonii  
Hoodia currorii  
Protea odorata  
Stangeria eriopus

Appendix G:  
Soil Scoping Study







**SCOPING PHASE REPORT**

**SOIL, LAND USE, LAND CAPABILITY AND AGRICULTURAL POTENTIAL  
SURVEY:**

**PROPOSED HARTEBEESTPAN PV SOLAR ENERGY FACILITY IN THE  
NORTH WEST PROVINCE**

January 10<sup>th</sup>, 2012

**Compiled by:**

**J.H. van der Waals**

**(PhD Soil Science, Pr.Sci.Nat)**

Member of:

Soil Science Society of South Africa (SSSSA)

Soil Science Society of America (SSSA)

Accredited member of:

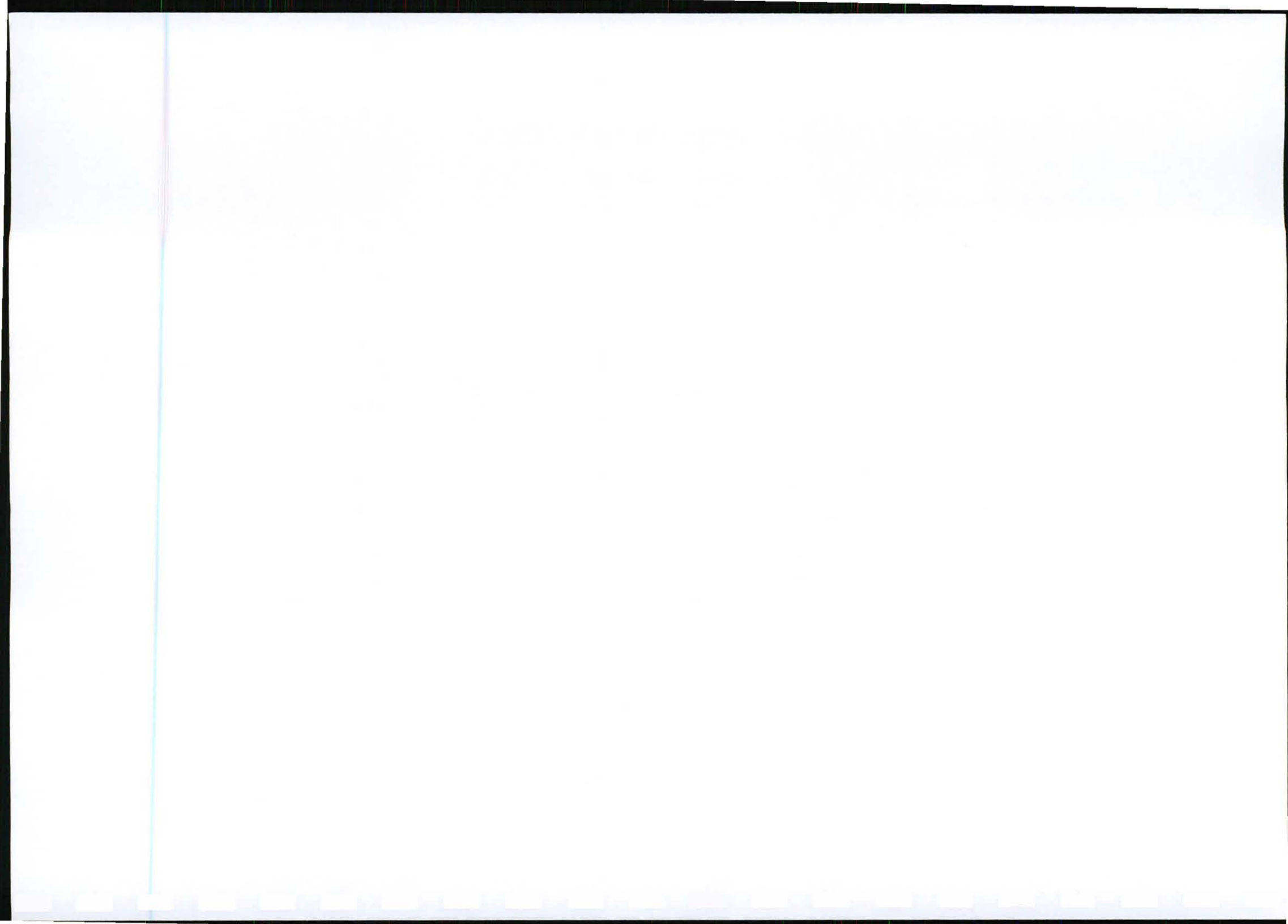
South African Soil Surveyors Organisation (SASSO)

Registered with:

The South African Council for Natural Scientific Professions

Registration number: 400106/08





## **DECLARATION**

I, Johan Hilgard van der Waals, declare that I –

- 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 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.

