MULILO
RENEWABLE PROJECT DEVELOPMENTS

Environmental Impact Assessment for the proposed Kuruman Phase 1 Wind Energy Facility near Kuruman in the Northern Cape

# Draft Scoping Report

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MULILO

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# Draft Scoping Report

# APPENDIX A:

## Curriculum Vitae of the Environmental Assessment Practitioners

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CSIR
Jan Cilliers Street
PO Box 320
Stellenbosch
7600 South Africa

Phone: +27 21 888 2400
Fax: +27 21 888 2693
Email:
plochner@csir.co.za

# Curriculum Vitae: Paul Lochner – Technical Advisor and Quality Assurance (EAPSA) Certified

| | |
|---|---|
| **Name of firm:** | CSIR |
| **Name of staff:** | Paul Lochner |
| **Profession:** | Environmental Assessment and Management |
| **Position in firm:** | Manager: CSIR Environmental Management Services |
| **Years' experience:** | 24 years |
| **Nationality:** | South African |

**BIO-SKETCH:**

Paul Lochner commenced work at CSIR in 1992, after completing a degree in Civil Engineering and a Masters in Environmental Science, both at the University of Cape Town. His initial work at CSIR focused on sediment dynamics and soft engineering applications in the coastal zone, in particular, beach and dune management. He conducted several shoreline erosion analyses and prepared coastal zone management plans for beaches. He also prepared wetland management plans.

As the market for environmental assessment work grew, he led Environmental Impact Assessments (EIAs), in particular for coastal resort developments and large-scale industrial developments located on the coast; and Environmental Management Plans (EMPs), in particular for wetlands, estuaries and coastal developments. He has also been involved in researching and applying higher-level approaches to environmental assessment and management, such as Strategic Environmental Assessment (SEA). In 1998-1999, he coordinated the SEA research programme within the CSIR, which led to him being a lead author of the Guideline Document for SEA in South Africa, published by CSIR and national Department of Environmental Affairs (DEA) in February 2000.

In 1999 and 2000, he was the project manager for the legal, institutional, policy, financial and socio-economic component of the Cape Action Plan for the Environment ("CAPE"), a large-scale multi-disciplinary study to ensure the sustainable conservation of the Cape Floral Kingdom. This was funded by the Global Environmental Fund (GEF) and prepared for WWF-South Africa. The study required extensive stakeholder interaction, in particular with government institutions, leading to the development of a Strategy and Action Plan for regional conservation.

In July 2003, he was certified as an Environmental Assessment Practitioner by the Interim Certification Board for Environmental Assessment Practitioners of South Africa.

He has authored several guidelines for government. In 2004, he was lead author of the *Overview of IEM* document in the updated Integrated Environmental Management (IEM) Information Series published by national Department of Environmental Affairs and Tourism (DEAT). In 2005, he was part of the CSIR team that prepared the series entitled *Guidelines for involving specialists in EIA processes* for the Western Cape Department of Environmental Affairs and Development Planning (DEADP); and he authored the *Guideline for Environmental Management Plans* published by Western Cape government in 2005. In 2006-2007, he worked closely with the (then) Dept of Minerals and Energy (DME) of South Africa to prepare a Guideline for Scoping, Environmental Impact Assessment and Environmental Management Plans for mining in South Africa.

Over the past 20 years has been closely involved with several environmental studies for industrial and port-related projects in Coega Industrial Development Zone (IDZ), near Port Elizabeth. This included the SEA for the establishment of the Coega IDZ in 1996/7, an EIA and EMP for a proposed aluminium smelter in 2002/3, and assistance with environmental permit applications for air, water and waste. At the Coega IDZ and port, he has also conducted environmental assessments for port development, LNG storage and a combined cycle gas turbine power plant, manganese export, rail development, marine pipelines, and wind energy projects.

Since 2009, he has undertaken numerous EIAs for the renewable energy sector, in particular for wind and solar photovoltaic energy projects. In these EIAs, he has been project leader and integrated the specialist findings from a range of specialist disciplines.

He is currently project leader on two Strategic Environmental Assessments (SEAs) that are being undertaken for national DEA. These SEAs are to support the implementation of the Strategic Integrated Projects (SIPs) that are being promoted by the Presidential Infrastructure Coordinating Committee (PICC). The SEA for Wind and Solar Photovoltaic Energy for South Africa is being conducted over 2013-2014, and the SEA for electricity grid infrastructure commenced January 2014.

Since 2009, Paul has been the manager of the Environmental Management Services (EMS) group within CSIR. This group currently consists of approximately 20 environmental assessment practitioners and a group assistant, with offices in Stellenbosch and Durban. EMS focuses on conducting complex environmental studies in challenging environments, such as remote and data poor regions in Africa (e.g. Cameroon, Gabon, Angola, Namibia and Ethiopia). We also specialise in environmental studies for emerging and innovative technologies, drawing on research and applied scientific expertise within CSIR. Our role is to assist in ensuring the sustainability of projects in terms of environmental and social criteria, by providing a range of environmental services that extend across the project lifecycle, from the pre-feasibility stage through to feasibility, commissioning, operations and closure. We provide this service to government, international agencies, private sector and non-government organisations.

## EMPLOYMENT TRACK RECORD

The following table presents a sample of the projects that Paul Lochner has been involved in to this date:

| Completion Date | Project description | Role | Client |
|---|---|---|---|
| In progress | **SEA for the identification of Energy Corridors** and Development of a **Gas Pipeline Network** for South Africa | Project leader | Dept. of Environmental Affairs (DEA), DoE and DPE |
| In progress | **SEA for Aquaculture** Development in South Africa (marine and freshwater) | Project leader | DEA and DAFF |
| 2015-2017 | **SEA for the Square Kilometre Array** radio-telescope in the Karoo, South Africa | Project leader | DEA and DST |
| 2015-2017 | **SEA for Shale Gas Development** in South Africa | Project co-leader | DEA, DMR, DoE, DST, DWS |
| 2015-2016 | SEA for the development of **Electrical Grid Infrastructure** for South Africa | Project leader | DEA |
| 2016-2017 | EIA for the 75 MW x 12 **solar photovoltaic** energy projects near Dealesville, Free State | Project Leader | Mainstream Renewable Power SA |
| 2014-2015 | SEA of **planning** for the far south Cape | Project Leader | City of Cape Town |

| Completion Date | Project description | Role | Client |
|---|---|---|---|
| | Peninsula | | |
| 2013-2015 | EIA for the Ishwati Emoyeni 140 MW **wind energy project** and supporting electrical infrastructure near Murraysburg, Western Cape | Project Leader | Windlab |
| 2013-2015 | EIA for the Saldanha marine outfall **pipeline** | Project Leader | Frontier Saldanha Utilities |
| 2012-2015 | SEA for identification of **renewable energy zones** for wind and solar PV projects in South Africa | Project leader | DEA |
| 2012-2013 | **Environmental Screening Study for a desalination plant** for the City of Cape Town | Project leader | City of Cape Town & WorleyParsons |
| 2012-2013 | EIA for **LNG Import** to the Mossel Bay Gas-to-Liquid refinery (stopped end of Scoping) | Project leader | PetroSA |
| 2012-2013 | EIA for the **desalination plant** for the Saldanha area | Project leader | West Coast District Municipality & WorleyParsons |
| 2012-2013 | EIA for the **manganese export terminal** at the Port of Ngqura and Coega IDZ | Project leader | Transnet |
| 2011 - 2012 | EIA for the **100 MW solar photovoltaic** project proposed by Mainstream Renewable Power at Blocuso, near Keimoes in the Northern Cape | Project leader | Mainstream Renewable Power |
| 2011 – 2012 | EIA for the **100 MW solar photovoltaic** project proposed by Mainstream Renewable Power at Roode Kop Farm, near Douglas, in the Northern Cape | Project leader | Mainstream Renewable Power |
| 2011 – 2012 | EIA for the 75 MW **solar photovoltaic project** proposed by Solaire Direct at **GlenThorne**, near Bloemfontein in the Free State | Project leader | Solaire Direct |
| 2011 – 2012 | EIA for the 75 MW **solar photovoltaic project** proposed by SolaireDirect at **Valleydora**, near Springfontein in the Free State | Project leader | Solaire Direct |
| 2010-2011 | More than 10 Basic Assessments (BAs) for **solar photovoltaic projects** in the western cape, Northern Cape, Eastern Cape and Free State | Project leader | Various clients including Dutch, German, French and South African companies |
| 2010/2011 | **EIA for the Langerfontein** wind project near Darling, Western Cape. | Project leader | Mr Herman Oelsner, Khwe Khoa |
| 2010/2011 | **EIA for a 100 MW wind project at Zuurbron and a 50 MW wind project Broadlands** in the Eastern Cape | Project leader | WindCurrent SA (German-based company) |
| 2010/2011 | **EIA for the proposed 143 MW Biotherm wind energy project near Swellendam,** | Project leader | Biotherm South Africa (Pty) Ltd |

| Completion Date | Project description | Role | Client |
|---|---|---|---|
| | Western Cape, South Africa | | |
| 2010/2011 | **EIA for the proposed InnoWind wind energy projects near Swellendam, Heidelberg, Albertinia and Mossel Bay (totalling approx 210 MW),** Western Cape, South Africa | Project leader | InnoWind South Africa (Pty) Ltd |
| 2009/2010 | **EIA for the proposed Electrawinds wind energy facility** of 45-75 MW capacity in the Coega IDZ, Eastern Cape | Project leader | Electrawinds N.V. (Belgium) |
| 2009/2010 | **EIA for proposed 180 MW Jeffreys Bay wind energy project,** Eastern Cape | Project Leader and co-author | Mainstream Renewable Power South Africa |
| 2009/2010 | **Basic Assessment for the national wind Atlas for South Africa** | Project leader | SANERI and SA Wind Energy Programme, Dept of Energy |
| 2009/2010 | **EIA for the proposed Gecko soda plant,** Otjivalunda and Arandis, Namibia (cancelled) | Project leader | Gecko, Namibia |
| 2009-2010 | **EIA for the proposed desalination plant** at Swakopmund, Namibia | Project leader | NamWater, Namibia |
| 2009 | **EMP for the Operational Phase of the Berg River Dam**, Franschoek, South Africa | Project leader and report co-author | TCTA, South Africa |
| 2009/2010 *(on hold)* | **EIA for the proposed crude oil refinery** at Coega, South Africa | Project leader and lead author | PetroSA, South Africa |
| 2008 | **Environmental Risk Review** for proposed LNG/CNG import to Mossel Bay, South Africa | Project leader and lead author | PetroSA, South Africa |
| 2008 | **Review of the Business Plan** for catchment management for the Berg Water Dam Project, Franschhoek, South Africa | Project reviewer and co-author | TCTA, South Africa |
| 2007 – 2010 | **EIA for proposed Jacobsbaai Tortoise Reserve eco-development**, Saldanha, Western Cape | Project Leader and co-author | Jacobsbaai Tortoise Reserve (Pty) Ltd |
| 2007 – 2010 | **Independent reviewer** for the EIA proposed Amanzi lifestyle development, Port Elizabeth | Independent reviewer appointed to advise EAP | Public Process Consultants and Pam Golding |
| 2007 – 2008 | **EIA for proposed 18 MW Kouga wind energy project,** Eastern Cape | Project Leader and co-author | Genesis Eco-Energy (Approved by DEDEA in March 2009) |
| 2007 | **Review of EIA for the proposed Hanglip Eco-Development**, Plettenberg Bay, Western Cape | Co-author of review of EIA, undertaken on behalf of DEADP | Dept of Environmental Affairs & Development Planning, Western Cape |
| 2006-2007 | **Scoping phase for the EIA for the proposed Coega LNG-to-Power Project** at the Port of Ngqura, Coega IDZ | Project Leader and co-author | Eskom and iGas |
| 2006-2007 | **Guideline** for Scoping, Environmental Impact Assessment and Environmental Management Plans for mining in South | Project leader and co-author | Dept of Minerals and Energy (DME), South Africa |

| Completion Date | Project description | Role | Client |
|---|---|---|---|
| | Africa | | |
| 2006 | **Environmental Impact Assessment (EIA)** for the extension of the Port of Ngqura, Eastern Cape | Project Leader and co-author | Transnet |
| 2006 | **Integrating Sustainability Into Strategy: Handbook** (Version 1) | Project Leader and co-author | CSIR (STEP research report) |
| 2005 | **Technology Review** for the proposed aluminium smelter at Coega, South Africa | Project Leader and lead author | Alcan, Canada |
| 2005 | **Environmental and Social Impact Assessment (ESIA) report** for the proposed alumina refinery near Sosnogorsk, Komi Republic, Russia | Project manager and co-author | Komi Aluminium, Russia, IFC, EBRD |
| 2005 | **Guideline for Environmental Management Plans (EMPs)** for the Western Cape province, including conducting a training course for provincial government | Author | Dept of Environmental Affairs & Development Planning, Western Cape |
| 2005 | **Guideline for the review of specialist studies** undertaken as part of environmental assessments | Member of Steering Committee and project facilitator | Dept of Environmental Affairs & Development Planning, Western Cape |
| 2004 | **Review of Strategic Management Plan** for Table Mountain National Park (2001-2004) | Reviewer and co-author | South African National Parks |
| 2004 | **Strategic Needs Assessment Process** for mainstreaming sustainable development into business operations | Researcher and co-author | CSIR (internal research) |
| 2004 | **Environmental Monitoring Committees** booklet in the IEM Information Series for DEAT | Contributing author | Department of Environmental Affairs and Tourism (DEAT) |
| 2004 | **Overview of Integrated Environmental Management** (IEM) booklet in the IEM Information Series | Lead author and researcher | DEAT |
| 2003 | **Environmental Screening Study** for gas power station, South Africa | Project Manager and lead author | Eskom, iGas and Shell |
| 2003 | **Environmental Management Programme** (EMP) Framework for the proposed Coega Aluminium Smelter; and assistance with preparing permit and licence applications | Project Manager and lead author | Pechiney, France |
| 2003 | **Environmental Management Plan** for the Operational Phase of the wetlands and canals at Century City, Cape Town | Project leader and lead author | Century City Property Owners' Association |
| 2002 | **Environmental Impact Assessment** for the proposed Pechiney aluminium smelter at Coega, South Africa | Project Manager and lead author | Pechiney, France |
| 2002 - 2003 | **Research project:** Ecological impact of large-scale groundwater abstraction on the Table Mountain Group aquifer | Project Manager | Water Research Commission |
| 2002 | **Environmental Management Plan** for the Eskom Wind Energy Demonstration Facility | Co-author | Eskom |

| Completion Date | Project description | Role | Client |
|---|---|---|---|
| | in the Western Cape | | |
| 2001-2002 | **Environmental Impact Assessment** for the Eskom Wind Energy Demonstration Facility in the Western Cape | Quality control & co-author | Eskom |
| 2001 | **Environmental Due Diligence** study of four strategic oil storage facilities in South Africa | Project manager and co-author | SFF Association |
| 2000 | **Cape Action Plan for the Environment**: a biodiversity Strategy and Action Plan for the Cape Floral Kingdom - legal, institutional, policy, financial and socio-economic component | Project manager and contributing writer | World Wide Fund for Nature (WWF): South Africa |
| 1999 | **Environmental Management Plan** for the establishment phase of the wetlands and canals at Century City, Cape Town | Project manager and lead author | Monex Development Company |
| 1999 | **Environmental Management Programme** for the Thesen Islands development, Knysna | Process design and Co-author | Chris Mulder Associates Inc; Thesen and Co. |
| 1999 | **Management Plan** for the coastal zone between the Eerste and Lourens River, False Bay, South Africa | Project manager and lead author | Heartland Properties and Somchem (a Division of Denel) |
| 1998 | **Environmental Assessment** of the Mozal Matola Terminal Development proposed for the Port of Matola, Maputo, Mozambique | Project manager and author. | *SNC-Lavalin-EMS* |
| 1998 | **Strategic Environmental Assessment (SEA)** for the Somchem industrial complex at Krantzkop, South Africa | Project manager and co-author | Somchem, a Division of Denel |
| 1997 | **Strategic Environmental Assessment (SEA)** for the proposed Industrial Development Zone and Harbour at Coega, Port Elizabeth, South Africa | SEA project manager and report writer | Coega IDZ Initiative Section 21 Company |
| 1996 | **Environmental Impact Assessment** of Development Scenarios for Thesen Island, Knysna, South Africa | Project manager and report writer | Thesen and Co. |
| 1996 | **Environmental Impact Assessment** of the Management Options for the Blouvlei wetlands, Cape Town | Project manager and report writer | Ilco Homes Ltd (now Monex Ltd) |
| 1995 | **Environmental Impact Assessment** for the Saldanha Steel Project, South Africa | Report writing and management of specialist studies | Saldanha Steel Project |
| 1994 | **Environmental Impact Assessment** for the upgrading of resort facilities on Frégate Island, Seychelles | Member of the project management team, co-author, process facilitator | Schneid Israelite and Partners |
| 1994 | **Environmental Impact Assessment** for exploration drilling in offshore Area 2815, Namibia | Project manager and co-author | Chevron Overseas (Namibia) Limited |
| 1994 | **Management Plan** for the Rietvlei Wetland Reserve, Cape Town | Project manager and lead author | Southern African Nature Foundation |

| Completion Date | Project description | Role | Client |
|---|---|---|---|
| | | | (now WWF-SA) |
| 1993 | **Beach management plan** for Stilbaai beachfront and dunes, South Africa | Project manager and lead author | Stilbaai Municipality |
| 1993 | **Beach and dune management plan for Sedgefield** for the beach east of the mouth of the Swartvlei estuary | Project manager and lead author | Nel and De Kock Planners, George |
| 1993 | **Coastal Stability analysis and beach management plan** for the Table View coastline north of Blaauwberg Road, Cape Town. | Project manager and lead author | Milnerton Municipality |

## EMPLOYMENT RECORD

- **1992 to present** Involved in coastal engineering studies; and various forms of environmental assessment and management studies. Council for Scientific and Industrial Research – Environmental Management Services (EMS) - Stellenbosch

## QUALIFICATIONS/EDUCATION

- M. Phil. Environmental Science (University of Cape Town)
- B.Sc. Civil Engineering (awarded with Honours) (University of Cape Town)

## LANGUAGE CAPABILITY

| ***LANGUAGES*** | ***Speaking*** | ***Reading*** | ***Writing*** |
|---|---|---|---|
| English | Excellent | Excellent | Excellent |
| Afrikaans | Moderate | Moderate | Moderate |

CSIR
Jan Cilliers Street
PO Box 320
Stellenbosch 7599
South Africa

Phone: +27 21 888 2495/2661
Fax: +27 21 888 2693
Email: mlevendal@csir.co.za

## Curriculum Vitae: Minnelise Levendal – Project Leader

| | |
|---|---|
| **Name of firm** | CSIR |
| **Name of staff** | Minnelise Rouchelle-Ann Levendal |
| **Profession** | Environmental Assessment Practitioner/Project Manager |
| **Position in firm** | Senior Environmental Assessment Practitioner |
| **Years' experience** | 17 years |
| **Nationality** | South African |
| **Languages** | Afrikaans and English |
| **Licence** | Code EB (22 years) |

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### BIO-SKETCH:

Minnelise has been working in the Environmental Management sector for 17 years. She completed her BSc degree in Botany at the University of the Western Cape in 1994 and her Masters (MSc) in Botany at the University of Stellenbosch in 1998. After completing her Honours degree she lectured Mycology at the Peninsula Technicon (now known as the Cape Peninsula University of Technology (CPUT) in 1995. She then lectured Botany to second year students at the University of the Western Cape (UWC) in 1996.

Following the completion of her Masters Degree she was selected as one of 20 students from third world countries to attend a course on desertification in 1999 sponsored by the Shalom programme at the Ramon Science Center, Sede Boqer, Mitrani Department of Desert Ecology, Bengurion University of the Negev, Israel. After successfully completing the one-month course, she worked at the said institution as a research assistant for two months. The research she conducted led to the publication of an article that was published in the Journal of Arid Environments in 2004-see list of publications.

Following her studies and research work at the Bengurion University, she was appointed as an Environmental Officer at the Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) in November 1999. Her work included commenting on Environmental Impact Assessments (EIAs), Basic Assessments (BAs) and Environmental Management Plans (EMPs) to ensure that environmental issues are adequately addressed in development applications. At DEA&DP she also worked in the Biodiversity unit to promote the mainstreaming of biodiversity issues into environmental decision-making, policies and planning. From 2003 until 2004 she was the secretary for the Interim Western Cape Coastal Coordinating Committee (IWCCC). She was also a member of the IAIA (Western Cape) steering committee from 2001 to 2002. At DEA&DP she attended numerous courses on Environmental Management (including Environmental Law)-a full list of courses is available on request.

Minnelise is currently a Senior Environmental Assessment Practitioner (EAP) in the Environmental Management Services (EMS) Group at the Council for Scientific and Industrial Research (CSIR) in Stellenbosch. She joined the CSIR in 2004. Her current work entails managing EIAs and BAs to ensure that environmental criteria are adequately assessed in development applications, including monitoring and evaluation. She also prepares proposals and write reports.

She is currently managing various EIAs for renewable energy projects in South Africa, including wind and solar. She was the project manager for ten BAs for wind monitoring masts in South Africa as part of the National Wind Atlas Project of the Department of Energy. Environmental Authorisation for these 10 BAs were granted by the f national Department of Environmental Affairs (DEA) in 2010. She was the CSIR project manager for the 100 MW Ubuntu Wind Energy Facility near Jeffrey's Bay (Environmental Authorisation granted in June 2012), as well as the 50 MW Banna Ba Pifhu Wind Energy proposed by WKN Windcurrent near Humansdorp in the Eastern Cape (Environmental Facility Authorisation granted in July 2014). She also managed seven EIAs for seven solar Photovoltaic (PV) Facilities near Kenhardt for Mulilo Renewable Project Developments (2015-2016). She is currently managing two EIAs for two wind energy facilities near Victoria West in the Northern Cape for Mainstream Renewable Power Developments.

Minnelise is currently managing the Special Needs and Skills Development Programme of DEA (2014-2018) which provide *pro bono* environmental services to applicants with special needs. This involves mentoring interns and Junior Environmental Assessment Practitioners.

In addition to the EIAs and BAs undertaken by Minnelise, she was also the Project Manager of other diverse projects to promote environmental management including *inter alia*:

- Biodiversity Management Plan for the African Lion (*Panthera leo*) (2014);
- Development of a National Management Plan and Strategy for Invasive Alien species (2014);
- South Africa's Second National Communication under the United Nations Framework Convention on Climate change (2010); and
- The development of protocols for the monitoring and evaluation of benefits arising from the Working for Water Programme (2008).

In undertaking these projects, Minnelise has developed a keen grasp of national and international sustainability issues which affect people and the environment. She has a good knowledge of environmental legislation and environmental management in general.

## EDUCATION

| | | |
|---|---|---|
| M.Sc. (Botany) | Stellenbosch University | 1998 |
| B.Sc. (Hons.) (Botany) | University of the Western Cape | 1994 |
| B.Sc. (Education) | University of the Western Cape | 1993 |

## PROFESSIONAL REGISTRATIONS / MEMBERSHIPS

- International Association for Impact Assessment (IAIA), Western Cape (member of their steering committee from 2001-2002).
- Professional Natural Scientist (Pr.Sci.Nat) – registration imminent)

## EMPLOYMENT RECORD

| Name of current employer | Position | From | To |
|---|---|---|---|
| CSIR (Environmental Management Services; Implementation Unit) | Senior Environmental Assessment Practitioner | 2006 | Present |
| CSIR (Natural Resources and the Environment) | Environmental Researcher | 2004 | 2006 |
| Western Cape Department of Environmental Affairs and Development Planning (DEA&DP) | Assistant Director | 2003 | 2004 |
| | Principal Environmental Officer | 2002 | 2003 |
| | Principal Environmental Officer | 2002 | 2003 |
| | Senior Environmental Officer | 2001 | 2002 |
| | Environmental Officer | 1999 | 2000 |
| University of the Western Cape | Junior Lecturer | 1996 | 1996 |
| Cape Peninsula University of Technology (CPUT) | Junior Lecturer | 1995 | 1995 |

## KEY COURSES

- Public Participation in Environmental Authorisation in South Africa: IAIA workshop presented by Tisha Greyling and Erika Du Plessis (2016).
- Environmental Law: Shepstone Wylie Attorneys; Presented by Janice Tooley (2015).
- Sharpening the Tool: New techniques and methods in Environmental Impact Assessment: Sustainable Environmental Solutions (Pty) Ltd (2015).
- Effective Skills for Challenging Meetings & Engagements: Conflict Dynamics (2015).
- Science Communication and Working with the Media: Proof Communications/Jive Media Africa (2014).
- Leadership, Innovation and Change Management: University of Stellenbosch (Business School) (2013).
- MS Project: CILLA (2011).
- Project Management I and II: CILLA (2005)
- Social Impact Assessment: IAIA workshop (2002)
- Environmental Law (“The New Environmental Law Course for Environmental Managers): University of Potchefstroom: Center for Environmental Management) (2002).
- Implementing Environmental Management Systems (SABS/ISO 14001:1996): University of Potchefstroom: Center for Environmental Management (2002).
- Conflict Management in Environmental Issues: University of Potchefstroom: Center for Environmental Management) (2001).

## PROJECT EXPERIENCE RECORD

The following table presents a list of key projects undertaken by Minnelise Levendal at the CSIR to date, as well as the role played in each project:

**Environmental Impact Assessment (EIAs) and Basic Assessments (BAs)-including their respective Environmental Management Programmes (EMPRs):**

| Completion Date | Project description | Role | Client |
|---|---|---|---|
| 2016-present | EIA for the proposed Platberg Wind Energy Facility near Victoria West in the Northern Cape | Project Manager and EAP | South Africa Mainstream Renewable Power Developments (Pty) Ltd |
| 2016-present | EIA for the proposed Teekloof Wind Energy Facility near Victoria West in the Northern Cape | Project Manager and EAP | South Africa Mainstream Renewable Power Developments (Pty) Ltd |
| 2015-2016 | EIA for the Gemsbok Solar Photovoltaic, PV 3 near Kenhardt in the Northern Cape | Project Manager and EAP | Mulilo Renewable Project Developments |
| 2015-2016 | EIA for the Gemsbok Solar PV 4 near Kenhardt in the Northern Cape | Project Manager and EAP | Mulilo Renewable Project Developments |
| 2015-2016 | EIA for the Gemsbok Solar PV 5 near Kenhardt in the Northern Cape | Project Manager and EAP | Mulilo Renewable Project Developments |
| 2015-2016 | EIA for the Gemsbok Solar PV 6 near Kenhardt in the Northern Cape | Project Manager and EAP | Mulilo Renewable Project Developments |
| 2015-2016 | EIA for the Boven Solar PV 2 near Kenhardt in the Northern Cape | Project Manager and EAP | Mulilo Renewable Project Developments |
| 2015-2016 | EIA for the Boven Solar PV 3 near Kenhardt in the Northern Cape | Project Manager and EAP | Mulilo Renewable Project Developments |
| 2015-2016 | EIA for the Boven Solar PV 4 near Kenhardt in the Northern Cape | Project Manager and EAP | Mulilo Renewable Project Developments |
| 2014-2016 | Special Needs and Skills Development Programme | Project Manager | DEA |
| 2010-2011 (EA Granted) | EIA for the proposed Ubuntu wind energy project, Eastern Cape | Project Manager | WKN Windkraft SA |
| 2010-2011 (EA granted) | EIA for the proposed Banna Ba Pifhu wind energy project, Eastern Cape | Project Manager | WKN Windkraft SA |
| 2010-2011 (EA granted) | BA for a powerline for a WEF near Swellendam in the Western Cape | Project Manager | BioTherm Energy (Pty Ltd |
| 2010-2011 (EA Granted) | EIA for a proposed wind farm near Swellendam in the Western Cape | Project Manager | BioTherm Energy (Pty Ltd |
| 2010 (EAs granted) | Basic Assessment for the erection of two wind monitoring masts near Swellendam and Bredasdorp in the Western Cape | Project Manager | BioTherm Energy (Pty Ltd |
| 2010 (complete) | Basic Assessment for the erection of two wind monitoring masts near Jeffrey's Bay in the Eastern Cape | Project Manager | Windcurrent (Pty Ltd |

| Completion Date | Project description | Role | Client |
|---|---|---|---|
| 2009-2010 (EAs granted) | Basic Assessment Process for the proposed erection of 10 wind monitoring masts in SA as part of the national wind atlas project | Project Manager | Department of Energy through SANERI; GEF |
| 2009 (EAs granted) | Basic Assessment Report for a proposed boundary wall at the Port of Port Elizabeth, Eastern Cape | Project Manager | Transnet Ltd |
| **Other Environmental Assessments, Strategies, Biodiversity Management Plans, Frameworks and Reporting tools:** | | | |
| 2013-2014 | Development of a National Management Plan and Strategy for Invasive Alien species | Project Manager | DEA |
| 2012-2014 | Development of a Biodiversity Management Plan for the African Lion (*Panthera leo*) | Project Manager | DEA |
| 2010 | South Africa's Second National Communication under the United Nations Framework Convention on Climate Change | Project Manager | SANBI |
| 2006-2008 | Monitoring and Evaluation of aspects of Biodiversity | Project Leader | Internal project awarded through the Young Researchers Fund |
| 2006 | Integrated veldfire management in South Africa. An assessment of current conditions and future approaches. | Co- author | Working on Fire |
| 2004-2005 | Biodiversity Strategy and Action Plan Wild Coast, Eastern Cape, SA | Co-author | Wilderness Foundation |
| 2005 | Western Cape State of the Environment Report: Biodiversity section. (Year One). | Co- author and Project Manager | Department of Environmental Affairs and Development Planning |

## AWARDS

- 2008: Best presentation Award at Arid Zone Conference (Northern Cape)
- 2015: CSIR award for Human Capital Development: Special Needs and Skills Development Programme

## CONFERENCE PRESENTATIONS & PAPERS

- **Levendal, M**. (2012). "Challenges in the Environmental Assessment of Renewable Energy Projects in South Africa" In IAIA (Portugal) Conference Proceedings.
- **Bowie, M.** (née Levendal) (1998). "Ecophysiological responses of four succulent Karoo species under different temperature and water regimes." In *Arid Zone Conference (Northern Cape) Conference Proceedings*.

## PUBLICATIONS

- **Bowie, M.** (néé Levendal) and Ward, D. (2004). Water status of the mistletoe Plicosepalus acaciae parasitic on isolated Negev Desert populations of Acacia raddiana differing in level of mortality. Journal of Arid Environments 56: 487-508.
- Wand, S.J.E., Esler, K.J. and **Bowie, M.R** (2001). Seasonal photosynthetic temperature responses and changes in 13C under varying temperature regimes in leaf-succulent and drought-deciduous shrubs from the Succulent Karoo, South Africa. South African Journal of Botany 67:235-243.

- **Bowie, M.R.,** Wand, S.J.E. and Esler, K.J. (2000). Seasonal gas exchange responses under three different temperature treatments in a leaf-succulent and a drought-deciduous shrub from the Succulent Karoo. South African Journal of Botany 66:118-123.

## LANGUAGE CAPABILITY

| ***Language*** | ***Speaking*** | ***Reading*** | ***Writing*** |
|---|---|---|---|
| *English* | *Excellent* | *Excellent* | *Excellent* |
| *Afrikaans* | *Excellent* | *Excellent* | *Excellent* |

## REFERENCES

**Mr Henri Fortuin**
Director: Land Management: Department of Environmental Affairs & Development Planning; Western Cape (DEA&DP); (ex-colleague at CSIR)
Tel: 021 483 2787 / 083 226 9127
Email: henri.fortuin@westerncape.gov.za

**Mr Patrick Morant**
Independent (Private) Consultant
Tel: 021 888 2480
Cell: 076 266 033
Email: pmorant@csir.co.za

Minnelise Levendal

April 2018

PO Box 320
Stellenbosch
7599
South Africa

Office : +27 21 888 2489
Cell : +27 83 799 0949
Fax : +27 21 888 2473
Email lkellerman@csir.co.za

# Curriculum Vitae: Lizande Kellerman - Project Manager

| | |
|---|---|
| **Position in Firm:** | Principal Environmental Assessment Practitioner |
| **Full Name:** | Millicent Johanna Susanna Kellerman |
| **Specialisation:** | Strategic Environmental Assessment & Integrated Environmental Management |
| **Date of Birth:** | 11 October 1978 |
| **Nationality:** | South African |
| **Drivers licence:** | Code EB and Advanced Driver Qualification (4x4) |

**BIO-SKETCH:**

Lizande holds a Bachelor's degree in Zoology and Entomology, with an Honours and Masters both in Botany from the University of Pretoria. She also obtained a Postgraduate Certificate for Higher Education and Further Training from the University of South Africa. Lizande is currently completing her PhD in Plant Ecology specialising in natural restoration of degraded rangeland in the Succulent Karoo. For almost 15 years, Lizande spent teaching and mentoring, as a researcher and lecturer, numerous undergraduate and postgraduate students in subjects of biological, ecological and environmental sciences at University of Pretoria, University of South Africa and the Midrand Graduate Institute.

Following her academic career, Lizande has 10 years' experience in environmental assessment and management studies, primarily in planning, preparing, managing and conducting environmental impact assessments (BA & EIAs), environmental management plans (EMPs), environmental screening studies and fatal flaw assessments, as well as license applications for air emissions, water use, waste management, mining rights, ploughing rights, bioprospecting, biotrade and biodiversity permitting for numerous projects in the agricultural (including aquaculture), biodiversity, bioprospecting, construction and mining sectors.

Lizande has joined the CSIR in January 2012 as a full time employee and Senior Enterprise Development Specialist in the Enterprise Creation for Development (ECD) unit in Pretoria. Her main responsibility was the planning, design, implementation, management and financial administration of various rural community-based government-funded agro-processing projects/enterprises in the following South African provinces; Limpopo, North West, Mpumalanga, Northern Cape, Eastern Cape, Western Cape, Free State and KwaZulu-Natal. The focus was on the sustainable cultivation, harvesting and processing of essential oils and indigenous plant species with cosmetic, medicinal and nutritional value to enable community upliftment and poverty alleviation. As an Environmental Scientist, she was also responsible for all authority liaison and stakeholder engagement, as well as for environmental screening and legal compliance of these projects, specifically relating to the application for and management of environmental impact assessments (EIAs), environmental management plans/programmes (EMPr), water use and waste management licenses, ploughing rights, biodiversity and bioprospecting permitting, and the facilitation and coordination of specialist assessments. During this time, Lizande has also provided specialist input relating to aspects of environmental impact assessment requirements and legal compliance into the preparation of numerous proposals, tenders, feasibility studies, development strategies, business plans and socio-economic development enabling frameworks conducted by CSIR ECD. These studies covered a range of industry sectors including agriculture, bioprospecting, agro-processing (including hydroponics, essential oils, medicinal plants, dairy, wine and fruit), biodiversity and conservation, automotive components, composites, electronics, food processing, furniture & wood products, petrochemicals, leather, light engineering & fabrication, pharmaceutical & household products, health, retail, renewable energy, chemicals, plastics, textiles, telecommunications (including call centres), aquaculture (marine and freshwater) and charcoal production, as well as the public sector (including national, provincial and local government).

Since April 2016, Lizande has been working as a Principal Environmental Assessment Practitioner (EAP) in the CSIR Environmental Management Services (EMS) group situated in Stellenbosch. She is currently managing the national-scale Strategic Environmental Assessment (SEA) for marine and freshwater aquaculture development in South Africa. Apart from managing the EIA process for the proposed development of the Kuruman Phase 1 and 2 Wind Energy Facilities with supporting electrical infrastructure near Kuruman in the Northern Cape, Lizande is also part of a team that is presently undertaking the development of a Biodiversity Economy Transformation Strategy for the North West Province.

## PROJECT EXPERIENCE RECORD

The following table presents a sample of key projects that Lizande Kellerman has undertaken to date:

| Completion Date | Project description | Role | Client |
|---|---|---|---|
| 2018 to present | Development of a Biodiversity Economy Transformation Strategy for the North West | Specialist input, Contributing author | North West READ |
| 2017 to present | EIA for Kuruman Wind Energy Facilities (WEF) Phase 1 and 2 near Kuruman, Northern Cape | Project Manager and EAP | Mulilo Renewable Project Developments |
| 2017 to present | BA for supporting electrical infrastructure for the Kuruman WEFs Phase 1 and 2 near Kuruman, Northern Cape | Project Manager and EAP | Mulilo Renewable Project Developments |
| 2017 to present | Bioprospecting, biotrade and biodiversity permitting applications for *Boscia albitrunca,* as part of a feasibility study on Motlopi coffee | Project Manager | North West DEED |
| 2016 to present | SEA for marine and freshwater aquaculture development in South Africa | Project Manager | DEA and DAFF |
| 2012 – 2016 | Bioprospecting beneficiation and implementation of the Nourivier Medicinal Plants Project at Nourivier, Northern Cape | Project Manager, Environmental Scientist | DST |
| 2012 – 2016 | Bioprospecting beneficiation and implementation of the Witdraai Medicinal Plants Project at Andriesvale, Northern Cape | Project Manager, Environmental Scientist | DST |
| 2012 – 2016 | Bioprospecting beneficiation and implementation of the Letsemeng Medicinal Plants Project at Petrusburg, Free State | Project Manager, Environmental Scientist | DST |
| 2013 – 2016 | Bioprospecting beneficiation and implementation of the Abbey Medicinal Plants Project near Madibeng, Northern Cape | Project Manager, Environmental Scientist | DST |
| 2013 – 2016 | Bioprospecting beneficiation and implementation of the Driekop Essential Oils and Moringa Project near Burgersfort, Limpopo | Project Manager, Environmental Scientist | DRDLR |
| 2013 – 2014 | Resource assessment, including bioprospecting, biotrade and biodiversity permitting applications for *Elephantorrhiza elephantina*, Northern Cape | Project Manager, Environmental Scientist | DST and CSIR Biosciences |

| Completion Date | Project description | Role | Client |
|---|---|---|---|
| 2009 – 2010 | Environmental screening and legal compliance of the Sidasoas Essential Oils (Rose Geranium) project near Onseepkans, Northern Cape | Environmental Scientist | DST and CSIR ECD |
| 2009 – 2010 | Environmental screening and legal compliance of the Pelsan Essential Oils (Rose Geranium) project near Pella, Northern Cape | Environmental Scientist | DST and CSIR ECD |
| 2009 – 2010 | Environmental screening and legal compliance of the Oppermans Essential Oils (Rose Geranium) project near Maubane, North West | Environmental Scientist | DST and CSIR ECD |
| 2009 – 2010 | Section 24G Rectification Application for the Sidasoas Essential Oils (Rose Geranium) project near Onseepkans, Northern Cape | Environmental Scientist | DST and CSIR ECD |
| 2009 – 2011 | Bioprospecting beneficiation, environmental screening and legal compliance of the Nourivier Medicinal Plants Project at Nourivier, Northern Cape | Environmental Scientist | DST and CSIR ECD |
| 2009 – 2011 | Bioprospecting beneficiation, environmental screening and legal compliance of the Witdraai Medicinal Plants Project at Witdraai, Northern Cape | Environmental Scientist | DST and CSIR ECD |
| 2009 – 2010 | EIA and Waste Management License Application at the Kumba Iron Ore Mine at Sishen, Northern Cape | Project Manager and EAP | Anglo American / Kumba Iron Ore |
| 2009 – 2010 | EIA for the development of the new Veremo Magnetite Mine near Stoffberg, Mpumalanga | Project Manager and EAP | Veremo Holdings / Kermas Limited |
| 2009 – 2010 | EIA for the proposed construction and upgrades of roads on various properties east of Orange Farm and west of the R82, Gauteng | Project Manager and EAP | Basil Read (Pty) Ltd |
| 2009 – 2010 | BA for the proposed establishment of the new head office complex for the National Department of Land Affairs (DLA) as part of a public private partnership process, Pretoria, Gauteng | Project Manager and EAP | Basil Read (Pty) Ltd |
| 2009 – 2010 | BA for the proposed construction of the internal road network and associated storm water pipes at Flamingo Park X2, Welkom, Free State | Project Manager and EAP | Basil Read (Pty) Ltd |
| 2009 – 2010 | BA for the proposed construction of an access road and a sewer pipeline for the use of the proposed Gautrain Visitors Centre, Midrand, Gauteng | Project Manager and EAP | Bombela Consortium |
| 2009 – 2010 | BA for the proposed residential development and associated infrastructure on Erf 7402 and Erf 19642, Mamelodi-West, City of Tshwane, Gauteng | Project Manager and EAP | Basil Read (Pty) Ltd |
| 2009 – 2010 | BA for the MTN Fibre Optic Deployment along roads R21 and R101, Gauteng | Project Manager and EAP | MTN Group Limited |
| 2009 – 2010 | BA and Waste Management License Application for the establishment of Phase 1 of the proposed provision of Bulk Water Supply Infrastructure and Purified Water Supply, Jozini, Kwa-Zulu Natal | Project Manager and EAP | PD Naidoo and Associates |
| 2009 – 2010 | BA for the proposed housing development situated on Klipspruit Ext 11, a portion of the remaining extent of the Farm Freehold 389 IQ, Gauteng | Project Manager and EAP | Basil Read (Pty) Ltd |
| 2009 – 2010 | Environmental Management Plan for the Blouberg Local Municipality, Capricorn District, Limpopo | Project Manager and EAP | Capricorn District Municipality |
| 2009 – 2010 | Environmental Fatal Flaw Assessment for the proposed development of the Statistics South Africa Head Office Complex: Persequor Park, Gauteng | Project Manager and EAP | Eco-Agent CC |

| Completion Date | Project description | Role | Client |
|---|---|---|---|
| 2009 – 2010 | Environmental Fatal Flaw Assessment for the proposed development of the Statistics South Africa Head Office Complex: Salvokop, Gauteng | Project Manager and EAP | Eco-Agent CC |

## EMPLOYMENT RECORD

- CSIR Environmental Management Services (EMS) — Apr 2016 – present
- CSIR Enterprise Creation for Development (ECD) — Jan 2012 – Mar 2016
- Midrand Graduate Institute — Jan 2011 – Dec 2011
- Polygon Environmental Planning cc — Jan 2011 – Dec 2011
- The MSA Group (Environmental, Legal and Mining Services) — Apr 2009 – Dec 2010
- Department of Botany, University of Pretoria — Aug 2003 – Mar 2009

## QUALIFICATIONS

- 2006 University of South Africa (Postgraduate Certificate for Higher Education and Further Training)
- 2004 University of Pretoria MSc *Cum Laude* (Botany)
- 2001 University of Pretoria BSc Honours (Botany)
- 2000 University of Pretoria BSc (Zoology and Entomology)

## SHORT-COURSES / WORKSHOPS

- 2015 Finances for Non-Financial Managers, CSIR Innovation Leadership & Learning Academy, Pretoria.
- 2014 IWRM, the NWA, and Water Use Authorisations, focusing on Water Use License Applications – Procedures, Guidelines, IWWMP's and Monitoring, Carin Bosman Sustainable Solutions, Pretoria.

## CONFERENCE PRESENTATIONS & PAPERS

### *INTERNATIONAL CONFERENCES*

- **Kellerman, L.** Snyman-Van der Walt, L., Morant, P., Mashabela, K. & Lochner, P. (2017). Progress on the Strategic Environmental Assessment (SEA) for aquaculture development in South Africa. International Association for Impact Assessment – South Africa Conference 2017, Rawsonville, Western Cape Province.
- **Kellerman, L.** Snyman-Van der Walt, L., Morant, P., Mashabela, K. & Lochner, P. (2017). National Strategic Environmental Assessment (SEA) for aquaculture development in South Africa – A synopsis of the current marine and freshwater aquaculture environment and the need to promote sustainable growth and incentivisation. World Aquaculture Conference 2017, Cape Town, Western Cape Province.
- **Kellerman, L.** (2012). Success with Technology Transfer activities within the context of Enterprise Development that generate Social and Economic Development Opportunities. Conference on Innovation for Poverty Alleviation: South Africa - European Union Summit, Brussels, Belgium.
- **Kellerman, L.** (2012). New Medicinal Plants Demonstration Agronomy. European Union's Conference for Sector Budget Support. Department of Science and Technology, Roodevallei, Pretoria, Gauteng Province.
- **Kellerman, L.** (2012). Wild-harvesting for Commodity Beneficiation. European Union's Conference for Sector Budget Support. Department of Science and Technology, Roodevallei, Pretoria, Gauteng Province.

### *NATIONAL CONFERENCES*

- **Kellerman, L.** & Moeng, E. (2013). Technology transfer to facilitate the sustainable cultivation harvesting and processing of arid zone indigenous plants. Annual Conference of the Indigenous Plant Use Forum, Agricultural Research Council, Nelspruit, Mpulamalanga Province.

- **Kellerman, L.** (2012). Capitalizing on South Africa's Indigenous Plants – Demonstration agro-processing for social impact. Annual Conference of the Indigenous Plant Use Forum, University of Venda, Thohoyandou, Limpopo Province.
- **Kellerman, M.J.S.**, Strobach, M. & Van Rooyen, M.W. (2008). Comparison of leaf trait spectra of two contrasting southern African environments. Annual Conference of South African Association for Botanists, Drakensville, Free State Province.
- Strobach, M, **Kellerman, M.J.S.** & Van Rooyen, M.W. (2008). Comparison of leaf functional types of two contrasting southern African environments. Annual Conference of South African Association for Botanists, Drakensville, Free State Province.
- **Kellerman, M.J.S.** & Grote, W. (2007). The Tswaing Crater… A blast from the past. 10th Annual Conference of the South African Association for Science and Technology Centres, Bayworld, Port Elizabeth, Eastern Cape Province.
- **Kellerman, M.J.S.** & Van Rooyen, M.W. (2006). Plant diversity in old fields of various ages in the Upland Succulent Karoo, South Africa. Arid Zone Ecology Forum, Kamieskroon, Northern Cape Province.
- **Kellerman, M.J.S.** & Van Rooyen, M.W. (2002). Seed bank dynamics of selected habitat types in the Tembe Elephant Park, Maputaland. Annual Conference of South African Association for Botanists, Rhodes University, Eastern Cape Province.

***NATIONAL SYMPOSIA***

- **Kellerman, L**., Horak, M., Van Rooyen, N. & Van Rooyen, G. (2014). Elephantorrhiza elephantina: From geoxylic suffrutex to its application in the cosmetic industry. Kimberley Biodiversity Research Symposium, McGregor Museum, Kimberley, Northern Cape Province.
- Joseph, M.S.V., Horak, R.M. & **Kellerman, M.J.S.** (2013). Nourivier Medicinal Plants – *Sceletium tortuosum*. Kimberley Biodiversity Research Symposium, McGregor Museum, Kimberley, Northern Cape Province.
- Pietersen, J.J., Horak, R.M. & **Kellerman, M.J.S.** (2013). Khomani San Medicinal Plants – *Citrullus lanatus* and *Harpagophytum procumbens*. Kimberley Biodiversity Research Symposium, McGregor Museum, Kimberley, Northern Cape Province.
- **Kellerman, M.J.S,** Strobach, M. & Van Rooyen, M.W. (2007). Comparison of leaf trait spectra of two contrasting southern African environments. Department of Plant Science, University of Pretoria.
- Strobach, M, **Kellerman, M.J.S.** & Van Rooyen, M.W. (2007). Comparison of leaf functional types of two contrasting southern African environments. Department of Plant Science, University of Pretoria.
- **Kellerman, M.J.S.** & Van Rooyen, M.W. (2000). The seed bank dynamics of the Tembe Elephant Park, Maputaland. Department of Botany, University of Pretoria.
- **Kellerman, M.J.S.** & Van Rooyen, M.W. (2000). The role of seed banks in the management and restoration of natural vegetation. Department of Botany, University of Pretoria.
- **Kellerman, M.J.S.** & Van Wyk, A.E. (2000). A comparative study between the Sand Forests of Maputaland (South Africa) and the Florida Scrub (USA). Department of Botany, University of Pretoria.

## SCIENTIFIC BOOKS / JOURNAL PUBLICATIONS

- **Kellerman, L.** & Wild, S. (2015): A 'happy pill' to boost rural economies. – In: Wild, S. (Author), Fraser, S. [Editor]: Innovation – Shaping South Africa Through Science. Part 3: pp. 113-120, Pac Macmillan South Africa, in association with the Gordon Institute of Business Science, University of Pretoria.
- Wesuls, D., Strohbach, M., Horn, A., Kos, M., Zimmermann, J., Hoffmann, J., Geldenhuys, C., Dreber, N., **Kellerman, L.**, van Rooyen, M. W., Poschlod, P. (2010): Plant functional traits and types as a tool to analyse landuse impacts on vegetation. – In: Schmiedel, U., Jürgens, N. [Eds.]: Biodiversity in

southern Africa. Volume 2: Patterns and processes at regional scale: pp. 222–232, Klaus Hess Publishers, Göttingen & Windhoek.

- **Kellerman, L** & Van Rooyen, G. (2009). Can time heal the old fields of the Kamiesberg? Veld & Flora 95(2): 78-81.
- **Kellerman, M.J.S.** & Van Rooyen, M.W. (2007). Seasonal variation in soil seed bank size and species composition of selected habitat types in Maputaland, South Africa. Bothalia 37,2: 249-258.
- Van Rooyen, M.W., Tosh, C.A., Van Rooyen, N., Matthews, W.S. & **Kellerman, M.J.S.** (2004). Impact of harvesting and fire on *Phragmites australis* reed quality in Tembe Elephant Park, Maputaland. Koedoe 47(1): 31-40.
- Steenkamp, Y., **Kellerman, M.J.S.** & Van Wyk, A.E. (2001). Fire, frost, waterlogged soil or something else: What selected for the Geoxylic Suffrutex growth form in Africa? Plantlife 25: 4-6.

## MEDIA INTERVIEWS / PUBLICATIONS

- **L Kellerman**, article on the Nile Tilapia Citizen Science Survey for the Aquaculture SEA published online at the Landbouweekblad on 26 May 2017. http://www.landbou.com/nuus/help-die-wnnr-met-nylkurper-opname/
- **L Kellerman**, article on the Nile Tilapia Citizen Science Survey for the Aquaculture SEA published in the Farmersweekly Magazine on 09 June 2017.
- **L Kellerman**, article on the Nile Tilapia Citizen Science Survey for the Aquaculture SEA published in the Stywe Lyne/Tight Lines Magazine, Issue 690 in August 2017.
- **L Kellerman**, article on the Nile Tilapia Citizen Science Survey for the Aquaculture SEA published online at the CSIR website on 26 June 2017. https://www.csir.co.za/csir-calls-public-participate-rapid-citizen-science-survey/
- **L Kellerman**, article on the Nile Tilapia Citizen Science Survey for the Aquaculture SEA published online at the DEA website in July 2017. https://www.environment.gov.za/projectsprogrammes/operationphakisa/oceanseconomy/
- **Kellerman, L**. (2015). Landbou – Kougoed. kykNet – Dagbreek television show.
- Interviewed by Wild, S. (2015). Bushmen cure – all's prospects hit a new high. Mail & Guardian Newspaper, pp: 26-27.
- Interviewed by Mostert, M. (2015). Kougoed-projek in Nourivier. Die Plattelander Newspaper, pp: Annexure.
- Interviewed by Smith, M. (2015). Geld te maak uit Kougoed, Jantjie-Bêrend. Landbouweekblad Magazine, pp: 28.
- **Kellerman, L**. (2014). Kougoed (*Sceletium tortuosum*) Medicinal Plants Project in Nourivier. SKEP eNews – www.skep.org.za
- Interviewed by Van Rooyen, B. (2014). Reaping rewards from South Africa's botanical riches. – In: Improving lives – Careers at the CSIR. ScienceScope, Volume 7(1), pp: 38-39. Publication of the Council for Scientific and Industrial Research, Pretoria.
- Interviewed by Van Rooyen, B. (2014). Successful cultivation of medicinal plants in the Kalahari generates work for hundreds. CSIR eNews – Enterprise Creation for Development.
- Interviewed by Van Rooyen, B. (2012). Local succulents yield natural, calmative agent. CSIR eNews – Enterprise Creation for Development.
- Interviewed by Van Rooyen, B. (2012). Mr Derek Hanekom visits DST-funded projects in the Northern Cape. CSIR eNews – Enterprise Creation for Development.

## LANGUAGE CAPABILITY

| | Speaking | Reading | Writing |
|---|---|---|---|
| **Afrikaans** | Excellent | Excellent | Excellent |
| **English** | Excellent | Excellent | Excellent |

## PROFESSIONAL REGISTRATIONS / MEMBERSHIPS

- Professional Natural Scientist (Pr.Sci.Nat. Number 400076/10 – Botanical Sciences) with the SACNASP
- International Association of Impact Assessment South Africa (IAIAsa) – Registration number: 343955
- Botanical Society of South Africa (BotSoc) – Registration Number: S01/58657

## REFERENCES

**Dr R.M. (Marthinus) Horak (retired)**
Manager: Essential Oils & Medicinal Plants
CSIR Enterprise Creation for Development (ECD)
Pretoria, Gauteng
Tel: (+27) 84 555 2489
E-mail: rmhorak@gmail.com

***Emeritus* Prof. Dr. M.W. (Gretel) van Rooyen *Pr.Sci.Nat.***
Department of Plant and Soil Sciences (previously Botany)
University of Pretoria
Pretoria, Gauteng
Tel: (+27) 72 025 3386
E-mail: gretel.vanrooyen@up.ac.za

**Mrs Louise Agenbag**
Director: Polygon Environmental Planning cc
Tzaneen, Limpopo
Tel: (+27) 15 307 3606
Mobile: (+27) 83 339 2731
E-mail: louise@polygonenvironmental.co.za

**Mrs Elmarie van der Walt**
The MSA Group: Environmental, Legal and Mining Services
Johannesburg, Gauteng
Tel: (+27) 81 598 5971
E-mail: elmarievdw@msagroupservices.com

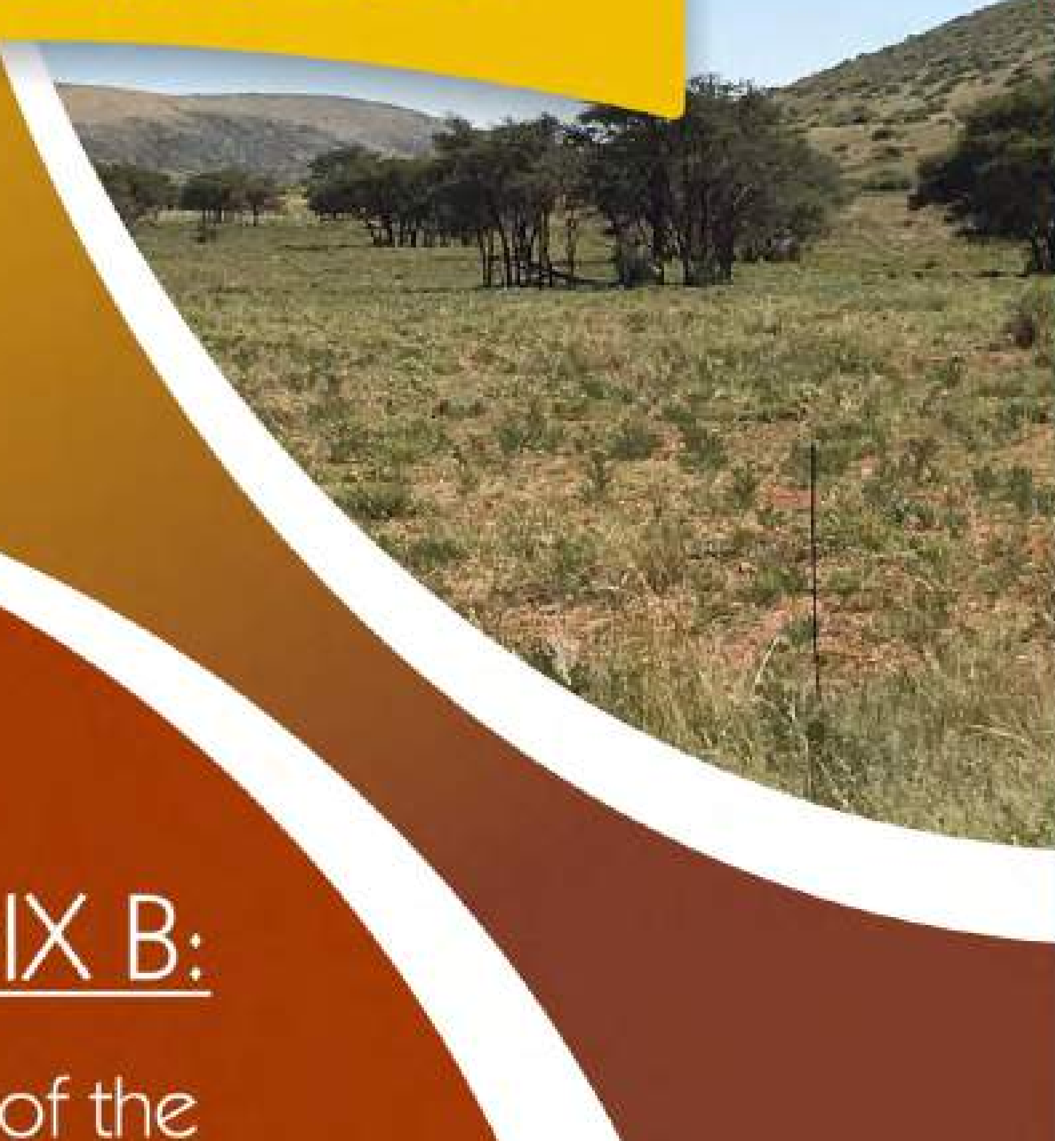
Lizande Kellerman

April 2018

MULILO
RENEWABLE PROJECT DEVELOPMENTS

Environmental Impact Assessment for the proposed Kuruman Phase 1 Wind Energy Facility near Kuruman in the Northern Cape

# Draft Scoping Report



# APPENDIX B:

## Declaration of the Environmental Assessment Practitioners

# Declaration of Independence of EAP

APPENDIX 9
9.1 DECLARATION OF THE EAP

I, Minnelise Levendal, ...

General declaration:

- I act as the independent environmental practitioner 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 environmental impact assessments, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in regulation 8 of the Regulations when preparing the application and any report relating to the application;
- 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;
- I will ensure that information containing all relevant facts in respect of the application is distributed or made available to interested and affected parties and the public and that participation by interested and affected parties is facilitated in such a manner that all interested and affected parties will be provided with a reasonable opportunity to participate and to provide comments on documents that are produced to support the application;
- I will ensure that the comments of all interested and affected parties are considered and recorded in reports that are submitted to the competent authority in respect of the application, provided that comments that are made by interested and affected parties in respect of a final report that will be submitted to the competent authority may be attached to the report without further amendment to the report;
- I will keep a register of all interested and affected parties that participated in a public participation process; and
- I will provide the competent authority with access to all information at my disposal regarding the application, whether such information is favourable to the applicant or not
- all the particulars furnished by me in this form are true and correct;
- will perform all other obligations as expected from an environmental assessment practitioner in terms of the Regulations; and
- I realise that a false declaration is an offence in terms of regulation 48 of the Regulations and is punishable in terms of section 24F of the Act.

**Disclosure of Vested Interest (delete whichever is not applicable)**

- I do not have and will not have any vested interest (either business, financial, personal or other) in the proposed activity proceeding other than remuneration for work performed in terms of the Regulations;

- ~~I have a vested interest in the proposed activity proceeding, such vested interest being:~~

Signature of the environmental assessment practitioner:

CSIR

Name of company:

14/05/2018

Date:

**APPENDIX 9**

**9.2 UNDERTAKING UNDER OATH/ AFFIRMATION**

I, Minnelise Levendal, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the environmental assessment practitioner

CSIR

Name of company

14/05/2018

Date

KOMMISSARIS VAN EDE / COMMISSIONER OF OATHS
DANIEL GIDEON GOSLETT
Kommissaris van Ede Ex Officio, Republiek van Suid Afrika
Commissioner of Oaths Ex Officio, Republic of South Africa
Jan Cilliers Str, Stellenbosch, 7600

Signature of the commissioner of oaths

14/05/2018

Date

MULILO
RENEWABLE PROJECT DEVELOPMENTS

Environmental Impact Assessment for the proposed Kuruman Phase 1 Wind Energy Facility near Kuruman in the Northern Cape

# Draft Scoping Report

# APPENDIX C:

## Database of Interested and Affected Parties

| No. | First Name | Surname | Company/ Organisation | Notice of Release of Draft Scoping Report for comments | Email: Notice of Submission of Scoping Reports to DEA | Notice of Release of Draft EIA Reports and BA Report | Email: Notice of Submission of EIA Reports and BA Report to DEA | Notice of EA for BAs and EIAs |
|---|---|---|---|---|---|---|---|---|
| **Organs of State** | | | | | | | | |
| 1. | H | Myburgh | Agri Northern Cape | ✓ | | | | |
| 2. | Ali | Diteme | Northern Cape Department of Agriculture, Land Reform & Rural Development | ✓ | | | | |
| 3. | Thoko | Buthelezi | Department of Agriculture, Forestry and Fisheries - AgriLand Liaison office | ✓ | | | | |
| 4. | D | Nhlakad | Department of Agriculture, Forestry and Fisheries - AgriLand Liaison office | ✓ | | | | |
| 5. | Anneliza | Collett | Department of Agriculture, Forestry and Fisheries - AgriLand Liaison office | ✓ | | | | |
| 6. | Mashudu | Marubini | Department of Agriculture, Forestry and Fisheries - Delegate of the Minister (Act 70 of 1970) | ✓ | | | | |
| 7. | Jacoline | Mans | Department of Agriculture, Forestry and Fisheries (Chief Forester: NFA Regulation) | ✓ | | | | |
| 8. | The Director | | Department of Energy: Northern Cape | ✓ | | | | |
| 9. | M | Lepheane | Department of Labour: Northern Cape | ✓ | | | | |
| 10. | Kgauta | Mokoena | Department of Mineral Resources: Northern Cape | ✓ | | | | |
| 11. | Denver | Van Heerden | Department of Public Works, Roads and Transport | ✓ | | | | |

| No. | First Name | Surname | Company/ Organisation | Notice of Release of Draft Scoping Report for comments | Email: Notice of Submission of Scoping Reports to DEA | Notice of Release of Draft EIA Reports and BA Report | Email: Notice of Submission of EIA Reports and BA Report to DEA | Notice of EA for BAs and EIAs |
|---|---|---|---|---|---|---|---|---|
| 12. | A | Botes | Department of Social Development | ✓ | | | | |
| 13. | Elliot | Sibeko | Department of Telecommunication & Postal Services | ✓ | | | | |
| 14. | Mashudu | Kgaphola (nee Randwedzi) | Department of Water and Sanitation | ✓ | | | | |
| 15. | Melinda | Mei | Department of Water and Sanitation | ✓ | | | | |
| 16. | Shaun | Cloete | Department of Water and Sanitation | ✓ | | | | |
| 17. | Andrew | Timothy | Department of Sports, Arts and Culture: Directorate - Heritage | ✓ | | | | |
| 18. | John | Geeringh | Eskom Holdings Ltd | ✓ | | | | |
| 19. | Kevin | Leask | Eskom Holdings Ltd | ✓ | | | | |
| 20. | Justine | Wyngaardt | Eskom Holdings Limited: Eskom Distribution Western Operating Unit | ✓ | | | | |
| 21. | Protea | Leserwane | Gamagara Local Municipality: Director - Strategic Services | ✓ | | | | |
| 22. | Boikanyo | Modise | Gamagara Local Municipality: Local Economic Development | ✓ | | | | |
| 23. | Ntsleleni | Nkhanedzini | Gamagara Local Municipality: Town planner | ✓ | | | | |
| 24. | Pierre | Burger | Gamagara Local Municipality: Environmental Health | ✓ | | | | |
| 25. | BB | Choche | Ga-Segonyana Local Municipality: Town planner | ✓ | | | | |

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|---|---|---|---|---|---|---|---|---|
| 26. | Tumela | Ditshetelo | John Taolo Gaetsewe District Municipality: Town planner | ✓ | | | | |
| 27. | Muhammad | Essop | Department of Environmental Affairs: Integrated Environmental Authorisations | ✓ | | | | |
| 28. | Wilma | Lutsch | Department of Environmental Affairs: Biodiversity Conservation | ✓ | | | | |
| 29. | Pieter | Buys | National Energy Regulator of South Africa (NERSA) | ✓ | | | | |
| 30. | Sharon | Steyn | Northern Cape Chamber of Commerce and Industry | ✓ | | | | |
| 31. | WVD | Mothibi | Northern Cape Department of Agriculture and Rural Development (HOD) | ✓ | | | | |
| 32. | Kholekile | Nongwini | Northern Cape Department of Roads and Public Works (HOD) | ✓ | | | | |
| 33. | Riaan | Warie | Northern Cape Economic Development Agency | ✓ | | | | |
| 34. | A | Yaphi | Provincial Department of Environment and Nature Conservation: Northern Cape | ✓ | | | | |
| 35. | M | Mathews | Provincial Department of Environment and Nature Conservation: Northern Cape | ✓ | | | | |
| 36. | Elsabe | Swart | Provincial Department of Environment and Nature Conservation: Northern Cape | ✓ | | | | |
| 37. | Thulani | Mthombeni | Provincial Department of Environment and Nature Conservation: Northern Cape | ✓ | | | | |

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|---|---|---|---|---|---|---|---|---|
| 38. | Sibonelo | Mbanjwa | Provincial Department of Environment and Nature Conservation: Northern Cape | ✓ | | | | |
| 39. | Ragna | Redelstorff | SAHRA | ✓ | | | | |
| 40. | Natasha | Higgit | SAHRA | ✓ | | | | |
| 41. | Adrian | Tiplady | SARAO: SKA SA | ✓ | | | | |
| 42. | Lizell | Stroh | South African Civil Aviation Authority | ✓ | | | | |
| 43. | Rene | De Kock | South African Roads Agency Limited (SANRAL): Northern Cape (Western Region) | ✓ | | | | |
| 44. | Chris | Coetzee | Southern African Large Telescope (SALT) Sutherland | ✓ | | | | |
| 45. | Ramotholo | Sefako | South African Astronomical Observatory (SAAO) | ✓ | | | | |
| 46. | Kgauta | Mokoena | Department of Mineral Resources | ✓ | | | | |
| 47. | Elliot | Sibeko | Department of Telecommunication & Postal Services | ✓ | | | | |
| 48. | Chris | Coetzee | Southern African Large Telescope (SALT) Sutherland | ✓ | | | | |
| 49. | Raoul | Van den Berg | Southern African Large Telescope (SALT) Sutherland | ✓ | | | | |
| **Conservation Organizations and NGOs** | | | | | | | | |

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|---|---|---|---|---|---|---|---|---|
| 50. | Simon | Gear | Birdlife South Africa | ✓ | | | | |
| 51. | Lubabalo | Ntsolo | C.A.P.E. Co-ordination Unit: Northern Cape | ✓ | | | | |
| 52. | Freyni | Du Toit | Grasslands Society of Southern Africa | ✓ | | | | |
| 53. | Dr Harriet | Davies-Mostert | Endangered Wildlife Trust: Wildlife and Energy Programme | ✓ | | | | |
| 54. | Dr Howard | Hendricks | South African National Parks (SANParks) - Snr GM: Policy & Governance Conservation Services Division | ✓ | | | | |
| 55. | Dr Joh R | Henschel | SAEON Arid Lands Node | ✓ | | | | |
| 56. | Dr Mike | Knight | SANParks | ✓ | | | | |
| 57. | Angus | Burns | WWF-SA: Land and Biodiversity Stewardship Programme | ✓ | | | | |
| 58. | Praneel | Ruplal | Independent Communications Authority of South Africa (ICASA) | ✓ | | | | |
| **WEF Land Owners and Adjacent Property Owners** | | | | | | | | |
| 59. | Clive | Albutt | Landowner | ✓ | | | | |
| 60. | Sarel and Aletta | Du Plessis | Landowner | ✓ | | | | |
| 61. | Tramab CC (1989/027778/23) | | Landowner | ✓ | | | | |

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|---|---|---|---|---|---|---|---|---|
| 62. | Clive | Albutt | Adjacent Landowners | ✓ | | | | |
| 63. | Johan | Voster | Adjacent Landowners | ✓ | | | | |
| 64. | Jan | Van Zyl | Adjacent Landowners | ✓ | | | | |
| 65. | Johan Lambrecht Trust (IT6/1998) | | Adjacent Landowners | ✓ | | | | |
| 66. | Hans | Kruger | Adjacent Landowners | ✓ | | | | |
| 67. | Wouter | Naude | Adjacent Landowners | ✓ | | | | |
| 68. | Anna Rita | Jordaan | Adjacent Landowners | ✓ | | | | |
| 69. | Abraham | Fourie | Adjacent Landowners | ✓ | | | | |
| 70. | Sarel JP and Aletta MJ | Du Plessies | Adjacent Landowners | ✓ | | | | |
| 71. | BALOKA TRUST (IT409/2000) | | Adjacent Landowners | ✓ | | | | |
| 72. | Hennie | Joubert | Adjacent Landowners | ✓ | | | | |
| 73. | Corheim CC | | Adjacent Landowners | ✓ | | | | |
| 74. | Hendan Boerdery CC | | Adjacent Landowners | ✓ | | | | |
| 75. | Petrus Retief | Malan | Adjacent Landowners | ✓ | | | | |

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|---|---|---|---|---|---|---|---|---|
| 76. | Mathys Machiel | Basson | Adjacent Landowners | ✓ | | | | |
| 77. | ME | Van Rooyen | Adjacent Landowners | ✓ | | | | |
| 78. | Herman | Laubcher | Adjacent Landowners | ✓ | | | | |
| 79. | Sarel Johannes | Koortz | Adjacent Landowners | ✓ | | | | |
| **EGI Land Owners and Adjacent Property Owners** | | | | | | | | |
| 80. | Daniel Jacobus | Fourie | Landowner | ✓ | | | | |
| 81. | Abraham Johannes | Fourie | Landowner | ✓ | | | | |
| 82. | Jacobus Hermanus | Fourie | Landowner | ✓ | | | | |
| 83. | Freddie | Markram | Landowner | ✓ | | | | |
| 84. | Johannes Hendrikus | Venter | Landowner | ✓ | | | | |
| 85. | Helena Susana Elizabeth | Steyn | Landowner | ✓ | | | | |
| 86. | Gert Johannes | Markram | Landowner | ✓ | | | | |
| 87. | Clive | Albutt | Landowner | ✓ | | | | |
| 88. | Alhoff (Pty) Ltd | | Landowner | ✓ | | | | |

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|---|---|---|---|---|---|---|---|---|
| 89. | Dihan Eiendoms Trust | | Landowner | ✓ | | | | |
| 90. | Henque 3516 CC | | Landowner | ✓ | | | | |
| 91. | Sishen Iron Ore Company (Pty Ltd) | | Landowner | ✓ | | | | |
| 92. | Ga-Segonyane (Kuruman) Local Municipality | | Landowner | ✓ | | | | |
| 93. | PEJ en CJFC | Duvenhage | Landowner | ✓ | | | | |
| 94. | Department of Defence | | Landowner | ✓ | | | | |
| 95. | Herman | Laubcher | Adjacent Landowners | ✓ | | | | |
| 96. | Jacobus Petrus | Steenkamp | Adjacent Landowners | ✓ | | | | |
| 97. | Bestwood Family Trust | | Adjacent Landowners | ✓ | | | | |
| 98. | PZK BELEGGINGS 3000 CC | | Adjacent Landowners | ✓ | | | | |
| 99. | KATHU MOTORS CC | | Adjacent Landowners | ✓ | | | | |
| 100. | Gerhard Theron Family Trust | (IT2587/1) | Adjacent Landowners | ✓ | | | | |
| 101. | LP, LJ, ME and J | Steyn | Adjacent Landowners | ✓ | | | | |
| 102. | JJ and DM | Waldeck | Adjacent Landowners | ✓ | | | | |

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|---|---|---|---|---|---|---|---|---|
| 103. | Jan Johannes | Coetzee | Adjacent Landowners | ✓ | | | | |
| 104. | Louisa Petronella | Rossouw | Adjacent Landowners | ✓ | | | | |
| 105. | Norman and Hannelie | Du Plooy | Adjacent Landowners | ✓ | | | | |
| 106. | Susara Magrieta | De Klerk | Adjacent Landowners | ✓ | | | | |
| 107. | Alfred | Markram | Adjacent Landowners | ✓ | | | | |
| 108. | Tramab CC (1989/027778/23) | | Adjacent Landowners | ✓ | | | | |
| 109. | Sishen Iron Ore Company (Pty) Ltd | | Adjacent Landowners | ✓ | | | | |
| 110. | Chris | Nel | Adjacent Landowners | ✓ | | | | |
| 111. | Clive | Albutt | Adjacent Landowners | ✓ | | | | |
| 112. | Jacob | Venter | Adjacent Landowners | ✓ | | | | |
| 113. | Johannes Hendrikus | Venter | Adjacent Landowners | ✓ | | | | |
| 114. | Baloka Trust (IT409/2000) | | Adjacent Landowners | ✓ | | | | |
| 115. | Hennie | Joubert | Adjacent Landowners | ✓ | | | | |
| 116. | Corheim CC | | Adjacent Landowners | ✓ | | | | |

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|---|---|---|---|---|---|---|---|---|
| 117. | Hendan Boerdery CC | | Adjacent Landowners | ✓ | | | | |
| 118. | Hans | Kruger | Adjacent Landowners | ✓ | | | | |
| 119. | Sarel Johannes | Koortz | Adjacent Landowners | ✓ | | | | |
| 120. | Wouter | Naude | Adjacent Landowners | ✓ | | | | |
| 121. | Anna Rita | Jordaan | Adjacent Landowners | ✓ | | | | |
| 122. | Carel Reitz Family Trust (IT179/97) | | Adjacent Landowners | ✓ | | | | |
| 123. | Transnet Ltd | | Adjacent Landowners | ✓ | | | | |
| 124. | Naftalia Boerdery CC | | Adjacent Landowners | ✓ | | | | |
| 125. | Johan Lambrecht Trust (IT6/1998) | | Adjacent Landowners | ✓ | | | | |
| 126. | Johan | Voster | Adjacent Landowners | ✓ | | | | |
| 127. | Freddie | Markram | Adjacent Landowners | ✓ | | | | |
| 128. | Sarel JP and Aletta MJ | Du Plessis | Adjacent Landowners | ✓ | | | | |
| 129. | Gamagara Local Municipality | | Adjacent Landowners | ✓ | | | | |
| 130. | Petrus Retief | Malan | Adjacent Landowners | ✓ | | | | |

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|---|---|---|---|---|---|---|---|---|
| 131. | Mathys Machiel | Basson | Adjacent Landowners | ✓ | | | | |
| 132. | ME | Van Rooyen | Adjacent Landowners | ✓ | | | | |
| 133. | Eskom Holdings Ltd | | Adjacent Landowners | ✓ | | | | |
| 134. | South African National Roads Agency Ltd | | Adjacent Landowners | ✓ | | | | |
| 135. | Sarel Jacobus | Coetzee | Adjacent Landowners | ✓ | | | | |
| 136. | Jacobus Hermanus | Fourie | Adjacent Landowners | ✓ | | | | |
| 137. | Gert Johannes | Markram | Adjacent Landowners | ✓ | | | | |
| **Additional Registered I&APS** | | | | | | | | |
| 138. | Dana | Poolman | Nearby Landowner | | | | | |
| **Distribution** | | | | | | | | |
| 139. | | | Kathu Public Library | | | | | |
| 140. | | | Kuruman Public Library | | | | | |

MULILO
RENEWABLE PROJECT DEVELOPMENTS

Environmental Impact Assessment for the proposed Kuruman Phase 1 Wind Energy Facility near Kuruman in the Northern Cape

# Draft Scoping Report

# APPENDIX D:

## Public Participation

# CONTENTS

## D1: NOTICE BOARDS

***Site Notice Board-Afrikaans***

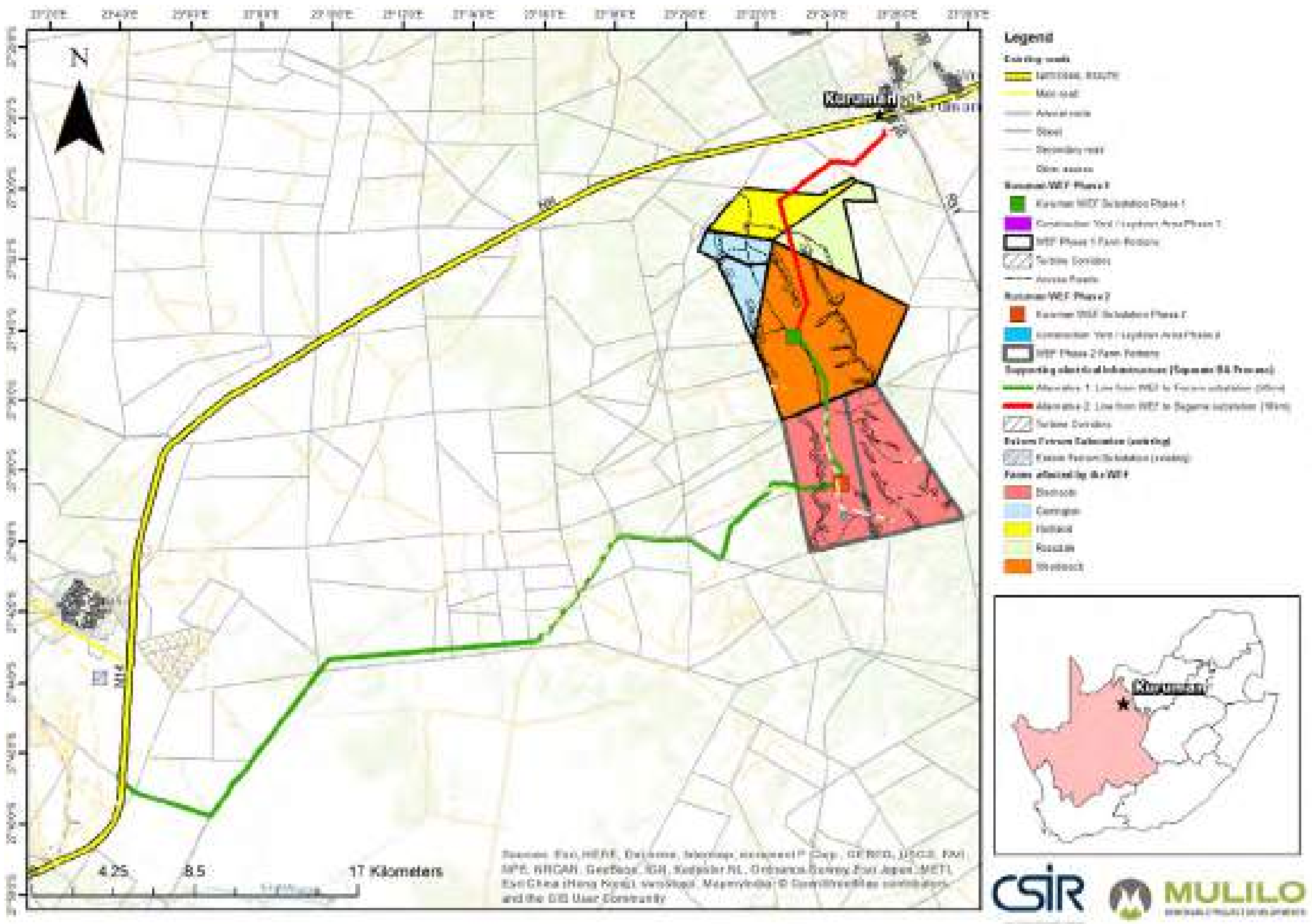
### GEÏNTEGREERDE OPENBARE DEELNAME PROSES VIR DIE VOORGESTELDE ONTWIKKELING VAN DIE KURUMAN FASE 1 EN 2 WIND ENERGIE AANLEGTE EN ONDERSTEUNENDE ELEKTRIESE INFRASTRUKTUUR, KURUMAN, NOORD-KAAP PROVINSIE

Mulilo Renewable Project Developments (Pty) Ltd ("Mulilo") is van voorneme om 'n twee wind energie aanlegte, naamlik Kuruman Fase 1 en Kuruman Fase 2 en ondersteunende elektriese infrastruktuur in die Ga-Segonyana plaaslike munisipaliteit en die John Taolo Gaetsewe distrik munisipaliteit, 8 km en 37 km suid-wes van Kuruman en Kathu, onderskeidelik, op te rig. Die projekte word voorgestel om energie te genereer wat in die nasionale elektriese sisteem sal invoer.

Die onderstaande figuur dui die plase aan wat deur die wind energie aanlegte en elektriese infrastruktuur geaffekteer gaan word. Aangesien die wind energie aanlegte en elektriese infrastruktuur in dieselfde geografiese area voorgestel word, word 'n geïntegreerde openbare deelname proses voorgestel. Aparte aansoeke vir die onderskeie ontwikkelings sal by die Nasionale Department van Omgewingsake (DOS) ingedien word.

Die Wetenskaplike Nywerheids- ens Navorsingsraad (WNNR) is aangestel as die onafhanklike Omgewingspraktisyn om die omgewingsimpakstudie prosesse te bestuur.

Ingevolge die Nasionale Omgewingsbestuurswet (Wet 107 van 1998, soos gewysig) (NEMA) en die 2014 NEMA Omgewingsimpakstudie Regulasies, soos gewysig, kan die volgende gelyste aktiwiteite van toepassing wees op die voorgestelde wind energie aanlegte: GN R 327 Listing Notice (LN) 1: 11, 12, 14, 19, 24, 56; GN R. 325 LN 2: 1, 15; GN R. 324 LN 3: 4, 10, 12, 14, 18; en die elektriese infrastruktuur: LN1: 11, 12, 19; LN 3: 12, 14. 'n Waterverbruikslisensie aansoek sal ook ingedien word vir die wind energie aanlegte en ondersteunende elektriese infrastruktuur soos bepaal deur die Nasionale Water Wet (Wet 36 van 1998, soos gewysig).




'n Agterground Inligtingsdokument (AID) is beskikbaar by die Kuruman openbare biblioteek, op die hoek van Foskor & Voortrekker Straat en die Kathu openbare biblioteek, 38 Kromhout straat, Kathu en op die webtuiste: http://www.csir.co.za/eia/kuruman.html. Sou u geïnteresseerd wees om te registreer as 'n Geïnteresseerde of Belanghebbende Party (G&BP) en/of om kommentaar op die voorgestelde projekte te lewer, word u vriendelik versoek om u naam, kontakinligting (voorkeur aan kommunikasie metode bv. E-pos, faks of pos) asook 'n aanduiding van enige finansiële, direkte besigheid, persoonlike of ander redes vir u belangstelling in die projekte aan Lizande Kellerman, adres: Posbus 320, Stellenbosch, 7599 Faks: 021 888 2693 of e-pos: LKellerman@csir.co.za te stuur. Die registrasie periode is tot en met **28 Maart 2018** (uitsluitend openbare vakansiedae).

***Site Notice Board-English***

**INTEGRATED PUBLIC PARTICIPATION PROCESS FOR THE PROPOSED DEVELOPMENT OF THE KURUMAN PHASE 1 AND 2 WIND ENERGY FACILITIES AND SUPPORTING ELECTRICAL INFRASTRUCTURE TO THE PROPOSED WIND ENERGY FACILITIES, KURUMAN, NORTHERN CAPE PROVINCE**

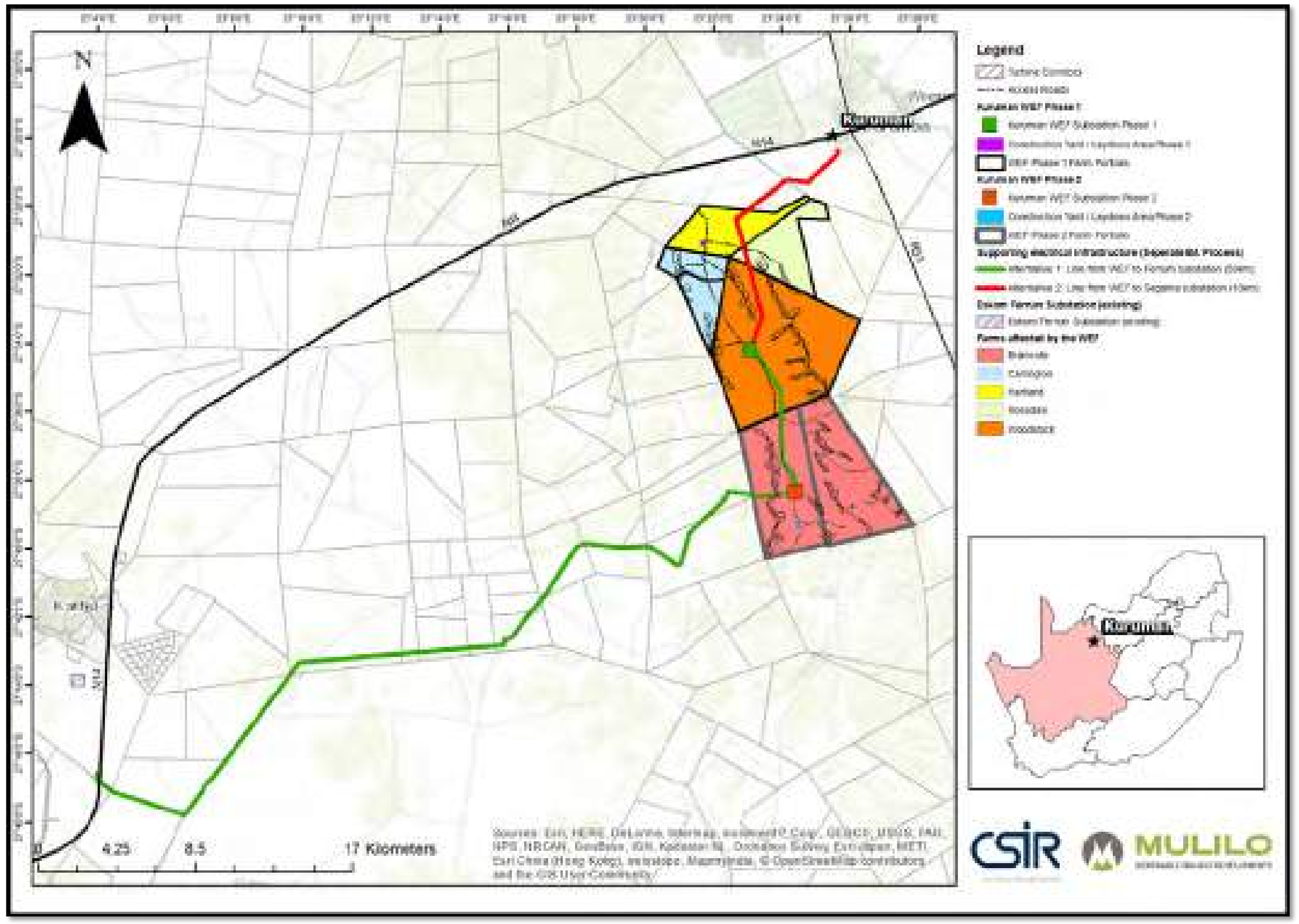
Mulilo Renewable Project Developments (Pty) Ltd (hereafter, “Mulilo”) is proposing to construct two Wind Energy Facilities (WEFs), namely Kuruman Phase 1 WEF and Kuruman Phase 2 WEF and supporting electrical infrastructure, in the Ga-Segonyana Local Municipality and the John Taolo Gaetsewe District Municipality, 8 km and 37 km south west from Kuruman and from Kathu, respectively, in the Northern Cape Province. The proposed projects are being developed to generate electricity via wind energy which will feed into and supplement the national electricity grid.

The respective farms portions affected by the two WEFs and the supporting electrical infrastructure and the relative location of the proposed projects are shown below. Since the WEFs and supporting electrical infrastructure are proposed within the same geographical area, an integrated Public Participation Process (PPP) will be undertaken for the proposed projects. However, separate applications for Environmental Authorisation (EA) will be lodged with the National Department of Environmental Affairs (DEA).

The Council for Scientific and Industrial Research (CSIR) as been appointed as the independent Environmental Assessment Practitioner (EAP) to manage the Environmental Impact Assessment (EIA) for the proposed wind farms and the Basic Assessment (BA) process for the proposed supporting electrical infrastructure.

In terms of the National Environmental Management Act (Act 107 of 1998, as amended) (NEMA) and the 2014 NEMA Environmental Impact Assessment (EIA) Regulations (as amended) the proposed WEFs potentially trigger the following activities, GN R. 327 Listing Notice (LN) 1: 11, 12, 14, 19, 24, 56; GN R. 325 LN 2: 1, 15; GN R. 324 LN 3: 4, 10, 12, 14, 18; and the supporting electrical infrastructure: LN1: 11, 12, 19; LN 3: 12, 14. A Water Use Licence Application will also be submitted for the WEFs and supporting electrical infrastructure in accordance with the National Water Act (NWA) (Act No. 36 of 1998, as amended).

A Background Information Document (BID) is also available at the Kuruman Public Library, Corner of Foskor & Voortrekker Street and the Kathu Public Library, 38 Kromhout Street, Kathu and on the following website: http://www.csir.co.za/eia/kuruman.html**.** Should you be interested in registering as an Interested and Affected Party (I&AP) and to provide comments on these proposed projects, you are kindly requested to email, fax or mail your name, contact details (preferred method of notification, e.g. e-mail address or fax number) and an indication of any direct business, financial, personal or other interest which they have in the applications to the CSIR Lizande Kellerman, address: PO Box 320, Stellenbosch, 7599 Fax: 021 888 2693 or email: LKellerman@csir.co.za. The registration period will extend to 28 March 2018 (excluding public holidays).



## D2: NEWSPAPER ADVERTISEMENT ("KATHU GAZETTE" DATED 24 FEBRUARY 2018)

24 Februarie / February / Tlhakole 2018 • KATHU GAZETTE 11

POSTMASBURG

# NG-kerk Pretdag vol pret en lewe

*Mimi Swart*


**Eerste, Nadia van Staden (middel in foto) tweede Karlien Goosen en derde Adele du Plooy.**

**Twee jongelinge wat die 15km fietswedren voltooi het : Naude Pienaar en Mienke Pretorius saam met René van Niekerk die organiseerder.**

Saterdag 17 Februarie 2018 was daar nie tyd vir laat slaap nie, want die eerste item, van die jaarlikse Sportdag het alreeds om 07:00 die wiele laat rol toe die bergfietse weggespring het op die 60km roete.

Die inskrywings het reeds 05:30 begin. Draf/stap-, trailrun- en bergfietsitems, oor verskillende afstande, en ook 'n roete vir kinders het dit moontlik gemaak dat elkeen kon deelneem.

Hierdie sportdag wat aanvanklik 'n projek van die NG-kerk was vir die insamelingfonds vir kinderhuise, se momentum het toegeneem sodat dit nou 'n algemene insameling is waarvan die fondse wyer aangewend kan word. Na verneem word is byna R30 000 ingesamel.

Die wegspringpunt was die Hoërskoolgronde in Houtstraat Postmasburg vanwaar daar op die onderskeie roetes "lewensreddende waterpunte" was. In die Noord-Kaap se son is dit vir baie die hoogtepunt van sy roete..

Die roetes is ook duidelik gemerk om nie die swoegtendes hulle pad byster te laat raak nie.

Natuurlik was eetgoed en koeldrank 'n vanselfsprekende deel van so 'n opwindende dag. Gelukkige trekkings en goeie pryse was deel van die belonings wat op die vasbytersgewag het.

Die sportdagreëlings is deur René van Niekerk hanteer. Vele hande en helpers was egter beskikbaar om al die noodsaaklike take glad te laat verloop.

Groot en klein wat deel van die prettige sportdag was, slyp alweer tande vir volgende jaar ...

**GEÏNTEGREERDE OPENBARE DEELNAME PROSES VIR DIE VOORGESTELDE ONTWIKKELING VAN DIE KURUMAN FASE 1 EN 2 WIND ENERGIE AANLEGTE EN ONDERSTEUNENDE ELEKTRIESE INFRASTRUKTUUR, KURUMAN, NOORD-KAAP PROVINSIE**

Mulilo Renewable Project Developments (Pty) Ltd ("Mulilo") is van voorneme om 'n twee wind energie aanlegte, naamlik Kuruman Fase 1 en Kuruman Fase 2 en ondersteunende elektriese infrastruktuur in die Ga-Segonyana plaaslike munisipaliteit en die John Taolo Gaetsewe distrik munisipaliteit, 8 km en 37 km suidwes van Kuruman en Kathu, onderskeidelik, op te rig. Die projekte word voorgestel om energie te genereer wat in die nasionale elektriese sisteem sal invoer.

Aangesien die wind energie aanlegte en elektriese infrastruktuur in dieselfde geografiese area voorgestel word, word 'n geïntegreerde openbare deelname proses voorgestel. Aparte aansoeke vir die onderskeie ontwikkelings sal by die Nasionale Department van Omgewingsake (DOS) ingedien word.

Die Wetenskaplike Nywerheids- en Navorsingsraad (WNNR) is aangestel deur Mulilo as die onafhanklike Omgewingsimpakpraktisyn om die impakstudie proses te bestuur.

Ingevolge die Nasionale Omgewingsbestuurswet (Wet 107 van 1998, soos gewysig) (NEMA) en die 2014 NEMA Omgewingsimpakstudie Regulasies, soos gewysig, kan die volgende gelyste aktiwiteite van toepassing wees op die voorgestelde wind energie aanlegte: GN R 327 Listing Notice (LN) 1: 11, 12, 14, 19, 24, 56; GN R. 325 LN 2: 1, 15; GN R. 324 LN 3: 4, 10, 12, 14, 18; en die elektriese infrastruktuur: LN1: 11, 12, 19; LN 3: 12, 14. 'n Waterverbruikslisensie aansoek sal ook ingedien word vir die wind energie aanlegte en ondersteunende elektriese infrastruktuur soos bepaal deur die Nasionale Water Wet (Wet 36 van 1998, soos gewysig).

'n Agtergrond Inligtingsdokument (AID) is beskikbaar by die Kuruman openbare biblioteek, op die hoek van Foskor & Voortrekker Straat en die Kathu openbare biblioteek, 34 Kronkelhout Straat, Kathu en op die webtuiste: **http://www.csir.co.za/eia/kuruman.html.** Sou u geïnteresseerd wees om te registreer as 'n Geïnteresseerde of Belanghebbende Party (GBBP) en/of om kommentaar op die voorgestelde projekte te lewer, word u vriendelik versoek om u naam, kontakinligting (voorkeur aan kommunikasie metode bv. E-pos, faks of pos) asook 'n aanduiding van enige finansiële, direkte besigheid, persoonlike of ander redes vir u belangstelling in die projekte aan Lizande Kellerman, adres: Posbus 320, Stellenbosch, 7599 Faks: 021 888 2693 of e-pos: LKellerman@csir.co.za te stuur.

Die registrasie periode is tot en met **28 Maart 2018** (uitsluitend openbare vakansiedae).

MULILO CSIR

**NOTIFICATION OF PUBLIC PARTICIPATION PROCESS**

Pan African Mineral Development (Pty) Ltd (PAMDC) is pursuing an integrated application for a Prospecting Right in terms of Section 16 of the Mineral and Petroleum Resources Development Act, 2002 (MPRDA); and Environmental Authorisation for activities listed in terms of the National Environmental Management Act, 1998 (NEMA) EIA Regulations (GNR982 of 2014) for various minerals across several properties within the Joe Morolong Local Municipality in the Northern Cape Province. The site is located 57 km north east of Kuruman and includes; Farm 703 Ptn 31, 32, 41, 42, 43, 49, 50, 59, 60, 75, 103, 108, 114; Farm 709 Ptn 1 and Re; and Farm 710 Ptn 1 and Re.

Prospecting activities will entail both non-invasive and invasive (drilling) methods.

Environmental Authorisation is required in terms of listing notice 1; GNR983 of 2014: no. 20 (Prospecting Right Application) and no. 27 (clearing of vegetation). The listed activities require that a Basic Assessment process be undertaken.

Prime Resources (Pty) Ltd has been appointed as the Environmental Assessment Practitioner to facilitate the above process.

**REGISTER AS AN INTERESTED OR AFFECTED PARTY (IAP)**

Individuals and organisations can register on the IAP database or request additional information by submitting their contact details to Prime Resources.

To register, SMS "PAMDC Project" followed by your name and contact number to 071 184 7956; or email prime@resources.co.za.

**PUBLIC COMMENT INVITED**

The Basic Assessment Report can be viewed from 23 February 2018 on the Prime Resources website or provided by email upon request. Please forward comments to Prime Resources by 26 March 2018.

For more information, please contact Jonathan van de Wouw or Bronwyn Grover at Prime Resources.
(T) 011 447 4888 (F) 086 604 2219 (E) prime@resources.co.za (W)

KATHU

# High School Kathu celebrates Valentine's Day

**Teachers enjoying themselves on Valentine's day at High School Kathu on 14 February. The theme was "Flower Power".**

**KITSISO KA GA TIREGO YA BOTSAYAKAROLO MO BATHONG BOTLHE**

Tlhabololo ya Dimenerale ya Pan African e bong Pan African Mineral Development (PTY) Ltd (PAMDC) e latedisa kopo e e kopantsweng ya Tshwanelo e e Solofetsweng go ya ka Karolo 16 ya molao wa Tlhabololo ya Didirisiwa tsa Dimenerale kana Dirafswa le Peterolieamo, 2002 (MPRDA) [illegible] Ya Tikologo ya ditiro tse di mo lenaneng go ya ka Molao wa Bosetšhaba wa Botsamaisi jwa Tikologo (National Environmental Management Act, 1998 (NEMA) Melawana ya EIA (GNR982 ya 2014) mo dimeneraleng tse di farologaneng go ralala ditlhoto di le mmalwa mo Mmasepaleng wa Selegae wa Morolong kwa Porofenseng ya Kapa Bokone. Setsha se bolelwa dikilometara di le 57 kwa bokone-botlhaba jwa Kurumane mme se akaretsa: Polasi ya 703 Ptn, 31, 32, 41, 42, 43, 49, 50, 59, 60, 75, 103, 108, 114; Polasi ya 709 Ptn 1 le Re; le Polasi ya 710 Ptn 1 le Re.