**J.H. VAN DER WAALS**  
**TERRA SOIL SCIENCE**



## Table of Contents

Declaration.....	ii
1. TERMS OF REFERENCE .....	1
2. INTRODUCTION.....	1
3. DESCRIPTION OF THE SURVEY AREA .....	1
3.1 Survey Area Boundary .....	1
3.2 Survey Area Physical Features .....	1
4. SOIL, LAND CAPABILITY, LAND USE SURVEY AND AGRICULTURAL POTENTIAL SURVEY.....	1
4.1 Method of Soil, Land Capability, Land Use Survey and Agricultural Potential Survey .....	1
4.1.1 Phase 1: Land Type Data .....	1
4.1.2 Phase 2: Aerial Photograph Interpretation and Land Use Mapping .....	3
4.2 Soil, Land Capability, Land Use and Agricultural Potential Survey Results .....	3
4.2.1 Phase 1: Land Type Data .....	3
4.2.2 Phase 2: Aerial Photograph Interpretation and Land Use/Capability Mapping .....	3
5. INTERPRETATION OF SOIL, LAND CAPABILITY AND LAND USE SURVEY RESULTS .....	5
5.1 Agricultural Potential .....	5
5.2 Overall Soil Impacts .....	6
6. ANTICIPATED SOIL / LAND USE / AGRICULTURE IMPACTS.....	7
6.1 Physical Soil Disturbance Due To Construction Activities.....	7
6.2 Impacts on Current Land Use Due To Construction Activities.....	7
6.3 Impacts on Agricultural Potential Due To Construction Activities.....	8
7. CONCLUSIONS AND RECOMMENDATIONS .....	8
8. LIMITATIONS / GAPS IN KNOWLEDGE .....	9
References .....	9

# **SCOPING PHASE SOIL, LAND USE, LAND CAPABILITY AND AGRICULTURAL POTENTIAL SURVEY – PROPOSED HARTEBEESTPAN PV SOLAR ENERGY FACILITY IN THE NORTH WEST PROVINCE**

## **1. TERMS OF REFERENCE**

Terra Soil Science (TSS) was commissioned by Savannah Environmental (Pty) Ltd to undertake a scoping level soil, land use, land capability and agricultural potential survey for the proposed Hartebeestpan PV Solar Energy Facility in the North West Province.

## **2. INTRODUCTION**

A scoping level soil, land use, land capability and agricultural potential survey was conducted for the proposed Hartebeestpan PV Solar Energy Facility in the North West Province.

## **3. DESCRIPTION OF THE SURVEY AREA**

### **3.1 Survey Area Boundary**

The survey area lies between 27° 56' 39" and 27° 58' 41" south and 25° 01' 07" and 25° 02' 35" east approximately 14 km east-south-east of the town of Christiana in the North West Province (**Figure 1**).

### **3.2 Survey Area Physical Features**

The survey area lies on level terrain without a clear slope or aspect. The altitude varies around 1220 m above mean sea level. The geology is dominated by andesitic and basaltic lava with occurrences of calcrete, tillite and quartzite.