[illegible]

Tetlelelo ya Tikologo e tlhokagala go ya ka kitsiso e e molemoneng 1, GNR983 la 2014: nomoro 20 (Kopo ya Tshwanelo e e Solofetsweng) le nomoro 27 ( [illegible] ). Ditiro tse di mo lenaneng di tlhoka gore tirego ya Tekanyetsotlhamo e diragadiwe.

Prime Resources (Pty) Ltd e tlhapilwe jaaka Modiri wa Tekanyetso Tikologo go [illegible] tirego e e fa godimo.

**IKWADISE JAAKA LEKOKO LE LE NANG LE KGATLHEGO KGOTSA LE LE AMEGANG. (IAP)**

[illegible] Prime Resources.

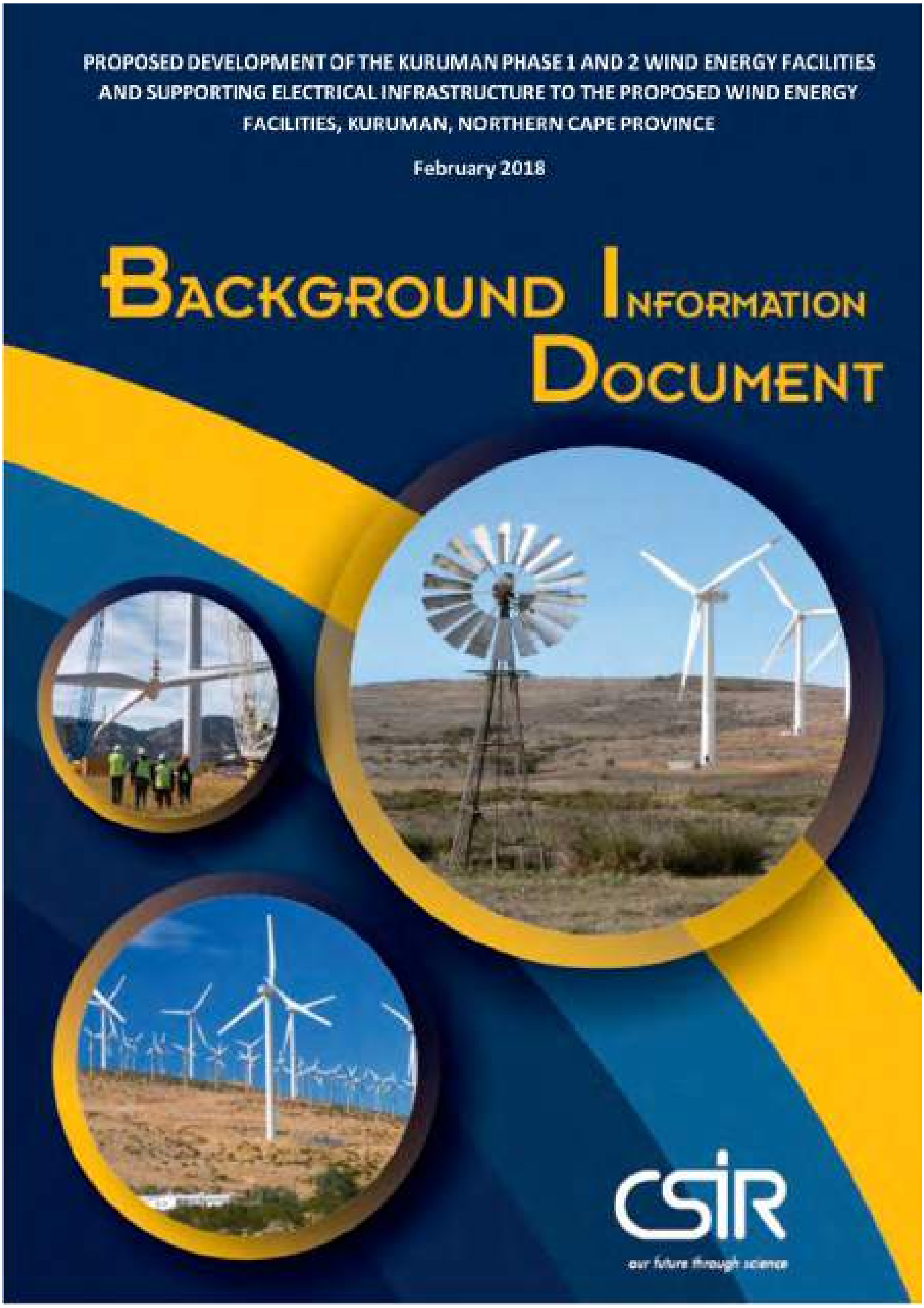
Go ikwadisa, [illegible] go "PAMDC Project" go latela leina le nomoro ya gago ya mogala mo nomorong ya 071 184 7956; kgotsa imeiling go prime@resources.co.za.

**TSHWAELA YA BOTLHE E A LALEDIWA**

Pego ya Tekanyetsotlhamo e ka bonwa go tloga ka la 23 Tlhakole 2018 mo webosaeteng ya Prime Resources kgotsa ya [illegible]. [illegible] go Prime Resources ka la 26 Mopitlwe 2018.

Go bona tshedimosetso e e fetang e, ikgolaganye le Jonathan van de Wouw kgotsa Bronwyn Grover kwa Prime Resources.
(T) 011 447 4888 (F) 086 604 2219 (E) prime@resources.co.za (W)

## D3: BACKGROUND INFORMATION DOCUMENT



## BACKGROUND INFORMATION DOCUMENT

**INTEGRATED PUBLIC PARTICIPATION PROCESS FOR THE PROPOSED DEVELOPMENT OF THE KURUMAN PHASE 1 AND 2 WIND ENERGY FACILITIES AND SUPPORTING ELECTRICAL INFRASTRUCTURE TO THE PROPOSED WIND ENERGY FACILITIES, KURUMAN, NORTHERN CAPE PROVINCE**

### BACKGROUND

Mulilo Renewable Project Developments (Pty) Ltd (hereafter, "Mulilo") is proposing to construct two Wind Energy Facilities (WEFs), namely Kuruman Phase 1 WEF and Kuruman Phase 2 WEF and supporting electrical infrastructure, in the Ga-Segonyana Local Municipality and the John Taolo Gaetsewe District Municipality, 8 km and 37 km south west from Kuruman and from Kathu, respectively, in the Northern Cape Province. The proposed projects are being developed to generate electricity via wind energy which will feed into and supplement the national electricity grid.

The respective farms portions affected by the two WEFs and the supporting electrical infrastructure and the relative location of the proposed projects are shown on the opposite page. Since the WEFs and supporting electrical infrastructure are proposed within the same geographical area, an integrated Public Participation Process (PPP) will be undertaken for the proposed projects. However, separate applications for Environmental Authorisation (EA) will be lodged with the National Department of Environmental Affairs (DEA).

The Council for Scientific and Industrial Research (CSIR) as been appointed as the independent Environmental Assessment Practitioner (EAP) to manage the Environmental Impact Assessment (EIA) for the proposed wind farms and the Basic Assessment (BA) process for the proposed supporting electrical infrastructure.

### AIM OF THIS DOCUMENT

The aim of this Background Information Document (BID) is to provide Interested and Affected Parties (I&AP's) with:

- Background information on the proposed projects;
- A description of the combined Environmental Authorisation and Public Participation Processes (PPP) that will be undertaken for the projects;
- Details on how I&APs can become involved in the proposed projects by registering their interest in the projects, raising issues of concern or interest, and receiving further information.

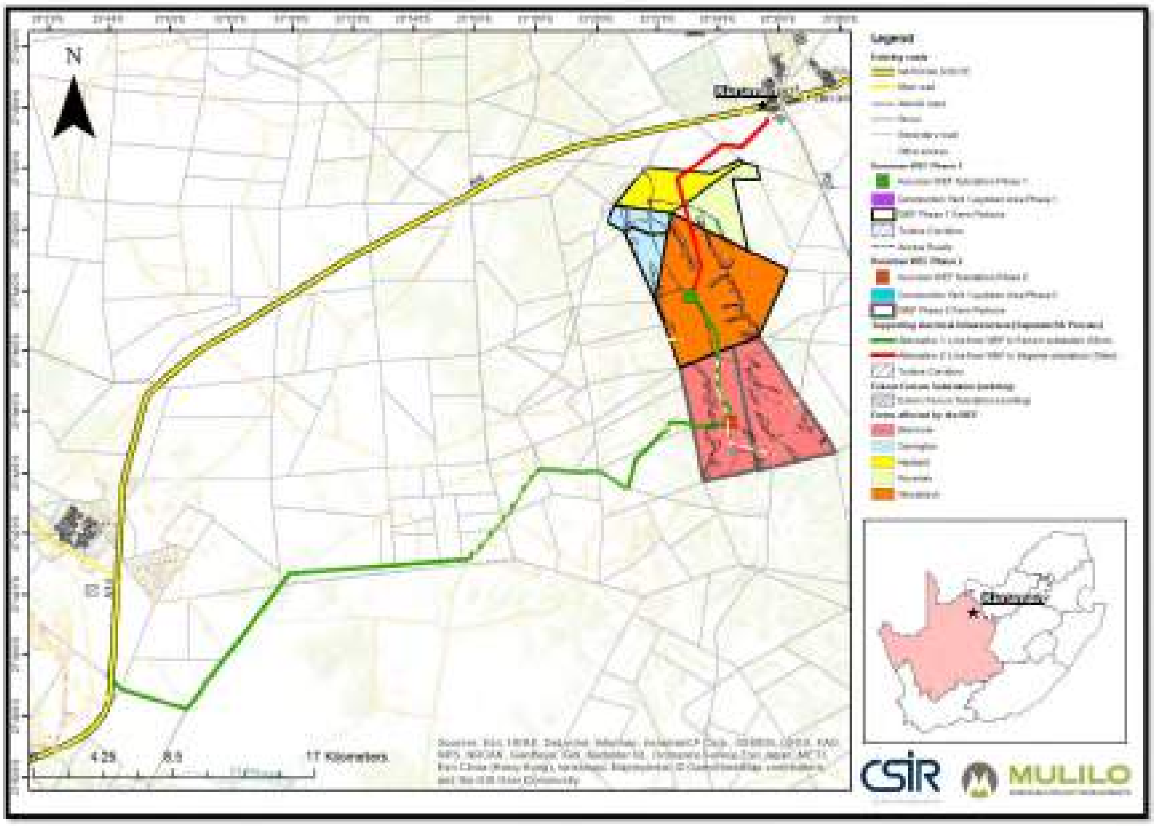
As a registered I&AP, there will be opportunities for involvement in the EIA process by receiving information, the contribution of issues and commenting on draft reports. The input received from I&APs together with the information and assessment provided by the EAP, will assist the Competent Authority, the DEA, with their decision making process.

### NEED AND JUSTIFICATION OF THE PROPOSED PROJECTS

The need to reduce greenhouse gas emissions and the importance of a secure and diversified energy supply has resulted in a global shift towards, and an increased focus on, the use of renewable energy technologies. In support of this, the national government has encouraged the utilisation of renewable energy through national policy and strategic planning.

The Integrated Resource Plan (IRP) for South Africa for the period 2010 to 2030 (referred to as "IRP2010") and the IRP Updated Report (2013) proposes to secure 17 800 MW of renewable energy capacity by 2030. The Department of Energy (DOE) has subsequently entered into a bidding process for the procurement of 3 725 MW of renewable energy from Independent Power Producers (IPPs) by 2016 and beyond to enable the Department to meet this target. On 18 August 2015, an additional procurement target of 6 300 MW to be generated from renewable energy sources was added to the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) for the years 2021 - 2025, as published in Government Gazette 39111. The additional target allocated for wind energy, solar PV energy, and solar CSP energy is 3 040 MW, 2 200 MW, and 600 MW respectively. Linked to this, in 2011, the Department of Energy (DOE) launched the REIPPPP and invited potential IPPs to submit proposals for the financing, construction, operation and maintenance of the first 3 725 MW of onshore wind, solar thermal, solar PV, biomass, biogas, landfill gas or small hydro projects. The bidders with the highest rankings (according to the aforementioned criteria) are appointed as "Preferred Bidders" by the DoE.

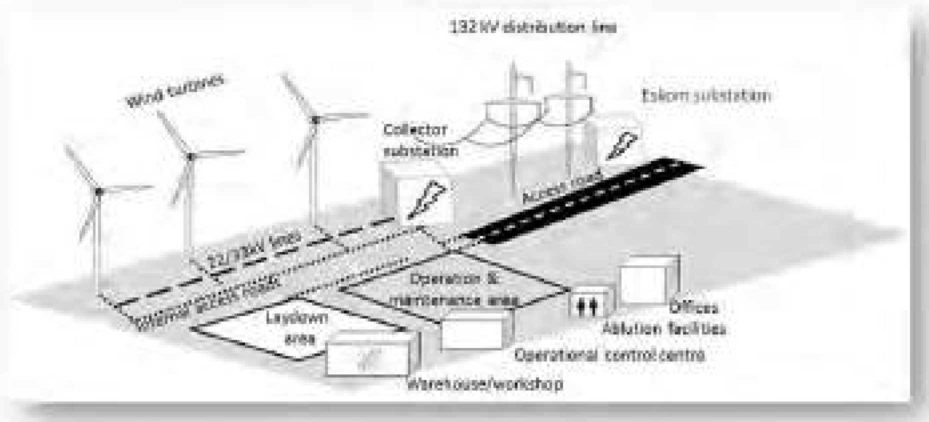
The proposed projects aim to contribute to the above strategic imperative.


N
Legend
4.25
8.5
17 Kilometers
CSIR
MULILO

WHAT DO THE PROPOSED PROJECTS ENTAIL?

The proposed projects will be situated on land that is owned by a third party and as such, consent will be obtained from the respective landowners for the development of the WEFs. It is anticipated that the properties on which the proposed projects will be constructed will be leased from the landowners.

It is proposed that each WEF will have a generation capacity of between 200 - 240 MW. The anticipated maximum amount of turbines to be constructed for each project is 52. These turbines will have a turbine height of 140 m and a rotor diameter of 80 m. In order to connect the proposed WEFs to the national grid, supporting electrical infrastructure would need to be constructed. This includes a 132 kV distribution line routed either to the Ferrum substation (located in Kathu) or to the Segame substation (located in Kuruman) and two collector substations (one for each WEF). Each WEF facility will consist of the components presented in the figure below. The components and their dimensions will be confirmed and discussed within the Scoping & EIA Reports produced for each WEF.




ENVIRONMENTAL AUTHORISATION PROCESS

In terms of the National Environmental Management Act (NEMA) (Act no. 107 of 1998) and the 2014 NEMA Environmental Impact Assessment (EIA) Regulations, as amended, the proposed projects potentially trigger, amongst others, the following activities:

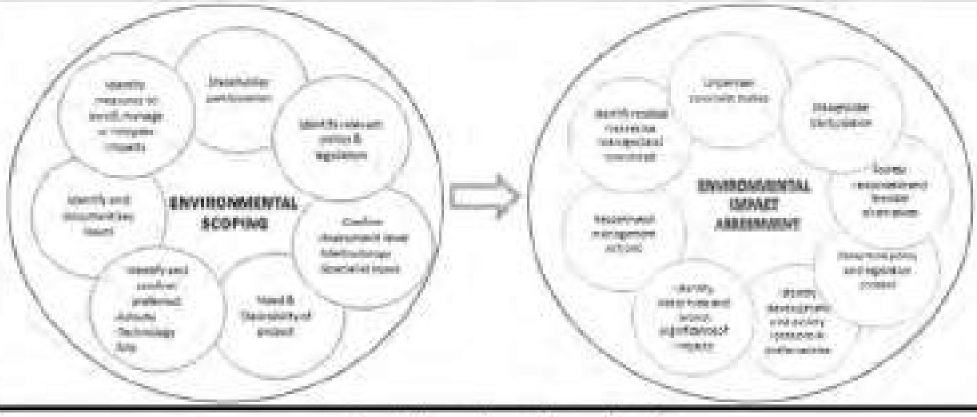
| | WEF | Electrical infrastructure |
|---|---|---|
| GN R. 327 Listing Notice 1: | 11, 12, 14, 19, 24, 56 | 11, 12, 19 |
| GN R. 325 Listing Notice 2: | 1, 15 | |
| GN R. 324 Listing Notice 3: | 4, 10, 12, 14, 18 | 12, 14 |

The EIA process is also designed to meet the requirements of the National Heritage Resources Act, 1999 (Act 25 of 1999). A Water Use Licence Application will also be submitted for the WEFs and supporting electrical infrastructure in accordance with the National Water Act (NWA) (Act No. 36 of 1998, as amended).

> *Note from the CSIR: A precautionary approach has been adopted by the CSIR when identifying listed activities, in that if there is any doubt at this stage of the project planning whether or not an activity is included in the project design, then the activity is listed. This **list may be refined during the course of the Scoping & EIA Processes, and listed triggers may be removed or added as applicable.***

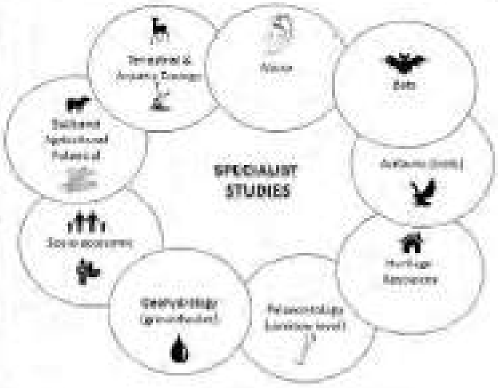
The applicable listed activities require EA from the DEA prior to the undertaking thereof. The main steps in Scoping & EIA Process are discussed and shown in the figure below. As also shown in Figure 2, proactive engagement with stakeholders forms a key component of the entire Scoping & EIA Process.

**The Scoping & EIA process for the proposed WEF developments**




**Specialist studies to be conducted**

| Name | Organisation | Specialist Study |
|---|---|---|
| Specialists | | |
| Kerry Schwartz | SiVEST | Visual |
| Nic Wiltshire | CTS Heritage | Heritage (incl. Palaeontology) |
| Natasha van der Haar | Enviroswift | Freshwater |
| Morne de Jager | EAR | Noise |
| Johann Lanz | Private consultant | Soils and Agricultural |
| Elena Broughton | Urban Econ | Socio-economic |
| Iris Wink | JG Afrika | Transportation Study |
| Julian Conrad | GEOSS | Geohydrological Study |
| Simon Todd | 3Foxes Biodiversity Solutions | Terrestrial Ecology (Fauna and Flo |
| Chris van Rooyen | Chris van Rooyen Consulting | Avifauna |
| Werner Marais | Animalia | Bats |




**Step 1: Notify Authorities and I&APs of the Scoping and EIA Processes (30 days)** **(WE ARE CURRENTLY AT THIS STEP)**

The initial step entails providing notification to Authorities and potential I&APs of the proposed projects and the commencement of the Scoping & EIA Processes. An initial database of potential I&APs and Authorities will be compiled. Authorities and potential I&APs will be provided with a BID (i.e. this document), including a Comment and Registration Form and written notification. Advertisements will also be placed in local newspapers and site notices will be placed at the project sites as well as in the closest towns during this phase.

During this period, I&APs are required to register their interest on the project database in order to be included from the outset of the Scoping & EIA Processes. **In terms of the EIA Regulations, in order to register as an I&AP, a person must provide their comments together with their name, contact details (preferred method of notification, e.g. e-mail address or fax number) and an indication of any direct business, financial, personal or other interest which they have in the application. Failure to do so may lead to a person not being registered as an I&AP for these projects.**

I&APs will be provided with a 30-day review period within which to raise any issues or concerns for inclusion in the Scoping Reports.

**Step 2: Preparation of Applications for Environmental Authorisation (EA) and Scoping Reports**

Two separate Applications for EA for the proposed WEF developments will be prepared. In addition, the Scoping Reports and a Plan of Study for EIA will be compiled in line with Appendix 2 of the 2014 EIA Regulations (GN R326).

All issues and concerns raised by the Authorities and I&APs during the review of the BID will be recorded and compiled into an Issues and Responses Trail for inclusion in the Scoping Reports.

**Step 3: Submission of Applications for EA**

Submit the Applications for EA for the proposed WEF developments (i.e. a total of two applications) to the National DEA for processing.

**Step 4: Authority and I&AP Review of the Scoping Reports (30 days)**

The Scoping Reports will be released to the public for a 30-day review period. All Authorities and registered I&APs will be notified in writing of the opportunity to review the Scoping Reports. A Comment and Registration Form will also be sent with the written notification to all registered I&APs. Copies of the Scoping Reports will be placed on the project website (http://www.csir.co.za/eia/kuruman.html) and at the local public libraries. The reports will be placed in the following libraries:

- Kuruman Public Library, Corner of Foster & Voortrekker Street; and
- Kathu Public Library, 38 Kremhout Street, Kathu

**Step 5: Commence with the undertaking of Specialist Studies and Submission of Scoping Reports to the National DEA for Decision-Making**

The comments received from I&APs during the 30-day review of the Scoping Reports will be recorded into a comprehensive Issues and Responses Trail, and will be included in the Scoping Reports before submission to the DEA. The Scoping Reports will thereafter be finalised and submitted to the DEA for decision making. The DEA will have 43 days (from receipt of the Scoping Reports) to either accept the Scoping Reports with or without conditions, or refuse EA.

All comments received on the Scoping Reports will be responded to within the Issues and Responses Trail. A copy of the Issues and Responses Trail will be sent to all I&APs registered on the project database.

**Step 6: Preparation of EIA and BA Reports (including the Environmental Management Programme (EMPr)) and submission of the EA application for the supporting electrical infrastructure**

Once the National DEA accepts the Scoping Reports, the Impact Assessment Phase may commence. During this phase, the EIA Reports (including the EMPr) and a BA Report for the supporting electrical infrastructure will be compiled in line with the 2014 EIA Regulations. An EA application will also be compiled for the supporting electrical infrastructure that will be subject to a BA process.

**Step 7: Authority and I&AP Review of the EIA and BA Reports (30 days)**

During this phase, the EIA and BA Reports will be released to the public for a 30-day review period. All Authorities and registered I&APs on the project database will be notified in writing of the opportunity to review the EIA and BA Reports. A Comment and Registration Form will also be sent with the written notification to all registered I&APs. Copies of the EIA and BA Reports will be placed on the project website and at the local public libraries. Depending on the interest in the project, public meetings may be scheduled.

**Step 8: Submission of the EIA and BA Reports to the DEA for Decision-Making**

A key component of the process is documenting and responding to the comments received from I&APs and Authorities. The comments received from I&APs during the 30-day review of the EIA and BA Reports will be recorded into a comprehensive Comments and Responses Trail, and will be included in the EIA and BA Reports before submission to the DEA. Following submission of the reports, the DEA will have 10 days (from receipt of the EIA and BA Reports) to acknowledge the reports and thereafter, the DEA will have 107 days to grant or refuse EA.

**Step 9: Notification of Environmental Decision and Appeal Period**

All registered stakeholders on the project database will be notified in writing of the environmental decision for the proposed projects, and will be informed of the opportunity to appeal.

**PUBLIC PARTICIPATION PROCESS**

Public involvement forms an important component of the EIA and BA Processes by assisting in the identification of issues and alternatives to be evaluated. The following outlines the steps in the PPP which will be undertaken to run in parallel to the BA and Scoping & EIA Processes.

| | PPP action by project team | HOW CAN YOU BE INVOLVED IN THIS PROCESS? |
|---|---|---|
| Step 1: Notify Authorities and I&APs of the Scoping and EIA Processes **(30 days)** | Notify Authorities and I&APs of the project by providing:<br>- Notification letters<br>- Comments & Registration Forms<br>- Basic Information Document<br>- Newspaper advertisements<br>- Site notices | ✓ **Register as an I&APs**<br>✓ **Provide comments on potential issues that should be considered during the EIA** |
| Step 2: Preparation of Applications for EA, and Scoping Reports | | |
| Step 3: Submission of Applications for EA | | |
| Step 4: Authority and I&AP Review of the Scoping Reports **(30 days)** | Provide Authority and I&APs with Reports for review | ✓ **Review Scoping Reports and provide written comment** |
| Step 5: Submission of Scoping Reports to the National DEA for Decision-Making | | |
| Step 6: Preparation of EIA and BA Reports and submission of the EA application for the supporting electrical infrastructure | | |
| Step 7: Authority and I&AP Review of the BA and EIA Reports and EMPr **(30 days)** | Provide Authorities and I&APs with Reports for review | ✓ **Review Basic Assessment and EIA Reports and provide written comment** |
| Step 8: Submission of the BA and EIA Reports to the National DEA for Decision Making | | |
| Step 9: Notification of Environmental Decision and Appeal Period | Notify I&APs of the Authorities decision on Environmental Authorisation | ✓ **Opportunity to lodge appeals** |

**GET INVOLVED!**

1. Respond to our invitation for your involvement advertised in local newspapers.
2. Email, fax or mail the attached Comment and Registration Form to CSIR: **Lizande Kellerman, address: PO Box 320, Stellenbosch, 7599 Fax: 021 888 2693 or email: LKellerman@csir.co.za.**
3. Visit the project website at https://www.csir.co.za/environmental-impact-assessment to download relevant project information.
4. Review the various reports within the stipulated comment periods provided.
5. Attend any public meeting, which may be held during the review period.

**To register as an I&AP, please complete the Comment and Registration Form included with this BID and kindly return to:**

CSIR
Lizande Kellerman
PO Box 320, Stellenbosch, 7599
Email: LKellerman@csir.co.za
Tel: 021 888 2489

## D4: COMMENTS RECEIVED FROM I&APS

**BASIC ASSESSMENT AND SCOPING AND ENVIRONMENTAL IMPACT ASSESSMENTS FOR THE PROPOSED DEVELOPMENT OF THE KURUMAN PHASE 1 AND 2 WIND ENERGY FACILITIES AND ASSOCIATED ELECTRICAL INFRASTRUCTURE SOUTH-WEST OF KURUMAN, NORTHERN CAPE PROVINCE**
**CSIR REFERENCE: CSIR/IU/021SE/ER/2018/0001/B)**

Project Applicant: Mulilo Renewable Project Developments (Pty) Ltd

***COMMENT AND REGISTRATION FORM***

09 March 2018

| | |
|---|---|
| Name: BOIKANYO MODISE | Telephone: 053 723 6000 |
| Organisation: GAMAGARA L.M | Fax: 053 723 2021 |
| Designation: LED. MANAGER | Email: modiseb@gamagara.co.za |
| Physical address: GAMAGARA LOCAL M CNR HENDRICK VAN ECK AND FRIKKIE MEYER ROAD KATHU 8446 | Postal address: P O BOX 1001 KATHU 8446 |

| Please indicate if you would like to register as an Interested and Affected Party (I&AP) for the proposed projects. Registration is required in order to receive further correspondence during the Basic Assessment, Scoping and EIA Processes. Please tick the appropriate box. | |
|---|---|
| YES | X |
| NO | |

Please indicate if you have any interest (business, financial, personal or other) in the proposed projects and/or the Applications for Environmental Authorisation:

BUSINESS AND ECONOMIC DEVELOPMENT ACTIVITIES

Please describe any issues or concerns you may have regarding the proposed development of the Kuruman Phase 1 and 2 Wind Energy Facilities which you think should be considered during Scoping and EIA processes or the associated electrical infrastructure which you think should be considered during the Basic Assessment process.

- PUBLIC PARTICIPATION
- LAND USE MANAGEMENT
- REGISTRATION TO MUNICIPAL IDP DOCUMENT
-

Please provide details of any other individuals or organisations that should be registered as I&APs:

TOWN PLANNERS AND RURAL DEVELOPMENT AGENCIES
AVIATION AUTHORITIES

Please complete this Comment and Registration Form and submit to us by no later than **16 April 2018** and submit it to:

Lizande Kellerman
CSIR
Postal Address: P. O. Box 320, Stellenbosch, 7599
Tel: 021 888 2489/2661
Fax: 021 888 2693
E-mail: lkellerman@csir.co.za

MULILO RENEWABLE PROJECT DEVELOPMENTS

CSIR

**BASIC ASSESSMENT AND SCOPING AND ENVIRONMENTAL IMPACT ASSESSMENTS FOR THE PROPOSED DEVELOPMENT OF THE KURUMAN PHASE 1 AND 2 WIND ENERGY FACILITIES AND ASSOCIATED ELECTRICAL INFRASTRUCTURE SOUTH-WEST OF KURUMAN, NORTHERN CAPE PROVINCE**
**CSIR REFERENCE: CSIR/IU/021SE/ER/2018/0001/B)**

Project Applicant: Mulilo Renewable Project Developments (Pty) Ltd

***COMMENT AND REGISTRATION FORM***

09 March 2018

| | |
|---|---|
| **Name:** Dana Poolman | **Telephone:** 0829206610 |
| **Organisation:** Farmer | **Fax:** |
| **Designation:** Owner | **Email:** spitzberg5@gmail.com |
| **Physical address:**<br>Farm Spitzberg Kuruman | **Postal address:**<br>P.O. Box 542, Kuruman |

| | |
|---|---|
| Please indicate if you would like to register as an Interested and Affected Party (I&AP) for the proposed projects. Registration is required in order to receive further correspondence during the Basic Assessment, Scoping and EIA Processes. Please tick the appropriate box. | |
| YES | X |
| NO | |
| Please indicate if you have any interest (business, financial, personal or other) in the proposed projects and/or the Applications for Environmental Authorisation: | |
| Business and Personal | |

| |
|---|
| Please describe any issues or concerns you may have regarding the proposed development of the Kuruman Phase 1 and 2 Wind Energy Facilities which you think should be considered during Scoping and EIA processes or the associated electrical infrastructure which you think should be considered during the Basic Assessment process. |
| Environment and Noise. |

| |
|---|
| Please provide details of any other individuals or organisations that should be registered as I&APs: |
| Herman Laubscher, 083 2888587 |

Please complete this Comment and Registration Form and submit to us by no later than **16 April 2018** and submit it to:

Lizande Kellerman
CSIR
Postal Address: P. O. Box 320, Stellenbosch, 7599
Tel: 021 888 2489/2661
Fax: 021 888 2693
E-mail: lkellerman@csir.co.za

>>> John Geeringh <GeerinJH@eskom.co.za> 12/03/2018 10:41 >>>

Please find attached Eskom requirements for developments near or at Eskom infrastructure. Please send me KMZ files of the affected land portions and proposed power line connector routes.

Kind regards

John Geeringh (Pr Sci Nat)
Senior Consultant Environmental Management
Land Development and Management
Group Capital
Megawatt Park, D1Y42, Maxwell Drive, Sunninghill, Sandton.
P O Box 1091, Johannesburg, 2000.
Tel: 011 516 7233
Cell: 083 632 7663
Fax: 086 661 4064
E-mail: john.geeringh@eskom.co.za

Eskom requirements for work at or near Eskom infrastructure.

1. Eskom's rights and services must be acknowledged and respected at all times.

2. Eskom shall at all times retain unobstructed access to and egress from its servitudes.

3. Eskom's consent does not relieve the developer from obtaining the necessary statutory, land owner or municipal approvals.

4. Any cost incurred by Eskom as a result of non-compliance to any relevant environmental legislation will be charged to the developer.

5. If Eskom has to incur any expenditure in order to comply with statutory clearances or other regulations as a result of the developer's activities or because of the presence of his equipment or installation within the servitude restriction area, the developer shall pay such costs to Eskom on demand.

6. The use of explosives of any type within 500 metres of Eskom's services shall only occur with Eskom's previous written permission. If such permission is granted the developer must give at least fourteen working days prior notice of the commencement of blasting. This allows time for arrangements to be made for supervision and/or precautionary instructions to be issued in terms of the blasting process. It is advisable to make application separately in this regard.

7. Changes in ground level may not infringe statutory ground to conductor clearances or statutory visibility clearances. After any changes in ground level, the surface shall be rehabilitated and stabilised so as to prevent erosion. The measures taken shall be to Eskom's satisfaction.

8. Eskom shall not be liable for the death of or injury to any person or for the loss of or damage to any property whether as a result of the encroachment or of the use of the servitude area by the developer, his/her agent, contractors, employees, successors in title, and assignees. The developer indemnifies Eskom against loss, claims or damages including claims pertaining to consequential damages by third parties and whether as a result of damage to or interruption of or interference with Eskom's services or apparatus or otherwise. Eskom will not be held responsible for damage to the developer's equipment.

9. No mechanical equipment, including mechanical excavators or high lifting machinery, shall be used in the vicinity of Eskom's apparatus and/or services, without prior written permission having been granted by Eskom. If such permission is granted the developer must give at least seven working days' notice prior to the commencement of work. This allows time for arrangements to be made for supervision and/or precautionary instructions to be issued by the relevant Eskom Manager

*Note: Where and electrical outage is required, at least fourteen work days are required to arrange it.*

10. Eskom's rights and duties in the servitude shall be accepted as having prior right at all times and shall not be obstructed or interfered with.

11. Under no circumstances shall rubble, earth or other material be dumped within the servitude restriction area. The developer shall maintain the area concerned to Eskom's satisfaction. The developer shall be liable to Eskom for the cost of any remedial action which has to be carried out by Eskom.

12. The clearances between Eskom's live electrical equipment and the proposed construction work shall be observed as stipulated by *Regulation 15* of the *Electrical Machinery Regulations of the Occupational Health and Safety Act, 1993 (Act 85 of 1993).*

13. Equipment shall be regarded electrically live and therefore dangerous at all times.

14. In spite of the restrictions stipulated by Regulation 15 of the Electrical Machinery Regulations of the Occupational Health and Safety Act, 1993 (Act 85 of 1993), as an additional safety precaution, Eskom will not approve the erection of houses, or structures occupied or frequented by human beings, under the power lines or within the servitude restriction area.

15. Eskom may stipulate any additional requirements to highlight any possible exposure to Customers or Public to coming into contact or be exposed to any dangers of Eskom plant.

16. It is required of the developer to familiarise himself with all safety hazards related to Electrical plant.

17. Any third party servitudes encroaching on Eskom servitudes shall be registered against Eskom's title deed at the developer's own cost. If such a servitude is brought into being, its existence should be endorsed on the Eskom servitude deed concerned, while the third party's servitude deed must also include the rights of the affected Eskom servitude.

John Geeringh (Pr Sci Nat)

Senior Consultant Environmental Management

Eskom GC: Land Development

| Eskom | SCOT | Technology |
|---|---|---|

| | | | |
|---|---|---|---|
| Title: | **Renewable Energy Generation Plant Setbacks to Eskom Infrastructure** | Unique Identifier: | **240-65559775** |
| | | Alternative Reference Number: | **N/A** |
| | | Area of Applicability: | **Power Line Engineering** |
| | | Documentation Type: | **Guideline** |
| | | Revision: | **0** |
| | | Total Pages: | **8** |
| | | Next Review Date: | **N/A** |
| | | Disclosure Classification: | **CONTROLLED DISCLOSURE** |

| **Compiled by** | **Approved by** | **Authorised by** |
|---|---|---|
| ............ | ............ | ............ |
| **J W Chetty** | **V Naidoo** | **R A Vajeth** |
| **Mechanical Engineer** | **Chief Engineer (Lines)** | **Acting Snr Manager (Lines)** |
| Date: 20/02/2014 | Date: 24/02/2014 | Date: 27/2/2014 |

**Supported by SCOT/SC**

............

**R Vajeth**

**SCOT/SC/ Chairperson**

Date: 27/2/2014

PCM Reference: 240-65132732 **LINE ENGINEERING SERVICES**

SCOT Study Committee Number/Name : **OVERHEAD LINES**

## CONTENTS



## FIGURES

## EXECUTIVE SUMMARY

In recent decades, the use of wind turbines, concentrated solar plants and photovoltaic plants have been on the increase as it serves as an abundant source of energy. This document specifies setbacks for wind turbines and the reasons for these setbacks from infrastructure as well as setbacks for concentrated solar plants and photovoltaic plants. Setbacks for wind turbines employed in other countries were compared and a general setback to be used by Eskom was suggested for use with wind turbines and other renewable energy generation plants.

## 1. INTRODUCTION

During the last few decades, a large amount of wind turbines have been installed in wind farms to accommodate for the large demand of energy and depleting fossil fuels. Wind is one of the most abundant sources of renewable energy. Wind turbines harness the energy of this renewable resource for integration in electricity networks. The extraction of wind energy is its primary function and thus the aerodynamics of the wind turbine is important. There are many different types of wind turbines which will all exhibit different wind flow characteristics. The most common wind turbine used commercially is the Horizontal Axis Wind Turbine. Wind flow characteristics of this turbine are important to analyse as it may have an effect on surrounding infrastructure.

Wind turbines also cause large turbulence downwind that may affect existing infrastructure. Debris or parts of the turbine blade, in the case of a failure, may be tossed behind the turbine and may lead to damage of infrastructure in the wake path.

This document outlines the minimum distances that need to be introduced between a wind turbine and Eskom infrastructure to ensure that debris and / or turbulence would not negatively impact on the infrastructure.

Safety distances of wind turbines from other structures as implemented by other countries were also considered and the reasons for their selection were noted.

Concentrated solar plants and photovoltaic plants setbacks away from substations were also to be considered to prevent restricting possible power line access routes to the substation.

## 2. SUPPORTING CLAUSES

### 2.1 SCOPE

This document provides guidance on the safe distance that a wind turbine should be located from any Eskom power line or substation. The document specifies setback distances for transmission lines (220 kV to 765 kV), distribution lines (6.6 kV to 132 kV) and all Eskom substations. Setbacks for concentrated solar plants and photovoltaic plants are also specified away from substations.

#### 2.1.1 Purpose

Setbacks for wind turbines and power lines / substations are required for various reasons. These include possible catastrophic failure of the turbine blade that may release fragments and which may be thrown onto nearby power lines that may result in damage with associated unplanned outages. Turbulence behind the turbine may affect helicopter flight during routine Eskom live line maintenance and inspections that may lead to safety risk of the aircraft / personnel. Concentrated solar plants and photovoltaic plants setback away from substations were required to prevent substations from being boxed in by these renewable generation plants limiting line route access to the substations.

#### 2.1.2 Applicability

This document is applicable to the siting of all new and existing wind turbines, concentrated solar plants and photovoltaic plants near power lines and substations.

### 2.2 NORMATIVE/INFORMATIVE REFERENCES

#### 2.2.1 Normative

1. http://www.envir.ee/orb.aw/class=file/action=preview/id=1170403/Hiiumaa+turbulence+impact+EMD.pdf.
2. http://www.energy.ca.gov/2005publications/CEC-500-2005-184/CEC-500-2005-184.PDF
3. http://www.adamscountywind.com/Revised%20Site/Windmills/Adams%20County%20Ordinance/Adams%20County%20Wind%20Ord.htm
4. http://www.dsireusa.org/incentives/incentive.cfm?Incentive_Code=PA11R&RE=1&EE=1
5. http://www.wind-watch.org/documents/european-setbacks-minimum-distance-between-wind-turbines-and-habitations/
6. http://www.publications.parliament.uk/pa/ld201011/ldbills/017/11017.1-i.html
7. http://www.caw.ca/assets/pdf/Turbine_Safety_Report.pdf
8. Rogers J, Slegers N, Costello M. (2011) A method for defining wind turbine setback standards. Wind energy 10.1002/we.468

#### 2.2.2 Informative

None

### 2.3 DEFINITIONS

| Definition | Description |
|---|---|
| Setback | The minimum distance between a wind turbine and boundary line/dwelling/road/infrastructure/servitude etc. |
| Flicker | Effect caused when rotating wind turbine blades periodically cast shadows |
| Tip Height | The total height of the wind turbine ie. Hub height plus half rotor diameter (see Figure1) |

### 2.3.1 Disclosure Classification

**Controlled disclosure:** controlled disclosure to external parties (either enforced by law, or discretionary).

### 2.4 ABBREVIATIONS

| Abbreviation | Description |
|---|---|
| None | |

### 2.5 ROLES AND RESPONSIBILITIES

All personnel involved in the positioning wind turbines, concentrated solar plants and photovoltaic plants near power lines/substations must follow the setbacks outlined in this guideline.

### 2.6 PROCESS FOR MONITORING

Approval by Eskom in writing.

### 2.7 RELATED/SUPPORTING DOCUMENTS

None

## 3. DOCUMENT CONTENT

### 3.1 INTERNATIONAL SETBACK COMPARISON

Wind Turbine setbacks employed by various countries were considered. It was found that setbacks were determined for various reasons that include noise, flicker, turbine blade failure and wind effects. The distances (setbacks) varied based on these factors and were influenced by the type of infrastructure

Wind turbine setbacks varied for roads, power lines, dwellings, buildings and property and it was noted that the largest setbacks were employed for reasons of noise and flicker related issues [1-7]. Very few countries specified setbacks for power lines.

The literature survey [1-7], yielded information about studies and experiments were conducted to determine the distance that a broken fragment from a wind turbine might be thrown. Even though of low probability of hitting a power line [$5.0 \times 10^{-5}$ [8]], the distances recorded were significant [750m [8]]

Setbacks were thus introduced to prevent any damage to Eskom infrastructure.

Wind turbines may also cause changes in wind patterns with turbulent effects behind the hub. These actors dictate the wind turbine setbacks specified in this document.

Concentrated solar plants and photovoltaic plants also can limit access into the substation for power lines of all voltages. A setback distance must therefore be employed to prevent the substation from being boxed in by these generation plants. These setback distances are specified in this document.

### 3.2 ESKOM REQUIRED SETBACKS

- Eskom requires a setback distance of 3 times the tip height of the wind turbine from the edge of the closest Eskom servitude (including vacant servitudes) for transmission lines.
- Eskom requires a setback distance of 1 times the tip height of the wind turbine from the edge of the closest Eskom servitude (including vacant servitudes) for distribution Lines.
- Eskom must be informed of any proposed wind turbine, concentrated solar plants and photovoltaic activity within a 5 km radius of a substation. No wind turbine structure shall be built within a 2 km radius of the closest point of the substation. Where concentrated solar plants and photovoltaic structures fall within a 2 km radius of the closest point of a substation, Eskom should be informed in writing during the planning phase of the construction of such plant or structure.
- Applicants must show that Eskom radio telecommunication systems (mainly microwave systems) will not be affected in any way by wind turbines.

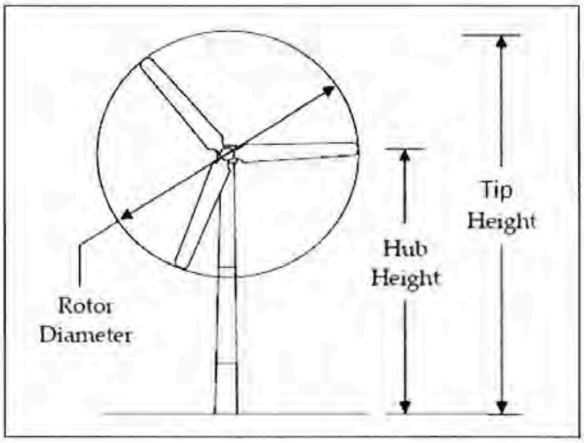



**Figure 1: Horizontal Axis Wind Turbine [2]**

### 4. AUTHORISATION

This document has been seen and accepted by:

| Name & Surname | Designation |
|---|---|
| V Naidoo | Chief Engineer |
| Dr P H Pretorius | Electrical Specialist |
| J Geeringh | Snr Consultant Environ Mngt |
| B Haridass | Snr Consultant Engineer |
| R A Vajeth | Acting Snr Manager (Lines) |

### 5. REVISIONS

| Date | Rev. | Compiler | Remarks |
|---|---|---|---|
| November 2013 | 0 | J W Chetty | First Publication - No renewable energy generation plant setback specification in existence |

## 6. DEVELOPMENT TEAM

The following people were involved in the development of this document:

Jonathan W Chetty (Mechanical Engineer)

Vivendhra Naidoo (Chief Engineer)

Dr Pieter H Pretorius (Electrical Specialist)

John Geeringh (Snr Consultant Environ Mngt)

Bharat Haridass (Snr Consultant Engineer)

Riaz A Vajeth (Acting Snr Manager (Lines))

>>> Ramotholo Sefako <rrs@saao.ac.za> 12/03/2018 09:42 >>>
Dear Lizande

The following was forwarded to me by my colleague, Chris, at Sutherland, given my responsibilities regarding these kind of issues at the South African Astronomical Observatory (SAAO).

The proposed wind energy facilities near Kuruman are too far from the Observatory in Sutherland to cause any detectable problem to optical observations at SALT and other SAAO telescopes.

Regards
Ramotholo

10-APR-2018 12:38 From: 0537322021 To:0218882693 Page:1/1

**BASIC ASSESSMENT AND SCOPING AND ENVIRONMENTAL IMPACT ASSESSMENTS FOR THE PROPOSED DEVELOPMENT OF THE KURUMAN PHASE 1 AND 2 WIND ENERGY FACILITIES AND ASSOCIATED ELECTRICAL INFRASTRUCTURE SOUTH-WEST OF KURUMAN, NORTHERN CAPE PROVINCE**
**CSIR REFERENCE: CSIR/IU/021SE/ER/2018/0001/B)**

Project Applicant: Mulilo Renewable Project Developments (Pty) Ltd

***COMMENT AND REGISTRATION FORM***

09 March 2018

| | |
|---|---|
| **Name:** PIERRE BURGER | **Telephone:** 053 723 6000 |
| **Organisation:** GAMAGARA LOCAL MUNICIPALITY | **Fax:** 053 72 32 021 |
| **Designation:** SENIOR ENVIRONMENTAL HEALTH PRACTITIONER | **Email:** pierreb@gamagara.co.za |
| **Physical address:** CNR FRIKKI MEYER AND HENDRIK VAN ECK KATHU 8446 | **Postal address:** P.O. BOX 4001 KATHU 8446 |

| | |
|---|---|
| Please indicate if you would like to register as an Interested and Affected Party (I&AP) for the proposed projects. Registration is required in order to receive further correspondence during the Basic Assessment, Scoping and EIA Processes: Please tick the appropriate box. | |
| YES | X |
| NO | |

Please indicate if you have any interest (business, financial, personal or other) in the proposed projects and/or the Applications for Environmental Authorisation:

N/A

Please describe any issues or concerns you may have regarding the proposed development of the Kuruman Phase 1 and 2 Wind Energy Facilities which you think should be considered during Scoping and EIA processes or the associated electrical infrastructure which you think should be considered during the Basic Assessment process.

Please provide details of any other individuals or organisations that should be registered as I&APs:

Please complete this Comment and Registration Form and submit to us by no later than 16 April 2018 and submit it to:

Lizande Kellerman
CSIR
Postal Address: P. O. Box 320, Stellenbosch, 7599
Tel: 021 888 2489/2661
Fax: 021 888 2693
E-mail: lkellerman@csir.co.za

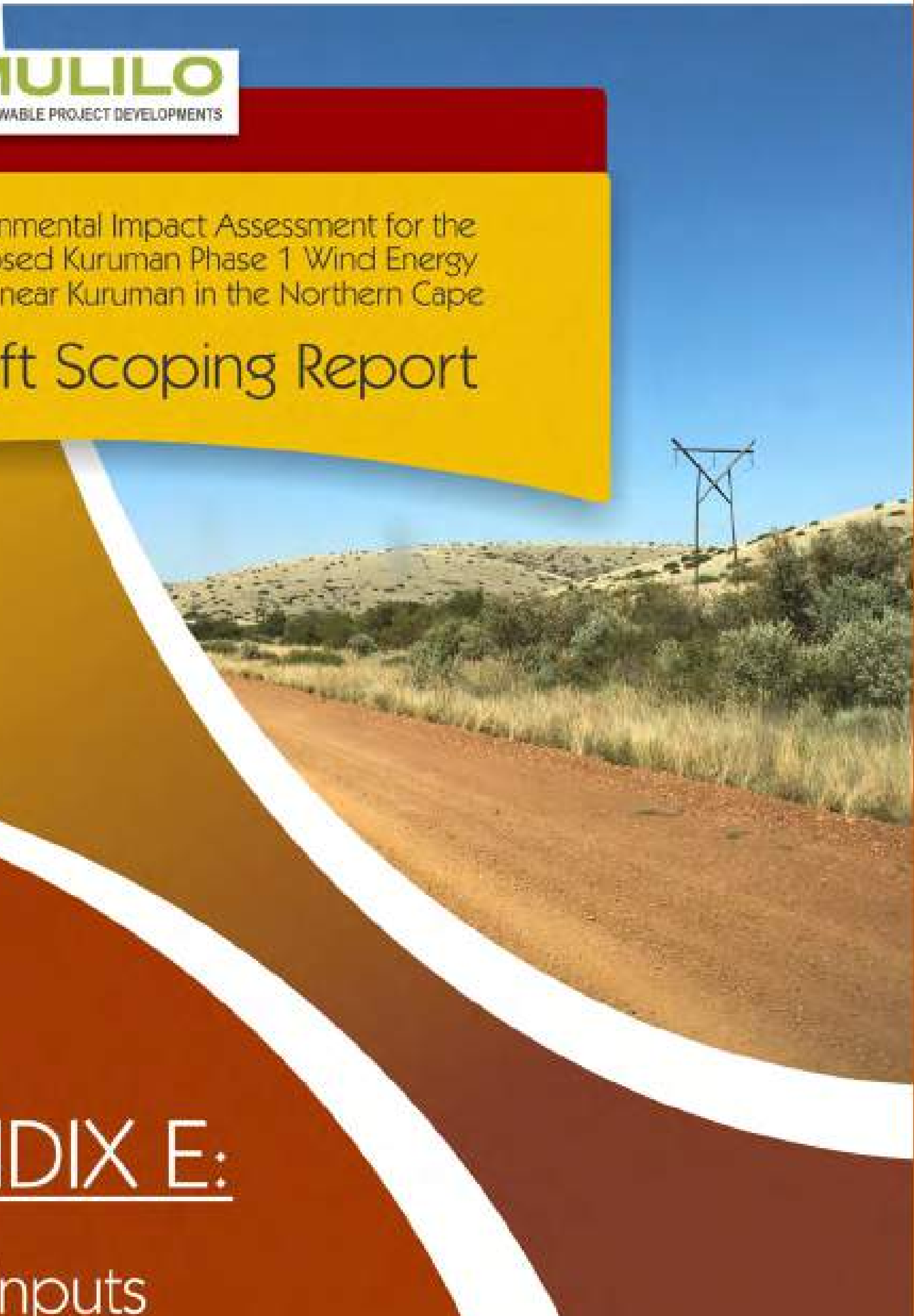
MULILO RENEWABLE PROJECT DEVELOPMENTS

CSIR

MULILO
RENEWABLE PROJECT DEVELOPMENTS

Environmental Impact Assessment for the proposed Kuruman Phase 1 Wind Energy Facility near Kuruman in the Northern Cape

# Draft Scoping Report



# APPENDIX E:

## Scoping inputs from Specialists

# CONTENTS

| STUDY | ORGANISATION | NAME |
|---|---|---|
| Terrestrial Ecology (including fauna and flora) | 3Foxes Biodiversity Solutions | Simon Todd |
| Bird Impact Assessment | Chris van Rooyen Consulting | Chris van Rooyen |
| Bat Impact Assessment | Animalia Consultants (Pty) Ltd | Werner Marais |
| Freshwater Assessment | EnviroSwift (Pty) Ltd | Natasha van de Haar |
| Geohydrology Assessment | Geohydrological and Spatial Solutions International (Pty) Ltd | Julian Conrad |
| Visual Impact Assessment | SiVEST SA (Pty) Ltd | Stephan Jacobs |
| Heritage Impact Assessment (Archaeology and Cultural Landscape) | Cedar Tower Services (Pty) Ltd | Nicholas Wiltshire |
| Palaeontological Impact Assessment | Private, sub-contracted by Cedar Tower Services (Pty) Ltd | Dr John Almond |
| Soils and Agricultural Potential Assessment | Private | Johann Lanz |
| Socio-Economic Impact Assessment | Urban-Econ Development Economists (Pty) Ltd | Elena Broughton |
| Noise Impact Assessment | Enviro-Acoustic Research cc | Morné de Jager |
| Transportation Impact Assessment | JG Afrika (Pty) Ltd | Adrian Johnson |

# Fauna and Flora Terrestrial Ecological Specialist Study

## Scoping and Environmental Impact Assessment for the Proposed Development of Phase 1 of the Kuruman Wind Farm, Northern Cape Province:

## SCOPING PHASE REPORT


*Report prepared for:*

CSIR – Environmental Management Services

P O Box 320

Stellenbosch

7600

*Report prepared by:*

Simon Todd – 3Foxes Biodiversity Solutions

60 Forrest Way

Glencairn

7975


March 2018

# EXECUTIVE SUMMARY

Mulilo Renewable Project Developments (Pty) Ltd is proposing the development of the Kuruman WEF Phase 1 Wind Energy Facility (WEF) located near Kuruman in the Northern Cape Province. It is anticipated that the Kuruman WEF Phase 1 Wind Farm will have a maximum of 47 turbines. The development is currently in the Scoping Phase and Mulilo has appointed Simon Todd Consulting to provide a Terrestrial Ecological (Fauna and Flora) specialist scoping study as part of the EIA process. The purpose of the study is to describe and detail the ecological features of the proposed site and provide an preliminary assessment of the ecological sensitivity of the site. A field assessment as well as a desktop review of the available ecological information for the area was conducted in order to identify and characterise the ecological features of the site. This information is used to derive a draft ecological sensitivity map that presents the likely ecological constraints and opportunities for development at the site. The information and sensitivity map presented here provides an ecological baseline to be used going into the EIA phase of the development to ensure that the potential negative ecological impacts associated with the development are minimised. Furthermore, the study defines the terms of reference for the EIA phase of the project and outlines a plan of study for the EIA which will follow the Scoping Study.

The Kuruman WEF Phase 1 site consists of Kuruman Mountain Bushveld on the rocky hills and Kuruman Thornveld on the lowlands. Both of these vegetation types are of least concern and have have not been significantly impacted by transformation to date. The abundance of plant species of conservation concern at the site is low and the overall impact of the development on vegetation would be low. In terms of fauna, the abundance of species of concern at the site is low and while some listed mammals may be present at the site, an significant impact on such species is unlikely.

The northern part of the site is located within a CBA 2 which forms a buffer area around the Billy Duvenhage Nature Reserve. The majority of the footprint of the development is however within an Ecological Support Area. The footprint within the CBA 2 area is low and a significant impact on the CBA is not likely. In addition, it is unlikely that the development would compromise the functioning of the ESA and with the appropriate mitigation, the development of a wind energy facility is considered compatible with the aims and objectives of ESAs, at least from a terrestrial biodiversity point of view.

Although there are a number of proposed solar energy facilities in the broad area around the Kuruman WEF Phase 1 site, these are on the plains habitat and there are no registered wind farm projects in the vicinity of the current site that would affect the same Kuruman Mountain Bushveld vegetation type. In addition, the Kuruman Mountain Bushveld habitat type is still largely intact and has not been significantly impacted by transformation. As a result, the contribution of the current development to cumulative impact would be relatively low and would not significantly impact the remaining extent of Kuruman Mountain Bushveld or Kuruman Thornveld.

The sensitivity mapping that was conducted indicates that the slopes of the target ridges are considered high sensitivity as a result of their vulnerability to disturbance and erosion as well as the higher ecological value of these areas on account of their higher faunal and botanical diversity. The plateau and ridge-top habitats that are the primary target for the development are considered to be moderate sensitivity. These areas are considered acceptable for turbine placement and would generate relatively low impacts. Although the access roads traverse some high sensitivity slope areas in order to access the target ridges, with the appropriate erosion control features, these would generate a relatively low impact and are considered to be acceptable.

Overall, the site is considered to be an acceptable site for development of a wind energy facility and the impacts associated with the development are likely to be moderate to low and would be of a local nature only. As such, there do not appear to by an major issues or impacts that cannot be mitigated to a low level and from a terrestrial ecology perspective, there are no reasons to prevent the development from proceeding to the EIA phase.

# Short CV/Summary of Expertise – Simon Todd


Simon Todd Pr.Sci.Nat
C: 082 3326502
O: 021 782 0377
Simon.Todd@3foxes.co.za
60 Forrest Way
Glencairn
7975
Ecological Solutions for People & the Environment

Simon Todd is Director and principal scientist at 3Foxes Biodiversity Solutions and has over 20 years of experience in biodiversity measurement, management and assessment. He has provided specialist ecological input on more than 200 different developments distributed widely across the country, but with a focus on the three Cape provinces. This includes input on the Wind and Solar SEA (REDZ) as well as the Eskom Grid Infrastructure (EGI) SEA and Karoo Shale Gas SEA. He is on the National Vegetation Map Committee as representative of the Nama and Succulent Karoo Biomes. Simon Todd is a recognised ecological expert and is a past chairman and current deputy chair of the Arid-Zone Ecology Forum. He is registered with the South African Council for Natural Scientific Professions (No. 400425/11).

*Skills & Primary Competencies*

- Research & description of ecological patterns & processes in Nama Karoo, Succulent Karoo, Thicket, Arid Grassland, Fynbos and Savannah Ecosystems.
- Ecological Impacts of land use on biodiversity
- Vegetation surveys & degradation assessment & mapping
- Long-term vegetation monitoring
- Faunal surveys & assessment.
- GIS & remote sensing

*Tertiary Education:*

- 1992-1994 – BSc (Botany & Zoology), University of Cape Town
- 1995 – BSc Hons, Cum Laude (Zoology) University of Natal
- 1996-1997- MSc, Cum Laude (Conservation Biology) University of Cape Town

*Employment History*

- 2009 – Present – Sole Proprietor of Simon Todd Consulting, providing specialist ecological services for development and research.
- 2007 Present – Senior Scientist (Associate) – Plant Conservation Unit, Department of Botany, University of Cape Town.

- 2004-2007 – Senior Scientist (Contract) – Plant Conservation Unit, Department of Botany, University of Cape Town
- 2000-2004 – Specialist Scientist (Contract ) - South African National Biodiversity Institute
- 1997 – 1999 – Research Scientist (Contract) – South African National Biodiversity Institute

A selection of recent work is as follows:

**Strategic Environmental Assessments**

Co-Author. Chapter 7 - Biodiversity & Ecosystems - Shale Gas SEA. CSIR 2016.

Co-Author. Chapter 1 Scenarios and Activities – Shale Gas SEA. CSIR 2016.

Co-Author – Ecological Chapter – Wind and Solar SEA. CSIR 2014.

Co-Author – Ecological Chapter – Eskom Grid Infrastructure SEA. CSIR 2015.

Contributor – Ecological & Conservation components to SKA SEA. CSIR 2017.

**Recent Specialist Ecological Studies in the Vicinity of the Current Site**

- Fauna Specialist Study for the proposed Eskom Kleinsee 300MW WEF. Savannah Environmental 2012.
- Fauna and Flora Specialist Study for the Project Blue Wind and Solar Energy Facility, Near Kleinsee. Savannah Environmental 2012.
- Fauna and Flora for the G7 Richtersveld Wind Farm. Environmental Resources Management 2011.
- Preconstruction Walk-Through of the Juno-Gromis 400kV Power Line. Nsovo Environmental 2016.
- Specialist Faunal Assessment of the West Coast Resources Mine Expansion. Myezo Environmental. 2016.
- Fauna and Flora specialist Scoping & EIA Study for the Tormin Mineral Sands Inland and Coastal Mining expansion. SRK. 2016.

# Specialist Declaration

I, ..Simon Todd..., as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

-
- I act as the independent specialist in this application;
- I 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;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- 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 have no vested interest in the proposed activity proceeding;
- 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;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist: ______________________________

Name of Specialist: ____Simon Todd______________________

Date: ____22 February 2018____________________________

# LIST OF ABBREVIATIONS

| | |
|---|---|
| DEA | Department of Environmental Affairs |
| EIA | Environmental Impact Assessment |
| SCC | Species of conservation concern |
| CBA | Critical Biodiversity Area |
| ESA | Ecological Support Area |
| NFEPA | National Freshwater Ecosystem Priority Assessment |
| NPAES | National Protected Area Expansion Strategy |
| NC-DENC | Northern Cape Department of Environment and Nature Conservation |
| | |

# GLOSSARY

# COMPLIANCE WITH THE APPENDIX 6 OF THE 2017 EIA REGULATIONS

| Requirements of Appendix 6 – GN R326 EIA Regulations 7 April 2017 | Addressed in the Specialist Report |
|---|---|
| 1. (1) A specialist report prepared in terms of these Regulations must contain-<br>a) details of-<br>i. the specialist who prepared the report; and<br>ii. the expertise of that specialist to compile a specialist report including a curriculum vitae; | Page *iii* |
| b) a declaration that the specialist is independent in a form as may be specified by the competent authority; | Page *v* |
| c) an indication of the scope of, and the purpose for which, the report was prepared; | P5 |
| (cA) an indication of the quality and age of base data used for the specialist report; | P9-10 |
| (cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change; | P38- |
| d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment; | P10 |
| e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used; | Section 1.1 |
| f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives; | P39 |
| g) an identification of any areas to be avoided, including buffers; | P39 |
| h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers; | P39 |
| i) a description of any assumptions made and any uncertainties or gaps in knowledge; | P9 |
| j) a description of the findings and potential implications of such findings on the impact of the proposed activity or activities; | Section 1.3 |
| k) any mitigation measures for inclusion in the EMPr; | Section 1.6 |
| l) any conditions for inclusion in the environmental authorisation; | |
| m) any monitoring requirements for inclusion in the EMPr or environmental authorisation; | Section 1.6 |
| n) a reasoned opinion-<br>i. whether the proposed activity, activities or portions thereof should be authorised;<br>(iA) regarding the acceptability of the proposed activity or activities and<br>ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan; | P56-57 |
| o) a description of any consultation process that was undertaken during the course of preparing the specialist report; | See Main EIA report |
| p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and | See Main EIA report |
| q) any other information requested by the competent authority. | |
| 2) Where a government notice gazetted by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply. | |

# Table of Contents

# LIST OF FIGURES

# SPECIALIST FAUNA AND FLORA SCOPING STUDY

## 1.1. INTRODUCTION AND METHODOLOGY

### *1.1.1. Scope and Objectives*

Mulilo Renewable Project Developments (Pty) Ltd has appointed CSIR to undertake the required Environmental Impact Assessment (EIA) process for the proposed Kuruman Wind Energy Facility, Phase 1 located southwest of Kuruman in the Northern Cape Province. It is anticipated that the Kuruman Wind Energy Facility, Phase 1 will have up to 47 turbines. A grid connection is also required, but this is assessed as part of an independent Basic Assessment process. The development is currently in the Scoping Phase and CSIR has appointed 3Foxes Biodiversity Solutions to provide a specialist Terrestrial Biodiversity Scoping Study of the development as part of the EIA process.

The purpose of the Terrestrial Biodiversity Scoping Report is to describe and detail the ecological features of the proposed site; provide a preliminary assessment of the ecological sensitivity of the site and identify and assess the likely impacts associated with the proposed development of the site as a wind energy facility. A full field assessment as well as a desktop review of the available ecological information for the area is used to identify and characterise the ecological features of the site. This information is used to derive a draft ecological sensitivity map that presents the likely ecological constraints and opportunities for development at the site. The information and sensitivity map presented here provides an ecological baseline to be used in the planning phase of the development to ensure that the potential negative ecological impacts associated with the development are minimised. Furthermore, the study defines the terms of reference for the EIA phase of the project and outlines a plan of study for the EIA which will follow the Scoping Study.

### *1.1.2. Terms of Reference*

The study includes the following activities:

- a description of the environment that may be affected by a specific activity and the manner in which the environment may be affected by the proposed project;
- a description and evaluation of environmental issues and potential impacts (including assessment of direct, indirect and cumulative impacts) that have been identified;
- a statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts;
- an indication of the methodology used in determining the significance of potential environmental impacts;
- an assessment of the significance of direct indirect and cumulative impacts of the development;

- a description and comparative assessment of all alternatives including cumulative impacts;
- recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the EMPr;
- an indication of the extent to which the issue could be addressed by the adoption of mitigation measures;
- a description of any assumptions uncertainties, limitations and gaps in knowledge; and
- an environmental impact statement which contains:
    - a summary of the key findings of the environmental impact assessment;
    - an assessment of the positive and negative implications of the proposed activity; and
    - a comparative assessment of the positive and negative implications of identified alternatives.

General Considerations for the study included the following:

- Disclose any gaps in information (and limitations in the study) or assumptions made.
- Identify recommendations for mitigation measures to minimise impacts.
- Outline additional management guidelines.
- Provide monitoring requirements, mitigation measures and recommendations in a table format as input into the EMPr for faunal or flora related issues.
- The assessment of the potential impacts of the development and the recommended mitigation measures provided have been separated into the following project phases:
    - Planning and Construction
    - Operational
    - Decommissioning

#### *1.1.3. Assessment Approach*

This assessment is conducted according to Appendix 6 – GN R326 EIA Regulations, as amended in terms of the National Environmental Management Act (Act 107 of 1998) as amended (NEMA), as well as best-practice guidelines and principles for biodiversity assessment as outlined by Brownlie (2005) and De Villiers *et al*. (2005).

In terms of NEMA, this assessment demonstrates how the proponent intends to comply with the principles contained in Section 2 of NEMA, which amongst other things, indicates that environmental management should:

- (In order of priority) aim to: avoid, minimise or remedy disturbance of ecosystems and loss of biodiversity (Figure 1);
- Avoid degradation of the environment;
- Avoid jeopardising ecosystem integrity;
- Pursue the best practicable environmental option by means of integrated environmental management;
- Protect the environment as the people's common heritage;

- Control and minimise environmental damage; and
- Pay specific attention to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic or stressed ecosystems.

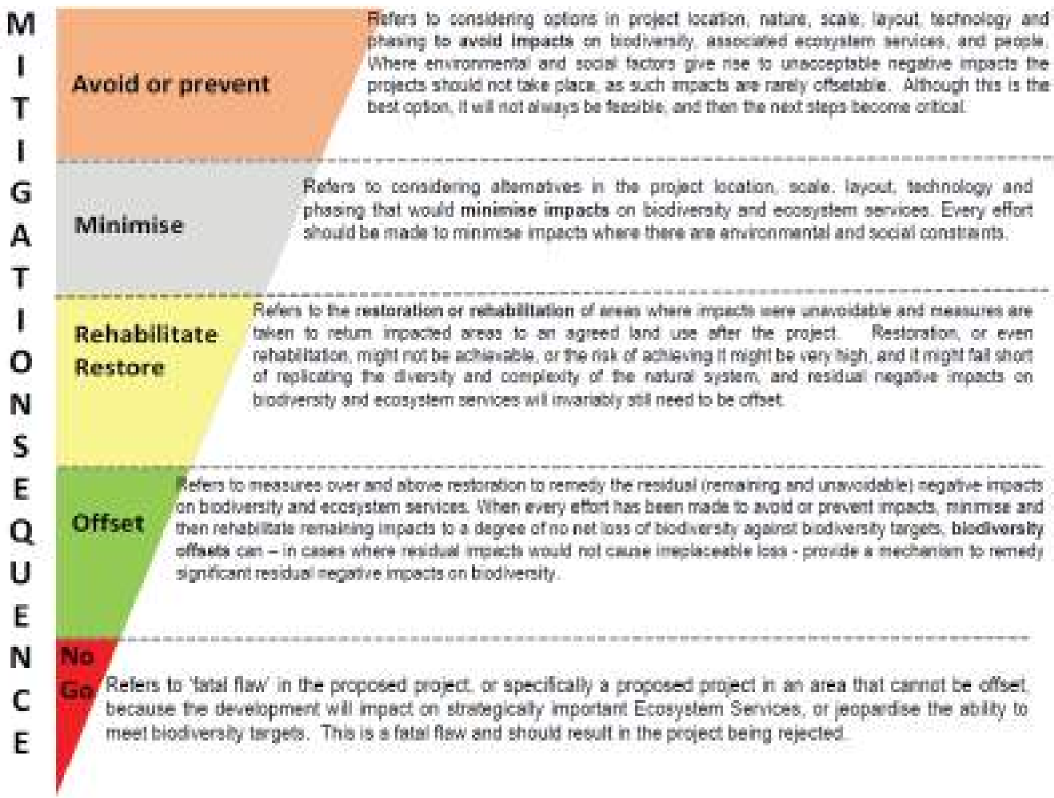



**Figure 1.** The mitigation hierarchy that is used to guide the study in terms of the priority of different mitigation and avoidance strategies.

Furthermore, in terms of best practice guidelines as outlined by Brownlie (2005) and De Villiers et al. (2005), a precautionary and risk-averse approach should be adopted for projects which may result in substantial detrimental impacts on biodiversity and ecosystems, especially the irreversible loss of habitat and ecological functioning in threatened ecosystems or designated sensitive areas: i.e. Critical Biodiversity Areas (CBAs) (as identified by systematic conservation plans, Biodiversity Sector Plans or Bioregional Plans) and Freshwater Ecosystem Priority Areas.

In order to adhere to the above principles and best-practice guidelines, the following approach forms the basis for the study approach and assessment philosophy:

- The study includes data searches, desktop studies, site walkovers / field survey of the property and baseline data collection, including:
    - o A description of the broad ecological characteristics of the site and its surrounds in terms of any mapped spatial components of ecological processes and/or

patchiness, patch size, relative isolation of patches, connectivity, corridors, disturbance regimes, ecotones, buffering, viability, etc.

In terms of **pattern**, the following will be identified or described:

***Community and ecosystem level***

- The main vegetation type, its aerial extent and interaction with neighbouring types, soils or topography;
- Threatened or vulnerable ecosystems (*cf. SA vegetation map/National Spatial Biodiversity Assessment, fine-scale systematic conservation plans, etc*).

***Species level***

- Species of Conservation Concern (SCC) (giving location if possible using GPS)
- The viability of an estimated population size of the SCC that are present (including the degree of confidence in prediction based on availability of information and specialist knowledge, i.e. High=70-100% confident, Medium 40-70% confident, low 0-40% confident)
- The likelihood of other RDB species, or SCC, occurring in the vicinity (include degree of confidence).

***Fauna***

- Describe and assess the terrestrial fauna present in the area that will be affected by the proposed development.
- Conduct a faunal assessment that can be integrated into the ecological study.
- Describe the existing impacts of current land use as they affect the fauna.
- Clarify SSC and that are known to be:
    - endemic to the region;
    - that are considered to be of conservational concern;
    - that are in commercial trade (CITES listed species); or
    - are of cultural significance.
- Provide monitoring requirements as input into the EMPr for faunal related issues.

***Other pattern issues***

- Any significant landscape features or rare or important vegetation associations such as seasonal wetlands, alluvium, seeps, quartz patches or salt marshes in the vicinity.
- The extent of alien plant cover of the site, and whether the infestation is the result of prior soil disturbance such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than infestation of undisturbed sites).
- The condition of the site in terms of current or previous land uses.

In terms of **process**, the following will be identified and/or described:

- The key ecological “drivers” of ecosystems on the site and in the vicinity, such as fire.
- Any mapped spatial component of an ecological process that may occur at the site or in its vicinity (i.e. *corridors* such as watercourses, upland-lowland gradients, migration routes,

coastal linkages or inland-trending dunes, and *vegetation boundaries* such as edaphic interfaces, upland-lowland interfaces or biome boundaries).

- Any possible changes in key processes, e.g. increased fire frequency or drainage/artificial recharge of aquatic systems.
- Furthermore, any further studies that may be required during or after the EIA process will be outlined.
- All relevant legislation, permits and standards that would apply to the development will be identified.
- The opportunities and constraints for development will be described and shown graphically on an aerial photograph, satellite image or map delineated at an appropriate level of spatial accuracy.

### *1.1.4. Assumptions and Limitations*

The current study is based on a detailed field assessment as well as a desktop study, which serves to reduce the limitations and assumptions required for the study. The site was visited in the wet season in mid-summer when the vegetation was in an excellent condition for sampling. As a result, the plant species lists obtained for the site are considered reliable and comprehensive. While there are likely some species present at the site which were not observed, this is likely a minority of species and it is unlikely that there are any plant habitats or communities present which were not observed As such, there are no significant limitations with regards to the vegetation assessment for the site.

In terms of fauna, camera trapping for larger mammals, Sherman trapping for small mammals and searches for reptiles and amphibians was conducted. This provides a comprehensive characterization of the faunal community of the site. Although some fauna are difficult to observe in the field, their potential presence at the site was evaluated based on the literature and available databases. In order to ensure a conservative approach in this regard, the species lists derived for the site from the literature were obtained from an area significantly larger than the study site. As a result, there are no significant limitations with regards to the faunal assessment at the site.

### *1.1.5. Source of Information*

Data sources from the literature consulted and used where necessary in the study includes the following:

*Vegetation:*

- Vegetation types and their conservation status were extracted from the South African National Vegetation Map (Mucina and Rutherford 2006 and 2012 update) as well as the National List of Threatened Ecosystems (2011), where relevant.
- Information on plant and animal species recorded for the area was extracted from the new Plants of South Africa (POSA) database hosted by the South African National Biodiversity Institute (SANBI). Data was extracted for a significantly larger area than the study area, but this is necessary to ensure a conservative approach as well as counter the fact that the site itself has not been well sampled in the past.

- The IUCN conservation status of the species in the list was also extracted from the database and is based on the Threatened Species Programme, Red List of South African Plants (2017).

*Habitats & Ecosystems:*

- Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011).
- Important protected areas expansion areas were extracted from the Northern Cape Protected Areas Expansion Strategy (NC-NPAES 2017).
- Critical Biodiversity Areas in the study area were obtained from the Northern Cape Conservation Plan (Oosthuysen & Holness 2016).

*Fauna:*

- Lists of mammals, reptiles and amphibians which are likely to occur at the site were derived based on distribution records from the literature and the ADU databases http://vmus.adu.org.za.
- Literature consulted includes Branch (1988) and Alexander and Marais (2007) for reptiles, Du Preez and Carruthers (2009) for amphibians, EWT & SANBI (2016) and Skinner and Chimimba (2005) for mammals.
- The faunal species lists provided are based on species which are known to occur in the broad geographical area, as well as a preliminary assessment of the availability and quality of suitable habitat at the site.
- The conservation status of mammals is based on the IUCN Red List Categories (EWT/SANBI 2016), while reptiles are based on the South African Reptile Conservation Assessment (Bates et al. 2013) and amphibians on Minter et al. (2004) as well as the IUCN (2017).

#### *1.1.6. Field Assessment*

The site was visited over four days from 18-22 February 2018. During the site visit, the various affected ridges as well as the lowland areas within the development footprint were sampled in the field. A full plant species list for the different habitats present within the site was developed based on walk-through surveys within the different habitats present. A total of 12 camera traps were distributed across the site, placed along roads, fences, paths and other areas most likely to be frequented by mammals. These will be retrieved before the EIA phase commences and the information on animal presence and habitat use collated and used to inform the final assessment. Small mammal trapping was conducted within different habitats at the site including the lowlands, uplands and rocky hills. A total of 60 Sherman live traps were left out for 3 days, giving a total of 180 trap nights. Additional information on faunal presence at the site was collected through searching for reptiles within areas likely to harbor reptiles as well as through casual observation of fauna at the site while conducting the other field work at the site.

#### *1.1.7. Sensitivity Mapping and Assessment*

An ecological sensitivity map of the site was produced by integrating the information collected on-site with the available biodiversity information available in the literature and various spatial databases. This includes delineating the habitat units identified in the field and assigning sensitivity values to the units based on their vegetation composition, faunal habitat or conservation value and the potential presence of SCC.

The sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

- **Low** – Areas of natural or transformed habitat with a low sensitivity where there is likely to be a negligible impact on ecological processes and terrestrial biodiversity. Most types of development can proceed within these areas with little ecological impact.
- **Medium**- Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impact such as erosion low. These areas usually comprise the bulk of habitats within an area. Development within these areas can proceed with relatively little ecological impact provided that appropriate mitigation measures are taken.
- **High** – Areas of natural or transformed land where a high impact may occur due to the high flora or faunal habitat value, sensitivity or important ecological role of the area. These areas may contain, or be important habitat for, SCC or provide important ecological services such as water flow regulation or forage provision. Development within these areas is generally undesirable and should proceed with caution as additional specific mitigation and avoidance is usually required to reduce impacts within these areas to acceptable levels. High sensitivity areas are also usually more sensitive to cumulative impact and the total developed footprint within these areas should be kept low.
- **No-Go/Very High** – Critical and unique habitats that serve as habitat for rare/endangered species or perform critical ecological roles. These areas are considered to be no-go areas from a developmental perspective and should be avoided.

In some situations, areas were also classified between the above categories, such as Medium/High, where it was deemed that an area did not fit well into a certain category but rather fell most appropriately **between** two sensitivity categories. There are however no sensitivities that are identified as “Medium to High” or similar ranged categories because this adds uncertainty to the mapping as it is not clear if an area falls at the bottom or top of such a range.

## 1.2. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO ECOLOGICAL IMPACTS

The project is described in full in the main EIA report and this information is not repeated here, but rather a summary of the relevant components and footprint areas are described briefly below. It is anticipated that the Kuruman Wind Energy Facility Phase 1 will have an output capacity of up to 200MW, which would be generated from a maximum of 47 turbines with a rotor diameter of up 160 m. The basic components of the development that would require vegetation clearing or generate potential impacts include the following:

- A total of up to 50 km of internal gravel surface access roads linking turbines, 5 m wide;
- Each turbine would have a reinforced foundation of 20 m x 20 m, with an associated Crane Platform of 0.25 ha each;
- A concrete on-site batching plant of 0.25 ha;
- Operations and maintenance building occupying an area of approximately 1 ha;
- Temporary laydown and construction areas of approximately 6 ha in total;
- On-site 22/33 kV to132 kV collector substation of approximately 2 ha.

## 1.3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

### *1.3.1. Vegetation Types*

According to the national vegetation map (Mucina & Rutherford 2006/2012), there are only two vegetation types within the boundaries of the study area, with Kuruman Mountain Bushveld occupying the rocky hills and lowlands consisting of Kuruman Thornveld (Figure 2).

The majority of the site is mapped as Kuruman Mountain Bushveld. Kuruman Mountain Bushveld is not widely distributed and has a total mapped extent of 4 360 km$^2$ which is a narrow range for an arid vegetation type. It is distributed in the Northern Cape and North-West Provinces from Asbestos Mountains southwest and northwest of Griekwastad, along the Kuruman Hills north of Danielskuil, passing west of Kuruman and re-emerging as isolated hills at Makhubung and around Pomfret. This vegetation unit is associated with rolling hills with gentle to moderate slopes and hill pediment areas and typically consists of an open shrubveld. Soils are shallow sandy soils of the Hutton form and the most common land type is Ib with lesser amounts of Ae, Ic and Ag. Kuruman Mountain Bushveld has been little impacted by transformation and is classified as Least Threatened, but is not currently conserved within any formal conservation areas. One vegetation-type endemic species *Euphorbia planiceps* is known from Kuruman Mountain Bushveld.

The plains of the site are mapped as Kuruman Thornveld. This is also a restricted vegetation type which occupies 5 794 km$^2$ of the Northern Cape and North West Provinces from the vicinity of Postmasburg and Danielskuil in the south, extending via Kuruman to Tsineng and Dewar in the North. It has been little impacted by transformation and more than 98% of the original extent is still intact and it is classified as Least Threatened. This vegetation unit occupies flat rocky plains and sloping hills with a very well developed, closed shrub layer and well-developed tree stratum usually consisting of *Acacia erioloba*. The most important land types are Ae, Ai, Ag and Ah with Hutton soil form. The only endemic taxon known from this vegetation type is *Gnaphalium englerianum*.

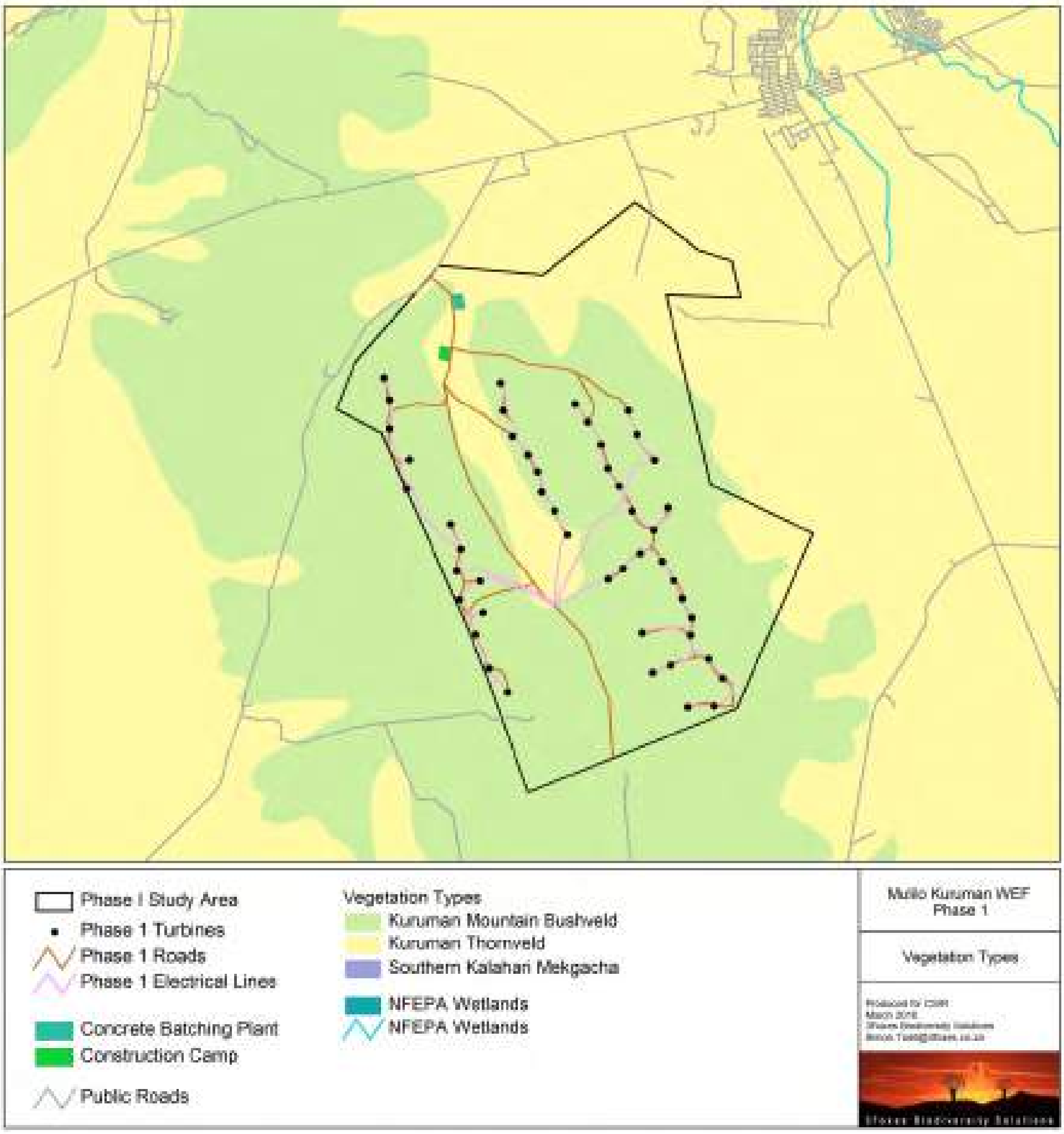



**Figure 2.** Vegetation map (Mucina and Rutherford 2006 and 2012 Powrie Update) of the Kuruman WEF Phase 1 study area and surrounding area.

### *1.3.2. Fine-Scale Vegetation Description*

**Kuruman Mountain Bushveld on Rocky Hills**

The site is characterised by the presence of numerous broad rocky ridges which project as much as 200 m above the surrounding plains, but are mostly in the order of 100 m high. Some of these have flat plateau areas on top, while others are more rounded. The vegetation of the ridges is affected by slope, aspect and elevation, but in general the vegetation is fairly well differentiated from the surrounding more grassy plains. The vegetation of the rocky hills is classified as Kuruman Mountain

Bushveld and corresponds well the description of this unit as described by Mucina & Rutherford (2006).

The vegetation of the rocky hills is dominated by a well-developed grass layer with a variable tree and shrub layer. Common and dominant trees and large shrubs include *Searsia lancea*, *Diospyros austro-africana*, *Euclea crispa*, *Olea europea* subsp. *africana*, *Searsia pyroides*, *Searsia tridactyla*, *Searsia ciliata*, *Tarchonanthus camphoratus*, *Lantana rugosa*, *Lebeckia macrantha*, and *Wahlenbergia nodosa*. The grass layer is dominated by grasses such as *Heteropogon contortus*, *Eragrostis chloromelas*, *E.nindensis*, *Cymbopogon caesius*, *Aristida meridionalis*, *Aristida congesta*, *Melinis repens*, *Bulbostylis burchellii*, *Anthephora pubescens*, *Themeda triandra*, *Brachiaria nigropedata*, *Trichoneura grandiglumis* and *Schizachyrium sanguineum*. Forbs and low shrubs that occur within the grass layer include *Chrysocoma cilliata*, *Chascanum hederaceum*, *Anthospermum rigidum*, *Striga elegans*, *Hermannia tomentosa*, *Dicoma schinzii*, *Corchorus asplenifolius*, *Monsonia angustifolia* and *Melhania virescens*.

**Figure 3.** Example of a lower-elevation ridge with a relatively high density of woody species, mostly *Searsia* and *Tarchonanthus*.

**Figure 4.** The higher elevation ridges have a lower density of woody species and generally consist of relatively open grassland. The target ridges are generally broad-backed and have sufficient space to accommodate the development without encroaching on the steeper slopes which are considered higher sensitivity and vulnerable to disturbance.

#### Kuruman Thornveld on Plains

The plains of the site consist of Kuruman Thornveld and consist of open to shrub-encroached plains with a well developed grass layer and a tree layer dominated by *Acacia erioloba*. Common and dominant species include *Acacia mellifera* subsp. *detinens*, *Grewia flava*, *Tachonanthus camphoratus*, *Gymnosporia buxifolia*, *Acacia hebeclada* subsp. *hebeclada*, *Searsia lancea*, *Acacia haematoxylon*, *Olea europea* subsp. *africana*, *Monechma divaricatum*, *Ehretia alba*, *Gnidia polycephala*, *Pentzia calcarea*, *Senna italica*, *Aristida meridionalis*, *A.stipitata* subsp. *stipitata*, *Eragrostis lehmannniana*, *Cynodon dactylon*, *Enneapogon scoparius*, *Schmidtia pappophoroides*, *Themeda triandra* and *Asparagus capensis*.

**Figure 5.** Vegetation of the plains, at the location of the on-site substation, showing a relatively dense shrub layer dominated by *Tarchonanthus camphoratus* and *Olea europea* subsp. *africana* with occasional *Acacia haematoxylon*.

**Figure 6.** Open plains in the south of the site, with scattered *Acacia erioloba*.

### *1.3.3. Listed and Protected Plant Species*

Based on the SANBI POSA database as well as the fieldwork that has been conducted at the proposed Kuruman WEF Phase 1 WEF site, the abundance of listed and protected species at the site is low. No threatened plant species were observed at the site and while the SANBI POSA database also indicates that few such species are present in the wider area, the site is large and it is possible that some red-listed species are present at the site, but if present they would not be common. There are however at least three protected tree species present at the site *Boscia albitrunca*, which is rare and was not observed within the development footprint; *Acacia haematoxylon* which occurs at a low density across the plains and would be affected to some extent by the development; and *Acacia erioloba*, which is a common to dominant species across the plains of the site and would also be impacted to some degree. However, no local populations of any protected species would be compromised by the development.

### *1.3.4. Faunal Communities*

#### *1.3.4.1. Mammals*

According to the MammalMap database, 39 mammals are known from the broad area around the site. The affected property is however also used as a game farm and numerous additional large ungulate species are present, but are considered to be part of the farming system as they are not free ranging beyond the property. Naturally-occurring species present at the site includes Kudu, Common Duiker, Cape Hare, Steenbok, Chacma Baboon, Rock Hyrax, Yellow Mongoose, Porcupine and Smith's Red Rock Rabbit as well as numerous other species which will be identified through the camera trapping that is being conducted at the site. Small mammals trapped or observed at the site includes South African Pouched Mouse, Namaqua Rock Mouse, Four-striped Mouse and Multimammate Mouse. The only species of conservation concern that may occur in the area includes the Southern African Hedgehog *Atelerix frontalis* (NT) as well as Ground Pangolin *Smutsia temminckii* (VU). It is likely that the Hedgehog is present in the area as the habitat is broadly suitable and it is also possible that the Pangolin is present in the area, but this species occurs at a low density the extent of habitat loss for this species would be low. The affected property is also fenced externally and internally with numerous electrified fences, which have a negative impact on this species with the result that it may have been extirpated from the property if present.

Important habitats for mammals include rocky outcrops and cliffs which provide shelter and habitat for rock-dwelling species; densely-vegetated lowlands along drainage lines which provide cover for numerous species. Overall, the site is however relatively homogenous in terms of mammalian habitat and it is not likely that the development will have a significant negative impact on any habitats of concern. It is likely that the major impact of development on most mammals would be habitat loss equivalent to the footprint of the facility. Some species may however be wary of the turbines or negatively affected by the noise generated and may avoid them to the greater degree. It is however unlikely that the local or regional populations of any species would be compromised by the development and long-term impacts on mammals are likely to be low to moderate after mitigation.

Figure 7. Small mammals trapped at the site include the Pouched Mouse and Multimammate Mouse.

#### *1.3.4.2. Reptiles*

A list of Reptiles known from the vicinity of the Kuruman WEF Phase 1 site, based on records from the ReptileMap database is provided in Appendix 3 of this report and indicates that as many as 38 species are known to occur in the wider area. No reptile species of concern have however been recorded from the area, which can be explained by the ubiquitous nature and broad distribution of the habitats present in the area. Within the site, the rocky hills are likely to have a greater diversity of reptiles than the plains. Species observed at the site (**Figure 8**) include Ground Agama, Boomslang, Rock Monitor, Spotted Sand Lizard, Variegated Skink and Leopard Tortoise. There are no habitats of particular concern for reptiles at the site which would be impacted by the development and the species and habitats present are all widely distributed. As a result, the overall impacts of the development on reptiles are likely to be of local significance only and there are no species with a very narrow distribution range or of high conservation concern present at the site which may be compromised by the development.

**Figure 8.** Reptiles observed at the site include from bottom left, Cape Gecko, Spotted Sand Lizard and Boomslang.

### *1.3.4.3. Amphibians*

There does not appear to be any natural permanent water at the site, although there are numerous earth dams which hold water at least seasonally. Such sites represent the only breeding habitat for most amphibians at the site, although there are some species present such as Bushveld Rain Frogs which are independent of water. No listed species are known from the area and while the Giant Bullfrog occurs widely in the Savannah Biome, there are no records from the vicinity of the Kuruman area, suggesting that this species does not occur in the area. Even if present, no suitable breeding habitat for this species was observed at the site. The only species observed in the area was the Tremelo Sand Frog although some of the other toad species such as Olive Toad are also likely to be present in the area.

Given the paucity of important amphibian habitats at the site and the low diversity of amphibians, a significant impact on frogs is not likely.

### *1.3.5. Critical Biodiversity Areas*

The CBA map for the wider area around the study site is illustrated below in **Figure 9**. The northern parts of the site fall within the Tier 2 CBA which forms a buffer area around the Billy Duvenhage

Nature Reserve. The majority of the footprint of the development is within an Ecological Support Area with some footprint areas such as the substation are within areas that are classified as *other natural areas*. The footprint within the CBA 2 area is low and a significant impact would not occur in this area. It is highly unlikely that the development would compromise the functioning of the ESA and with the appropriate mitigation, the development of a wind energy facility is considered compatible with the aims and objectives of ESAs, at least from a terrestrial biodiversity point of view. As a result, the overall impact of the development on CBAs and ESAs is considered to be low and a long-term significant impact is unlikely. In addition, the site does not fall within an area identified as being a priority conservation expansion area under the Northern Cape Protected Area Expansion Strategy (NCPAES) Focus Area (2017).

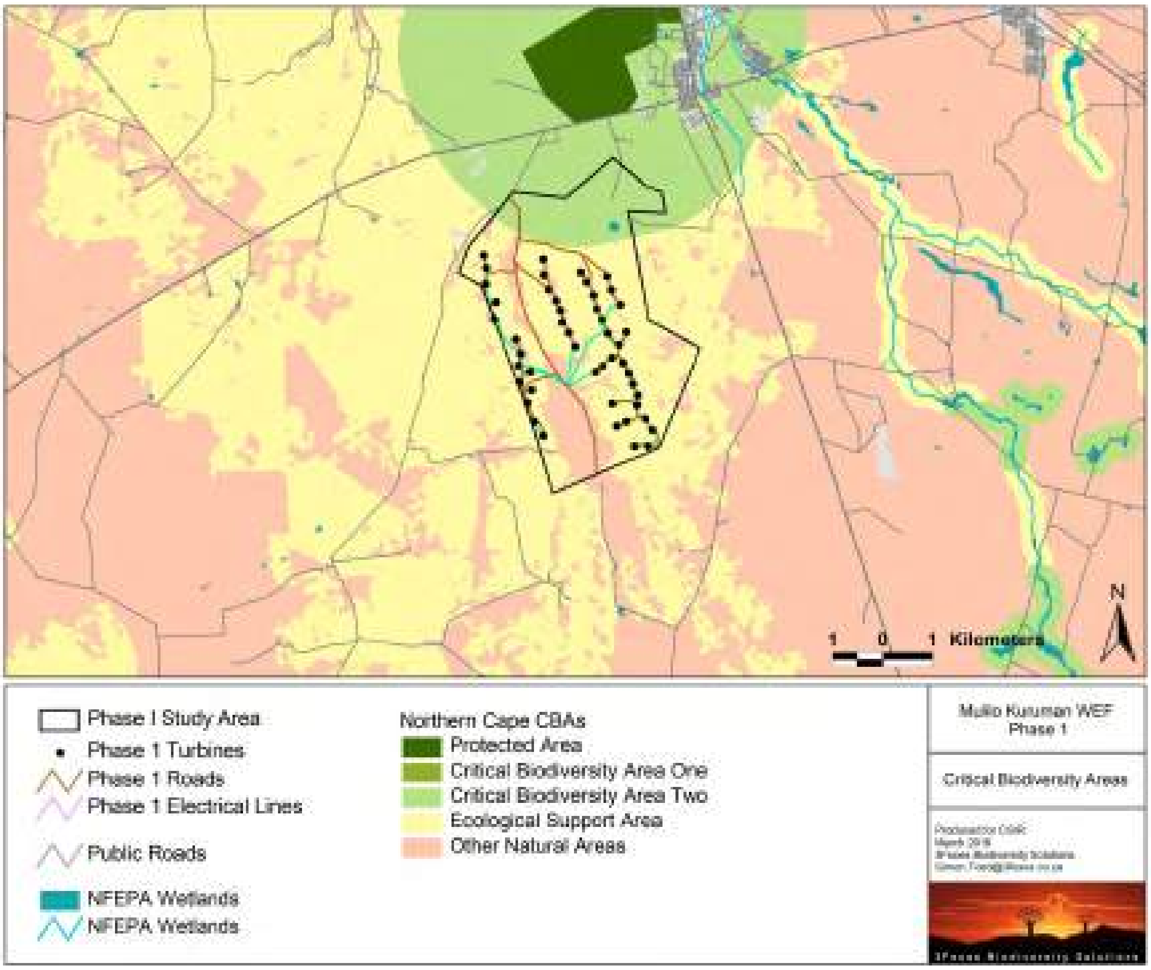



**Figure 9.** Critical Biodiversity Areas map for the study area, showing that the site lies mostly within Ecological Support Areas, with an area of CBA 2 in the north.

### *1.3.6. Cumulative Impacts*

There are a number of proposed solar energy facilities in the broad area around the Kuruman WEF Phase 1 site (**Figure 12**). However all of these are on the plains habitat and there are no registered wind farm projects in the vicinity of the current site that would affect the same Kuruman Mountain Bushveld vegetation type. In addition, the Kuruman Mountain Bushveld habitat type is still largely intact and has not been significantly impacted by transformation. As a result, the contribution of the current development to cumulative impact would be relatively low and is estimated at less than 100ha in total. This would not significantly impact the remaining extent of Kuruman Mountain Bushveld or Kuruman Thornveld.


**Figure 10.** Map of other renewable energy developments in the wide area around the affected Kuruman WEF Phase 1 properties indicated in blue. All existing projects are solar PV projects restricted to the plains of the area.

### *1.3.7. Results of the Field Study*

The ecological sensitivity map for the study area is illustrated below in Figure 13. The slopes of the ridges are considered high sensitivity as a result of their vulnerability to disturbance and erosion as well as the higher ecological value of these areas on account of their higher faunal and botanical diversity. The plains are considered to be low sensitivity, while the plateau and ridge-top habitats are considered to be moderate sensitivity. The substation is located in an area that is considered to be relatively low sensitivity and the site is considered suitable for the substation. The majority of turbines are located within areas classified as moderate sensitivity. These areas are considered acceptable for turbine placement and would generate relatively low impacts. Some of the access roads traverse high sensitivity slope areas. This is however usually along existing road alignments and is also unavoidable to access the target ridges. With the appropriate erosion control features, the access roads will generate a relatively low impact and are considered to be acceptable. Overall, the site is considered to be an acceptable site for development of a wind energy facility and the impacts associated with the development are likely to be moderate to low and would be of a local nature only as there are no habitats or species of very high conservation concern that are likely to be associated with the development.