## **4. SOIL, LAND CAPABILITY, LAND USE SURVEY AND AGRICULTURAL POTENTIAL SURVEY**

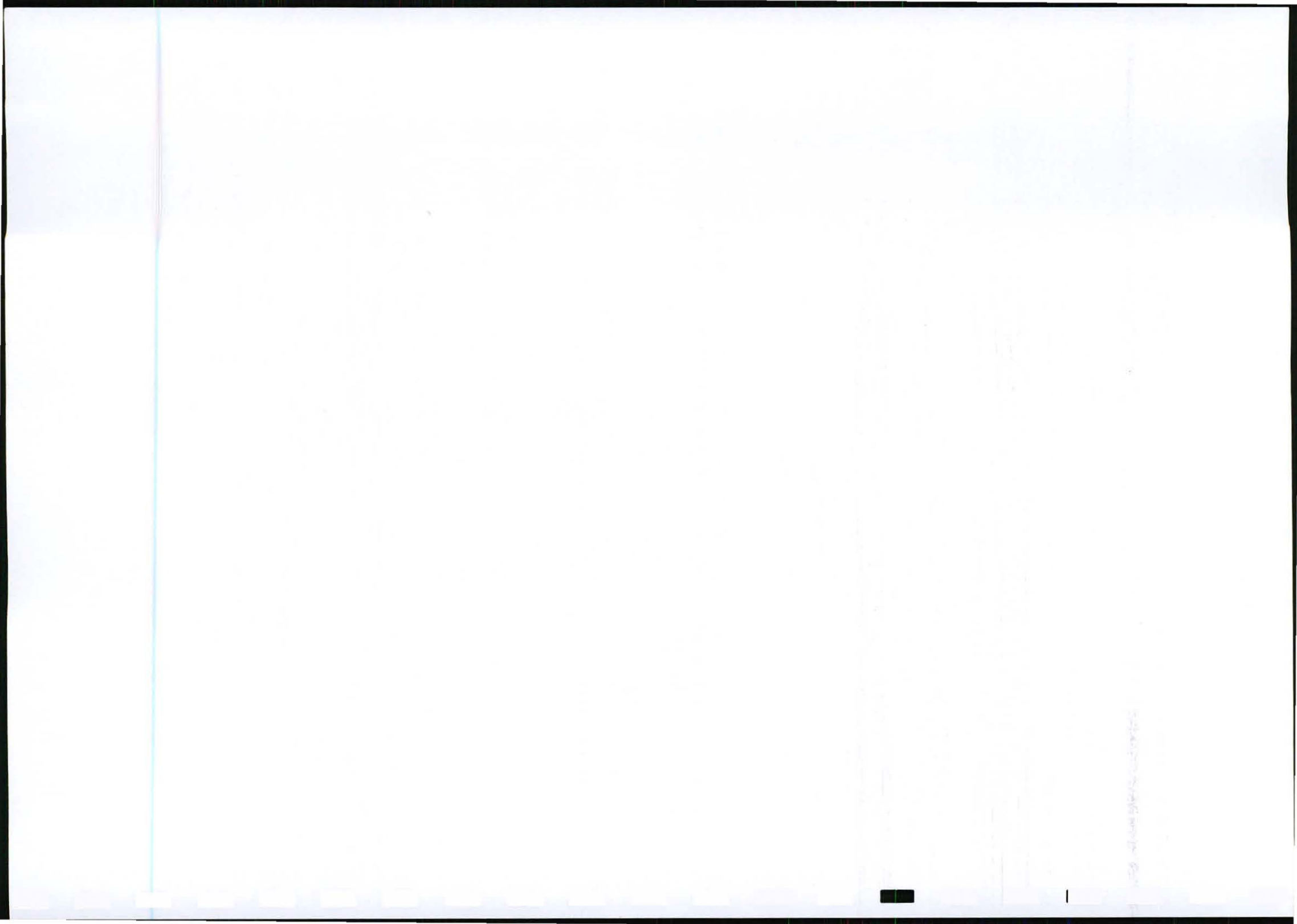
### **4.1 Method of Soil, Land Capability, Land Use Survey and Agricultural Potential Survey**

The scoping soil, land capability, land use and agricultural potential surveys were conducted in two phases.