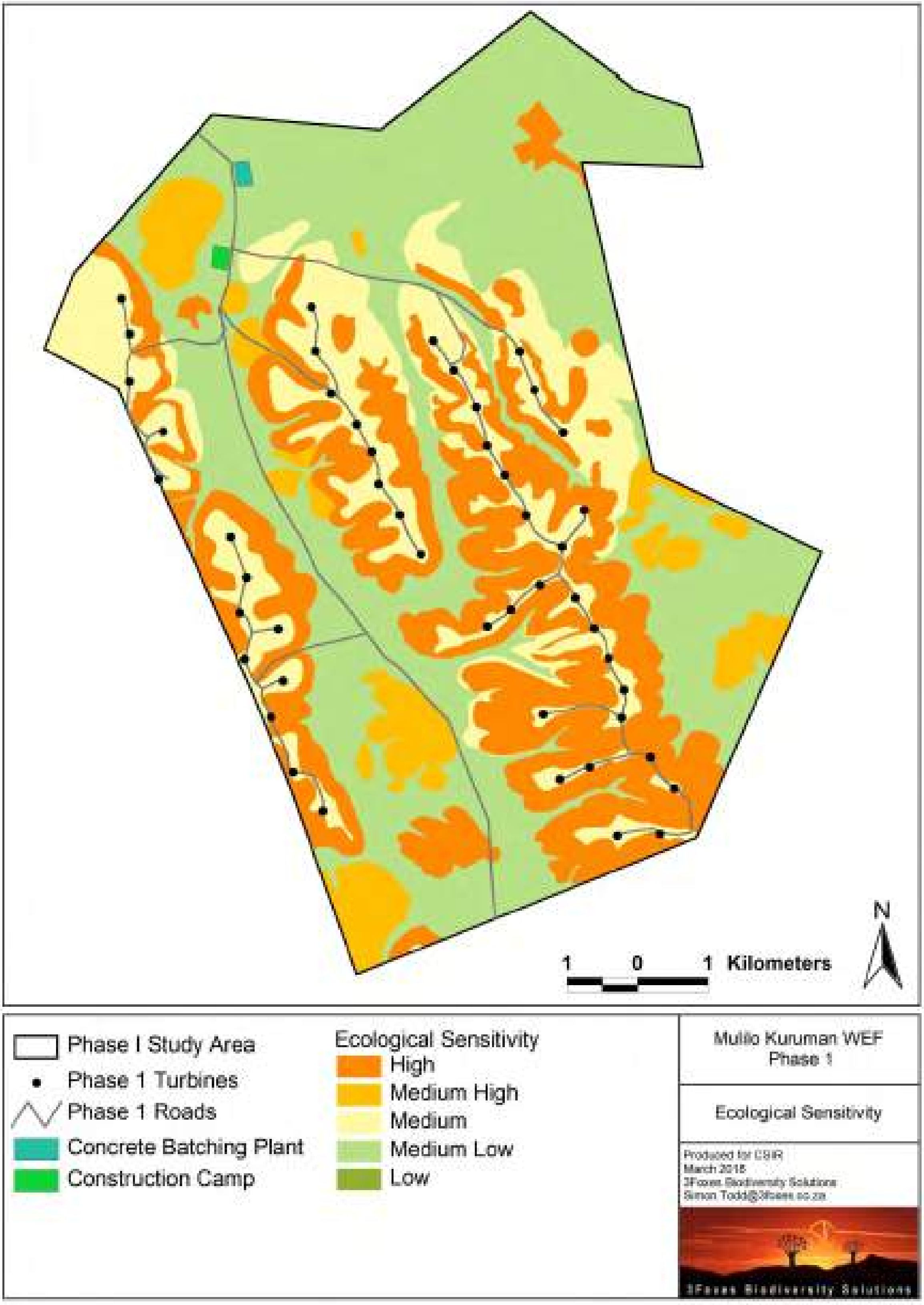



**Figure 11.** Ecological sensitivity map for the study area, showing the target ridges are largely considered to be moderate sensitivity and considered suitable for development.

## 1.4. LEGISLATION AND PERMIT REQUIREMENTS

A summary of the environmental legislation and permitting requirements that would be triggered by the development of the site is outlined below.

Under the **Environmental Impact Assessment Regulations Listing Notice 1 of 2014** the following activities are likely to be triggered:

Activity 1. The development of facilities or infrastructure for the generation of electricity from a renewable resource where-

(i) the electricity output is more than 10 megawatts but less than 20 megawatts; or

(ii) the output is 10 megawatts or less but the total extent of the facility covers an area in excess of 1 hectare; excluding where such development of facilities or infrastructure is for photovoltaic installations and occurs within an urban area.

**Under the Environmental Impact Assessment Regulations Listing Notice 2 of 2014 the following activities are likely to be triggered:**

**Activity 1:** The development of facilities or infrastructure for the generation of electricity from a renewable resource where the electricity output is 20 megawatts or more, excluding where such development of facilities or infrastructure is for photovoltaic installations and occurs within an urban area.

**Activity 15.** The clearance of an area of 20 hectares or more of indigenous vegetation, excluding where such clearance of indigenous vegetation is required for-

(i) the undertaking of a linear activity; or

(ii) maintenance purposes undertaken in accordance with a maintenance management plan.

**And, under Environmental Impact Assessment Regulations Listing Notice 3 of 2014:**

**Activity 4**. The construction of a road wider than 4 metres with a reserve less than 13,5 metres.

ii. Outside urban areas, in:

(a) A protected area identified in terms of NEMPAA, excluding disturbed areas;
(b) National Protected Area Expansion Strategy Focus areas;
(c) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;
(d) Sites or areas identified in terms of an International Convention;
(e) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;

(f) Core areas in biosphere reserves;
(g) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core areas of a biosphere reserve, excluding disturbed areas; or
(h) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined;

**Activity 12.** The clearance of an area of 300 square metres or more of indigenous vegetation except where such clearance of indigenous vegetation is required for maintenance purposes undertaken in accordance with a maintenance management plan.

g. Northern Cape:

i. Within any critically endangered or endangered ecosystem listed in terms of section 52 of the NEMBA or prior to the publication of such a list, within an area that has been identified as critically endangered in the National Spatial Biodiversity Assessment 2004;
ii. Within critical biodiversity areas identified in bioregional plans;
iii. Within the littoral active zone or 100 metres inland from high water mark of the sea or an estuary, whichever distance is the greater, excluding where such removal will occur behind the development setback line on erven in urban areas; or
iv. On land, where, at the time of the coming into effect of this Notice or thereafter such land was zoned open space, conservation or had an equivalent zoning.

Activity 18. The widening of a road by more than 4 metres, or the lengthening of a road by more than 1 kilometre.

g. Northern Cape

i. In an estuary;

ii. Outside urban areas:

(aa) A protected area identified in terms of NEMPAA, excluding conservancies;
(bb) National Protected Area Expansion Strategy Focus areas;
(cc) Sensitive areas as identified in an environmental management framework as contemplated in chapter 5 of the Act and as adopted by the competent authority;
(dd) Sites or areas identified in terms of an international convention;
(ee) Critical biodiversity areas as identified in systematic biodiversity plans adopted by the competent authority or in bioregional plans;
(ff) Core areas in biosphere reserves;
(gg) Areas within 10 kilometres from national parks or world heritage sites or 5 kilometres from any other protected area identified in terms of NEMPAA or from the core area of a biosphere reserve;

(hh) Areas seawards of the development setback line or within 1 kilometre from the high-water mark of the sea if no such development setback line is determined; or
(ii) Areas within a watercourse or wetland; or within 100 metres from the edge of a watercourse or wetland;

**National Forest Act (No. 84 of 1998):**

The National Forests Act provides for the protection of forests as well as specific tree species, quoting directly from the Act: “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 licence or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated”.

Three protected tree species have been observed at the site, *Acacia erioloba*, *Acacia haematoxylon* and *Boscia albitrunca.* Although the numbers of affected individuals is low, a permit from DAFF would be required for any impacts to these species. Under the draft layout provided for scoping, there would be some individuals of *Acacia erioloba* lost to the development as well as a few *Acacia haematoxylon*. No individuals of *Boscia albitrunca* were observed within the footprint. The number of affected individuals of protected tree species would be very low in comparison with the numbers present on the study area.

**Conservation of Agricultural Resources Act (Act 43 of 1983):**

The Conservation of Agricultural Resources Act provides for the regulation of control over the utilisation of the natural agricultural resources in order to promote the conservation of soil, water and vegetation and provides for combating weeds and invader plant species. The Conservation of Agricultural Resources Act defines different categories of alien plants and those listed under Category 1 are prohibited and must be controlled while those listed under Category 2 must be grown within a demarcated area under permit. Category 3 plants includes ornamental plants that may no longer be planted but existing plants may remain provided that all reasonable steps are taken to prevent the spreading thereof, except within the floodline of water courses and wetlands.

## 1.5. IDENTIFICATION OF KEY ISSUES

### *1.5.1. Identification of Potential Impacts*

The primary source of impact associated with the development is the transformation of currently intact habitat to hard infrastucture associated with the development such as turbine platforms and access roads. A significant proportion of the impact would occur during the construction phase of the development as a result of the direct transformation of intact habitat as well as disturbance associated with construction activities. During operation, impacts associated with the development would be lower and largely restricted to low-level faunal impacts as well as some potential disruption of ecosystem processes such as landscape connectivity. Impacts on CBAs are expected to be low given the low footprint within CBAs. The following activities are identified as being potentially associated with the development:

#### 1.5.1.1. *Construction Phase*

- Impacts on vegetation and protected tree species
- Direct and indirect faunal impacts

#### 1.5.1.2. *Operational Phase*

- Increased soil erosion
- Increased alien plant invasion
- Impacts on fauna due to operation
- Impacts on Critical Biodiversity Areas and ESAs

#### 1.5.1.3. *Decommissioning Phase*

- Increased alien plant invasion
- Increased soil erosion
- Direct and indirect impacts on fauna

#### 1.5.1.4. *Cumulative impacts*

- Cumulative impacts on habitat loss and broad-scale ecological processes

## 1.6. ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

An assessment of the likely impacts associated with the development, is provided below. It is however important to note that this is a scoping level assessment and the final impacts to be assessed in the EIA phase may differ from those below depending on the final layout provided by the developer in response to the various scoping-level inputs.

### 1.6.1. *Construction Phase Impact 1. Impacts on vegetation and plant species of conservation concern*

- The abundance of plant species of concern at the site is very low, although there are three protected tree species present that would be impacted by the development to a greater or lesser degree. However, the main impact of the development would be the loss of approximately 100 ha of currently intact vegetation. Given the low current levels of impact on the affected vegetation types, the significance of this impact is considered to be of low magnitude and of local significance only.

Without mitigation this impact would be of **Moderate** potential significance.

Essential mitigation measures include:

- No development of turbines, roads of other infrastructure within identified no-go areas.
- Pre-construction walk-through of the development footprint to further refine the layout and further reduce impacts on sensitive habitats and protected species through micro-siting of the turbines and access roads.

With the implementation of the suggested mitigation the impact on vegetation likely be reduced to a **Low** significance.

### *1.6.2. Construction Phase Impact 2. Direct and indirect faunal impacts*

The construction of the development will result in significant habitat loss, noise and disturbance on site. This will lead to direct and indirect disturbance of resident fauna. Some slow-moving or retiring species such as many reptiles would likely not be able to escape the construction machinery and would be killed. There are also several species present at the site which are vulnerable to poaching and there is a risk that these species may be targeted. This impact would be caused by the presence and operation of construction machinery and personnel on the site. This impact would however be transient and restricted to the construction phase, with significantly lower levels of disturbance during the operational phase.

Without mitigation this impact is likely to be of **Moderate** significance.

Essential mitigation measures would include:

- Avoidance of identified areas of high fauna importance.
- Search and rescue for reptiles and other vulnerable species during construction, before areas are cleared.
- Limiting access to the site and ensuring that construction staff and machinery remain within the demarcated construction areas during the construction phase.
- Environmental induction for all staff and contractors on-site.

With the implementation of the suggested mitigation the construction phase impact on fauna can likely be reduced to a **Moderate to Low Significance**.

### *1.6.3. Operational Phase Impact 1. Increased Soil Erosion*

The site has steep slopes and sandy soils that are vulnerable to erosion and the disturbance created during construction will increase erosion risk at the site. The access roads onto the ridges pose a particular risk and specific mitigation would be required to manage erosion risk in these vulnerable areas.

Without mitigation, this impact would potentially be of **Moderate significance**.

Essential mitigation measures would include:

- Avoiding areas of high erosion vulnerability as much as possible.
- Using barriers, geotextiles, active rehabilitation and other measures during and after construction to minimise soil movement at the site.

With the effective implementation of the mitigation measures, it is likely that this impact can be reduced to an acceptable, **low significance**.

### *1.6.4. Operational Phase Impact 2. Increased Alien Plant Invasion*

There are already several alien species present on the site such as *Prosopis glandulosa* and disturbance created during construction would leave the site vulnerable to further alien plant invasion, especially along the access roads and other areas which receive additional run-off from the hardened surfaces of the development.

Without mitigation this impact would likely be of **Moderate to Low Significance**.

Essential mitigation measures would include:

- Alien management plan to be implemented during the operational phase of the development, which makes provision for regular alien clearing and monitoring.
- Rehabilitation of disturbed areas that are not regularly used after construction.

With the effective implementation of the mitigation measures, it is likely that this impact can be reduced to a **Low Significance**.

### *1.6.5. Operational Phase Impact 3. Operational Impacts on Fauna*

Operational activities as well as the presence of the turbines and the noise they generate may deter some sensitive fauna from the area. In addition, the access roads may function to fragment the habitat for some fauna, which are either unable to or unwilling to traverse open areas. For some species this relates to predation risk as slow-moving species such as tortoises are vulnerable to predation by crows and other predators. In terms of habitat disruption, subterranean species such burrowing snakes and skinks are particularly vulnerable to this type of impact as they are unable to traverse the hardened roads or become very exposed to predation when doing so. This is a low-level continuous impact which could have significant cumulative impact on sensitive species. The majority of the site however consists of rocky terrain where this would have a minimal impact as the soils are already shallow and fragmented.

Without mitigation this impact would likely be of **Moderate to Low Significance**.

Essential mitigation measures would include:

- Open space management plan for the development, which makes provision for favourable management of the facility and the surrounding area for fauna.
- Limiting access to the site to staff and contractors only.

- Appropriate design of roads and other infrastructure where appropriate to minimise faunal impacts and allow fauna to pass through or underneath these features.
- No electrical fencing within 30cm of the ground as tortoises become stuck against such fences and are electrocuted to death.

With the effective implementation of the mitigation measures, it is likely that this impact can be reduced to a **Low Significance**.

### *1.6.6. Operational Phase Impact 4. Impacts on Critical Biodiversity Areas and ESAs*

A part of the site is within a CBA 2 and the majority of the development footprint is within an Ecological Support Area. With mitigation, the wind energy facility is considered compatible with the role of the ESA and a long-term significant impact on CBAs and ESAs is not likely. As such impacts on CBA, ESAs and associated ecological processes are considered to be low.

Without mitigation this impact would likely be of **Moderate Significance**.

Essential mitigation measures would include:

- Minimise the development footprint as far as possible, which includes locating temporary-use areas such as construction camps and lay-down areas in previously disturbed areas.
- Avoid impact to restricted and specialised habitats such as large rocky outcrops.

With the effective implementation of the mitigation measures, it is likely that this impact will be reduced to a **Low Significance**.

### *1.6.7. Decommissioning Phase Impact 1. Increased Soil Erosion*

As already described, the site has steep slopes that are vulnerable to erosion. Decommissioning will remove the hard infrastructure from the site, generating disturbance and leaving areas that are unvegetated and vulnerable to erosion.

Without mitigation, this impact would potentially be of **Moderate significance**.

Essential mitigation measures would include:

- Revegetation of cleared areas with monitoring and follow-up to ensure that rehabilitation is successful.
- Using net barriers, geotextiles, active rehabilitation and other measures during and after decommissioning to minimise sand movement at the site.

With the effective implementation of the mitigation measures, it is likely that this impact can be reduced to an acceptable, **low significance**.

### *1.6.8. Decommissioning Phase Impact 2. Increased Alien Plant Invasion*

There are already some alien species present on the site such as *Prosopis* and disturbance created during decommissioning would leave the site vulnerable to further alien plant invasion.

Without mitigation this impact would likely be of **Moderate Significance**.

Essential mitigation measures would include:

- Alien management plan to be implemented during the decommissioning phase of the development, which makes provision for regular alien clearing and monitoring for up 5 years after decommissioning.
- Rehabilitation of disturbed areas that have been generated by decommissioning.

With the effective implementation of the mitigation measures, it is likely that this impact can be reduced to a **Low Significance**.

### *1.6.9. Cumulative Impact 1. Cumulative habitat loss and impact on broad-scale ecological processes*

There are several other renewable energy developments in the wider area and along with the current development, these would contribute to cumulative impacts on habitat loss and fragmentation and negative impact on broad-scale ecological processes such as dispersal and climate change resilience. However, not all of the developments in the area would impact on the same ridge habitat as the current development and overall, the current levels of cumulative development impact in the wider area is relatively low.

Without mitigation, this impact is likely to be of **Moderate to Low Significance.**

Essential mitigation measures would include:

- Minimise the current development footprint as much as possible and rehabilitate cleared areas after construction.
- Ensure that management of the facility occurs in a biodiversity-conscious manner in accordance with an open-space management plan for the facility.

With the effective implementation of the mitigation measures, it is likely that this impact will be reduced to a **Low Significance**.

## 1.7. IMPACT ASSESSMENT SUMMARY

The assessment of impacts and recommendation of mitigation measures as discussed above are collated in Table 1-1 to 1-4 below. Impacts are assessed for the construction, operational and decommissioning phases of the development as well as for overall cumulative impacts.

*Table 1-1 Impact assessment summary table for the Construction Phase*

**CONSTRUCTION PHASE**

**Direct impacts**

## Impact on vegetation

| Impact pathway | Status | Extent | Duration | Consequence | Probability | Reversibility of impact | Irreplaceability of receiving environment/ resource | Significance of impact/risk (before mitigation) | Can impact be avoided? | Can impact be managed or mitigated? | Significance o residual risk/impact (after mitigation) | Ranking o impact/ risk | Confidence level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Habitat Loss | - | Local | Long-term | Moderate | Very Likely | Low | Moderate | Moderate Risk (3) | Partly | Partly | Low | 4 | High |

**Suggested Mitigation:**

- No development of turbines, roads or other infrastructure within No-Go areas.
- Preconstruction walk-through of the development footprint to further refine the layout and reduce impacts on protected species through micro-siting of the turbines and access roads.
- Demarcate all areas to be cleared with construction tape or other appropriate and effective means. However caution should be exercised to avoid using material that might entangle fauna.

## Faunal Impacts due to construction

| Impact pathway | Status | Extent | Duration | Consequence | Probability | Reversibility of impact | Irreplaceability of receiving environment/ resource | Significance of impact/risk (before mitigation) | Can impact be avoided? | Can impact be managed or mitigated? | Significance o residual risk/impact (after mitigation) | Ranking o impact/ risk | Confidence level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Habitat Loss | - | Local | Short-term | Substantial | Very Likely | Moderate | Moderate | Moderate Risk (3) | Partly | Partly | Low | 3 | High |

| **Suggested Mitigation:**<br><br>• Avoidance of identified areas of high faunal importance at the design stage.<br>• Ensure that lay-down and other temporary infrastructure is within medium- or low- sensitivity areas, preferably previously transformed areas if possible.<br>• Search and rescue for reptiles and other vulnerable species during construction, before areas are cleared.<br>• During construction any fauna directly threatened by the construction activities should be removed to a safe location by the ECO or other suitably qualified person.<br>• Limit access to the site and ensure that construction staff and machinery remain within the demarcated construction areas during the construction phase.<br>• Environmental induction for all staff and contractors on-site.<br>• All construction vehicles should adhere to a low speed limit (40km/h for cars and 30km/h for trucks) to avoid collisions with susceptible species such as snakes and tortoises and rabbits or hares. Speed limits should apply within the facility as well as on the public gravel access roads to the site.<br>• If any parts of site such as construction camps must be lit at night, this should be done with low-UV type lights (such as most LEDs) as far as practically possible, which do not attract insects and which should be directed downwards. |
|---|
| |

*Table 1-2 Impact assessment summary table for the Operational Phase*

**OPERATIONAL PHASE**

**Direct impacts**

## Increased soil erosion

| Impact pathway | Status | Extent | Duration | Consequence | Probability | Reversibility of impact | Irreplaceability of receiving environment/ resource | Significance of impact/risk (before mitigation) | Can impact be avoided? | Can impact be managed or mitigated? | Significance of residual risk/impact (after mitigation) | Ranking of impact/ risk | Confidence level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Disturbance | - | Local | Long-term | Moderate | Likely | Moderate | Moderate | Moderate Risk (3) | Yes | Yes | Low | 4 | High |

**Suggested Mitigation:**

- Erosion management at the site should take place according to the Erosion Management Plan and Rehabilitation Plan.
- All roads and other hardened surfaces should have runoff control features which redirect water flow and dissipate any energy in the water which may pose an erosion risk.
- Regular monitoring for erosion after construction to ensure that no erosion problems have developed as result of the disturbance, as per the Erosion Management and Rehabilitation Plans for the project.
- All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques.
- All cleared areas should be revegetated with indigenous perennial species from the local area.
- Avoid areas of high erosion vulnerability as much as possible.
- Use active rehabilitation and other passive measures during and after construction to minimise erosion at the site.

## Increased alien plant invasion

| Impact pathway | Status | Extent | Duration | Consequence | Probability | Reversibility of impact | Irreplaceability of receiving environment/ resource | Significance of impact/risk (before mitigation) | Can impact be avoided? | Can impact be managed or mitigated? | Significance of residual risk/impact (after mitigation) | Ranking of impact/ risk | Confidence level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Disturbance | - | Local | Medium-term | Moderate | Likely | Moderate | Moderate | Moderate Risk (3) | Yes | Yes | Low | 4 | High |

**Suggested Mitigation:**

- Alien management plan to be implemented during the operational phase of the development, which makes provision for regular alien clearing and monitoring.
- Wherever excavation is necessary, topsoil should be set aside and replaced after construction to encourage natural regeneration of the local indigenous species.
- Due to the disturbance at the site as well as the increased runoff generated by the hard infrastructure, alien plant species are likely to be a long-term problem at the site and a long-term control plan will need to be implemented.
- Regular monitoring for alien plants within the development footprint as well as adjacent areas which receive runoff from the facility as there are also likely to be prone to invasion problems.
- Regular alien clearing should be conducted, as needed, using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible.

## Operational impacts on fauna

| Impact pathway | Status | Extent | Duration | Consequence | Probability | Reversibility of impact | Irreplaceability of receiving environment/ resource | Significance of impact/risk (before mitigation) | Can impact be avoided? | Can impact be managed or mitigated? | Significance of residual risk/impact (after mitigation) | Ranking of impact/ risk | Confidence level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Noise & Disturbance | - | Local | Long-term | Moderate | Likely | Moderate | Moderate | Moderate Risk (3) | Partly | Partly | Low | 4 | High |

**Suggested Mitigation:**

- Open space management plan for the development, which makes provision for favourable management of the facility and the surrounding area for fauna.
- Limiting access to the site to staff and contractors only.
- Appropriate design of roads and other infrastructure where appropriate to minimise faunal impacts and allow fauna to pass through or underneath these features.
- No electrical fencing within 30cm of the ground as tortoises become stuck against such fences and are electrocuted to death.
- If the site must be lit at night for security purposes, this should be done with downward-directed low-UV type lights (such as most LEDs) as far as possible, which do not attract insects.
- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
- All vehicles accessing the site should adhere to a low speed limit (40km/h max) to avoid collisions with susceptible species such as snakes and tortoises.

## Impacts on Critical Biodiversity Areas and ESAs

| Impact pathway | Status | Extent | Duration | Consequence | Probability | Reversibility of impact | Irreplaceability of receiving environment/ resource | Significance of impact/risk (before mitigation) | Can impact be avoided? | Can impact be managed or mitigated? | Significance of residual risk/impact (after mitigation) | Ranking of impact/ risk | Confidence level |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Habitat loss and disturbance** | **-** | **Local** | **Long-term** | **Moderate** | **Likely** | **Moderate** | **Moderate** | **Moderate Risk (3)** | **Partly** | **Partly** | **Low** | **4** | **High** |

**Suggested Mitigation:**

- Minimise the development footprint as far as possible, which includes locating temporary-use areas such as construction camps and lay-down areas in previously disturbed areas.
- Avoid impact to restricted and specialised habitats such as drainage areas and rocky outcrops
- 

***Table 1-3 Impact assessment summary table for the Decommissioning Phase***

| DECOMMISSIONING PHASE | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct impacts | | | | | | | | | | | | | |
| **Increased soil erosion** | | | | | | | | | | | | | |
| Impact pathway | Status | Extent | Duration | Consequence | Probability | Reversibility of impact | Irreplaceability of receiving environment/ resource | Significance of impact/risk (before mitigation) | Can impact be avoided? | Can impact be managed or mitigated? | Significance of residual risk/impact (after mitigation) | Ranking of impact/ risk | Confidence level |
| Habitat loss and disturbance | - | Local | Long-term | Moderate | Likely | Low | Moderate | Moderate Risk (3) | Yes | Yes | Low | 4 | High |
| **Suggested Mitigation:**<br>• All hard infrastructure should be removed and the footprint areas rehabilitated with locally-sourced perennial species.<br>• The use of net barriers, geotextiles, active rehabilitation and other measures after decommissioning to minimise sand movement and enhance revegetation at the site.<br>• Monitoring of rehabilitation success at the site for at least 5 years after decommissioning.<br>• All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques. | | | | | | | | | | | | | |
| **Increased alien plant invasion** | | | | | | | | | | | | | |
| Impact pathway | Status | Extent | Duration | Consequence | Probability | Reversibility of impact | Irreplaceability of receiving environment/ resource | Significance of impact/risk (before mitigation) | Can impact be avoided? | Can impact be managed or mitigated? | Significance of residual risk/impact (after mitigation) | Ranking of impact/ risk | Confidence level |
| Habitat loss and disturbance | - | Local | Long-term | Moderate | Likely | Low | Moderate | Moderate Risk (3) | Yes | Yes | Low | 4 | High |

| **Suggested Mitigation:**<br><br>• Alien management plan to be implemented during the decommissioning phase of the development, which makes provision for regular alien clearing and monitoring for at least 5 years after decommissioning.<br>• Active rehabilitation and revegetation of previously disturbed areas with indigenous species selected from the local environment.<br>• Wherever excavation is necessary for decommissioning, topsoil should be set aside and replaced after decommissioning activities are complete to encourage natural regeneration of the local indigenous species.<br>• Due to the disturbance at the site alien plant species are likely to be a long-term problem at the site following decommissioning and regular control will need to be implemented until a cover of indigenous species has returned.<br>• Regular monitoring for alien plants within the disturbed areas for at least two years after decommissioning or until alien invasives are no longer a problem at the site.<br>• Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible. |
|---|
| |

*Table 1-4 Impact assessment summary table for Cumulative Impacts*

| Cumulative Impacts | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Cumulative habitat loss and impact on broad scale ecological processes** | | | | | | | | | | | | | | |
| **Impact pathway** | **Status** | **Extent** | **Duration** | **Consequence** | **Probability** | **Reversibility of impact** | **Irreplaceability of receiving environment/ resource** | **Significance of impact/risk = consequence x probability (before mitigation)** | **Can impact be avoided?** | **Can impact be managed or mitigated?** | | **Significance of residual risk/impact (after mitigation)** | **Ranking of impact/ risk** | **Confidence level** |
| **Habitat loss and disturbance** | **-** | **Regional** | **Long-term** | **Moderate** | **Likely** | **Low** | **Moderate** | **Moderate Risk (3)** | **Partly** | **Partly** | | **Low** | **4** | **High** |

**Suggested Mitigation:**

- Minimise the development footprint as far as possible.
- The facility should be managed in a biodiversity-conscious manner in accordance with an open-space management plan for the facility.

## 1.8. CONCLUSIONS AND RECOMMENDATIONS

The Kuruman WEF Phase 1 site consists of Kuruman Mountain Bushveld on the rocky hills and Kuruman Thornveld on the lowlands. Both of these vegetation types are of least concern and have not been significantly impacted by transformation to date. The abundance of plant species of conservation concern at the site is low and the overall impact of the development on vegetation would be low. In terms of fauna, the abundance of species of concern at the site is low and while some listed mammals may be present at the site, a significant impact on such species is unlikely.

The northern part of the site is located within a CBA 2 which forms a buffer area around the Billy Duvenhage Nature Reserve. The majority of the footprint of the development is however within an Ecological Support Area. The footprint within the CBA 2 area is low and a significant impact on the CBA is not likely. In addition, it is unlikely that the development would compromise the functioning of the ESA and with the appropriate mitigation, the development of a wind energy facility is considered compatible with the aims and objectives of ESAs, at least from a terrestrial biodiversity point of view.

Although there are a number of proposed solar energy facilities in the broad area around the Kuruman WEF Phase 1 site, these are on the plains habitat and there are no registered wind farm projects in the vicinity of the current site that would affect the same Kuruman Mountain Bushveld vegetation type. In addition, the Kuruman Mountain Bushveld habitat type is still largely intact and has not been significantly impacted by transformation. As a result, the contribution of the current development to cumulative impact would be relatively low and would not significantly impact the remaining extent of Kuruman Mountain Bushveld or Kuruman Thornveld.

The sensitivity mapping that was conducted indicates that the slopes of the target ridges are considered high sensitivity as a result of their vulnerability to disturbance and erosion as well as the higher ecological value of these areas on account of their higher faunal and botanical diversity. The plateau and ridge-top habitats that are the primary target for the development are considered to be moderate sensitivity. These areas are considered acceptable for turbine placement and would generate relatively low impacts. Although the access roads traverse some high sensitivity slope areas in order to access the target ridges, with the appropriate erosion control features, these would generate a relatively low impact and are considered to be acceptable.

Overall, the site is considered to be an acceptable site for development of a wind energy facility and the impacts associated with the development are likely to be moderate to low and would be of a local nature only. As such, there do not appear to be any major issues or impacts that cannot be mitigated to a low level and from a terrestrial ecology perspective, there are no reasons to prevent the development from proceeding to the EIA phase. A plan of study for the EIA phase is presented below.

## 1.9. PLAN OF STUDY FOR THE EIA PHASE

The current study is based on a full field assessment which includes detailed fauna and flora surveys of the site. As such, the field-assessment component of the study is considered complete and the results obtained here are considered thorough and reliable. As such, the major tasks remaining going into the EIA phase are around assessing the final layout, assessing the cumulative impacts associated with the development in more detail and making the appropriate recommendations with regards to the most appropriate mitigation and avoidance measures to be included in the EMPr for the development.

Based on the results of the current study and the features of the site, the following activities and outputs are planned to inform the EIA phase of the development:

- Characterise the faunal communities at the site in greater detail. The information obtained from the camera traps that have been deployed at the site will be analysed and included in the EIA. This will be complemented with the information from the small mammal trapping and reptile surveys conducted, which have not been fully detailed here.

- Characterise the plant communities of the site in greater detail. A full plant species list has been collected from the site and while the vegetation patterns at the site have been described here is broad terms, some additional detail in this regard is still available.

- Provide a more detailed assessment of cumulative impact associated with the development of the site. Including an assessment of the extent of habitat lost to wind energy development in the area to date and the likely future potential loss from the current as well as other proposed developments in the area.

- Evaluate, based on the site attributes and final layout of the development, what the most applicable mitigation measures to reduce the impact of the development on the site would be and if there are any areas where specific precautions or mitigation measures should be implemented.

- Assess the impacts identified above in light of the site-specific findings and the final layout for assessment in the EIA Phase to be provided by the developer.

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# 1.11. APPENDICES

### 1.11.1. Appendix 1. List of Plants

List of plant species known from the broad area around the Kuruman WEF Phase 1 based on the SANBI POSA database. .

| Family | Genus | Species | Rank | Subspecies | IUCN | Family | Genus | Species | Rank | Subspecies | IUCN |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Acanthaceae | *Barleria* | *lichtensteiniana* | | | | Acanthaceae | *Barleria* | *macrostegia* | | | |
| Acanthaceae | *Glossochilus* | *burchellii* | | | | Acanthaceae | *Hypoestes* | *forskaolii* | | | |
| Acanthaceae | *Justicia* | *divaricata* | | | | Acanthaceae | *Barleria* | *bechuanensis* | | | LC |
| Acanthaceae | *Barleria* | *media* | | | | Acanthaceae | *Justicia* | *australis* | | | |
| Acanthaceae | *Justicia* | *incana* | | | | Acanthaceae | *Justicia* | *puberula* | | | |
| Aizoaceae | *Nananthus* | *aloides* | | | LC | Aizoaceae | *Plinthus* | *sericeus* | | | LC |
| Aizoaceae | *Trianthema* | *parvifolia* | var. | *parvifolia* | LC | Aizoaceae | *Trichodiadema* | *pomeridianum* | | | LC |
| Aizoaceae | *Prepodesma* | *orpenii* | | | | Aizoaceae | *Ruschia* | *calcarea* | | | DD |
| Amaranthaceae | *Aerva* | *leucura* | | | LC | Amaranthaceae | *Amaranthus* | *thunbergii* | | | LC |
| Amaranthaceae | *Chenopodium* | *hederiforme* | var. | *undulatum* | LC | Amaranthaceae | *Hermbstaedtia* | *fleckii* | | | LC |
| Amaranthaceae | *Hermbstaedtia* | *odorata* | var. | *albi-rosea* | NE | Amaranthaceae | *Hermbstaedtia* | *odorata* | var. | aurantiaca | NE |
| Amaranthaceae | *Hermbstaedtia* | *odorata* | var. | *odorata* | NE | Amaranthaceae | *Pupalia* | *lappacea* | var. | lappacea | LC |
| Amaranthaceae | *Salsola* | *rabieana* | | | LC | Amaranthaceae | *Salsola* | *tuberculata* | | | LC |
| Amaranthaceae | *Sericorema* | *remotiflora* | | | LC | Amaranthaceae | *Achyranthes* | *aspera* | var. | pubescens | Alien |
| Amaranthaceae | *Achyranthes* | *aspera* | var. | *aspera* | Alien | Amaranthaceae | *Amaranthus* | *hybridus* | subsp. | hybridus | Alien |
| Amaranthaceae | *Atriplex* | *semibaccata* | | | Alien invasive | Amaranthaceae | *Dysphania* | *cristata* | | | Alien invasive |
| Amaryllidaceae | *Nerine* | *laticoma* | | | LC | Amaryllidaceae | *Strumaria* | *gemmata* | | | LC |
| Anacampserotaceae | *Avonia* | *albissima* | | | | Anacampserotaceae | *Anacampseros* | *filamentosa* | subsp. | filamentosa | |
| Anacardiaceae | *Searsia* | *ciliata* | | | | Anacardiaceae | *Searsia* | *lancea* | | | |
| Anacardiaceae | *Searsia* | *dregeana* | | | | Anacardiaceae | *Searsia* | *tridactyla* | | | |
| Apiaceae | *Afrosciadium* | *magalismontanum* | | | LC | Apiaceae | *Berula* | *thunbergii* | | | LC |
| Apiaceae | *Deverra* | *burchellii* | | | LC | Apocynaceae | *Brachystelma* | *circinatum* | | | LC |
| Apocynaceae | *Gomphocarpus* | *fruticosus* | subsp. | *fruticosus* | LC | Apocynaceae | *Gomphocarpus* | *tomentosus* | subsp. | tomentosus | LC |
| Apocynaceae | *Piaranthus* | *decipiens* | | | LC | Araliaceae | *Hydrocotyle* | *verticillata* | | | LC |

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| Asparagaceae | *Asparagus* | *cooperi* | | | LC | Asparagaceae | *Asparagus* | *laricinus* | | | LC |
| Asparagaceae | *Asparagus* | *nelsii* | | | LC | Asparagaceae | *Asparagus* | *suaveolens* | | | LC |
| Asphodelaceae | *Aloe* | *bergeriana* | | | DD | Asphodelaceae | *Aloe* | *claviflora* | | | LC |
| Asphodelaceae | *Aloe* | *grandidentata* | | | LC | Asphodelaceae | *Bulbine* | *abyssinica* | | | LC |
| Asphodelaceae | *Bulbine* | *frutescens* | | | LC | Asphodelaceae | *Trachyandra* | *laxa* | var. | laxa | LC |
| Aspleniaceae | *Asplenium* | *adiantum-nigrum* | var. | *adiantum-nigrum* | LC | Aspleniaceae | *Asplenium* | *cordatum* | | | LC |
| Asteraceae | *Amphiglossa* | *triflora* | | | LC | Asteraceae | *Arctotis* | *leiocarpa* | | | LC |
| Asteraceae | *Athrixia* | *phylicoides* | | | LC | Asteraceae | *Chrysocoma* | *ciliata* | | | LC |
| Asteraceae | *Cineraria* | *vallis-pacis* | | | LC | Asteraceae | *Dicoma* | *anomala* | subsp. | gerrardii | LC |
| Asteraceae | *Dicoma* | *schinzii* | | | LC | Asteraceae | *Dimorphotheca* | *cuneata* | | | LC |
| Asteraceae | *Erlangea* | *misera* | | | LC | Asteraceae | *Felicia* | *clavipilosa* | subsp. | clavipilosa | LC |
| Asteraceae | *Felicia* | *filifolia* | subsp. | *filifolia* | LC | Asteraceae | *Felicia* | *muricata* | subsp. | muricata | LC |
| Asteraceae | *Felicia* | *muricata* | subsp. | *cinerascens* | LC | Asteraceae | *Foveolina* | *dichotoma* | | | LC |
| Asteraceae | *Gazania* | *krebsiana* | subsp. | *arctotoides* | LC | Asteraceae | *Gazania* | *krebsiana* | subsp. | serrulata | LC |
| Asteraceae | *Geigeria* | *brevifolia* | | | LC | Asteraceae | *Geigeria* | *filifolia* | | | LC |
| Asteraceae | *Geigeria* | *ornativa* | subsp. | *ornativa* | LC | Asteraceae | *Helichrysum* | *argyrosphaerum* | | | LC |
| Asteraceae | *Helichrysum* | *caespititium* | | | LC | Asteraceae | *Helichrysum* | *cerastioides* | var. | cerastioides | LC |
| Asteraceae | *Helichrysum* | *lineare* | | | LC | Asteraceae | *Helichrysum* | *nudifolium* | var. | nudifolium | LC |
| Asteraceae | *Helichrysum* | *spiciforme* | | | LC | Asteraceae | *Helichrysum* | *zeyheri* | | | LC |
| Asteraceae | *Hirpicium* | *echinus* | | | LC | Asteraceae | *Kleinia* | *longiflora* | | | LC |
| Asteraceae | *Leysera* | *tenella* | | | LC | Asteraceae | *Nidorella* | *hottentotica* | | | LC |
| Asteraceae | *Nolletia* | *ciliaris* | | | LC | Asteraceae | *Osteospermum* | *microphyllum* | | | LC |
| Asteraceae | *Osteospermum* | *muricatum* | subsp. | *muricatum* | LC | Asteraceae | *Pegolettia* | *retrofracta* | | | LC |
| Asteraceae | *Pentzia* | *argentea* | | | LC | Asteraceae | *Pentzia* | *calcarea* | | | LC |
| Asteraceae | *Pteronia* | *mucronata* | | | LC | Asteraceae | *Pulicaria* | *scabra* | | | LC |
| Asteraceae | *Rosenia* | *humilis* | | | LC | Asteraceae | *Senecio* | *consanguineus* | | | LC |
| Asteraceae | *Senecio* | *inaequidens* | | | LC | Asteraceae | *Tarchonanthus* | *camphoratus* | | | LC |
| Asteraceae | *Tolpis* | *capensis* | | | LC | Asteraceae | *Ursinia* | *nana* | subsp. | nana | LC |
| Asteraceae | *Dicoma* | *kurumanii* | | | LC | Asteraceae | *Eriocephalus* | *glandulosus* | | | LC |

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| Asteraceae | *Gnaphalium* | *englerianum* | | | LC | Asteraceae | *Osteospermum* | *leptolobum* | | | LC |
| Asteraceae | *Pentzia* | *quinquefida* | | | LC | Asteraceae | *Pteronia* | *glauca* | | | LC |
| Asteraceae | *Senecio* | *burchellii* | | | LC | Asteraceae | *Tarchonanthus* | *obovatus* | | | LC |
| Asteraceae | *Bidens* | *pilosa* | | | Alien | Asteraceae | *Zinnia* | *peruviana* | | | Alien |
| Asteraceae | *Sonchus* | *oleraceus* | | | Alien invasive | Aytoniaceae | *Plagiochasma* | *rupestre* | var. | rupestre | |
| Bignoniaceae | *Catophractes* | *alexandri* | | | LC | Bignoniaceae | *Rhigozum* | *obovatum* | | | LC |
| Bignoniaceae | *Rhigozum* | *trichotomum* | | | LC | Boraginaceae | *Anchusa* | *riparia* | | | LC |
| Boraginaceae | *Ehretia* | *alba* | | | LC | Boraginaceae | *Heliotropium* | *ovalifolium* | | | LC |
| Boraginaceae | *Heliotropium* | *strigosum* | | | LC | Brassicaceae | *Erucastrum* | *strigosum* | | | LC |
| Brassicaceae | *Heliophila* | *suavissima* | | | LC | Brassicaceae | *Brassica* | *tournefortii* | | | Alien invasive |
| Bryaceae | *Bryum* | *apiculatum* | | | | Bryaceae | *Rosulabryum* | *capillare* | | | |
| Campanulaceae | *Wahlenbergia* | *androsacea* | | | LC | Campanulaceae | *Wahlenbergia* | *denticulata* | var. | transvaalensis | LC |
| Campanulaceae | *Wahlenbergia* | *nodosa* | | | LC | Caryophyllaceae | *Dianthus* | *namaensis* | var. | dinteri | |
| Caryophyllaceae | *Pollichia* | *campestris* | | | | Celastraceae | *Gymnosporia* | *buxifolia* | | | LC |
| Celastraceae | *Putterlickia* | *pyracantha* | | | LC | Celastraceae | *Putterlickia* | *saxatilis* | | | LC |
| Cleomaceae | *Cleome* | *angustifolia* | subsp. | *diandra* | LC | Cleomaceae | *Cleome* | *conrathii* | | | NT |
| Cleomaceae | *Cleome* | *kalachariensis* | | | LC | Cleomaceae | *Cleome* | *oxyphylla* | var. | oxyphylla | LC |
| Colchicaceae | *Ornithoglossum* | *vulgare* | | | | Commelinaceae | *Commelina* | *africana* | var. | lancispatha | LC |
| Commelinaceae | *Commelina* | *africana* | var. | *barberae* | LC | Commelinaceae | *Commelina* | *livingstonii* | | | LC |
| Convolvulaceae | *Evolvulus* | *alsinoides* | | | LC | Convolvulaceae | *Ipomoea* | *obscura* | var. | obscura | LC |
| Convolvulaceae | *Ipomoea* | *suffruticosa* | | | LC | Convolvulaceae | *Seddera* | *suffruticosa* | | | LC |
| Convolvulaceae | *Xenostegia* | *tridentata* | subsp. | *angustifolia* | | Crassulaceae | *Crassula* | *capitella* | subsp. | nodulosa | |
| Crassulaceae | *Crassula* | *lanceolata* | subsp. | *transvaalensis* | LC | Crassulaceae | *Kalanchoe* | *brachyloba* | | | |
| Crassulaceae | *Kalanchoe* | *lanceolata* | | | | Crassulaceae | *Kalanchoe* | *rotundifolia* | | | |
| Crassulaceae | *Crassula* | *subaphylla* | var. | *subaphylla* | | Cucurbitaceae | *Acanthosicyos* | *naudinianus* | | | LC |
| Cucurbitaceae | *Citrullus* | *lanatus* | | | LC | Cucurbitaceae | *Coccinia* | *sessilifolia* | | | LC |
| Cucurbitaceae | *Cucumis* | *africanus* | | | LC | Cucurbitaceae | *Kedrostis* | *africana* | | | LC |
| Cucurbitaceae | *Cucumis* | *heptadactylus* | | | LC | Cyperaceae | *Bulbostylis* | *burchellii* | | | LC |

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| Cyperaceae | *Bulbostylis* | *humilis* | | | LC | Cyperaceae | *Cladium* | *mariscus* | subsp. | jamaicense | LC |
| Cyperaceae | *Cyperus* | *bellus* | | | LC | Cyperaceae | *Cyperus* | *fulgens* | | | LC |
| Cyperaceae | *Cyperus* | *longus* | var. | *tenuiflorus* | NE | Cyperaceae | *Cyperus* | *margaritaceus* | var. | margaritaceus | LC |
| Cyperaceae | *Cyperus* | *marginatus* | | | LC | Cyperaceae | *Cyperus* | *marlothii* | | | LC |
| Cyperaceae | *Cyperus* | *sphaerospermus* | | | LC | Cyperaceae | *Scleria* | *dregeana* | | | LC |
| Cyperaceae | *Kyllinga* | *alba* | | | LC | Cyperaceae | *Afroscirpoides* | *dioeca* | | | |
| Cyperaceae | *Cyperus* | *capensis* | | | LC | Dipsacaceae | *Scabiosa* | *columbaria* | | | LC |
| Ebenaceae | *Diospyros* | *austro-africana* | var. | *microphylla* | | Ebenaceae | *Diospyros* | *lycioides* | subsp. | lycioides | |
| Ebenaceae | *Euclea* | *crispa* | subsp. | *ovata* | | Ebenaceae | *Euclea* | *undulata* | | | |
| Elatinaceae | *Bergia* | *pentheriana* | | | LC | Equisetaceae | *Equisetum* | *ramosissimum* | subsp. | ramosissimum | LC |
| Euphorbiaceae | *Croton* | *gratissimus* | var. | *gratissimus* | LC | Euphorbiaceae | *Euphorbia* | *spartaria* | | | LC |
| Euphorbiaceae | *Euphorbia* | *duseimata* | | | LC | Euphorbiaceae | *Euphorbia* | *juttae* | | | LC |
| Euphorbiaceae | *Euphorbia* | *rhombifolia* | | | LC | Euphorbiaceae | *Euphorbia* | *peplus* | | | Alien |
| Fabaceae | *Bolusia* | *acuminata* | | | LC | Fabaceae | *Calobota* | *cuspidosa* | | | LC |
| Fabaceae | *Chamaecrista* | *biensis* | | | LC | Fabaceae | *Chamaecrista* | *mimosoides* | | | LC |
| Fabaceae | *Crotalaria* | *leubnitziana* | | | LC | Fabaceae | *Crotalaria* | *podocarpa* | | | LC |
| Fabaceae | *Crotalaria* | *spartioides* | | | LC | Fabaceae | *Crotalaria* | *sphaerocarpa* | subsp. | sphaerocarpa | LC |
| Fabaceae | *Crotalaria* | *virgultalis* | | | LC | Fabaceae | *Elephantorrhiza* | *elephantina* | | | LC |
| Fabaceae | *Indigofera* | *alternans* | var. | *alternans* | LC | Fabaceae | *Indigofera* | *comosa* | | | LC |
| Fabaceae | *Indigofera* | *daleoides* | var. | *daleoides* | NE | Fabaceae | *Indigofera* | *flavicans* | | | LC |
| Fabaceae | *Indigofera* | *hololeuca* | | | LC | Fabaceae | *Indigofera* | *sessilifolia* | | | LC |
| Fabaceae | *Indigofera* | *vicioides* | var. | *vicioides* | LC | Fabaceae | *Leobordea* | *divaricata* | | | LC |
| Fabaceae | *Lessertia* | *frutescens* | subsp. | *frutescens* | LC | Fabaceae | *Lotononis* | *crumanina* | | | LC |
| Fabaceae | *Lotononis* | *divaricata* | | | NE | Fabaceae | *Lotononis* | *laxa* | | | LC |
| Fabaceae | *Melolobium* | *calycinum* | | | LC | Fabaceae | *Melolobium* | *macrocalyx* | var. | macrocalyx | LC |
| Fabaceae | *Otoptera* | *burchellii* | | | LC | Fabaceae | *Parkinsonia* | *africana* | | | LC |
| Fabaceae | *Ptycholobium* | *biflorum* | subsp. | *biflorum* | LC | Fabaceae | *Requienia* | *pseudosphaerosperma* | | | LC |
| Fabaceae | *Requienia* | *sphaerosperma* | | | LC | Fabaceae | *Rhynchosia* | *confusa* | | | NE |
| Fabaceae | *Rhynchosia* | *holosericea* | | | LC | Fabaceae | *Rhynchosia* | *totta* | var. | venulosa | |