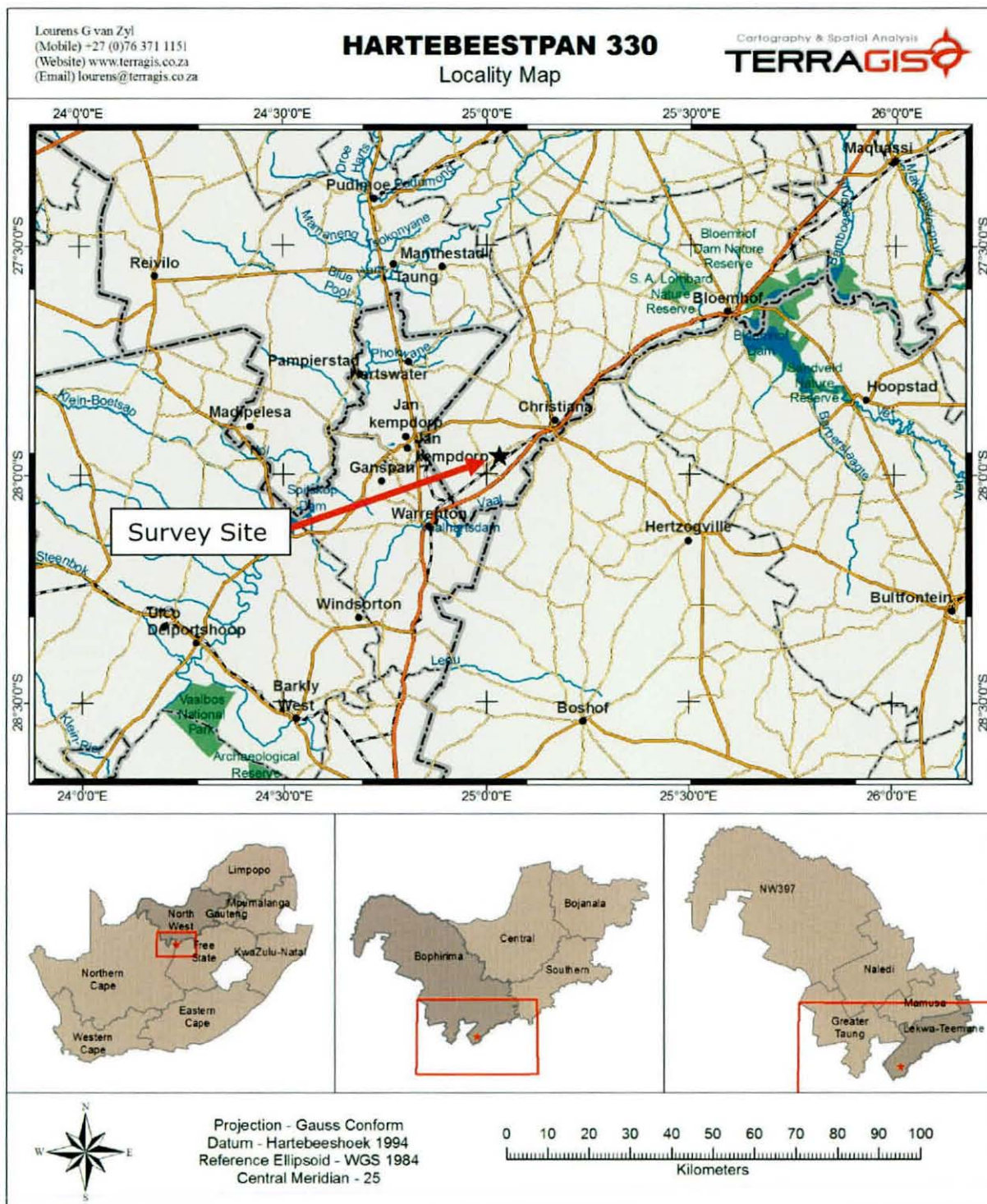
#### **4.1.1 Phase 1: Land Type Data**

Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC). The land type data is presented at a scale of 1:250 000 and entails the division of land into land types, typical terrain cross sections for the land type and the presentation of dominant soil types for each of the identified terrain units (in the