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| Fabaceae | *Rhynchosia* | *totta* | var. | *rigidula* | | Fabaceae | *Rhynchosia* | *totta* | var. | totta | LC |
| Fabaceae | *Senegalia* | *hereroensis* | | | LC | Fabaceae | *Senegalia* | *mellifera* | subsp. | detinens | LC |
| Fabaceae | *Senna* | *italica* | subsp. | *arachoides* | LC | Fabaceae | *Tephrosia* | *burchellii* | | | LC |
| Fabaceae | *Tephrosia* | *lupinifolia* | | | LC | Fabaceae | *Tephrosia* | *purpurea* | subsp. | leptostachya | NE |
| Fabaceae | *Vachellia* | *erioloba* | | | LC | Fabaceae | *Vachellia* | *haematoxylon* | | | LC |
| Fabaceae | *Vachellia* | *hebeclada* | subsp. | *hebeclada* | LC | Fabaceae | *Vachellia* | *karroo* | | | LC |
| Fabaceae | *Vigna* | *unguiculata* | subsp. | *unguiculata* | NE | Fabaceae | *Argyrolobium* | *incanum* | | | LC |
| Fabaceae | *Melolobium* | *exudans* | | | LC | Fabaceae | *Medicago* | *laciniata* | var. | laciniata | Alien |
| Fabaceae | *Melilotus* | *albus* | | | Alien | Fabaceae | *Caesalpinia* | *gilliesii* | | | Alien invasive |
| Fissidentaceae | *Fissidens* | *erosulus* | | | | Gentianaceae | *Chironia* | *palustris* | subsp. | palustris | LC |
| Geraniaceae | *Monsonia* | *angustifolia* | | | LC | Geraniaceae | *Pelargonium* | *myrrhifolium* | var. | myrrhifolium | LC |
| Gisekiaceae | *Gisekia* | *africana* | var. | *africana* | LC | Hyacinthaceae | *Albuca* | *seineri* | | | |
| Hyacinthaceae | *Albuca* | *tortuosa* | | | | Hyacinthaceae | *Dipcadi* | *marlothii* | | | |
| Iridaceae | *Babiana* | *bainesii* | | | LC | Iridaceae | *Gladiolus* | *permeabilis* | subsp. | edulis | LC |
| Iridaceae | *Moraea* | *polystachya* | | | LC | Iridaceae | *Psilosiphon* | *sandersonii* | subsp. | sandersonii | |
| Juncaceae | *Juncus* | *exsertus* | | | LC | Juncaceae | *Juncus* | *rigidus* | | | LC |
| Lamiaceae | *Leonotis* | *pentadentata* | | | LC | Lamiaceae | *Mentha* | *aquatica* | | | LC |
| Lamiaceae | *Salvia* | *disermas* | | | LC | Lamiaceae | *Stachys* | *burchelliana* | | | LC |
| Lamiaceae | *Salvia* | *stenophylla* | | | | Lentibulariaceae | *Utricularia* | *gibba* | | | LC |
| Limeaceae | *Limeum* | *arenicolum* | | | LC | Limeaceae | *Limeum* | *fenestratum* | var. | fenestratum | LC |
| Limeaceae | *Limeum* | *sulcatum* | var. | *sulcatum* | LC | Limeaceae | *Limeum* | *aethiopicum* | var. | intermedium | NE |
| Limeaceae | *Limeum* | *aethiopicum* | var. | *aethiopicum* | NE | Limeaceae | *Limeum* | *viscosum* | subsp. | transvaalense | LC |
| Lobeliaceae | *Lobelia* | *erinus* | | | LC | Lobeliaceae | *Lobelia* | *thermalis* | | | LC |
| Lophiocarpaceae | *Lophiocarpus* | *polystachyus* | | | LC | Loranthaceae | *Septulina* | *ovalis* | | | LC |
| Loranthaceae | *Tapinanthus* | *oleifolius* | | | LC | Malpighiaceae | *Sphedamnocarpus* | *pruriens* | subsp. | pruriens | LC |
| Malpighiaceae | *Triaspis* | *hypericoides* | subsp. | *hypericoides* | LC | Malvaceae | *Abutilon* | *dinteri* | | | LC |
| Malvaceae | *Abutilon* | *rehmannii* | | | LC | Malvaceae | *Corchorus* | *asplenifolius* | | | LC |
| Malvaceae | *Corchorus* | *pinnatipartitus* | | | LC | Malvaceae | *Grewia* | *flava* | | | LC |
| Malvaceae | *Hermannia* | *bicolor* | | | LC | Malvaceae | *Hermannia* | *comosa* | | | LC |

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| Malvaceae | *Hermannia* | *geniculata* | | | LC | Malvaceae | *Hermannia* | *linnaeoides* | | | LC |
| Malvaceae | *Hermannia* | *stellulata* | | | LC | Malvaceae | *Hermannia* | *tomentosa* | | | LC |
| Malvaceae | *Melhania* | *burchellii* | | | LC | Malvaceae | *Melhania* | *prostrata* | | | LC |
| Malvaceae | *Melhania* | *virescens* | | | LC | Malvaceae | *Pavonia* | *burchellii* | | | LC |
| Malvaceae | *Sida* | *chrysantha* | | | LC | Malvaceae | *Sida* | *cordifolia* | subsp. | cordifolia | LC |
| Malvaceae | *Waltheria* | *indica* | | | LC | Malvaceae | *Hermannia* | *quartiniana* | | | LC |
| Malvaceae | *Hermannia* | *linearifolia* | | | LC | Malvaceae | *Hibiscus* | *marlothianus* | | | LC |
| Menispermaceae | *Antizoma* | *angustifolia* | | | LC | Molluginaceae | *Suessenguthiella* | *scleranthoides* | | | LC |
| Nymphaeaceae | *Nymphaea* | *nouchali* | var. | *caerulea* | | Oleaceae | *Olea* | *europaea* | subsp. | cuspidata | |
| Orobanchaceae | *Alectra* | *pumila* | | | LC | Orobanchaceae | *Striga* | *bilabiata* | subsp. | bilabiata | LC |
| Orobanchaceae | *Striga* | *elegans* | | | LC | Orobanchaceae | *Striga* | *gesnerioides* | | | LC |
| Oxalidaceae | *Oxalis* | *depressa* | | | LC | Oxalidaceae | *Oxalis* | *lawsonii* | | | LC |
| Oxalidaceae | *Oxalis* | *corniculata* | | | Alien invasive | Papaveraceae | *Argemone* | *ochroleuca* | subsp. | ochroleuca | Alien invasive |
| Passifloraceae | *Adenia* | *repanda* | | | LC | Pedaliaceae | *Ceratotheca* | *triloba* | | | LC |
| Pedaliaceae | *Harpagophytum* | *procumbens* | subsp. | *procumbens* | NE | Pedaliaceae | *Sesamum* | *capense* | | | LC |
| Phyllanthaceae | *Phyllanthus* | *loandensis* | | | LC | Phyllanthaceae | *Phyllanthus* | *maderaspatensis* | | | LC |
| Phyllanthaceae | *Phyllanthus* | *parvulus* | var. | *parvulus* | LC | Phyllanthaceae | *Phyllanthus* | *pentandrus* | | | LC |
| Plantaginaceae | *Veronica* | *anagallis-aquatica* | | | LC | Poaceae | *Agrostis* | *lachnantha* | var. | lachnantha | LC |
| Poaceae | *Andropogon* | *chinensis* | | | LC | Poaceae | *Andropogon* | *eucomus* | | | LC |
| Poaceae | *Andropogon* | *schirensis* | | | LC | Poaceae | *Anthephora* | *argentea* | | | LC |
| Poaceae | *Anthephora* | *pubescens* | | | LC | Poaceae | *Aristida* | *congesta* | subsp. | congesta | LC |
| Poaceae | *Aristida* | *congesta* | subsp. | *barbicollis* | LC | Poaceae | *Aristida* | *engleri* | var. | ramosissima | LC |
| Poaceae | *Aristida* | *meridionalis* | | | LC | Poaceae | *Aristida* | *mollissima* | subsp. | mollissima | LC |
| Poaceae | *Aristida* | *stipitata* | subsp. | *stipitata* | LC | Poaceae | *Aristida* | *stipitata* | subsp. | spicata | LC |
| Poaceae | *Aristida* | *stipitata* | subsp. | *graciliflora* | LC | Poaceae | *Aristida* | *vestita* | | | LC |
| Poaceae | *Brachiaria* | *marlothii* | | | LC | Poaceae | *Brachiaria* | *nigropedata* | | | LC |
| Poaceae | *Brachiaria* | *serrata* | | | LC | Poaceae | *Bromus* | *pectinatus* | | | LC |
| Poaceae | *Cenchrus* | *ciliaris* | | | LC | Poaceae | *Chrysopogon* | *serrulatus* | | | LC |
| Poaceae | *Coelachyrum* | *yemenicum* | | | LC | Poaceae | *Cymbopogon* | *caesius* | | | LC |

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| Poaceae | *Cymbopogon* | *pospischilii* | | | NE | Poaceae | *Cynodon* | *dactylon* | | | LC |
| Poaceae | *Digitaria* | *eriantha* | | | LC | Poaceae | *Digitaria* | *polyphylla* | | | LC |
| Poaceae | *Digitaria* | *seriata* | | | LC | Poaceae | *Diheteropogon* | *amplectens* | var. | amplectens | LC |
| Poaceae | *Eleusine* | *coracana* | subsp. | *africana* | LC | Poaceae | *Elionurus* | *muticus* | | | LC |
| Poaceae | *Enneapogon* | *cenchroides* | | | LC | Poaceae | *Enneapogon* | *desvauxii* | | | LC |
| Poaceae | *Enneapogon* | *scoparius* | | | LC | Poaceae | *Eragrostis* | *capensis* | | | LC |
| Poaceae | *Eragrostis* | *chloromelas* | | | LC | Poaceae | *Eragrostis* | *curvula* | | | LC |
| Poaceae | *Eragrostis* | *echinochloidea* | | | LC | Poaceae | *Eragrostis* | *gummiflua* | | | LC |
| Poaceae | *Eragrostis* | *homomalla* | | | LC | Poaceae | *Eragrostis* | *lehmanniana* | var. | lehmanniana | LC |
| Poaceae | *Eragrostis* | *micrantha* | | | LC | Poaceae | *Eragrostis* | *nindensis* | | | LC |
| Poaceae | *Eragrostis* | *obtusa* | | | LC | Poaceae | *Eragrostis* | *pallens* | | | LC |
| Poaceae | *Eragrostis* | *procumbens* | | | LC | Poaceae | *Eragrostis* | *rigidior* | | | LC |
| Poaceae | *Eragrostis* | *trichophora* | | | LC | Poaceae | *Eragrostis* | *viscosa* | | | LC |
| Poaceae | *Eustachys* | *paspaloides* | | | LC | Poaceae | *Fingerhuthia* | *africana* | | | LC |
| Poaceae | *Hemarthria* | *altissima* | | | LC | Poaceae | *Heteropogon* | *contortus* | | | LC |
| Poaceae | *Hyparrhenia* | *anamesa* | | | LC | Poaceae | *Imperata* | *cylindrica* | | | LC |
| Poaceae | *Megaloprotachne* | *albescens* | | | LC | Poaceae | *Melinis* | *nerviglumis* | | | LC |
| Poaceae | *Melinis* | *repens* | subsp. | *grandiflora* | LC | Poaceae | *Melinis* | *repens* | subsp. | repens | LC |
| Poaceae | *Oropetium* | *capense* | | | LC | Poaceae | *Panicum* | *coloratum* | | | LC |
| Poaceae | *Panicum* | *kalaharense* | | | LC | Poaceae | *Panicum* | *maximum* | | | LC |
| Poaceae | *Panicum* | *stapfianum* | | | LC | Poaceae | *Pogonarthria* | *squarrosa* | | | LC |
| Poaceae | *Schizachyrium* | *sanguineum* | | | LC | Poaceae | *Schmidtia* | *pappophoroides* | | | LC |
| Poaceae | *Setaria* | *sphacelata* | var. | *torta* | LC | Poaceae | *Sporobolus* | *acinifolius* | | | LC |
| Poaceae | *Sporobolus* | *fimbriatus* | | | LC | Poaceae | *Stipagrostis* | *amabilis* | | | LC |
| Poaceae | *Stipagrostis* | *hirtigluma* | subsp. | *patula* | LC | Poaceae | *Stipagrostis* | *uniplumis* | var. | neesii | LC |
| Poaceae | *Stipagrostis* | *uniplumis* | var. | *uniplumis* | LC | Poaceae | *Themeda* | *triandra* | | | LC |
| Poaceae | *Tragus* | *berteronianus* | | | LC | Poaceae | *Tragus* | *koelerioides* | | | LC |
| Poaceae | *Tragus* | *racemosus* | | | LC | Poaceae | *Tricholaena* | *monachne* | | | LC |
| Poaceae | *Trichoneura* | *grandiglumis* | | | LC | Poaceae | *Triraphis* | *andropogonoides* | | | LC |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Poaceae | *Triraphis* | *schinzii* | | | LC | Poaceae | *Urelytrum* | *agropyroides* | | | LC |
| Poaceae | *Eragrostis* | *amabilis* | | | LC | Poaceae | *Leptochloa* | *fusca* | | | LC |
| Poaceae | *Cynodon* | *incompletus* | | | LC | Poaceae | *Eragrostis* | *pseudobtusa (x)* | | | NE |
| Poaceae | *Eragrostis* | *barrelieri* | | | Alien | Poaceae | *Eragrostis* | *mexicana* | subsp. | virescens | Alien |
| Poaceae | *Paspalum* | *dilatatum* | | | Alien | Polygalaceae | *Polygala* | *leptophylla* | var. | leptophylla | LC |
| Polygonaceae | *Oxygonum* | *alatum* | var. | *alatum* | LC | Polygonaceae | *Oxygonum* | *dregeanum* | subsp. | canescens | NE |
| Polygonaceae | *Persicaria* | *lapathifolia* | | | Alien | Polygonaceae | *Rumex* | *crispus* | | | Alien invasive |
| Portulacaceae | *Portulaca* | *quadrifida* | | | | Pottiaceae | *Syntrichia* | *ammonsiana* | | | |
| Pteridaceae | *Actiniopteris* | *radiata* | | | LC | Pteridaceae | *Cheilanthes* | *eckloniana* | | | LC |
| Pteridaceae | *Cheilanthes* | *multifida* | var. | *multifida* | LC | Pteridaceae | *Pellaea* | *calomelanos* | var. | calomelanos | LC |
| Pteridaceae | *Cheilanthes* | *hirta* | var. | *brevipilosa* | LC | Ranunculaceae | *Clematis* | *brachiata* | | | LC |
| Rhamnaceae | *Helinus* | *spartioides* | | | LC | Ricciaceae | *Riccia* | *albolimbata* | | | |
| Ricciaceae | *Riccia* | *okahandjana* | | | | Rosaceae | *Rubus* | *rosifolius* | | | Alien |
| Rubiaceae | *Anthospermum* | *rigidum* | subsp. | *rigidum* | LC | Rubiaceae | *Anthospermum* | *rigidum* | subsp. | pumilum | LC |
| Rubiaceae | *Galium* | *capense* | subsp. | *capense* | LC | Rubiaceae | *Kohautia* | *caespitosa* | subsp. | brachyloba | LC |
| Rubiaceae | *Vangueria* | *infausta* | subsp. | *infausta* | LC | Ruscaceae | *Eriospermum* | *corymbosum* | | | LC |
| Santalaceae | *Thesium* | *resedoides* | | | LC | Santalaceae | *Viscum* | *rotundifolium* | | | |
| Scrophulariaceae | *Aptosimum* | *elongatum* | | | LC | Scrophulariaceae | *Aptosimum* | *indivisum* | | | LC |
| Scrophulariaceae | *Aptosimum* | *marlothii* | | | LC | Scrophulariaceae | *Buddleja* | *saligna* | | | LC |
| Scrophulariaceae | *Chaenostoma* | *halimifolium* | | | LC | Scrophulariaceae | *Jamesbrittenia* | *atropurpurea* | subsp. | atropurpurea | LC |
| Scrophulariaceae | *Jamesbrittenia* | *atropurpurea* | subsp. | *pubescens* | LC | Scrophulariaceae | *Jamesbrittenia* | *aurantiaca* | | | LC |
| Scrophulariaceae | *Jamesbrittenia* | *integerrima* | | | LC | Scrophulariaceae | *Peliostomum* | *leucorrhizum* | | | LC |
| Scrophulariaceae | *Selago* | *mixta* | | | LC | Scrophulariaceae | *Sutera* | *griquensis* | | | LC |
| Solanaceae | *Lycium* | *hirsutum* | | | LC | Solanaceae | *Lycium* | *schizocalyx* | | | LC |
| Solanaceae | *Solanum* | *campylacanthum* | subsp. | *panduriforme* | LC | Solanaceae | *Solanum* | *catombelense* | | | LC |
| Solanaceae | *Solanum* | *retroflexum* | | | LC | Solanaceae | *Solanum* | *supinum* | var. | supinum | LC |
| Solanaceae | *Solanum* | *tomentosum* | var. | *tomentosum* | LC | Solanaceae | *Withania* | *somnifera* | | | LC |
| Solanaceae | *Solanum* | *nigrum* | | | Alien | Tecophilaeaceae | *Cyanella* | *lutea* | | | |
| Theophrastaceae | *Samolus* | *valerandi* | | | LC | Thymelaeaceae | *Lasiosiphon* | *burchellii* | | | LC |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Thymelaeaceae | *Lasiosiphon* | *polycephalus* | | | LC | Verbenaceae | *Chascanum* | *adenostachyum* | | | |
| Verbenaceae | *Chascanum* | *hederaceum* | var. | *hederaceum* | | Verbenaceae | *Chascanum* | *pinnatifidum* | var. | pinnatifidum | |
| Verbenaceae | *Lantana* | *rugosa* | | | | Verbenaceae | *Verbena* | *brasiliensis* | | | Alien invasive |
| Zygophyllaceae | *Roepera* | *lichtensteiniana* | | | | Zygophyllaceae | *Roepera* | *pubescens* | | | |
| Zygophyllaceae | *Tribulus* | *terrestris* | | | LC | Zygophyllaceae | *Tribulus* | *zeyheri* | subsp. | zeyheri | LC |

### 1.11.2. Appendix 2. List of Mammals

List of Mammals known from the broad area around the Kuruman WEF Phase 1 site, based on the MammalMap Database (http://vmus.adu.org.za), with species confirmed present at the site indicated in **bold.**

| Family | Scientific name | Common name | Red list category |
|---|---|---|---|
| ***Bathyergidae*** | ***Cryptomys hottentotus*** | **Southern African Mole-rat** | **Least Concern** |
| *Bovidae* | *Aepyceros melampus* | Impala | Least Concern |
| ***Bovidae*** | ***Alcelaphus buselaphus caama*** | **Red Hartebeest** | **Least Concern** |
| ***Bovidae*** | ***Connochaetes gnou*** | **Black Wildebeest** | **Least Concern** |
| *Bovidae* | *Kobus ellipsiprymnus* | Waterbuck | Least Concern |
| ***Bovidae*** | ***Oryx gazella*** | **Gemsbok** | **Least Concern** |
| ***Bovidae*** | ***Sylvicapra grimmia*** | **Bush Duiker** | **Least Concern** |
| ***Bovidae*** | ***Taurotragus oryx*** | **Common Eland** | **Least Concern** |
| *Canidae* | *Canis mesomelas* | Black-backed Jackal | Least Concern |
| *Cercopithecidae* | *Papio ursinus* | Chacma Baboon | Least Concern |
| *Erinaceidae* | *Atelerix frontalis* | Southern African Hedgehog | Near Threatened |
| *Felidae* | *Felis nigripes* | Black-footed Cat | Least Concern |
| ***Herpestidae*** | ***Cynictis penicillata*** | **Yellow Mongoose** | **Least Concern** |
| *Herpestidae* | *Suricata suricatta* | Meerkat | Least Concern |
| ***Hystricidae*** | ***Hystrix africaeaustralis*** | **Cape Porcupine** | **Least Concern** |
| ***Leporidae*** | ***Lepus capensis*** | **Cape Hare** | **Least Concern** |
| *Leporidae* | *Lepus saxatilis* | Scrub Hare | Least Concern |
| ***Leporidae*** | ***Pronolagus rupestris*** | **Smith's Red Rock Hare** | **Least Concern** |
| *Macroscelididae* | *Elephantulus myurus* | Eastern Rock Elephant Shrew | Least Concern |
| *Macroscelididae* | *Elephantulus rupestris* | Western Rock Elephant Shrew | Least Concern |
| *Macroscelididae* | *Macroscelides proboscideus* | Short-eared Elephant Shrew | Least Concern |
| *Muridae* | *Aethomys chrysophilus* | Red Veld Aethomys | Least Concern |
| ***Muridae*** | ***Aethomys namaquensis*** | **Namaqua Rock Mouse** | **Least Concern** |
| *Muridae* | *Desmodillus auricularis* | Cape Short-tailed Gerbil | Least Concern |
| *Muridae* | *Gerbilliscus leucogaster* | Bushveld Gerbil | Data Deficient |
| *Muridae* | *Mastomys coucha* | Southern African Mastomys | Least Concern |
| *Muridae* | *Mus (Nannomys) minutoides* | Southern African Pygmy Mouse | Least Concern |
| *Muridae* | *Otomys auratus* | Southern African Vlei Rat | |
| *Muridae* | *Parotomys brantsii* | Brants's Whistling Rat | Least Concern |
| ***Muridae*** | ***Rhabdomys pumilio*** | **Xeric Four-striped Grass Rat** | **Least Concern** |
| *Mustelidae* | *Ictonyx striatus* | Striped Polecat | Least Concern |
| ***Nesomyidae*** | ***Saccostomus campestris*** | **Southern African Pouched Mouse** | **Least Concern** |
| ***Orycteropodidae*** | ***Orycteropus afer*** | **Aardvark** | **Least Concern** |

| | | | |
|---|---|---|---|
| ***Pedetidae*** | ***Pedetes capensis*** | **South African Spring Hare** | **Least Concern** |
| ***Procaviidae*** | ***Procavia capensis*** | **Cape Rock Hyrax** | **Least Concern** |
| ***Sciuridae*** | ***Xerus inauris*** | **South African Ground Squirrel** | **Least Concern** |
| *Soricidae* | *Crocidura cyanea* | Reddish-gray Musk Shrew | Data Deficient |
| *Soricidae* | *Crocidura hirta* | Lesser Red Musk Shrew | Data Deficient |
| *Suidae* | *Phacochoerus africanus* | Common Warthog | Least Concern |

### 1.11.3. Appendix 3. List of Reptiles

List of Reptiles known from the vicinity of the Kuruman WEF Phase 1 site, based on records from the ReptileMap database. Conservation status is from Bates *et al*. 2013.

| Family | Scientific name | Common name | Red list category |
|---|---|---|---|
| ***Agamidae*** | ***Agama aculeata aculeata*** | **Common Ground Agama** | **Least Concern** |
| *Agamidae* | *Agama atra* | Southern Rock Agama | Least Concern |
| *Amphisbaenidae* | *Zygaspis quadrifrons* | Kalahari Dwarf Worm Lizard | Least Concern |
| *Chamaeleonidae* | *Chamaeleo dilepis dilepis* | Common Flap-neck Chameleon | Least Concern |
| *Colubridae* | *Dasypeltis scabra* | Rhombic Egg-eater | Least Concern |
| ***Colubridae*** | ***Dispholidus typus typus*** | **Boomslang** | **Least Concern** |
| *Colubridae* | *Telescopus semiannulatus semiannulatus* | Eastern Tiger Snake | Least Concern |
| *Cordylidae* | *Karusasaurus polyzonus* | Karoo Girdled Lizard | Least Concern |
| *Elapidae* | *Aspidelaps scutatus scutatus* | Speckled Shield Cobra | Least Concern |
| *Gekkonidae* | *Lygodactylus capensis capensis* | Common Dwarf Gecko | Least Concern |
| *Gekkonidae* | *Pachydactylus capensis* | Cape Gecko | Least Concern |
| *Gerrhosauridae* | *Gerrhosaurus flavigularis* | Yellow-throated Plated Lizard | Least Concern |
| *Lacertidae* | *Heliobolus lugubris* | Bushveld Lizard | Least Concern |
| *Lacertidae* | *Meroles squamulosus* | Common Rough-scaled Lizard | Least Concern |
| *Lacertidae* | *Nucras intertexta* | Spotted Sandveld Lizard | Least Concern |
| *Lacertidae* | *Pedioplanis lineoocellata lineoocellata* | Spotted Sand Lizard | Least Concern |
| *Lacertidae* | *Pedioplanis namaquensis* | Namaqua Sand Lizard | Least Concern |
| *Lamprophiidae* | *Aparallactus capensis* | Black-headed Centipede-eater | Least Concern |
| *Lamprophiidae* | *Atractaspis bibronii* | Bibron's Stiletto Snake | Least Concern |
| *Lamprophiidae* | *Atractaspis duerdeni* | Duerden's Stiletto Snake | Least Concern |
| *Lamprophiidae* | *Boaedon capensis* | Brown House Snake | Least Concern |
| *Lamprophiidae* | *Lycophidion capense capense* | Cape Wolf Snake | Least Concern |
| *Lamprophiidae* | *Psammophis brevirostris* | Short-snouted Grass Snake | Least Concern |
| *Lamprophiidae* | *Psammophis trinasalis* | Fork-marked Sand Snake | Least Concern |
| *Lamprophiidae* | *Pseudaspis cana* | Mole Snake | Least Concern |
| *Leptotyphlopidae* | *Leptotyphlops scutifrons scutifrons* | Peters' Thread Snake | |
| *Pelomedusidae* | *Pelomedusa subrufa* | Central Marsh Terrapin | Least Concern |
| *Pythonidae* | *Python natalensis* | Southern African Python | Least Concern |
| *Scincidae* | *Panaspis wahlbergi* | Wahlberg's Snake-eyed Skink | Least Concern |
| *Scincidae* | *Trachylepis punctatissima* | Speckled Rock Skink | Least Concern |
| *Scincidae* | *Trachylepis spilogaster* | Kalahari Tree Skink | Least Concern |

| | | | |
|---|---|---|---|
| *Scincidae* | *Trachylepis sulcata sulcata* | Western Rock Skink | Least Concern |
| ***Scincidae*** | ***Trachylepis variegata*** | **Variegated Skink** | **Least Concern** |
| *Testudinidae* | *Psammobates oculifer* | Serrated Tent Tortoise | Least Concern |
| ***Testudinidae*** | ***Stigmochelys pardalis*** | **Leopard Tortoise** | **Least Concern** |
| *Typhlopidae* | *Rhinotyphlops lalandei* | Delalande's Beaked Blind Snake | Least Concern |
| *Varanidae* | *Varanus albigularis albigularis* | Rock Monitor | Least Concern |
| *Viperidae* | *Bitis arietans arietans* | Puff Adder | Least Concern |

### *1.11.4. Appendix 4. List of Amphibians*

List of Amphibians known from the vicinity of the Kuruman WEF Phase 1 site, based on records from the FrogMap database. Conservation status is from Minter et al. 2004.

| Family | Scientific name | Common name | Red list |
|---|---|---|---|
| *Brevicepitidae* | *Breviceps adspersus* | Bushveld Rain Frog | Least Concern |
| *Bufonidae* | *Sclerophrys garmani* | Olive Toad | Least Concern |
| *Bufonidae* | *Sclerophrys gutturalis* | Guttural Toad | Least Concern |
| *Bufonidae* | *Sclerophrys poweri* | Power's Toad | Least Concern |
| *Hyperoliidae* | *Kassina senegalensis* | Bubbling Kassina | Least Concern |
| *Pyxicephalidae* | *Amietia delalandii* | Delalande's River Frog | Least Concern |
| *Pyxicephalidae* | *Cacosternum boettgeri* | Common Caco | Least Concern |
| *Pyxicephalidae* | *Tomopterna cryptotis* | Tremelo Sand Frog | Least Concern |

# BIRD IMPACT SCOPING REPORT:

## for the Proposed Development of the Phase 1 Kuruman Wind Farm Facility, Kuruman, Northern Cape Province

| *Report prepared for:* | *Report prepared by:* |
|---|---|
| CSIR – Environmental Management Services | Chris van Rooyen Consulting |
| P O Box 320 | 30 Roosevelt Street |
| Stellenbosch | Robindale, Randburg |
| 7600 | 2194 |

11 March 2018

# SPECIALIST EXPERTISE

**Chris van Rooyen**

Chris has 20 years' experience in the management of wildlife interactions with electricity infrastructure. He was head of the Eskom-Endangered Wildlife Trust (EWT) Strategic Partnership from 1996 to 2007, which has received international acclaim as a model of co-operative management between industry and natural resource conservation. He is an acknowledged global expert in this field and has worked in South Africa, Namibia, Botswana, Lesotho, Tanzania, New Zealand, Texas, New Mexico and Florida. Chris also has extensive project management experience and has received several management awards from Eskom for his work in the Eskom-Endangered Wildlife Strategic Partnership. He is the author of 15 academic papers (some with co-authors), co-author of two book chapters and several research reports. He has been involved as ornithological consultant in more than 160 power line and 30 renewable energy projects. Chris is also co-author of the Best Practice for Avian Monitoring and Impact Mitigation at Wind Development Sites in Southern Africa, which is currently (2017) accepted as the industry standard. Chris also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

**Albert Froneman (Pr.Sci.Nat)**

Albert has an M. Sc. in Conservation Biology from the University of Cape Town and started his career in the natural sciences as a Geographic Information Systems (GIS) specialist at Council for Scientific and Industrial Research (CSIR). He is a registered Professional Natural Scientist in the field of zoological science with the South African Council of Natural Scientific Professionals (SACNASP). In 1998, he joined the Endangered Wildlife Trust where he headed up the Airports Company South Africa – Endangered Wildlife Strategic Partnership, a position he held until he resigned in 2008 to work as a private ornithological consultant. Albert's specialist field is the management of wildlife, especially bird related hazards at airports. His expertise is recognized internationally; in 2005 he was elected as Vice Chairman of the International Bird Strike Committee. Since 2010, Albert has worked closely with Chris van Rooyen in developing a protocol for pre-construction monitoring at wind energy facilities, and they are currently jointly coordinating pre-construction monitoring programmes at several wind farm facilities. Albert also works outside the electricity industry and had done a wide range of bird impact assessment studies associated with various residential and industrial developments.

**Nico Laubscher**

Nico holds a D.Sc. from the University of Potchefstroom and was head of the Statistics Division, National Research Institute for Mathematical Sciences of the CSIR from 1959 – 1975. He retired in 1989 as head of the Centre for Statistical Consultation at the University of Stellenbosch. Nico held several offices, including President of the South African Statistical Association, and editor of the South African Statistical Journal. Nico has five decades' experience in statistical analysis and data science applications, including specialisation in model building with massive data sets, designing of experiments for process improvement and analysis of data so obtained, and statistical process control. He also has published peer reviewed papers in several leading statistical journals, including Annals of Mathematical Statistics, American Statistical Journal, Technometrics and The American Statistician. He currently operates as a private statistical consultant to industry and academia.

# SPECIALIST DECLARATION

I, Chris van Rooyen, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- I act as the independent specialist in this application;
- I 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;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- 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 have no vested interest in the proposed activity proceeding;
- 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;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Name of Specialist: Chris van Rooyen

Date: 11 March 2018

# LIST OF ABBREVIATIONS

| | |
|---|---|
| DEA | Department of Environmental Affairs |
| ADU | Animal Demography Unit |
| BLSA | BirdLife South Africa |
| CWAC | The Coordinated Waterbird Count |
| EIA | Environmental Impact Assessment |
| EWT | Endangered Wildlife Trust |
| IBA | Important Bird Area |
| IKA | Index of Kilometric Abundance |
| SABAP1 | South African Bird Atlas Project 1 |
| SABAP2 | South African Bird Atlas Project 2 |
| VP | Vantage Point |
| WEF | Wind Energy Facility |

# GLOSSARY

| ***Definitions*** | |
|---|---|
| Greater Study Area | The area which comprises the pentad where the study area is located, as well as the surrounding eight pentads. |
| Study Area | The combined area which comprises the WEF development area and the control area. |
| WEF development area | The area where turbines are planned. |
| Pentad | A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. |

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## 1.5 INTRODUCTION AND METHODOLOGY

### *1.1.1. Scope and Objectives*

The proposed Kuruman Phase 1 project is a Wind Energy Facility (WEF) located approximately 10km south-west of the town of Kuruman in the Northern Cape (see Figure 1).

The proposed Kuruman Phase 1 WEF would consist of the following infrastructural components:

| | |
|---|---|
| Wind Turbines | Number of turbines: 47<br>MW output per turbine: 4.5 MW<br>Hub Height: 140 m<br>Blade Length: 80 m |
| Roads | New roads will be constructed with a width of 5 m and will connect all turbines<br>Existing roads to be used will be extended to a width of 8 m |
| Distribution lines | 33 kV underground lines |
| Collector substation | 2 ha<br>Height: 15 m |
| Laydown areas (additional to laydown areas next to each turbine) | Construction yards:<br>200m x 100m = 2 ha<br><br>Three construction yards will be established<br><br>It is anticipated that each construction yard will consist of the following:<br><br>- Welfare facilities including;<br>• Canteen<br>• Toilette<br>• Offices<br>• Changing Rooms<br>• Meeting Rooms<br>• Parking<br>- Storage including;<br>• Bunded fuel areas<br>• Oil storage areas<br>- General stores (containers)<br>- Skips |

**Figure 1: Lay-out of the proposed Kuruman Phase 1 WEF (WEF development area)**

### *1.1.2. Terms of Reference*

The terms of reference for this avifaunal scoping study are as follows:

- Describe the affected environment from an avifaunal habitat perspective.
- Discuss any applicable legislation pertaining to impacts on avifauna.
- Identify gaps in baseline data.
- Assess the expected impacts, including cumulative.
- Provide a sensitivity map of the proposed development site from an avifaunal perspective.
- Provide recommendations for the mitigation of impacts.

### *1.1.3. Approach and Methodology*

The following approach and methods were applied to compile this report:

- Bird distribution data of the South African Bird Atlas 2 (SABAP 2) was obtained from the Animal Demography Unit of the University of Cape Town (ADU 2017), as a means to ascertain which avifaunal species occurs within the broader area i.e. within a block consisting of nine pentad grid cells within which the proposed WEF is situated. The nine pentad grid cells are the following: 2725_2315; 2725_2320; 2725_2325; 2730_2315; 2730_2320; 2730_2325; 2735_2315; 2735_2320; 2735_2325. A pentad grid cell covers 5 minutes of latitude by 5 minutes of longitude (5'× 5'). Each pentad is approximately 8 × 7.6 km. From 15 August 2009 to 16 December 2017, 67 full protocol cards (i.e. 67 surveys lasting a minimum of two hours or more each) have been completed for this area.
- Priority species were identified from the updated list (2014) of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al.* 2012).
- The national threatened status of all priority species was determined with the use of the most recent edition of the Red Data Book of Birds of South Africa (Taylor *et al.* 2015), and the latest authoritative summary of southern African bird biology (Hockey *et al.* 2005).
- The global threatened status of all priority species was determined by consulting the (2017.3) IUCN Red List of Threatened Species (http://www.iucnredlist.org/).
- A classification of the vegetation types in the study area was obtained from the Atlas of Southern African Birds 1 (SABAP1) and the National Vegetation Map compiled by the South African National Biodiversity Institute (Mucina & Rutherford 2006).

- The Important Bird and Biodiversity Areas of South Africa (Marnewick *et al.* 2015) was consulted for information on potentially relevant Important Bird Areas (IBAs).
- The website of the Coordinated Waterbird Count project of the ADU was interrogated to establish if there are any potentially relevant important waterbodies which could be of relevance to the study.
- Information on potentially relevant areas included in the National Protected Areas Expansion Strategy was obtained from the South Africa National Biodiversity Institute (SANBI) website.
- Information on potentially relevant protected areas was sourced from the Protected Areas Database from the Department of Environmental Affairs (DEA).
- Satellite imagery from Google Earth was used in order to view the broader development area on a landscape level and to help identify sensitive bird habitat.
- The main source of information on avifaunal abundance and species diversity was the 12-months pre-construction monitoring which was conducted from September 2015 to January 2017. Data at the WEF and a control site was collected through a combination of drive and walk transects, as well as the recording of flight activity from vantage points (VPs) (See Appendix 2 for a detailed explanation of the methodology employed in the pre-construction programme).
- The number and locality of priority species were recorded during transects surveys and incidental sightings to determine the abundance and spatial distribution of priority species at the WEF and control sites.
- The flight lines of priority species recorded during VP watches were mapped. This information was used to develop a basic collision risk index to identify the priority species most likely to collide with the turbines.
- One potential focal point of bird activity, a small dam, was identified and was monitored. The power lines running in the vicinity of the project area were also inspected for raptor nests.
- Information on the locality of renewable energy project applications within a 50km radius around the proposed WEF was obtained from the Department of Environmental Affairs website.

#### *1.1.4. Assumptions and Limitations*

The following assumptions and limitations are applicable to this study:

- A total of 67 full protocol lists have been completed to date for the 9 pentads where the study area is located (i.e. lists surveys lasting a minimum of two hours or more each). This is a comprehensive dataset which provides a reasonably accurate snapshot of the avifauna which could occur in the study area. For purposes of completeness, the list of species that could be encountered was supplemented with personal observations, general knowledge of the area, SABAP1 records (Harrison *et al.* 1997), and data from the pre-construction monitoring.
- Conclusions in this study are based on experience of these and similar species in different parts of South Africa. Bird behaviour can never be entirely reduced to formulas that will be valid under all circumstances, especially for a relatively new field in South Africa such as wind. However, power line and substation impacts can be predicted with a fair amount of certainty, based on a robust body of research stretching back over several decades.
- Few scientific publications are available on the impacts of wind farms on birds in South Africa. The precautionary principle was therefore applied throughout. The World Charter for Nature, which was adopted by the UN General Assembly in 1982, was the first international endorsement of the precautionary principle (http://www.unep.org). The principle was implemented in an international treaty as early as the 1987 Montreal Protocol and, among other international treaties and declarations, is reflected in the 1992 Rio Declaration on Environment and Development. Principle 15 of the 1992 Rio Declaration states that: "in order to protect the environment, the precautionary approach shall be widely applied by States according to their capabilities. Where there are threats of serious or irreversible damage, lack of full scientific certainty shall be not used as a reason for postponing cost-effective measures to prevent environmental degradation."
- Predicted mortality rates are often inaccurate, indicating that this is still a fledgling science in many respects, even in developed countries like Spain with an established wind industry (Ferrer *et al.* 2012). Mortality data from post-construction monitoring programmes currently implemented at wind farms in South Africa was used to assist with the priority species risk assessments (Ralston – Paton *et al.* 2017).
- The greater study area was defined as the area which comprises the pentad where the study area is located, as well as the surrounding eight pentads. The study area was defined as the combined area

which comprises the WEF development area and the control area. The WEF development area refers only to the area where turbines are planned.

- It is important to note that the assessment is made on the status quo as it is currently in the study area. A possible change in land use in the broader development area is not taken into account because the extent and nature of future developments are unknown at this stage. It is however highly unlikely that the land use will change in the foreseeable future.
- Cumulative impacts are assessed by adding expected impacts from this proposed development to existing and proposed developments with similar impacts in a 50 km radius. The existing and proposed developments that were taken into consideration for cumulative impacts are listed in Table 5.

### *1.1.5. Source of Information*

The following are the primary sources of information used to compile the report:

- Bird distribution data of the South African Bird Atlas 2 (SABAP 2).
- The Eskom Red Data Book of Birds of South Africa (Taylor *et al.* 2015).
- Robert's Birds of Southern Africa, seventh edition (Hockey *et al.* 2005).
- IUCN Red List of Threatened Species (2017.3) (http://www.iucnredlist.org/).
- Atlas of Southern African Birds 1 (SABAP1) (Harrison *et al.* 1997).
- The National Vegetation Map compiled by the South African National Biodiversity Institute (SANBI) (Mucina & Rutherford 2006).
- The Important Bird and Biodiversity Areas of South Africa (Marnewick *et al.* 2015).
- The Coordinated Waterbird Count (CWAC) project of the ADU (http://cwac.adu.org.za/).
- The National Protected Areas Expansion Strategy.
- The Protected Areas Database from the Department of Environmental Affairs (DEA).
- Renewable Energy EIA Application Database for SA from the Department of Environmental Affairs (DEA).
- Google Earth.
- The updated list (2014) of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief *et al.* 2012).
- The main source of information on avifaunal abundance and species diversity was the 12-months pre-construction monitoring which was conducted from September 2015 to January 2017 at the WEF.
- Wind Energy Impacts on Birds in South Africa: A Preliminary review of the results of operational monitoring at the first wind farms of the Renewable Energy Independent Power Producer Procurement Programme in South Africa. BLSA. Occasional Report Series: 2. (Ralston *et al.* 2017).
- A total of 34 bird impact assessment studies compiled by the authors for potential wind energy facilities throughout South Africa since 2011.

## 1.6 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

### *1.1.6. Agreements and conventions*

Table 1 below lists agreements and conventions which South Africa is party to and which is relevant to the conservation of avifauna (BirdLife International 2018).

**Table 1: Agreements and conventions which South Africa is party to and which is relevant to the conservation of avifauna**

| Convention name | Description | Geographic scope |
|---|---|---|
| African-Eurasian Waterbird Agreement (AEWA) | The Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) is an intergovernmental treaty dedicated to the conservation of migratory waterbirds and their habitats across Africa, Europe, the Middle East, Central Asia, Greenland and the Canadian Archipelago.<br><br>Developed under the framework of the Convention on Migratory Species (CMS) and administered by the United Nations Environment Programme (UNEP), AEWA brings together countries and the wider international conservation community in an effort to establish coordinated conservation and management of migratory waterbirds throughout their entire migratory range. | Regional |
| Convention on Biological Diversity (CBD), Nairobi, 1992 | The Convention on Biological Diversity (CBD) entered into force on 29 December 1993. It has 3 main objectives:<br>The conservation of biological diversity<br>The sustainable use of the components of biological diversity<br>The fair and equitable sharing of the benefits arising out of the utilization of genetic resources. | Global |
| Convention on the Conservation of Migratory Species of Wild Animals, (CMS), Bonn, 1979 | As an environmental treaty under the aegis of the United Nations Environment Programme, CMS provides a global platform for the conservation and sustainable use of migratory animals and their habitats. CMS brings together the States through which migratory animals pass, the Range States, and lays the legal foundation for internationally coordinated conservation measures throughout a migratory range. | Global |
| Convention on the International Trade in Endangered Species of Wild Flora and Fauna, (CITES), Washington DC, 1973 | CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival. | Global |

| | | |
|---|---|---|
| Ramsar Convention on Wetlands of International Importance, Ramsar, 1971 | The Convention on Wetlands, called the Ramsar Convention, is an intergovernmental treaty that provides the framework for national action and international cooperation for the conservation and wise use of wetlands and their resources. | Global |
| Memorandum of Understanding on the Conservation of Migratory Birds of Prey in Africa and Eurasia | The Signatories will aim to take co-ordinated measures to achieve and maintain the favourable conservation status of birds of prey throughout their range and to reverse their decline when and where appropriate. | Regional |

### *1.1.7. Best Practice Guidelines*

The latest edition of the South African *"Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa" (*Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Anderson, M.D., & A.H. Smit. 2011) are followed for this study. This document was published by the Endangered Wildlife Trust (EWT) and Birdlife South Africa (BLSA) in March 2011, and subsequently revised in 2011, 2012 and 2015.

# 1.3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

### *1.3.1 Baseline description of the receiving environment*

#### 1.3.1.1 Important Bird Areas

The study area is not located in an Important Bird Area. The border of the closest Important Bird Area (IBA), the Spitskop Dam IBA SA028, is located approximately 127km away to the south-east from the centre of the proposed WEF development area (Marnewick *et al.* 2015). It is therefore not expected that the proposed WEF will have any impact on the avifauna in an IBA.

#### 1.3.1.2 CWAC sites

The Animal Demography Unit (ADU) launched the Coordinated Waterbird Counts (CWAC) project in 1992 as part South Africa's commitment to International waterbird conservation. This is being done by means of a programme of regular mid-summer and mid-winter censuses at a large number of South African wetlands, known as CWAC sites.

The closest CWAC site is the Pudu Farm Dam, which is situated approximately 67km from the proposed WEF development area. Due to the distance from the WEF development area, no impacts on waterbirds at the Pudu Farm Dam is envisaged.

#### 1.3.1.3 Protected Areas

The closest protected area to the WEF development site is the 1 131ha Billy Duvenhage Nature Reserve outside of Kuruman, where 115 bird species have been recorded (Olivier & Olivier 2005). This protected area forms part of the greater study area. The habitat in the reserve is primarily Kuruman Thornveld, which consists of a well-developed, closed shrub layer and well-developed open tree stratum consisting of *Vachellia erioloba* (Mucina & Rutherford 2005).

#### 1.3.1.4 Biomes and vegetation types

The proposed WEF development area is situated in the savanna biome and consists of a series of parallel ridges with a general south-east to north-west orientation, known as the Kuruman Mountains, interspersed with broad valleys. The ridges consist of gentle slopes covered in short grassland with an open shrub layer, and a few exposed rocky ridges. The valleys are covered in tall grassland on red Kalahari sands with scattered trees. Two vegetation types are found in the WEF development area, namely Kuruman Mountain Bushveld and Kuruman Thornveld (Mucina & Rutherford 2006). The proposed turbines are located on the crest of the ridges in long, parallel lines. The elevation ranges roughly between 1500 – 1770 m.a.s.l. Kuruman normally receives about 266mm of rain per year, with most rainfall occurring during summer. It receives the lowest rainfall (0mm) in June and the highest (58mm) in February. The monthly distribution of average daily maximum temperatures ranges from 17.5°C in June to 32.6°C in January. The region is the coldest during June when the mercury drops to 0°C on average during the night (http://www.saexplorer.co.za/south-africa/climate/kuruman_climate.asp).

#### 1.3.1.5 Habitat classes and avifauna in the study area

SABAP1 recognises six primary vegetation divisions within South Africa, namely (1) Fynbos (2) Succulent Karoo (3) Nama Karoo (4) Grassland (5) Savanna and (6) Forest (Harrison *et al.* 1997). The criteria used by the authors to amalgamate botanically defined vegetation units, or to keep them separate were (1) the existence of clear differences in vegetation structure, likely to be relevant to birds, and (2) the results of published community studies on bird/vegetation associations. It is important to note that no new vegetation unit boundaries were created, with use being made only of previously published data. All the natural vegetation types in the study area can be collectively classified as savanna.

Whilst much of the distribution and abundance of the bird species in the study area can be explained by the description of the biomes and vegetation types above, it is as important to examine the modifications which have changed the natural landscape, and which may have an effect on the distribution of avifauna. These are sometimes evident at a much smaller spatial scale than the biome or vegetation types and are determined by a host of factors such as topography, land use and man-made infrastructure.

The bird habitat classes that were identified in the study area, are discussed below. See also Appendix 3 for a photographic record of the habitat in the study area.

- Savanna

This habitat class is described above under 1.3.1.4.

Priority species associated with savanna which occur or could potentially occur in the study area are African Rock Pipit (slopes), Black Harrier, Black-chested Snake-Eagle, Double-Banded Courser, Greater Kestrel, Grey-winged Francolin (slopes), Jackal Buzzard, Kori Bustard, Lesser Kestrel, Martial Eagle, Southern Pale Chanting Goshawk, Spotted Eagle-Owl, Verreaux's Eagle (slopes), Steppe Buzzard, Lanner Falcon and Northern Black Korhaan (valleys) (see Table 2 below for a complete list of priority species which could potentially occur at the site).

- Waterbodies

Surface water is of specific importance to avifauna in this semi-arid study area. The WEF development area contains several boreholes with water troughs and a number of small, man-made farm dams. Priority species that could attracted to surface water are mostly raptors such as Jackal Buzzard, Steppe Buzzard, Black Harrier, Black-chested Snake-Eagle, Greater Kestrel, Lanner Falcon, Martial Eagle and Verreaux's Eagle.

- High voltage lines and telephone lines

High voltage lines are an important potential roosting and breeding substrate for large raptors in the study area (Van Rooyen 2006). There are no existing high voltage lines crossing the actual WEF development area, but the Mercury – Ferrum 400kV line crosses the study area to the north of the WEF development area, running more or less parallel to the N14 national road. The Moffat – Valley 66kV distribution line runs east and south of the WEF development area and terminates at the Valley Substation in the study area. The Gryppoort - Valley 66kV distribution line enters the study area from the south and terminates at the Valley Substation. These powerlines, as well as a number of smaller reticulation lines and telephone lines are used as perches by priority species such as Lesser Kestrel, Jackal Buzzard, Steppe Buzzard, Black Harrier, Black-chested Snake-Eagle, Greater Kestrel, Lanner Falcon, Martial Eagle and Verreaux's Eagle. No raptor nests were recorded on any of the powerlines in the study area.

### *1.3.2 Results of the Field Study*

An estimated 201 species could potentially occur in the study area, of which 133 were recorded at the WEF development area during pre-construction monitoring (see Appendix 1). Of the 201 species that could occur at the site, 18 are classified as priority species for wind farm developments (Retief *et al.* 2012).

Tables 2 lists <u>priority</u> species[1] that could potentially occur in the study area. The list is based on a combination of the pre-construction monitoring that was conducted (see Appendix 2), supplemented with other data sources e.g. SABAP2 and personal experience of the avifauna occurring in the study area.

Table 3 lists the manner in which a specific priority species was recorded. Data was collected by means of drive transect and walk transects, vantage point (VP) watches, focal point counts and incidental sightings.

See Appendix 2 for a summary of the methodology employed in the pre-construction programme.

[1] Priority species were identified from the updated list (2014) of priority species for wind farms compiled for the Avian Wind Farm Sensitivity Map (Retief et al. 2012).

**Table 2: Priority species potentially occurring in the study area.**

| | Family name | Taxonomic name | Global status | Regional status | Endemic status South Africa | Endemic status Southern Africa | SABAP2 reporting rate | Recorded during pre-construction monitoring | Potential impacts | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | | | Collisions with turbines | Displacement through disturbance | Displacement through habitat transformation |
| 1 | Buzzard, Jackal | *Buteo rufofuscus* | LC | | Near endemic | Endemic | 4.48 | yes | x | | |
| 2 | Eagle, Booted | *Hieraaetus pennatus* | LC | | | | 0 | no | x | | |
| 3 | Eagle, Martial | *Polemaetus bellicosus* | VU | EN | | | 0 | yes | x | x* | |
| 4 | Eagle, Verreaux's | *Aquila verreauxii* | LC | VU | | | 1.49 | yes | x | x* | |
| 5 | Francolin, Grey-winged | *Scleroptila afra* | LC | | Endemic (SA, Lesotho, Swaziland) | Endemic | 0 | yes | x | x* | |
| 6 | Goshawk, Southern Pale Chanting | *Melierax canorus* | LC | | | Near-endemic | 14.93 | yes | x | | |
| 7 | Kestrel, Greater | *Falco rupicoloides* | LC | | | | 7.46 | yes | x | | |
| 8 | Kestrel, Lesser | *Falco naumanni* | LC | | | | 0 | yes | x | | |
| 9 | Pipit, African Rock | *Anthus crenatus* | LC | NT | Endemic (SA, Lesotho, Swaziland) | Endemic | 1.49 | yes | x | x* | |
| 10 | Buzzard, Steppe | *Buteo buteo* | LC | | | | 4.48 | yes | x | | |
| 11 | Eagle-owl, Spotted | *Bubo africanus* | LC | | | | 7.46 | yes | x | | |
| 12 | Falcon, Lanner | *Falco biarmicus* | LC | VU | | | 0 | no | x | | |
| 13 | Harrier, Black | *Circus maurus* | VU | EN | Near endemic | Endemic | 0 | yes | x | x* | |
| 14 | Korhaan, Northern Black | *Afrotis afraoides* | LC | | | Endemic | 4.48 | no | x | x* | x |
| 15 | Courser, Double-banded | | LC | | | | 1.49 | yes | | x* | |
| 16 | Bustard, Kori | | NT | NT | | | 0 | yes | | x* | x |
| 17 | Secretarybird | *Sagittarius serpentarius* | VU | VU | | | 0 | no | x | x* | x |
| 18 | Black-chested Snake-Eagle | *Circaetus pectoralis* | LC | LC | | | 0 | yes | x | x* | |

* This is likely to be a temporary impact associated with the construction phase only

**Table 3: The manner in which priority species were recorded during the pre-construction monitoring.**

| Priority Species | Taxonomic Name | Transects at WEF | Transects at Control | Vantage points at WEF | Vantage points at Control | Incidental sightings |
|---|---|---|---|---|---|---|
| African Rock Pipit | *Anthus crenatus* | | | | | * |
| Black Harrier | *Circus maurus* | | | | | * |
| Black-chested Snake-Eagle | *Circaetus pectoralis* | * | | | | * |
| Double-Banded Courser | *Rhinoptilus africanus* | | | | | * |
| Greater Kestrel | *Falco rupicoloides* | * | | | | * |
| Grey-winged Francolin | *Scleroptila africanus* | * | | * | | |
| Jackal Buzzard | *Buteo rufofuscus* | * | | * | | * |
| Kori Bustard | *Ardeotis kori* | | * | | | |
| Lesser Kestrel | *Falco naumanni* | * | | * | | * |
| Martial Eagle | *Polemaetus bellicosus* | | | | | * |
| Southern Pale Chanting Goshawk | *Melierax canorus* | * | * | | * | * |
| Spotted Eagle-Owl | *Bubo africanus* | | | | | * |
| Verreaux's Eagle | *Aquila verreauxii* | * | | * | | |
| **13** | **Total:** | **7** | **2** | **4** | **1** | **11** |

#### 1.3.2.1 Transect counts in the development area

See Appendix 2 for a detailed breakdown of the data capture methodology employed in the pre-construction programme, including the number of transects, vantage points and focal points.

The drive transect was surveyed three times per seasonal survey. A total of 2704 individual birds were recorded during drive transect counts at the proposed WEF development area, of which 27 were priority species and 2677 were non-priority species, belonging to 93 species (6 priority species and 86 non-priority species). At the control area, a total of 1748 birds were recorded during drive transect counts, of which 13 were priority species and 1735 non-priority species, belonging to 84 species (2 priority species and 82 non-priority species).

The walk transects were counted 32 times, i.e. 8 times per season. A total of 2456 individual birds were recorded at the proposed development area, of which 3 were priority species and 2453 non-priority species, belonging to 71 species (2 priority species and 69 non-priority species). At the control area, a total of 2570 birds were recorded, of which 5 were priority species and 2565 non-priority species, belonging to 84 species (1 priority species and 83 non-priority species).

An Index of Kilometric Abundance (IKA = birds/km) was calculated for each priority species, and also for all priority species combined recorded during transect counts. Figures 2 and 3 show the relative abundance of priority species recorded during the pre-construction monitoring through drive and walk transect counts. The IKA for all priority species combined recorded in the development area during drive transect counts was 0.091 birds/km, and 0.023 birds/km for walk transect counts. At the control site, the IKA for all priority species combined recorded during drive transect counts was 0.10 birds/km and 0.08 birds/km for walk transects.

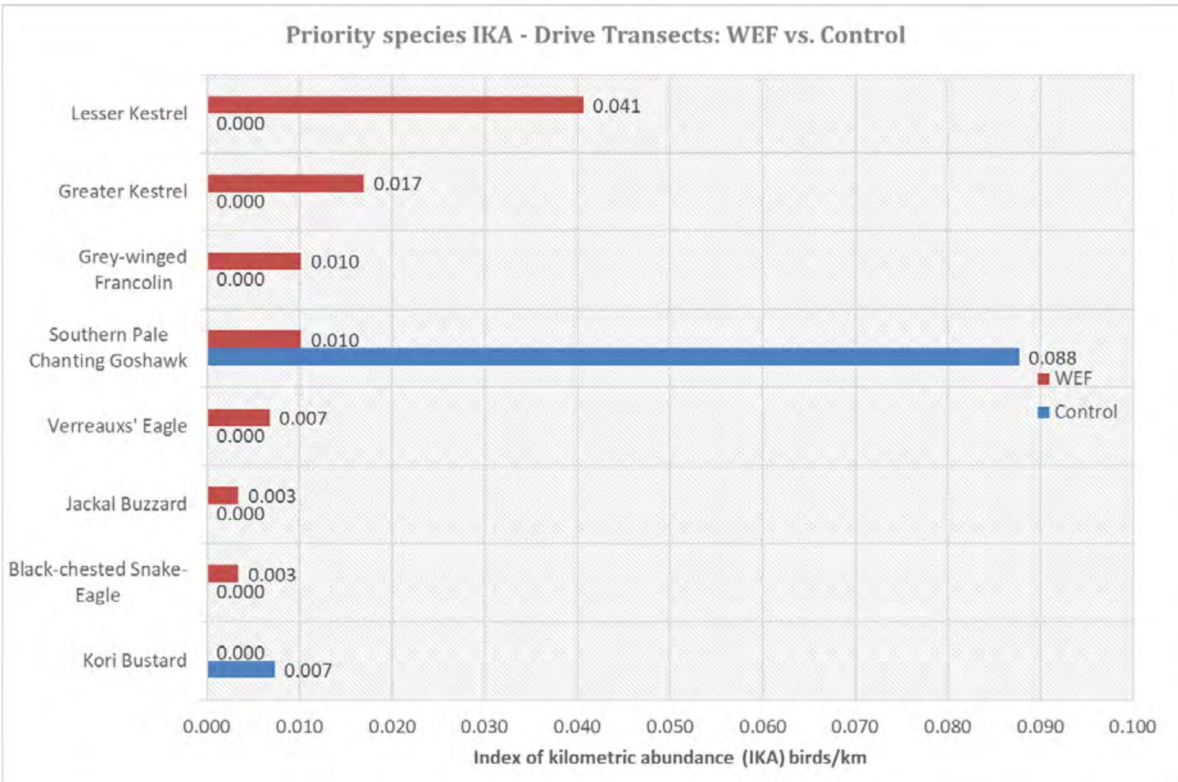


**Figure 2: Priority species recorded in the study area through drive transect counts**

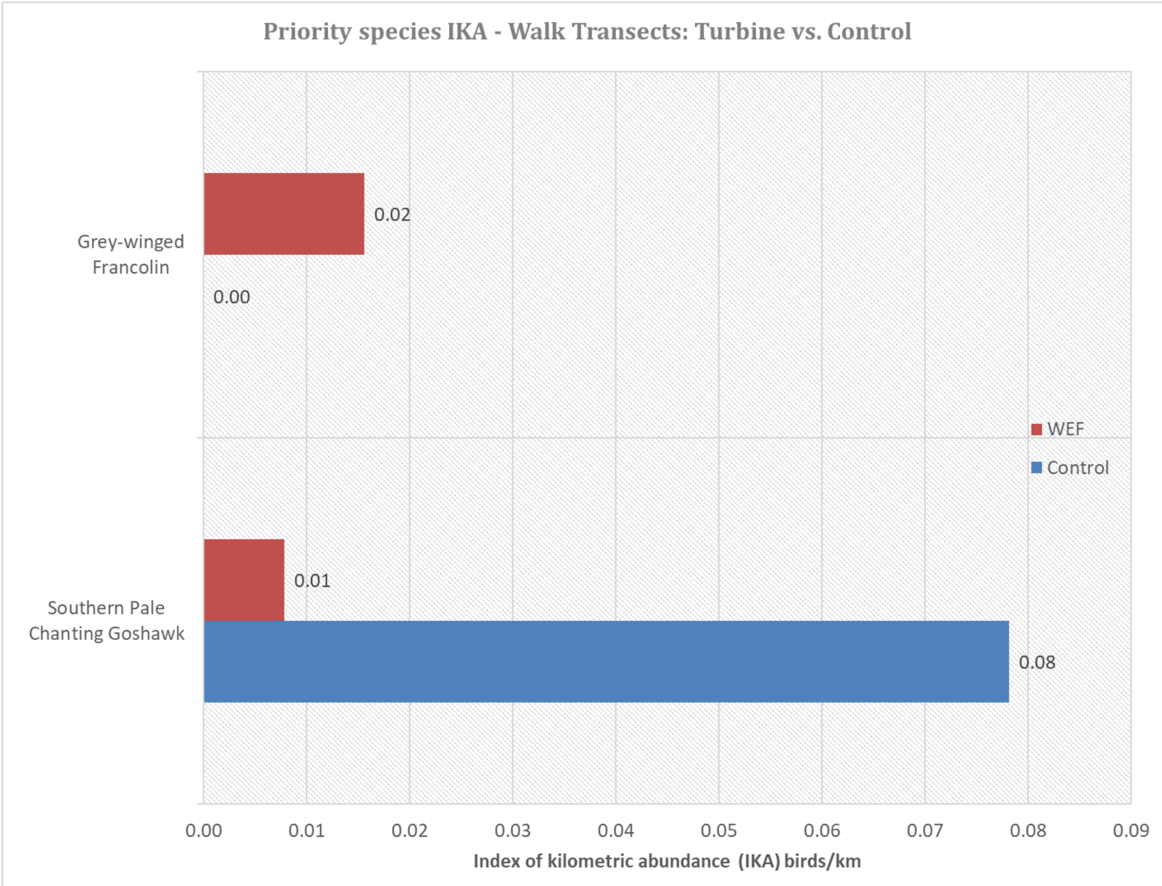


**Figure 3: Priority species recorded in the study area through walk transect counts**

#### 1.3.2.2 Overall species composition

The results of the transect counts indicate a moderate diversity of avifauna at both the development area and the control site. While this is to be expected to some extent of a fairly arid area such as this, the very low numbers or absence of some species e.g. Northern Black Korhaan is an indication that the avian populations might be under pressure from external factors, e.g. hunting.

#### 1.3.2.3 Abundance

The overall abundance of priority species at the WEF development area is very low, with 0.091 birds/km recorded during drive transect counts, and 0.023 birds/km during walk transect counts. The difference in overall numbers between the development area (n = 5160) and the control site (n = 4318) is likely to be a function of effort rather than inherent differences in habitat, as less time was spent on surveys in the control area than in the development area.

#### 1.3.2.4 Spatial distribution of transect records and incidental sightings in the development area

Figure 4 below indicates the spatial distribution of priority species recorded during transect counts and incidental sightings.

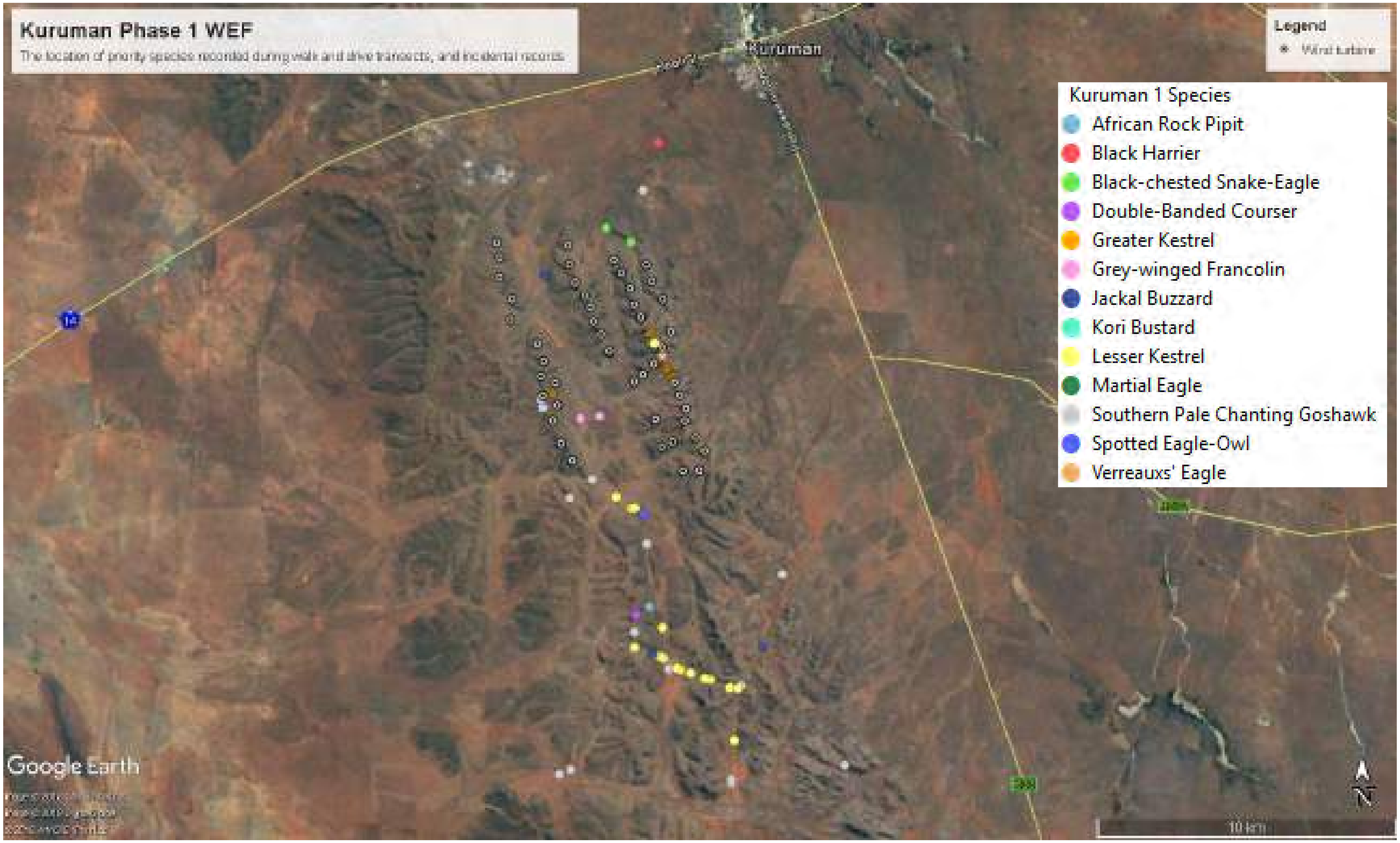


**Figure 4: Spatial distribution of sightings of priority species recorded during transect counts (includes incidental sightings).**

#### 1.3.2.5 Vantage point watches

Four priority species were recorded during vantage point (VP) watches in the proposed WEF development area. A total of 192 hours of vantage point watches (12 hours per sampling period per vantage point) was completed at 4 VPs in order to record flight patterns of priority species. In the four sampling periods, priority species were recorded flying over development areas for a total of 23 minutes and 45 seconds. A total of 9 individual flights were recorded. Of these, 0 (0%) flights were at high altitude (>220m), 7 (77.7%) were at medium altitude (between 30m and 220m) and 2 (22.2%) were at a low altitude (<30m). The passage rate for priority species (all flight heights) was 0.05 birds/hour[2]. See Figure 5 below for the duration of flights for each priority species, at each height class[3].

For purposes of flight analyses, priority species recorded during VP watches at the site were classified in two classes (see also statistical analysis Appendix 4):

- Terrestrial species: Birds that spend most of the time foraging on the ground. They do not fly often and then generally short distances at low to medium altitude, usually powered flight. Some larger species undertake longer distance flights at higher altitudes, when commuting between foraging and roosting areas. Korhaans, bustards, and francolins were included in this category.
- Soaring species: Species that spend a significant time on the wing in a variety of flight modes including soaring, kiting, hovering and gliding at medium to high altitudes. All the diurnal raptor species were included in this class.

[2] For calculating the passage rate, a distinction was drawn between passages and flights. A passage may consist of several flights e.g. every time an individual bird changes height or mode of flight; this was recorded as an individual flight, although all the flights still form part of the same passage.

[3] Flight duration was calculated by multiplying the flight time with the number of individuals in the flight e.g. if the flight time was 30 seconds and it contained two individuals, the flight duration was 30 seconds x 2 = 60 seconds.

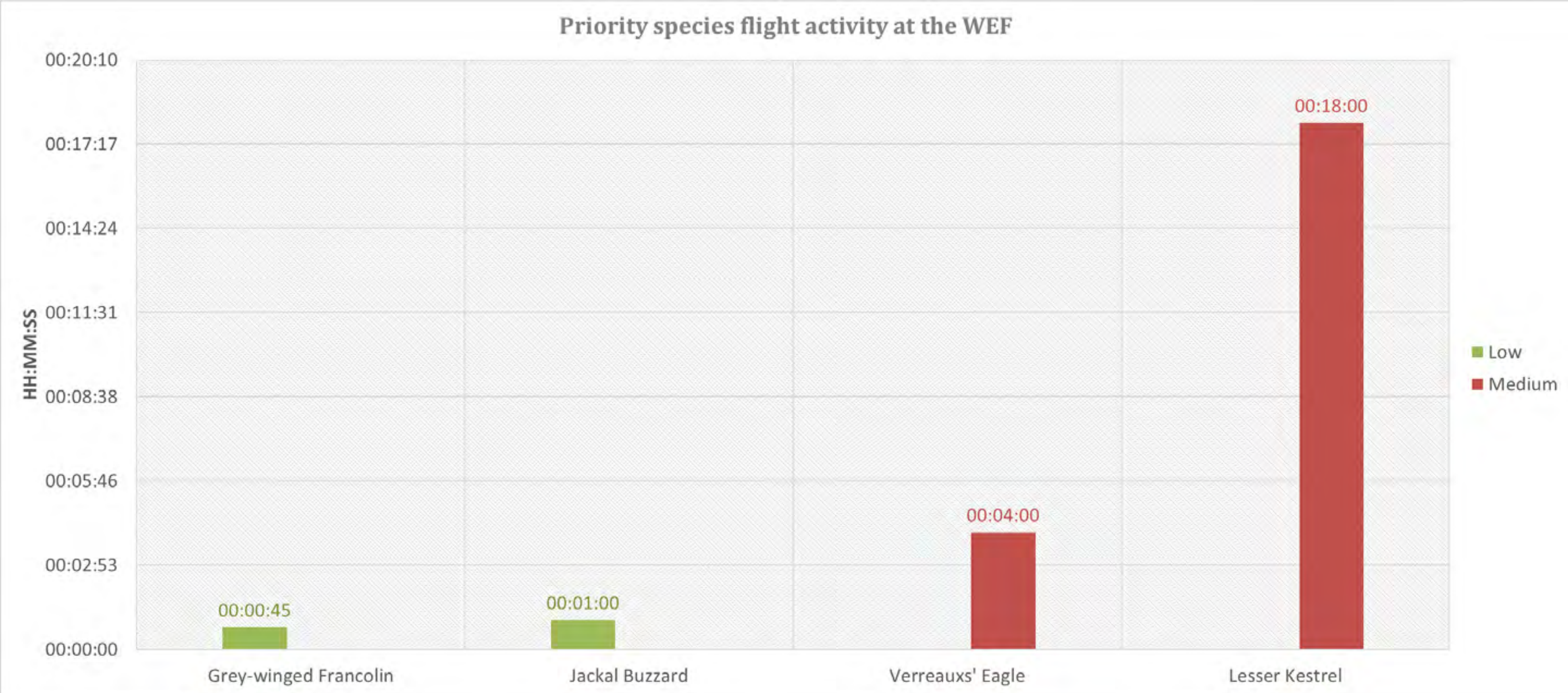


**Figure 5: Flight duration and heights recorded for priority species within the WEF development area. Duration (hours: minutes: seconds) are indicated on the bars.**

#### 1.3.2.6 Collision risk rating

A collision risk rating for each priority species recorded during VP watches was calculated to give an indication of the likelihood of an individual of a specific priority species to collide with the turbines. This was calculated taking into account the following factors:

- The duration of all rotor height flights;
- the susceptibility to collisions, based on morphology (size) and behaviour (soaring, predatory, ranging behaviour, flocking behaviour, night flying, aerial display and habitat preference) using the ratings for priority species in the Avian Wind Farm Sensitivity Map of South Africa (Retief *et al*. 2012); and
- the overall number of proposed turbines.

This was done in order to gain some understanding of which species are likely to be most at risk of collision. The formula used is as follows[4]:

*Collision risk rating = duration of medium altitude flights (decimal hours) x collision susceptibility score calculated as the sum of morphology and behaviour ratings in the Avian Wind Farm Sensitivity Map of South Africa x number of planned turbines ÷ 100.*

The results are displayed in Table 4 and Figure 8 below.

**Table 4**: **Site specific collision risk rating for all priority species recorded during VP watches in the development area.**

| **Species** | **Duration of flights (hr)** | **Avian Wind Farm Sensitivity Map Collision rating** | **Number of turbines** | **Collision Risk Rating** |
|---|---|---|---|---|
| Grey-winged Francolin | 0.00 | 50 | 47 | 0.00 |
| Jackal Buzzard | 0.00 | 95 | 47 | 0.00 |
| Verreauxs' Eagle | 0.07 | 110 | 47 | 3.45 |
| Lesser Kestrel | 0.30 | 72 | 47 | 10.15 |
| **Average** | **0.09** | **81.75** | | **3.40** |

[4] It is important to note that the formula does not incorporate avoidance behaviour. This may differ between species and may have a significant impact on the size of the risk associated with a specific species. It is generally assumed that 95-98% of birds will successfully avoid the turbines (SNH 2010). It is also important to note that there is not necessarily a direct correlation between time spent at rotor height, and the likelihood of collision.

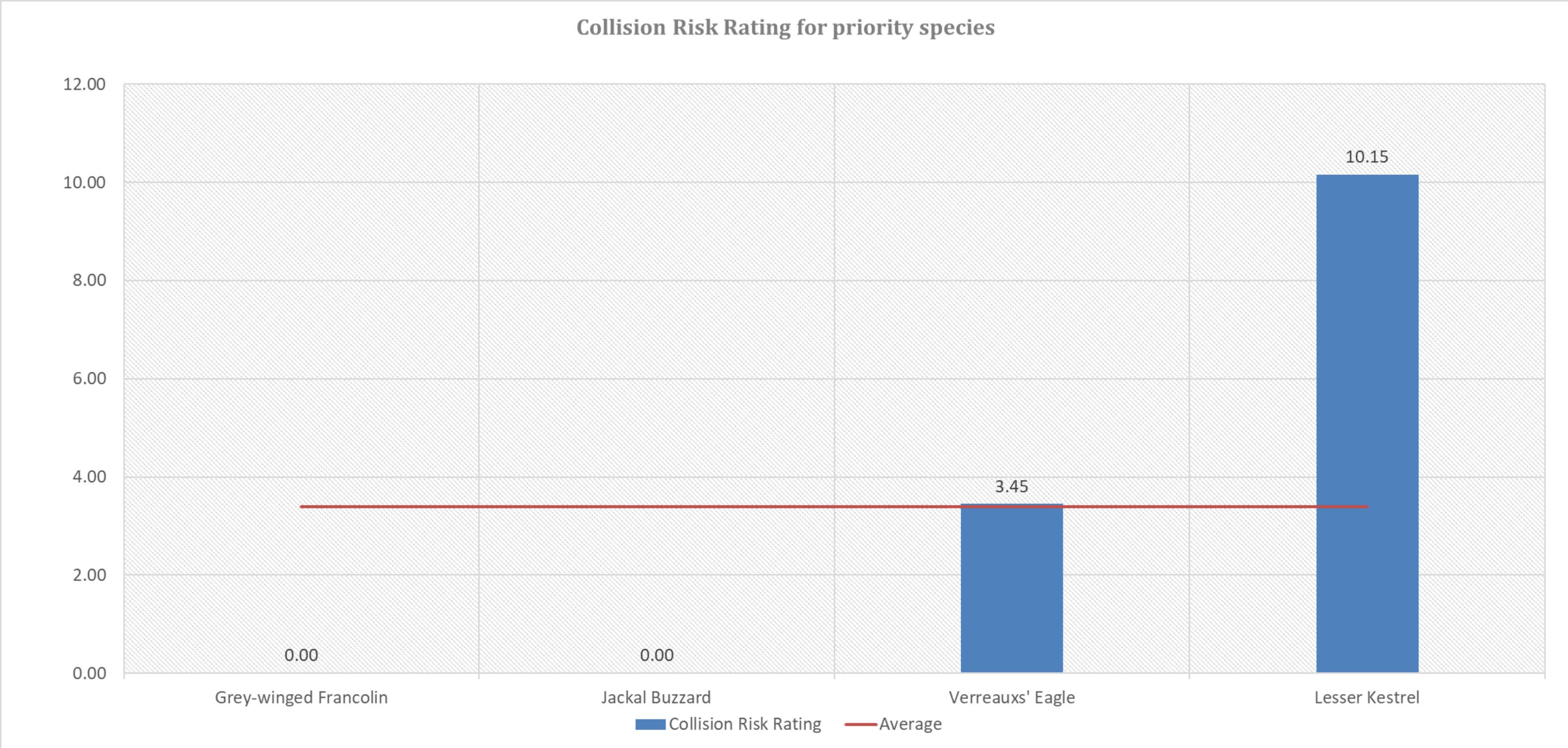


**Figure 6: Site specific collision risk rating for priority species recorded in the development area.**

#### 1.3.2.7 Sample size and representativeness of flight data

The computations and the outcome of the data exhibited in the tables and graphs in the statistical analysis (Appendix 4) show that the surveys may be taken to be statistically representative of the flight activity of priority species of birds that occur in the area during the sampling periods. It has also been demonstrated that more samples would not yield a meaningful improvement in the accuracy and precision.

See Appendix 4 for a detailed explanation of the statistical methods.

#### 1.3.2.8 Spatial distribution of flight activity

Flight maps were prepared for the two priority species with average to above average collision ratings, indicating the spatial distribution of flights observed from the various vantage points during the 12-month pre-construction monitoring programme (see Figures 7 -8 below). This was done by overlaying a 100m x 100m grid over the survey area. Each grid cell was then given a weighting score taking into account the duration and distance of individual flight lines through a grid cell and the number of individual birds associated with each flight crossing the grid cell. It is important to interpret these maps bearing in mind the amount of time that each species spent flying over the site e.g. the "High" (flight concentration) category on the map for Lesser Kestrel is not equivalent to the "High" (flight concentration) category on the map for Verreaux's Eagle, as the flight duration of flights for Lesser Kestrel is much higher than the flight duration for Verreaux's Eagle (see Figure 5).

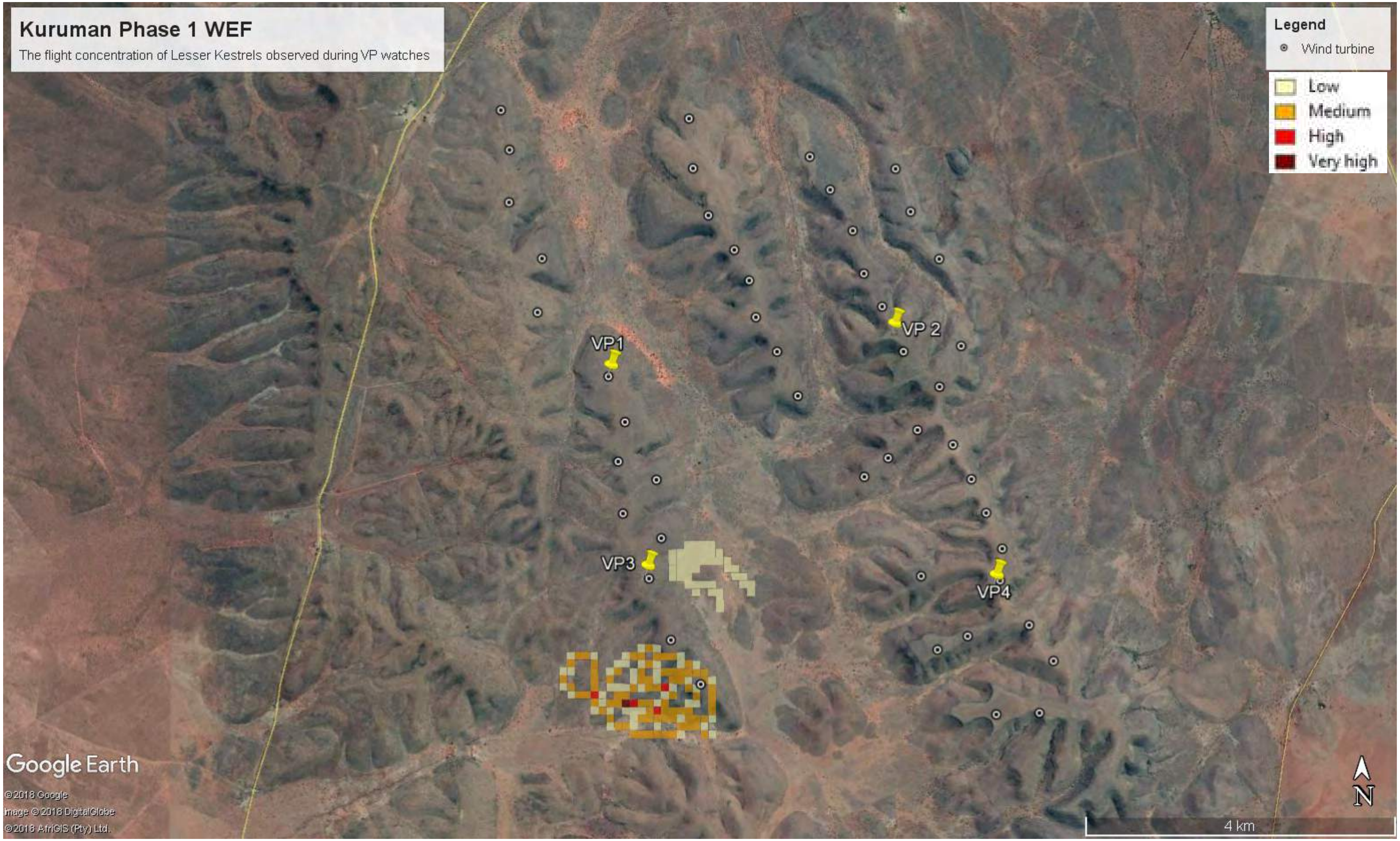


**Figure 7**: **Spatial distribution and concentration of rotor height flights of Lesser Kestrel.**

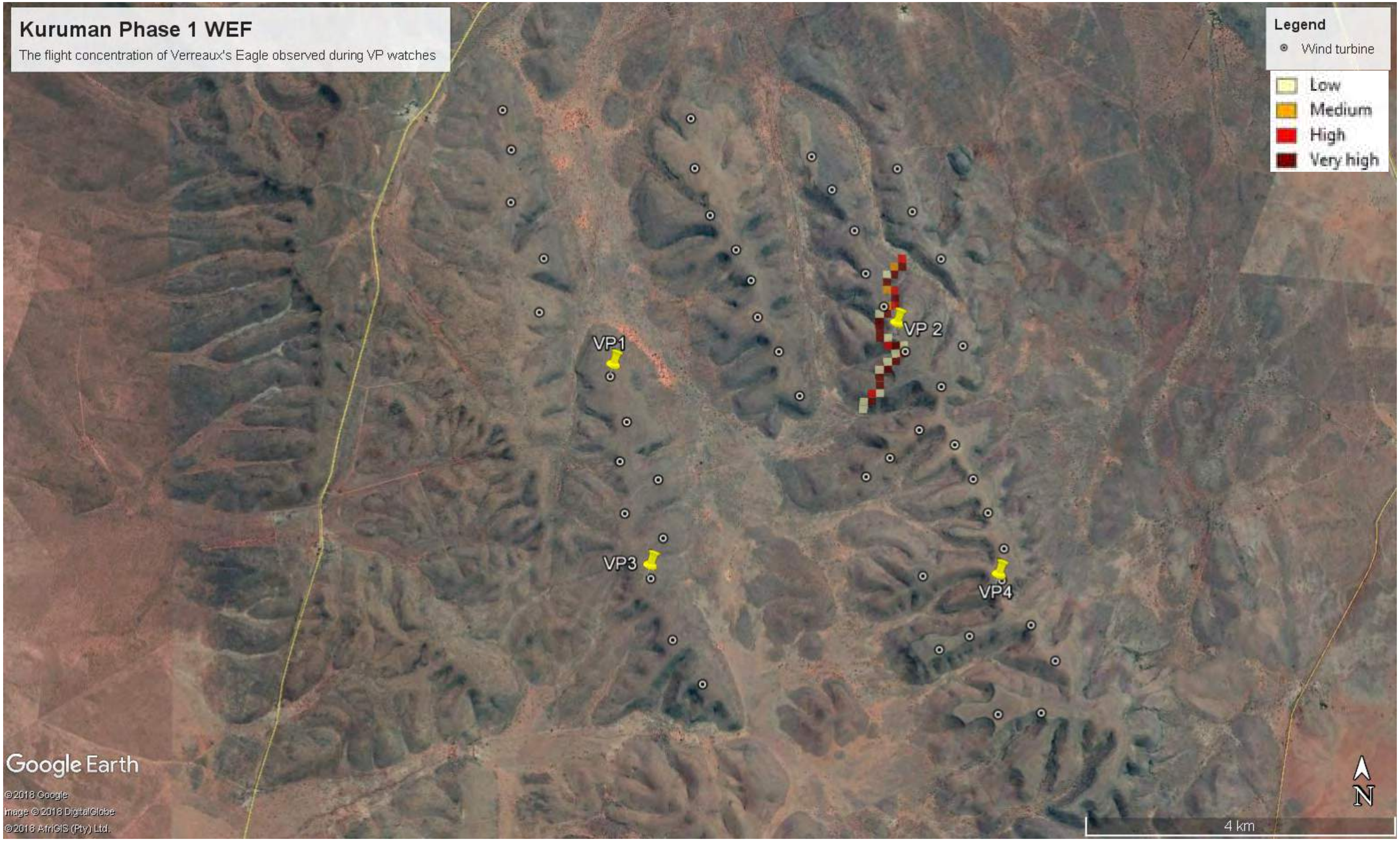


**Figure 8: Spatial distribution and concentration of rotor height flights of Verreaux's Eagle.**

#### 1.3.2.9 Focal points

One potential focal point of bird activity, a small dam, was identified during the initial site inspection and monitored during seasonal field surveys. The power lines in the study area were also inspected for raptor nests during each seasonal survey, but no raptor nests were recorded on the powerlines during any of the seasonal surveys. The small dam never held water during any of the surveys, which accounts for the lack of priority species.

### *1.3.3 Environmental Sensitivity Map*

The sensitive areas that have been identified from a bird impact perspective, are areas of surface water and ridge edges. A 300m no-turbine-zone (other infrastructure allowed) is recommended around all areas of surface water to reduce the risk of collisions for priority species, particularly raptors which are attracted to the surface water to drink and bath (see Figure 9 below). A 100m no turbine setback buffer (other infrastructure allowed) is recommended to reduce the risk of collisions for soaring raptors.

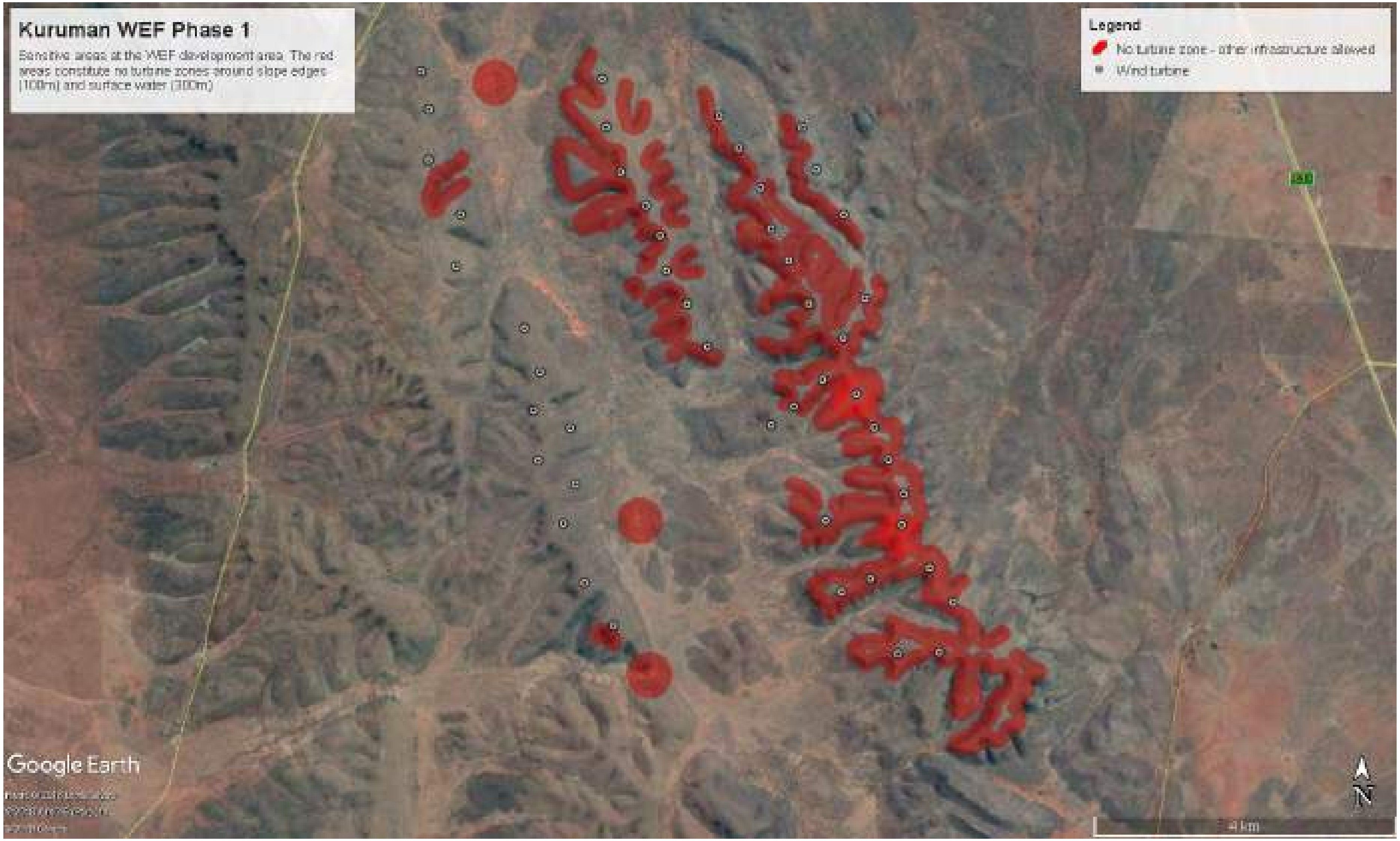


**Figure 9: The location of high sensitivity areas in the WEF development area.**

## 1.4 DESCRIPTION OF PROJECT ASPECTS RELEVANT TO AVIFAUNA

The following project aspects are relevant from a bird impact perspective:

- Wind turbines: Potential risk of priority species mortality due to collisions.
- Service roads, hard stands, lay-down areas, substation: Habitat transformation leading to displacement of priority species.
- Construction activities: Disturbance leading to displacement of priority species.

## 1.5 IDENTIFICATION OF IMPACTS

### *1.5.1 Identification of Potential Impacts*

The potential impacts to be further assessed during the EIA assessment are as follows:

#### 1.6.1.1 Construction Phase

- Displacement of priority species due to disturbance associated with the construction activities
- Displacement of priority species due to habitat transformation

#### 1.6.1.2 Operational Phase

- Mortality of priority species due to collisions with the wind turbines

#### 1.6.1.3 Decommissioning Phase

- Displacement of priority species due to disturbance associated with the de-commissioning activities

#### 1.6.1.4 Cumulative impacts

- Displacement of priority species due to habitat transformation
- Mortality of priority species due to collisions with the wind turbines

## 1.7 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

The effects of a wind farm on birds are highly variable and depend on a wide range of factors including the specification of the development, the topography of the surrounding land, the habitats affected and the number and species of birds present. With so many variables involved, the impacts of each wind farm must be assessed individually. The principal areas of concern with regard to effects on birds are listed below. Each of these potential effects can interact with each other, either increasing the overall impact on birds or, in some cases, reducing a particular impact (for example where habitat loss or displacement causes a reduction in birds using an area which might then reduce the risk of collision).

### *1.7.1 Displacement of priority species due to habitat transformation (Construction Phase)*

#### 1.7.1.1 Nature

The scale of permanent habitat loss resulting from the construction of a wind farm and associated infrastructure depends on the size of the project but, in general it, is likely to be small per turbine base. Typically, actual habitat loss amounts to 2–5% of the total development area (Fox *et al.* 2006 as cited by Drewitt & Langston 2006). Some changes could also be beneficial. For example, habitat changes following the development of the Altamont Pass wind farm in California led to increased mammal prey availability for some species of raptor, though this may also have increased collision risk (Thelander *et al.* 2003 as cited by Drewitt & Langston 2006).

However, the results of habitat transformation may be subtler, whereas the actual footprint of the wind farm may be small in absolute terms, the effects of the habitat fragmentation brought about by the associated infrastructure (e.g. power lines and roads) may be more significant. Sometimes Great Bustard can be seen close to or under power lines, but a study done in Spain (Lane *et al.* 2001 as cited by Raab *et al.* 2009) indicates that the total observation of Great Bustard flocks were significantly higher further from power lines than at control points. Shaw (2013) found that Ludwig's Bustard generally avoid the immediate proximity of roads within a 500m buffer. This means that power lines and roads also cause loss and fragmentation of the habitat used by the population in addition to the potential direct mortality. The physical encroachment increases the disturbance and barrier effects that contribute to the overall habitat fragmentation effect of the infrastructure (Raab *et al.* 2010). It has been shown that fragmentation of natural grassland in Mpumalanga (in that case by afforestation) has had a detrimental impact on the densities and diversity of grassland species (Alan *et al.* 1997).

Raptors are unlikely to be affected by the habitat transformation.

#### 1.7.1.2 Significance of impact without mitigation

The physical footprint of the proposed wind farm is likely to be fairly insignificant. The habitat fragmentation is likely to have a more significant displacement impact on priority species. It is expected that the densities of most priority species will decrease due to this impact, but complete displacement is unlikely. Indications are that bustards continue to use the wind farm areas (M. Langlands 2016 pers. comm, Rossouw 2016 pers.comm,). Raptors are unlikely to be affected at all. Species most likely to be affected by the habitat fragmentation are the terrestrial species namely Grey-winged Francolin, Northern Black Korhaan, Kori Bustard and Secretarybird. The overall significance of this impact prior to mitigation is regarded to be moderate.

#### 1.7.1.3 Proposed mitigation measures

Mitigation measures to reduce the impact of displacement due to habitat transformation are as follows:

- The recommendations of the specialist ecological study must be strictly adhered to.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist.

Rationale: The rehabilitation of disturbed areas will help to mitigate the impact of the habitat transformation to some extent, but the fragmentation of the habitat due to the construction of the internal road network cannot be mitigated and will remain an impact for the duration of the operational life-time of the facility.

#### 1.7.1.4 Significance of impact after mitigation

While the mitigation will have some effect, very little can be done about the habitat fragmentation, therefore the impact will remain at a moderate level.

### *1.7.2 Displacement of priority species due to disturbance (Construction Phase)*

#### 1.7.2.1 Nature

The displacement of birds from areas within and surrounding wind farms due to visual intrusion and disturbance in effect can amount to a form of habitat loss. Displacement may occur primarily during the construction phase of wind farms and may occur as a result of construction activities. The scale and degree of disturbance will vary according to site- and species-specific factors and must be assessed on a site-by-site basis (Drewitt & Langston 2006).

Unfortunately, few studies of displacement due to disturbance are conclusive, often because of the lack of before-and-after and control-impact (BACI) assessments. Onshore, disturbance distances (in other words the distance from wind farms up to which birds are absent or less abundant than expected) up to 800 m (including zero) have been recorded for wintering waterfowl (Pedersen & Poulsen 1991 as cited by Drewitt & Langston 2006), though 600m is widely accepted as the maximum reliably recorded distance (Drewitt & Langston 2006). The variability of displacement distances is illustrated by one study which found lower post-construction densities of feeding European White-fronted Geese Anser albifrons within 600 m of the turbines at a wind farm in Rheiderland, Germany (Kruckenberg & Jaene 1999 as cited by Drewitt & Langston 2006), while another showed displacement of Pink-footed Geese Anser brachyrhynchus up to only 100–200 m from turbines at a wind farm in Denmark (Larsen & Madsen 2000 as cited by Drewitt & Langston 2006). Indications are that Great Bustard *Otis tarda* could be displaced by wind farms up to one kilometre from the facility (Langgemach 2008). An Austrian study found displacement for Great Bustards up to 600m (Wurm & Kollar as quoted by Raab *et al.* 2009). However, there is also evidence to the contrary; information on Great Bustard received from Spain points to the possibility of continued use of leks at operational wind farms (Camiña 2012b). Research on small grassland species in North America indicates that permanent displacement is uncommon and very species specific (e.g. see Stevens *et al.* 2013, Hale *et al.* 2014). There also seem to be little evidence for a persistent decline in passerine populations at wind farm sites in the UK (despite some evidence of turbine avoidance), with some species, including Skylark, showing increased populations after wind farm construction (see Pierce-Higgins *et al.* 2012). Populations of Thekla Lark *Galerida theklae* were found to be unaffected by wind farm developments in Southern Spain (see Farfan *et al.* 2009).