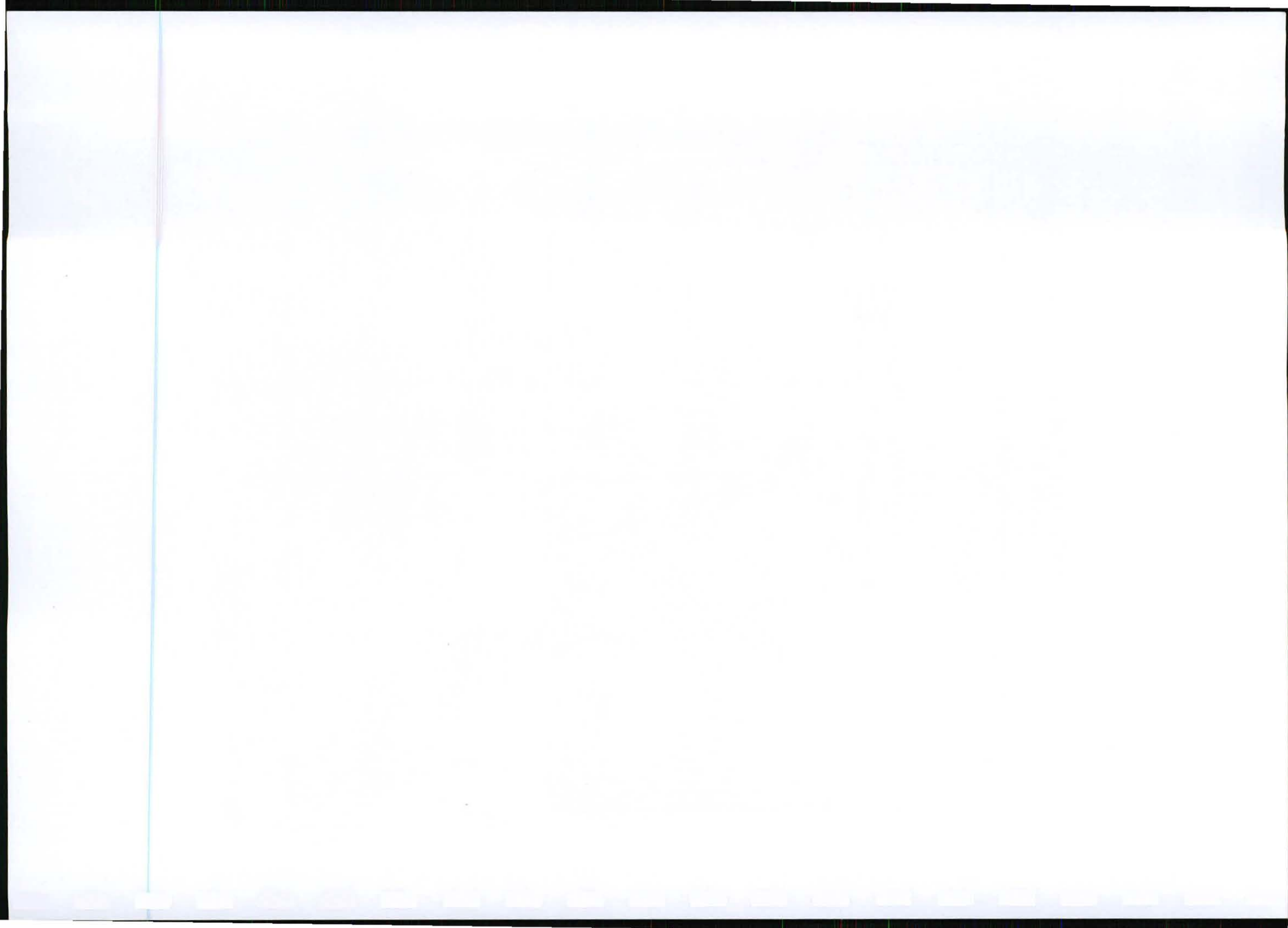


cross section). The soil data is classified according to the Binomial System (MacVicar et al., 1977). The soil data was interpreted and re-classified according to the Taxonomic System (MacVicar, C.N. et al. 1991).



**Figure 1** Locality of the survey site





#### **4.1.2 Phase 2: Aerial Photograph Interpretation and Land Use Mapping**

The most up to date aerial photographs of the site were obtained from Google Earth. The image was used to interpret aspects such as land use and land cover as well as historic land uses such as cultivation.

### **4.2 Soil, Land Capability, Land Use and Agricultural Potential Survey Results**

#### **4.2.1 Phase 1: Land Type Data**

The site falls into the **Ae36** land type (Land Type Survey Staff, 1972 - 2006). (Refer to **Figure 2** for the land type map of the area). Below follows a brief description of the land type in terms of soils, land capability, land use and agricultural potential.

##### **Land Type Ae36**

Soils: Predominantly shallow to intermediate depth apedal (structureless), sandy loam to sandy clay loam soils that are eutrophic or lime containing. Structured soils also occur and exhibit duplex as well as stable structure natures. Low lying areas and pans that occur throughout the landscape exhibit higher clay content and often structured soils with signs of wetness (morphological). The depression areas are characterised by soils with signs of incipient pedogenesis in the form of cutanic character and alluvial stratification.

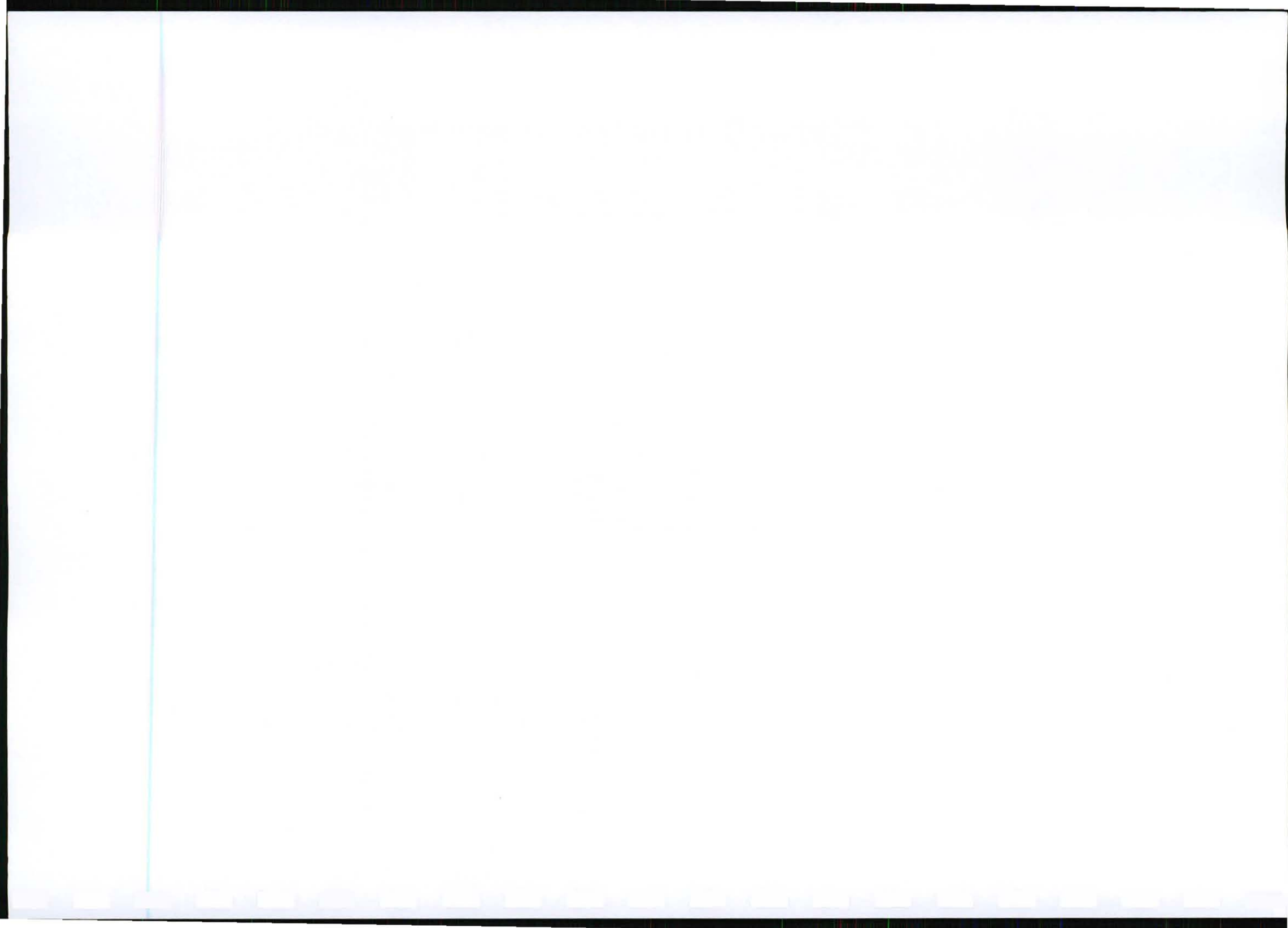
Land capability and land use: Predominantly extensive grazing due to climatic constraints in terms of dryland crop production. Due to the level terrain soil erosion is not a major factor.

Agricultural potential: Low potential due to the relatively low and erratic rainfall (around 400 mm per year – **Figure 3**). Certain areas can be used for irrigated crop production but then only if adequate water (quantity and quality) is available.

#### **4.2.2 Phase 2: Aerial Photograph Interpretation and Land Use/Capability Mapping**

The interpretation of the Google Earth image yielded one land use namely extensive grazing (**Figure 4**). The land capability of the site mimics the land use and is classified as "grazing". From the satellite imagery it appears that there are a number of depressions and potential pans on the site. From previous experience in the general area it is clear that these features on satellite images do not necessarily constitute wet areas. Rather, these areas represent potential depositional environments in a semi-arid climate and they are therefore probably indicative of areas with an increased incidence of lime and gypsum in the soil profiles.



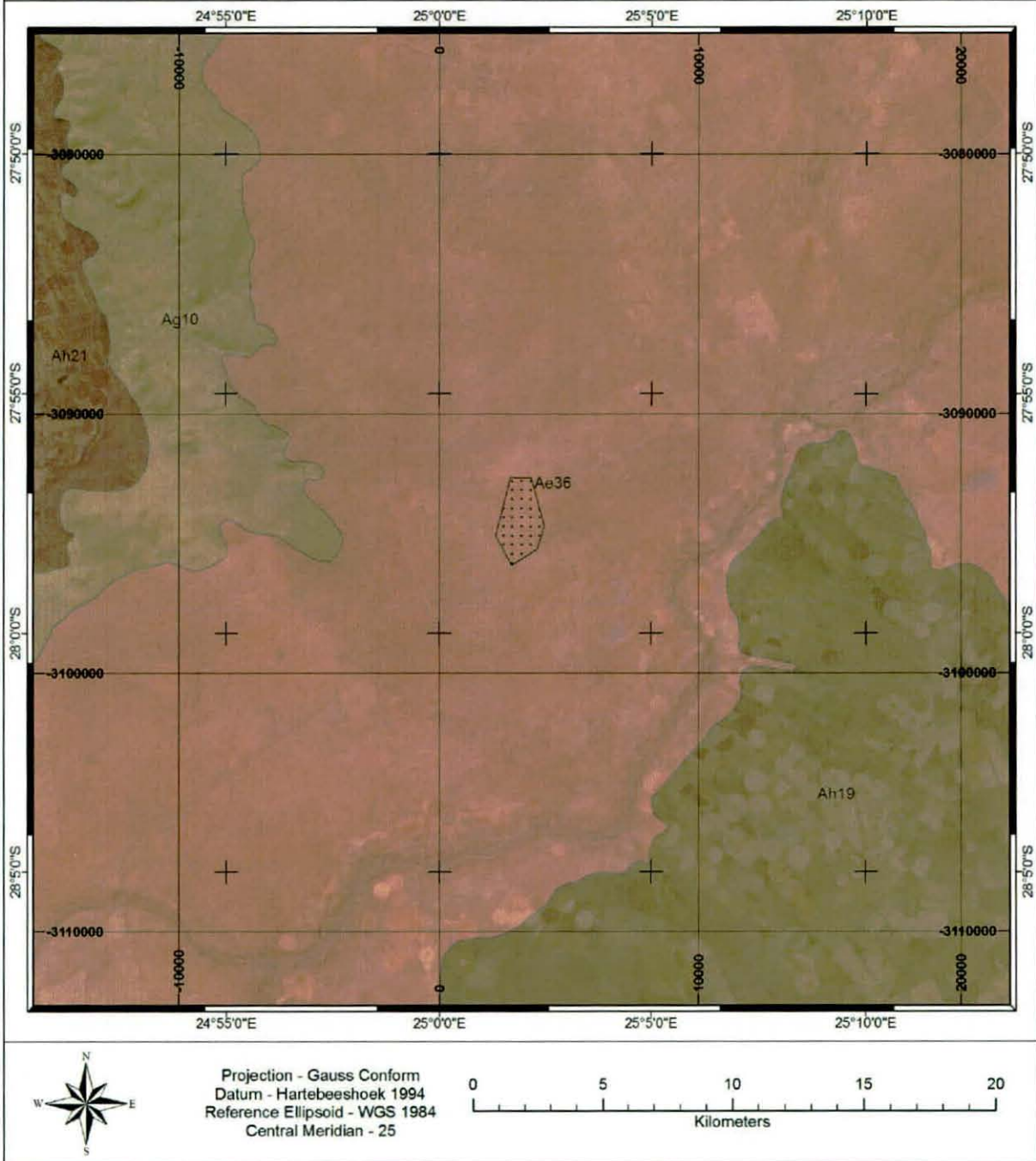


Lourens G van Zyl  
(Mobile) +27 (0)76 371 1151  
(Website) www.terragis.co.za  
(Email) lourens@terragis.co.za

# HARTEBEESTPAN 330

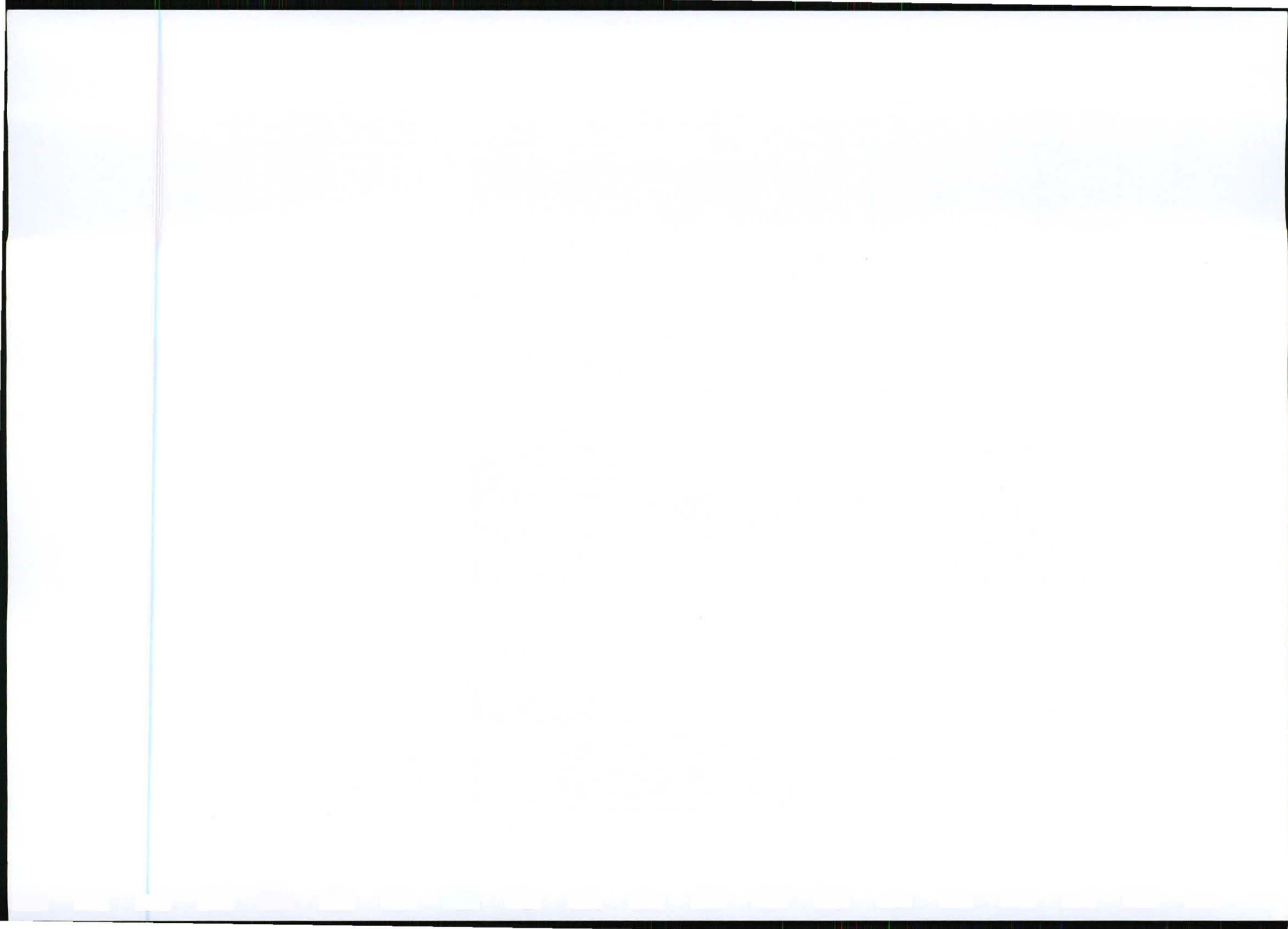
## Land Types Map

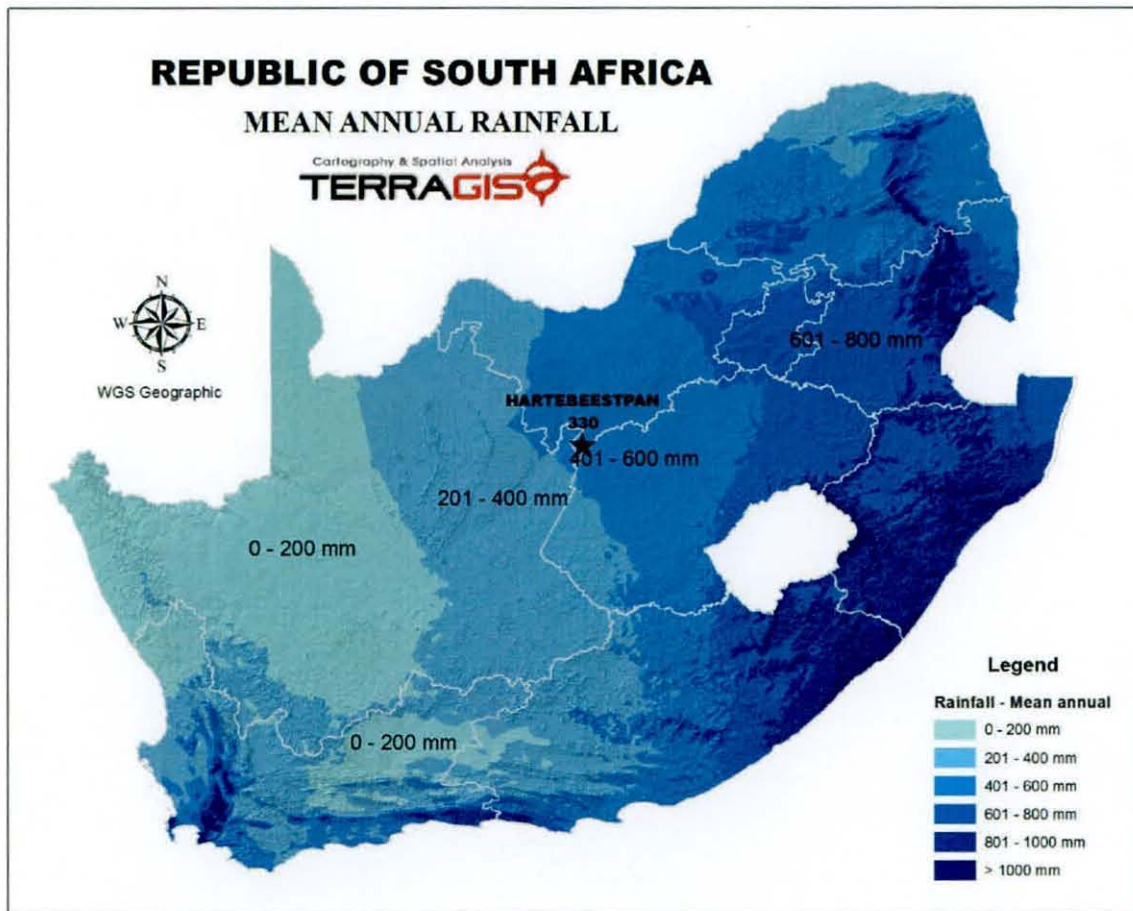
Cartography & Spatial Analysis  
**TERRAGIS**



**Figure 2** Land type map of the survey site with location of development phases







**Figure 3** Rainfall map of South Africa indicating the survey site

## 5. INTERPRETATION OF SOIL, LAND CAPABILITY AND LAND USE SURVEY RESULTS

The interpretation of the land use and land capability results yielded a number of aspects that are of importance to the project.

### 5.1 Agricultural Potential

The agricultural potential of the site is low and limited to extensive grazing mainly due to the low and erratic rainfall but also due to soil constraints. Although the soils are considered to be suitable for irrigated agriculture the limiting factor here is in all probability the lack of adequate water sources for such land uses. In the absence of adequate water the agricultural potential is limited to grazing land uses with a distinct requirement for adequate grazing rotation and field rest periods (for adequate recovery).