The consequences of displacement for breeding productivity and survival are crucial to whether or not there is likely to be a significant impact on population size. However, studies of the impact of wind farms on breeding birds are also largely inconclusive or suggest lower disturbance distances, though this apparent lack of effect may be due to the high site fidelity and long life-span of the breeding species studied. This might mean that the true impacts of disturbance on breeding birds will only be evident in the longer term, when new recruits replace existing breeding birds. Few studies have considered the possibility of displacement for short-lived passerines (such as larks), although Leddy *et al.* (1999) found increased densities of breeding grassland passerines with increased distance from wind turbines, and higher densities in the reference area than within 80m of the turbines. A review of minimum avoidance distances of 11 breeding passerines were found to be generally <100m from a wind turbine ranging from 14 – 93m (Hötker *et al.* 2006). A comparative study of nine wind farms in Scotland (Pearce-Higgens *et al.* 2009) found unequivocal evidence of displacement: Seven of the 12 species studied exhibited significantly lower frequencies of occurrence close to the turbines, after accounting for habitat variation, with equivocal evidence of turbine avoidance in a further two. No species were more likely to occur close to the turbines. Levels of turbine avoidance suggest breeding bird densities may be reduced within a 500m buffer of the turbines by 15–53%, with Common Buzzard *Buteo buteo*, Hen Harrier *Circus cyaneus*, Golden Plover *Pluvialis apricaria*, Snipe *Gallinago gallinago*, Curlew *Numenius arquata* and Wheatear *Oenanthe oenanthe* most affected. In a follow-up study, monitoring data from wind farms located on unenclosed upland habitats in the United Kingdom were collated to test whether breeding densities of upland birds were reduced as a result of wind farm construction or during wind farm operation. Red Grouse *Lagopus lagopus scoticus*, Snipe *Gallinago gallinago* and Curlew *Numenius arquata* breeding densities all declined on wind farms during construction. Red Grouse breeding densities recovered after construction, but Snipe and Curlew densities did not. Post-construction Curlew breeding densities on wind farms were also significantly lower than reference sites. Conversely, breeding densities of Skylark *Alauda arvensis* and Stonechat *Saxicola torquata* increased on wind farms during construction. Overall, there was little evidence for consistent post-construction population declines in any species, suggesting that wind farm construction can have greater impacts upon birds than wind farm operation (Pierce-Higgens *et al.* 2012).

The effect of birds altering their migration flyways or local flight paths to avoid a wind farm is also a form of displacement. This effect is of concern because of the possibility of increased energy expenditure when birds have to fly further, as a result of avoiding a large array of turbines, and the potential disruption of linkages between distant feeding, roosting, moulting and breeding areas otherwise unaffected by the wind farm. The effect depends on species, type of bird movement, flight height, distance to turbines, the layout and operational status of turbines, time of day and wind force and direction, and can be highly variable, ranging from a slight 'check' in flight direction, height or speed, through to significant diversions which may reduce the numbers of birds using areas beyond the wind farm (Drewitt & Langston 2006). A review of the literature suggests that none of the barrier effects identified so far have significant impacts on populations (Drewitt & Langston 2006). However, there are circumstances where the barrier effect might lead indirectly to population level impacts; for example, where a wind farm effectively blocks a regularly used flight line between nesting and foraging areas, or where several wind farms interact cumulatively to create an extensive barrier which could lead to diversions of many tens of kilometres, thereby incurring increased energy costs.

#### 1.7.2.2 Significance of impact without mitigation

None of the priority species are likely to be permanently displaced due to disturbance, although displacement in the short term during the construction phase is very likely. The risk of permanent displacement due to disturbance is bigger for large species such as Kori Bustard and Secretarybird although displacement of the closely related Denham's Bustard (*Neotis denhami*) is evidently not happening at existing wind farms in the Eastern Cape (M. Langlands 2016 pers. comm, Rossouw 2016 pers.comm). The overall significance of this impact prior to mitigation is regarded to be moderate, due to the temporary nature.

#### 1.7.2.3 Proposed mitigation measures

Mitigation measures to reduce the impact of displacement due to disturbance associated with construction activities are as follows:

- Restrict the construction activities to the construction footprint area.
- Do not allow any access to the remainder of the property during the construction period.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- The appointed Environmental Control Officer (ECO) should be trained by an avifaunal specialist to identify the signs that indicate possible breeding by priority species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of such species, and such efforts may include the training of construction staff to identify such species, followed by regular questioning of staff as to the regular whereabouts on site of the species. If any priority species are confirmed to be breeding (e.g. if a nest site is found), construction activities within 500m of the breeding site must cease, and the avifaunal specialist will be contacted immediately for further assessment of the situation and instruction on how to proceed.

#### 1.7.2.4 Significance of impact after mitigation

It is envisaged that the impact could be reduced to low with the application of the proposed mitigation measures.

### *1.7.3 Mortality of priority species due to collisions with the turbines (Operational Phase)*

#### 1.7.3.1 Nature[5]

Wind energy generation has experienced rapid worldwide development over recent decades as its environmental impacts are considered to be relatively lower than those caused by traditional energy sources, with reduced environmental pollution and water consumption (Saidur *et al.*, 2011). However, bird fatalities due to collisions with wind turbines have been consistently identified as a main ecological drawback of wind energy (Drewitt and Langston, 2006).

Collisions with wind turbines appear to kill fewer birds than collisions with other man-made infrastructures, such as power lines, buildings or even traffic (Calvert *et al.* 2013; Erickson *et al.* 2005). Nevertheless, estimates of bird deaths from collisions with wind turbines worldwide range from 0 to almost 40 deaths per turbine per year (Sovacool, 2009). The number of birds killed varies greatly between sites, with some sites posing a higher collision risk than others, and with some species being more vulnerable (e.g. Hull *et al.* 2013; May *et al.* 2012a). These numbers may not reflect the true magnitude of the problem, as some studies do not account for detectability biases such as those caused by scavenging, searching efficiency and search radius (Bernardino *et al.* 2013; Erickson *et al.* 2005; Huso and Dalthorp 2014). Additionally, even for low fatality rates, collisions with wind turbines may have a disproportionate effect on some species. For long-lived species with low productivity and slow maturation rates (e.g. raptors), even low mortality rates can have a significant impact at the population level (e.g. Carrete *et al.* 2009; De Lucas *et al.* 2012a; Drewitt and Langston, 2006). The situation is even more critical for species of conservation concern, which sometimes are most at risk (e.g. Osborn *et al.* 1998).

High bird fatality rates at several wind farms have raised concerns among the industry and scientific community. High profile examples include the Altamont Pass Wind Resource Area (APWRA) in California because of high fatality of Golden eagles (*Aquila chrysaetos*), Tarifa in Southern Spain for Griffon vultures (*Gyps fulvus*), Smøla in Norway for White-tailed eagles (*Haliaatus albicilla*), and the port of Zeebrugge in Belgium for gulls (Larus sp.) and terns (Sterna sp.) (Barrios and Rodríguez, 2004; Drewitt and Langston, 2006; Everaert and Stienen, 2008; May *et al.* 2012a; Thelander *et al.* 2003). Due to their specific features and location, and characteristics of their bird communities, these wind farms have been responsible for a large number of fatalities that culminated in the deployment of additional measures to minimize or compensate for bird collisions. However, currently, no simple formula can be applied to all sites; in fact, mitigation measures must inevitably be defined according to the characteristics of each wind farm and the diversity of species occurring there (Hull *et al.* 2013; May *et al.* 2012b). An in-depth understanding of the factors that explain bird collision risk and how they interact with one another is therefore crucial to proposing and implementing valid mitigation measures.

<u>Species-specific factors</u>

- Morphological features

Certain morphological traits of birds, especially those related to size, are known to influence collision risk with structures such as power lines and wind turbines. The most likely reason for this

[5] This section is adapted from a review paper by Ana Teresa Marques, Helena Batalha, Sandra Rodrigues, Hugo Costa, Maria João Ramos Pereira, Carlos Fonseca, Miguel Mascarenhas, Joana Bernardino. Understanding bird collisions at wind farms: An updated review on the causes and possible mitigation strategies. Biological Conservation 179 (2014) 40–52

is that large birds often need to use thermal and orographic updrafts to gain altitude, particularly for long distance flights. Thermal updrafts (thermals) are masses of hot, rising wind that form over heated surfaces, such as plains. Being dependent on solar radiation, they occur at certain times of the year or the day. Conversely, orographic lift (slope updraft), is formed when wind is deflected by an obstacle, such as mountains, slopes or tall buildings. Soaring birds use these two types of lift to gain altitude (Duerr *et al.* 2012). Janss (2000) identified weight, wing length, tail length and total bird length as being collision risk determinant. Wing loading (ratio of body weight to wing area) and aspect ratio (ratio of wing span squared to wing area) are particularly relevant, as they influence flight type and thus collision risk (Bevanger, 1994; De Lucas *et al.* 2008; Herrera-Alsina *et al.* 2013; Janss, 2000). Birds with high wing loading, such as the Griffon Vulture (*Gyps fulvus*), seem to collide more frequently with wind turbines at the same sites than birds with lower wing loadings, such as Common Buzzards (*Buteo buteo*) and Short-toed Eagles (*Circaetus gallicus*), and this pattern is not related with their local abundance (Barrios and Rodríguez, 2004; De Lucas *et al.* 2008). High wing-loading is associated with low flight manoeuvrability (De Lucas *et al.* 2008), which determines whether a bird can escape an encountered object fast enough to avoid collision.

- Sensorial perception

Birds are assumed to have excellent visual acuity, but this assumption is contradicted by the large numbers of birds killed by collisions with man-made structures (Drewitt and Langston, 2008; Erickson *et al.* 2005). A common explanation is that birds collide more often with these structures in conditions of low visibility, but recent studies have shown that this is not always the case (Krijgsveld *et al.* 2009). The visual acuity of birds seems to be slightly superior to that of other vertebrates (Martin, 2011; McIsaac, 2001). Unlike humans, who have a broad horizontal binocular field of 120°, some birds have two high acuity areas that overlap in a very narrow horizontal binocular field (Martin, 2011). Relatively small frontal binocular fields have been described for several species that are particularly vulnerable to power line collisions, such as vultures (Gyps sp.) cranes and bustards (Martin and Katzir, 1999; Martin and Shaw, 2010; Martin, 2012, 2011; O'Rourke *et al.* 2010). Furthermore, for some species, their high-resolution vision areas are often found in the lateral fields of view, rather than frontally (e.g. Martin and Shaw, 2010; Martin, 2012, 2011; O'Rourke *et al.* 2010). Finally, some birds tend to look downwards when in flight, searching for conspecifics or food, which puts the direction of flight completely inside the blind zone of some species (Martin and Shaw, 2010; Martin, 2011). For example, the visual fields of vultures (Gyps sp.) include extensive blind areas above, below and behind the head and enlarged supra-orbital ridges (Martin *et al.* 2012). This, combined with their tendency to angle their head toward the ground in flight, might make it difficult for them to see wind turbines ahead, which might at least partially explain their high collision rates with wind turbines (Martin, 2012).

Currently, there is little information on whether noise from wind turbines can play a role in bird collisions with wind turbines. Nevertheless, wind turbines with whistling blades are expected to experience fewer avian collisions than silent ones, with birds hearing the blades in noisy (windy) conditions. However, the hypothesis that louder blade noises (to birds) result in fewer fatalities has not been tested so far (Dooling, 2002).

- Phenology

It has been suggested that resident birds would be less prone to collision, due to their familiarity with the presence of the structures (Drewitt and Langston, 2008). However, recent studies have shown that, within a wind farm, raptor collision risk and fatalities are higher for resident than for migrating birds of the same species. An explanation for this may be that resident birds generally use the wind farm area several times while a migrant bird crosses it just once (Krijgsveld *et al.* 2009). However, other factors like bird behaviour are certainly relevant. Katzner *et al.* (2012) showed that Golden Eagles performing local movements fly at lower altitudes, putting them at a greater risk of collision than migratory eagles. Resident eagles flew more frequently over cliffs and steep slopes, using low altitude slope updrafts, while migratory eagles flew more frequently over flat areas and gentle slopes, where thermals are generated, enabling the birds to use them to gain lift and fly at higher altitudes. Also, Johnston *et al.* (2014) found that during migration when visibility is good Golden Eagles can adjust their flight altitudes and avoid the wind turbines.

At two wind farms in the Strait of Gibraltar, the majority of Griffon Vulture deaths occurred in the winter. This probably happened because thermals are scarcer in the winter, and resident vultures in that season probably relied more on slope updrafts to gain lift (Barrios and Rodríguez, 2004). The strength of these updrafts may not have been sufficient to lift the vultures above the turbine blades, thereby exposing them to a higher collision risk. Additionally, migrating vultures did not seem to follow routes that crossed these two wind farms, so the number of collisions did not increase during migratory periods. Finally, at Smøla, collision risk modelling showed that White-tailed Eagles are most prone to collide during the breeding season, when there is increased flight activity in rotor swept zones (Dahl *et al.* 2013).

The case seems to be different for passerines, with several studies documenting high collision rates for migrating passerines at certain wind farms, particularly at coastal or offshore sites. However, comparable data on collision rates for resident birds is lacking. This lack of information may result from fewer studies, lower detection rates and rapid scavenger removal (Johnson *et al.* 2002; Lekuona and Ursua, 2007). One of the few studies reporting passerine collision rates (from Navarra, northern Spain) documents higher collision rates in the autumn migration period, but it is unclear if this is due to migratory behaviour or due to an increase in the number of individuals because of recently fledged juveniles (Lekuona and Ursua, 2007).

- Bird behaviour

Flight type seems to play an important role in collision risk, especially when associated with hunting and foraging strategies. Kiting flight, which is used in strong winds and occurs in rotor swept zones, has been highlighted as a factor explaining the high collision rate of Red-tailed Hawks (*Buteo jamaicensis*) at APWRA (Hoover and Morrison, 2005). The hovering behaviour exhibited by Common Kestrels (*Falco tinnunculus*) when hunting may also explain the fatality levels of this species at wind farms in the Strait of Gibraltar (Barrios and Rodríguez, 2004). Kiting and hovering are associated with strong winds, which often produce unpredictable gusts that may suddenly change a bird's position (Hoover and Morrison, 2005). Additionally, while birds are hunting and focused on prey, they might lose track of wind turbine positions (Krijgsveld *et al.* 2009; Smallwood *et al.* 2009).

Collision risk may also be influenced by behaviour associated with a specific sex or age. In Belgium, only adult Common Terns (*Sterna hirundo*) were impacted by a wind farm (Everaert and Stienen, 2007) and the high fatality rate was sex-biased (Stienen *et al.* 2008). In this case, the wind farm is located in the foraging flight path of an important breeding colony, and the differences between fatality of males and females can be explained by the different foraging activity during egg-laying and incubation (Stienen *et al.* 2008). Another example comes from Portugal, where recent findings showed that the mortality of the Skylark (Alauda arvensis) is sex and age biased and affecting mainly adult males. This was related with the characteristic breeding male song-flights that make them more vulnerable to collision with wind turbines (Morinha *et al.* 2014). It seems this may also be responsible for mortalities of Red-capped Lark (*Calandrella cinerea*) at a wind farm in South Africa (Ralston, M. in litt. 2016).

Social behaviour may also result in a greater collision risk with wind turbines due to a decreased awareness of the surroundings. Several authors have reported that flocking behaviour increases collision risk with power lines as opposed to solitary flights (e.g. Janss, 2000). However, caution must be exercised when comparing the particularities of wind farms with power lines, as some species appear to be vulnerable to collisions with power lines but not with wind turbines, e.g. indications are that bustards, which are highly vulnerable to power line collisions, are not prone to wind turbine collisions – a Spanish database of over 7000 recorded turbine collisions contains no Great Bustards *Otis tarda* (A. Camiña 2012a). The same may be true for Blue Crane, as preliminary indications are that the species are not particularly vulnerable to turbine collisions (Ralston *et al.* 2017), despite being highly vulnerable to powerlines collisions.

Several collision risk models incorporate other variables related to bird behaviour. Flight altitude is widely considered important in determining the risk of bird collisions with offshore and onshore wind turbines, as birds that tend to fly at the height of rotor swept zones are more likely to collide (e.g. Band *et al.* 2007; Furness *et al.* 2013; Garthe and Hüppop, 2004).

- Avoidance behaviours

Collision fatalities are also related to displacement and avoidance behaviours, as birds that do not exhibit either of these behaviours are more likely to collide with wind turbines. The lack of avoidance behaviour has been highlighted as a factor explaining the high fatality of White-tailed Eagles at Smøla wind farm, as no significant differences were found in the total amount of flight activity within and outside the wind farm area (Dahl *et al.* 2013). However, the birds using the Smøla wind farm are mainly sub-adults, indicating that adult eagles are being displaced by the wind farm (Dahl *et al.* 2013).

Two types of avoidance have been described (Furness *et al.*, 2013): 'macro-avoidance' whereby birds alter their flight path to keep clear of the entire wind farm (e.g. Desholm and Kahlert, 2005; Plonczkier and Simms, 2012; Villegas-Patraca *et al.* 2014), and 'micro-avoidance' whereby birds enter the wind farm but take evasive actions to avoid individual wind turbines (Band *et al.* 2007). This may differ between species and may have a significant impact on the size of the risk associated with a specific species. It is generally assumed that 95-98% of birds will successfully avoid the turbines (SNH 2010). It is also important to note that there is not necessarily a direct correlation between time spent at rotor height, and the likelihood of collision.

Displacement due to wind farms, which can be defined as reduced bird breeding density within a short distance of a wind turbines, has been described for some species (Pearce-Higgins *et al.* 2009). Birds exhibiting this type of displacement behaviour when defining breeding territories are less vulnerable to collisions, not because of morphological or site-specific factors, but because of altered behaviour.

- Bird abundance

Some authors suggest that fatality rates are related to bird abundance, density or utilization rates (Carrete *et al.* 2012; Kitano and Shiraki, 2013; Smallwood and Karas, 2009), whereas others point out that, as birds use their territories in a non-random way, fatality rates do not depend on bird abundance alone (e.g. Ferrer *et al.* 2012; Hull *et al.* 2013; Smallie 2015). Instead, fatality rates depend on other factors such as differential use of specific areas within a wind farm (De Lucas *et al.* 2008). For example, at Smøla, White-tailed Eagle flight activity is correlated with collision fatalities (Dahl *et al.* 2013). In the APWRA, Golden Eagles, Red-tailed Hawks and American Kestrels (*Falco spaverius*) have higher collision fatality rates than Turkey Vultures (*Cathartes aura*) and Common Raven (*Corvus corax*), even though the latter are more abundant in the area (Smallwood *et al.* 2009), indicating that fatalities are more influenced by each species' flight behaviour and turbine perception. Also, in southern Spain, bird fatality was higher in the winter, even though bird abundance was higher during the pre-breeding season (De Lucas *et al.* 2008).

- Landscape features

Susceptibility to collision can also heavily depend on landscape features at a wind farm site, particularly for soaring birds that predominantly rely on wind updrafts to fly (see previous section). Some landforms such as ridges, steep slopes and valleys may be more frequently used by some birds, for example for hunting or during migration (Barrios and Rodríguez, 2004; Drewitt and Langston, 2008; Katzner *et al.* 2012; Thelander *et al.* 2003). In APWRA, Red-tailed Hawk fatalities occur more frequently than expected by chance at wind turbines located on ridge tops and swales, whereas Golden Eagle fatalities are higher at wind turbines located on slopes (Thelander *et al.* 2003). Other birds may follow other landscape features, such as peninsulas and shorelines, during dispersal and migration periods. Kitano and Shiraki (2013) found that the collision rate of White-tailed Eagles along a coastal cliff was extremely high, suggesting an effect of these landscape features on fatality rates.

- Flight paths

Although the abundance of a species per se may not contribute to a higher collision rate with wind turbines, as previous discussed, areas with a high concentration of birds seem to be particularly at risk of collisions (Drewitt and Langston, 2006), and therefore several guidelines on wind farm construction advise special attention to areas located in migratory paths (e.g. Atienza *et al.* 2012; CEC, 2007; USFWS, 2012). As an example, Johnson *et al.* (2002) noted that over two-thirds of the carcasses found at a wind farm in Minnesota were of migrating birds. At certain times of the year, nocturnally migrating passerines are the most abundant species at wind farm, particularly during spring and fall migrations, and are also the most common fatalities (Strickland *et al.* 2011).

For territorial raptors like Golden Eagles, foraging areas are preferably located near to the nest, when compared to the rest of their home range. For example, in Scotland 98% of movements were registered at ranges less than 6 km from the nest, and the core areas were located within a 2–3 km radius (McGrady *et al.* 2002). These results, combined with the terrain features selected by Golden Eagles to forage such as areas closed to ridges, can be used to predict the areas used by the species to forage (McLeod *et al.* 2002), and therefore provide a sensitivity map and guidance to the development of new wind farms (Bright *et al.* 2006). In Spain, on the other hand, a study spanning 7 provinces with an estimated Golden Eagle population of 384 individuals, with a combined total of 46 years of post-construction monitoring, involving 5 858 turbines, collisions did not occur at the nearest wind farm to the nest site but occurred in hunting areas with high prey availability far from the breeding territories, or randomly. A subset of data was used to investigate, inter alia, the relationship between collision mortality and proximity to wind turbines. Data was gathered for over a 12-year period. Analysis revealed that collisions are not related with the distance from the nest to the nearest turbine (Camiña 2014).

Wind farms located within flight paths can increase collision rates, as seen for the wind farm located close to a seabird breeding colony in Belgium (Everaert and Stienen, 2008). In this case, wind turbines were placed along feeding routes, and several species of gulls and terns were found to fly between wind turbines on their way to marine feeding grounds. Additionally, breeding adults flew closer to the structures when making frequent flights to feed chicks, which potentially increased the collision risk.

- Food availability

Factors that increase the use of a certain area or that attract birds, like food availability, also play a role in collision risk. For example, the high density of raptors at the APWRA and the high collision fatality due to collision with turbines is thought to result, at least in part, from high prey availability in certain areas (Hoover and Morrison, 2005; Smallwood *et al.* 2001). This may be particularly relevant for birds that are less aware of obstructions such as wind turbines while foraging (Krijgsveld *et al.* 2009; Smallwood *et al.* 2009). It is speculated that the mortality of three Verreaux's Eagles in 2015 at a wind farm site in South Africa may have been linked to the opportunistic foraging due to availability of food (Smallie 2015).

- Weather

Certain weather conditions, such as strong winds that affect the ability to control flight manoeuvrability or reduce visibility, seem to increase the occurrence of bird collisions with artificial structures (Longcore *et al.* 2013). Some high bird fatality events at wind farms have been reported during instances of poor weather. For example, at an offshore research platform in Helgoland, Germany, over half of the bird strikes occurred on just two nights that were characterized by very poor visibility (Hüppop *et al.* 2006). Elsewhere, 14 bird carcasses were found at two adjacent wind turbines after a severe thunderstorm at a North American wind farm (Erickson *et al.* 2001). However, in these cases, there may be a cumulative effect of bad weather and increased attraction to artificial light. Besides impairing visibility, low altitude clouds can in turn lower bird flight height, and therefore increasing their collision risk with tall obstacles (Langston and Pullan, 2003). For wind farms located along migratory routes, the collision risk may not be the same throughout a 24-

h period, as the flight altitudes of birds seem to vary. The migration altitudes of soaring birds have been shown to follow a typically diurnal pattern, increasing during the morning hours, peaking toward noon, and decreasing again in the afternoon, in accordance with general patterns of daily temperature and thermal convection (Kerlinger, 2010; Shamoun-Baranes *et al.* 2003).

Collision risk of raptors is particularly affected by wind. For example, Golden Eagles migrating over a wind farm in Rocky Mountain showed variable collision risk according to wind conditions, which decreased when the wind speed raised and increased under head- and tailwinds when compared to western crosswinds (Johnston *et al.* 2014).

- Turbine features

Turbine features may play a role in collision risk. Older lattice-type towers have been associated with high collision risk, as some species exhibiting high fatality rates used the turbine poles as roosts or perches when hunting (Osborn *et al.* 1998; Thelander and Rugge, 2000). However, in more recent studies, tower structure did not influence the number of bird collisions, as it was not higher than expected according to their availability when compared to collisions with tubular turbines (Barrios and Rodríguez, 2004).

Turbine size has also been highlighted as an important feature, as higher towers have a larger rotor swept zone and, consequently, a larger collision risk area. While this makes intuitive sense, the majority of published scientific studies indicate that an increase in rotor swept area do not automatically translate into a larger collision risk. Turbine dimensions seem to play an insignificant role in the magnitude of the collision risk in general, relative to other factors such as topography, turbine location, morphology and a species' inherent ability to avoid the turbines, and may only be relevant in combination with other factors, particularly wind strength and topography (see Howell 1997, Barrios & Rodriguez 2004; Barclay *et al.* 2007, Krijgsveld *et al.* 2009, Smallwood 2013; Everaert 2014). However, some studies did find a correlation between turbine hub height and mortality (De Lucas *et al.* 2008; Loss *et al.* 2013). In the most recent paper on the subject by Thaxter *et al.* (2017), the authors conducted a systematic literature review of recorded collisions between birds and wind turbines within developed countries. They related collision rate to species-level traits and turbine characteristics to quantify the potential vulnerability of 9538 bird species globally. For birds, larger turbine capacity (megawatts) increased collision rates; however, deploying a smaller number of large turbines with greater energy output reduced total collision risk per unit energy output. In other words, although there was a positive relationship between wind turbine capacity and collision rate per turbine, the strength of this relationship was insufficient to offset the reduced number of turbines required per unit energy generation with larger turbines. Therefore, to minimize bird collisions, wind farm electricity generation capacity should be met through deploying fewer, large turbines, rather than many, smaller ones.

Rotor speed (revolutions per minute) also seems to be relevant, as faster rotors are responsible for higher fatality rates (Thelander *et al.* 2003). However, caution is needed when analysing rotor speed alone, as it is usually correlated with other features that may influence collision risk as turbine size, tower height and rotor diameter (Thelander *et al.* 2003), and because rotor speed is not proportional to the blade speed. In fact, fast spinning rotors have fast moving blades, but rotors with lower resolutions per minute may drive higher blade tip speeds.

- Blade visibility

When turbine blades spin at high speeds, a motion smear (or motion blur) effect occurs, making wind turbines less conspicuous. This effect occurs both in the old small turbines that have high rotor speed and in the newer high turbines that despite having slower rotor speeds, achieve high blade tip speeds. Motion smear effect happens when an object is moving too fast for the brain to process the images and, as a consequence, the moving object appears blurred or even transparent to the observer. The effect is dependent on the velocity of the moving object and the distance between the object and the observer. The retinal-image velocity of spinning blades increases as birds get closer to them, until it eventually surpasses the physiological limit of the avian retina to process temporally changing stimuli. As a consequence, the blades may appear transparent and perhaps the rotor swept zone appears to be a safe place to fly (Hodos, 2003). For example, McIsaac (2001) showed that American Kestrels were not always able to distinguish moving turbine blades within a range of light conditions.

Recent experiments at the Smøla Wind Power facility in Norway where one turbine blade was painted black to reduce motion smear, led to a 70.9% reduction in the number of recorded collisions per search (Stokke *et al.* 2017).

- Wind farm configuration

Wind farm lay-out can also have a critical influence on bird collision risk. For example, it has been demonstrated that wind farms arranged perpendicularly to the main flight path may be responsible for a higher collision risk (Everaert *et al.* 2002 & Isselbacher and Isselbacher, 2001 in Hötker *et al.* 2006). At APWRA, wind turbines located at the ends of rows, next to gaps in rows, and at the edge of local clusters were found to kill disproportionately more birds (Smallwood and Thellander, 2004). In this wind farm, serially arranged wind turbines that form wind walls are safer for birds (suggesting that birds recognize wind turbines and towers as obstacles and attempt to avoid them while flying), and fatalities mostly occur at single wind turbines or wind turbines situated at the edges of clusters (Smallwood and Thellander, 2004). However, this may be a specificity of APWRA. For instance, De Lucas *et al.* (2012a) found that the positions of the wind turbines within a row did not influence the turbine fatality rate of Griffon Vultures at Tarifa. Additionally, engineering features of the newest wind turbines require a larger minimum distance between adjacent wind turbines and in new wind farms it is less likely that birds perceive rows of turbines as impenetrable walls. In fact, in Greece it was found that the longer the distance between wind turbines, the higher is the probability that raptors will attempt to cross the space between them (Cárcamo *et al.* 2011).

#### 1.7.3.2 Significance of impact without mitigation

<u>Species-specific factors</u>

Priority species that could potentially be vulnerable to wind turbine collisions due to morphological features (high wing loading) are Northern Black Korhaan, Grey-winged Francolin and Kori Bustard. It is noted though that no bustard mortalities have as yet been reported in published literature at wind farms in South Africa, despite initial concerns that they might be vulnerable in this respect (Ralston - Patton *et al.* 2017). Specific behaviour of some terrestrial species might put them at risk of collision, e.g. display flights of Northern Black Korhaan might place them within the rotor swept zone, but the species was not recorded during pre-construction monitoring, possibly due to hunting pressure. It is also noted that very little flight activity of terrestrial species was recorded during the 12-months pre-construction monitoring.

Many of the priority species potentially occurring at the proposed WEF development area probably have high resolution vision areas found in the lateral fields of view, rather than frontally, e.g. Northern Black Korhaan, Grey-winged Francolin, African Rock-Pipit and Double-banded Courser. The possible exceptions to this are the raptors which all have wider binocular fields, although as pointed out by Martin (2011, 2012), this does not necessarily result in these species being able to avoid obstacles better. It is therefore unlikely that differences in sensorial perception will play a significant role in the collision risk associated with priority species at the proposed wind farm, as behaviour is more important from a risk perspective.

While it is anticipated that birds at the proposed wind farm will successfully avoid the wind turbines most of the time, possible exceptions might be raptors (especially Lesser Kestrel, Jackal Buzzard and possibly Verreaux's Eagle) engaged in hunting which might serve to distract them and place them at risk of collision, or birds engaged in display behaviour, e.g. Northern Black Korhaan (see earlier point).

Based on the potential time spent flying at rotor height, soaring species are likely to be at greater risk of collision, especially Lesser Kestrel, which may be highly vulnerable to turbine collisions (Ralston-Patton *et al.* 2017). The closely related Amur Falcon is currently the species with the highest confirmed mortality due to collisions with wind turbines at South African wind farms (Ralston-Patton *et al.* 2017), it is therefore expected that Lesser Kestrel, which has a similar style of foraging, would display a similar high vulnerability to collisions. Verreaux's Eagle, which was recorded briefly, emerged with the second highest collision risk rating, which indicates that while the risk of collisions for the species may not be as high as a site with an active breeding pair, it cannot be entirely excluded. The risk rating for Jackal Buzzard is very low, compared to wind farm sites elsewhere (Van Rooyen *et al.* unpublished data)[6], yet the species is highly vulnerable to collisions with turbines, therefore the potential for collisions cannot be discounted.

The abundance of priority species at the proposed wind farm site will fluctuate depending on season of the year, and particularly in response to rainfall. This is a common phenomenon in arid ecosystems, where stochastic rainfall events can trigger irruptions of insect populations which in turn attract large numbers of birds. This is particularly likely to be the case with Lesser Kestrels. In general, higher populations of priority species are likely to be present when the veld conditions are good, especially in the rainy season. In the case of Verreaux's Eagles, mortality has been correlated with high flight activity (Ralston-Patton *et al.* 2017), but at least one Verreaux's Eagle mortality has been confirmed at a wind farm where no pre-construction flight activity was recorded for the species (Van Rooyen unpubl. data), indicating that for this species, low abundance does not entirely exclude the potential for collision mortality. As far as Jackal Buzzard is concerned, the species has proven to be highly susceptible to wind turbine collisions (Ralston-Patton *et al.* 2017), and the low reporting rate for the species at the WEF development area therefore does not exclude the possibility of collisions.

<u>Site-specific factors</u>

Landscape features are likely to play an important role at the WEF development area. The proposed turbine zones at the WEF development area are virtually surrounded by slopes. The slopes are generally not very steep, but in some areas the drop-off from the plateau at the ridge top is more pronounced. The slopes are likely to be important landscape features for soaring species, particularly raptors such as Jackal Buzzard, Booted Eagle, Verreaux's Eagle and Lesser Kestrel, due to the presence of declivity currents, especially at the steeper slopes, which will require a set-back from the edge to reduce the risk of collision for soaring raptors. The flight activity map for Verreaux's Eagle points towards a concentration of flight activity along the ridges. In the case of the Lesser Kestrels, the grass covered slopes seems to be the area of choice. It is therefore necessary to buffer the edges of the escarpment, as it is likely to be the area where most of the raptor flight activity will take place at turbine height. Other areas which can be specifically pinpointed as potentially sensitive are the water points, i.e. areas of surface water, which are likely to attract a variety of raptors. See Figure 9 indicating proposed avifaunal turbine-free buffer zones, linked to the presence of surface water and slopes.

The proposed WEF development area is not located on any known migration route. The migratory Lesser Kestrels at the site can be regarded as summer residents as they will remain in the area as long as there are adequate food supplies. In semi-arid zones such as where this proposed wind farm is located, food availability is often linked to rainfall. It is a well-known fact that insect outbreaks may occur after rainfall events, which could draw in various priority species, and particularly Lesser Kestrel. This in turn could heighten the risk of collisions.

Rock piles which are created as a result of construction activities at the proposed site could create habitat for Rock Hyrax, which in turn could result in Verreaux's Eagles being attracted to the area and exposing themselves to collision risk. However, the habitat at the wind farm as it currently stands is not ideal for Rock Hyrax as it lacks the boulder strewn slopes that the animal require for

[6] A dataset comprising 12 potential wind farm sites where the species was recorded during monitoring, recorded collision risk ratings for Jackal Buzzard ranging from 1.38 to 283.

shelter. It is therefore not expected that Verreaux's Eagles will regularly forage over the site, but occasional forays cannot be excluded.

Weather conditions at the proposed wind farm are likely to influence flight behaviour in much the same manner as has been recorded elsewhere at wind farms. Analysis of the flight data collected during the pre-construction monitoring indicates that the majority of soaring flights happened during fresh breezes, in winds with a predominantly easterly orientation (see Appendix 4 tables F and G). However, the overall low incidence of priority species flight activity means the confidence in these predictions are low due to paucity of data.

Wind farm-specific factors

Due to the fact that the turbine dimensions are constantly changing as newer models are introduced, it is best to take a pre-cautionary approach in order to anticipate any future potential changes in the turbine dimensions. The pre-construction monitoring programme worked on a potential rotor swept area of 30m – 220m above ground to incorporate a wide range of models, which accommodates the current proposed turbines. The latest published literature on the subject recommends that to minimize bird collisions, wind farm electricity generation capacity should be met through deploying fewer, large turbines, rather than many, smaller ones (Thaxter *et al.* 2017). Any reduction of the current complement of 47, 4.5MW proposed turbines should therefore lower the collision risk for birds. Several of the proposed turbines are currently placed close to ridge edges, which heightens the risk of turbine collisions for soaring raptors.

Conclusion

The pre-mitigation impact of mortality due to turbine collisions is rated to be of moderate significance. While the topography of the terrain (many slopes) contributes to the risk of collisions, especially for soaring species, the very low reporting rate for priority species[7] reduces the chances of the impact materialising with regularity.

#### 1.7.3.3 Proposed mitigation measures

The following proposed mitigation measures could reduce the risk of mortality through collisions with the turbines:

- A 100m no-turbine set-back buffer zone (other infrastructure is allowed) is recommended around selected ridge edges to minimise the risk of collisions for slope soaring species (see Figure 9).
- A 300m no turbine buffer zone (other infrastructure allowed) is recommended around selected water points (see Figure 9).
- Care should be taken not to create habitat for prey species that could draw Verreaux's Eagles into the area and expose them to collision risk. Rock piles must be removed from site or covered with topsoil to prevent them from becoming habitat for Rock Hyrax.
- One blade of each turbine should be painted black to reduce the potential for motion smear and thereby reduce the risk of raptor collisions.
- The avifaunal specialist, in consultation with external experts and relevant NGO's such as BLSA, should determine annual mortality thresholds for priority anticipated to be at risk of collision mortality, prior to the wind farm going operational.
- If actual collision rates approach the pre-determined threshold levels, curtailment of turbines should be implemented for high risk situations.
- In the event of a massive influx of Lesser Kestrels due to an irruption of insects, pro-active curtailment must be implemented under the guidance of the avifaunal specialist. A site-specific regime must be designed in consultation with the wind farm operator which will specify the

[7] The passage rate of 0.05 birds/hour is equal to the lowest of all the passage rates for priority species at 36 potential wind farms sites where the authors implemented pre-construction monitoring.

duration of the curtailment period as well as the specific time of the day when the turbines will be curtailed.

Rationale: The impact is likely to persist for the operational life-time of the project. Implementation of the proposed mitigation measures should reduce the probability and severity of the impact on priority species to such an extent that the overall significance should be reduced to low.

#### 1.7.3.4 Significance of impact after mitigation

It is envisaged that the impact could be reduced to low with the application of the proposed mitigation measures.

### *1.7.4 Displacement of priority species due to disturbance (De-commissioning Phase)*

#### 1.7.4.1 Nature

Displacement occurs primarily during the construction phase of wind farms and may occur as a result of construction activities (see 1.6.2 above). However, temporary displacement could also happen due to activities related to the dismantling of the wind farm after its operational life-time. In theory, the wind farm's operational lifetime is about 20 – 25 years, after which it is supposed to be de-commissioned and dismantled. The scale and degree of disturbance will vary according to site- and species-specific factors and must be assessed on a site-by-site basis.

#### 1.7.4.2 Significance of impact without mitigation

None of the priority species are likely to be permanently displaced due to disturbance during the de-commissioning phase, although displacement in the short term is very likely. The overall significance of this impact prior to mitigation is regarded to be moderate, due to the temporary nature.

#### 1.7.4.3 Proposed mitigation measures

Mitigation measures to reduce the impact of displacement due to disturbance associated with de-commissioning activities are as follows:

- Restrict the activities to the footprint area.
- Do not allow any access to the remainder of the property during the de-commissioning period.
- Measures to control noise and dust should be applied according to current best practice in the industry.
- Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
- The appointed Environmental Control Officer (ECO) should be trained by an avifaunal specialist to identify the signs that indicate possible breeding by priority species. The ECO must then, during audits/site visits, make a concerted effort to look out for such breeding activities of such species, and such efforts may include the training of staff to identify such species, followed by regular questioning of staff as to the regular whereabouts on site of the species. If any priority species are confirmed to be breeding (e.g. if a nest site is found), activities within 500m of the breeding site must cease, and the avifaunal specialist will be contacted immediately for further assessment of the situation and instruction on how to proceed.

#### 1.7.4.4 Significance of impact after mitigation

It is envisaged that the impact could be reduced to low with the application of the proposed mitigation measures.

### *1.7.5 Cumulative Impacts*

Table 5 lists the renewable energy applications are currently registered with DEA within a 50km radius around the proposed WEF:

**Table 5: Renewable energy facilities proposed within a 50km radius around the proposed WEF**

| Name | DEA reference number | Status | Was a bird impact assessment study compiled? | Recommendations pertaining specifically to bird impacts |
|---|---|---|---|---|
| Keren Energy Whitebank Solar Plant On Farm Whitebank 379, Kuruman, Northern Cape Province | 14/12/16/3/3/1/475 | Approved | Unknown, no reports were found on the internet | Unknown |
| Solar farm for Bestwood, Kgalagadi District Municipality, NC | 12/12/20/1906 | Approved | Yes. The findings were that the project should have minimal impact on Red Data avifauna | None listed in the EIA report |
| Kathu Solar PV Energy Facility | 14/12/16/3/3/2/911 | Approved | No, only an ecological report | None |
| 75 MW AEP Legoko Photovoltaic Solar Facility | 14/12/16/3/3/2/819 | Approved | No, only an ecological report | None |
| 75 MW AEP Mogobe Photovoltaic Solar Facility | 14/12/16/3/3/2/820 | Approved | No, only an ecological report | None |
| Kalahari Solar Power Project | 12/12/20/1994/AM4 | Approved | No, only an ecological report | • Avoiding the removal of Acacia trees that have breeding raptors present until the conclusion of the breeding season at the end of November;<br>• Raptor-proofing all open reservoirs, dams or ponds to allow birds to drink and bathe, preventing drowning, and thus contributing to raptor conservation<br>• Bird-unsafe electrical servitudes must be modified by Eskom to insulate dangerous live components, and to cut a gap in the earth wire – perch deterrents can also be installed to keep birds away from the dangerous areas on the structure. |

| | | | | |
|---|---|---|---|---|
| San Solar Energy Facility | 14/12/16/3/3/2/273/AM1 | Approved | No, only an ecological report | Fit power-lines with suitable reflectors to enhance their visibility to birds, and fit pylons with suitable deterring structures to discourage birds from perching on such structures |
| 115 Megawatt (MW) Boitshoko Solar Power Plant | 14/12/16/3/3/2/935 | Approved | Yes | All new transmission lines be marked with bird diverters, as they go up. The priority areas - those with the highest mortality rate - should be considered first.<br><br>There are three classes of mitigation for the PV panels: (i) move them well away from highly sensitive bird area (especially pans or other well-used bird areas), or (ii) employ bird-diverters to deter birds mistaking the panels for open water. If, in the post-construction monitoring, hornbills are found to attack their own reflections in the panels, and smash them, then covering the affected panels with a fine wire mesh is recommended.<br>It is also recommended that Boitshoko install video cameras above some panels for postconstruction monitoring of any mortality of birds in the vicinity, through direct observation and carcass searches in a systematic and regular fashion. |
| 25MW Kathu2 Solar Energy Facility, Northern Cape Province | 12/12/20/1858/2/AM2 | Approved | No information on this project as available on the internet | No information on this project as available on the internet |
| Sishen Solar Farm | 12/12/20/1977 | Lapsed/ withdrawn | N/A | N/A |
| 150mw Adams Photo-Voltaic Solar Energy Facility | 12/12/20/2567 | Approved | No, only an ecological report | None |
| Proposed renewable energy generation project on Portion 1 of the Farm Shirley No. 367, Kuruman RD, Gamagara Local Municipality, Shirley Solar Park | 14/12/16/3/3/2/616 | Approved | No, only an ecological report | The high-risk sections of the power line should be marked with a suitable anti-collision marking device on the earth wire as per the Eskom guidelines |

#### 1.7.5.1 Nature

A cumulative impact, in relation to an activity, is the impact of an activity that may not be significant on its own but may become significant when added to the existing and potential impacts arising from similar or other activities in the area.

There are currently no wind energy facilities planned within a 50km radius around the proposed WEF, but at least 11 solar PV facilities. The primary potential long-term impact of these solar facilities on avifauna, is displacement due to habitat transformation.

#### 1.7.5.2 Significance of impact before mitigation

The mitigation measures pertaining to avifauna in the existing applications for solar plants do not address the issue of displacement due to habitat transformation, as this impact cannot be effectively mitigated at solar facilities for the majority of avifauna. The question is therefore to what extent the relatively moderate envisaged impact of displacement at the WEF will increase in significance when viewed collectively with the aggregate impact of displacement of all the renewable energy facilities combined. The total land parcel area covered by current solar applications is approximately 222km². This amounts to 2.7% of the total area of 8 136km² contained in the 50km radius around the proposed WEF. The land parcel area for the WEF is approximately 73km². If this is added to the solar applications, it comes to 295km², or approximately 3.6% of the total area encompassed in a 50km radius around the proposed WEF. While this is a significant increase in the area to be potentially transformed, it still only a fraction of the total available habitat. It should also be borne in mind that the actual development footprint for all these applications is usually considerably smaller than the land parcel. It therefore follows that the significance of the cumulative displacement impact of the WEF, viewed with the other potential renewable energy projects, is still relatively moderate.

#### 1.7.5.3 Proposed mitigation measures

As mentioned already, the impact of displacement due to habitat transformation is difficult to mitigate in the case of solar plants, because it involves the physical footprint of the infrastructure, which cannot be avoided. In the case of the WEF, the impact not only involves the physical footprint of the infrastructure, which is relatively minor, but also the habitat fragmentation which is caused by the network of roads. The mitigation measures listed below, or variations of them, are recommended at all the proposed renewable energy projects:

- The recommendations of the specialist ecological study must be strictly adhered to, to limit the habitat destruction.
- Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.
- Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist.

#### 1.7.5.4 Significance of impact after mitigation

The mitigation measures listed above will address the issue of displacement to some extent, but due to the inherent nature of the displacement impact, the significance of the impacts will likely remain at a moderate level, even after mitigation.

## 1.8 IMPACT ASSESSMENT SUMMARY

The assessment of impacts and recommendation of mitigation measures as discussed above a collated in Table 6 to 8 below. The potential impacts identified in this scoping study have been assessed based on the criteria and methodology outlined in Chapter 4 of the Draft EIA Report, and will not be repeated here.

**Table 6: Impact assessment summary table for the Construction Phase**

| Construction Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct Impacts | | | | | | | | | | | | | |
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk: Without Mitigation/ Management | Significance of Impact and Risk: With Mitigation/ Management (Residual Impact/ Risk) | Ranking of Residual Impact/ Risk | Confidence Level |
| Avifauna | Displacement of priority species due to habitat transformation | Negative | Local | Long term | Substantial | Likely | Moderate | Low | • The recommendations of the specialist ecological study must be strictly adhered to.<br>• Maximum used should be made of existing access roads and the Construction of new roads should be kept to a minimum.<br>• Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist. | Moderate | Moderate | 3 | Medium |
| Avifauna | Displacement of priority species due to disturbance associated with the construction activities | Negative | Local | Short term | Substantial | Likely | High | Low | • Restrict the construction activities to the construction footprint area.<br>• Do not allow any access to the remainder of the property during the construction period.<br>• Measures to control noise and dust should be applied according to current best practice in the industry.<br>• Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.<br>• The ECO must then, during audits/site visits, make a concerted effort to look out for breeding activities of priority species, and such efforts may include the training of construction staff to identify such species, followed by regular questioning of staff as to the regular whereabouts on site of the species. If any priority species are confirmed to be breeding (e.g. if a nest site is found), construction activities within 500m of the breeding site must cease, and the avifaunal specialist will be contacted immediately for further assessment of the situation and instruction on how to proceed. | Moderate | Low | 4 | Medium |

**Table 7: Impact assessment summary table for the Operational Phase**

| Operational Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct Impacts | | | | | | | | | | | | | |
| **Aspect/ Impact Pathway** | **Nature of Potential Impact/ Risk** | **Status** | **Spatial Extent** | **Duration** | **Consequence** | **Probability** | **Reversibility of Impact** | **Irreplaceability** | **Potential Mitigation Measures** | **Significance of Impact and Risk** | | **Ranking of Residual Impact/ Risk** | **Confidence Level** |
| | | | | | | | | | | **Without Mitigation/ Management** | **With Mitigation/ Management (Residual Impact/ Risk)** | | |
| Avifauna | Mortality of priority species due to collisions with the turbines | Negative | International (Lesser Kestrels are Palearctic summer migrants) | Long term | Substantial | Likely | High | Low | • A 100m no-turbine set-back buffer zone (other infrastructure is allowed) is recommended around selected ridge edges to minimise the risk of collisions for slope soaring species (see Figure 9).<br>• A 300m no turbine buffer zone (other infrastructure allowed) is recommended around selected water points (see Figure 9).<br>• Care should be taken not to create habitat for prey species that could draw Verreaux's Eagles into the area and expose them to collision risk. Rock piles must be removed from site or covered with topsoil to prevent them from becoming habitat for Rock Hyrax.<br>• One blade of each turbine should be painted black to reduce the potential for motion smear and thereby reduce the risk of raptor collisions.<br>• Formal monitoring should be resumed for period of two years once the turbines have been constructed, as per the most recent edition of the best practice guidelines (Jenkins *et al*. 2011). The exact scope and nature of the post-construction monitoring will be informed on an ongoing basis by the result of the monitoring through a process of adaptive management. The purpose of this would be (a) to establish if and to what extent displacement of priority species has occurred through the altering of flight patterns post-construction, and (b) to search for carcasses at turbines.<br>• The avifaunal specialist, in consultation with external experts and relevant NGO's such as BLSA, should determine annual mortality thresholds for priority anticipated to be at risk of collision mortality, prior to the wind farm going operational.<br>• If actual collision rates approach the pre-determined threshold levels, curtailment of turbines should be implemented for high risk situations.<br>• In the event of a massive influx of Lesser Kestrels due to an irruption of insects, pro-active curtailment must be implemented under the guidance of the avifaunal specialist. A site-specific regime must be designed in consultation with the wind farm operator which will specify the duration of the curtailment period as well as the specific time of the day when the turbines will be curtailed. | Moderate | Low | 4 | Medium |

Table 8: Impact assessment summary table for the Decommissioning Phase

| Decommissioning Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct Impacts | | | | | | | | | | | | | |
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation/ Management (Residual Impact/ Risk) | | |
| Avifauna | Displacement of priority species due to disturbance associated with the decommissioning activities | Negative | Local | Short term | Substantial | Likely | High | Low | • Restrict the construction activities to the footprint area.<br>• Do not allow any access to the remainder of the property during for the duration of the decommissioning activities.<br>• Measures to control noise and dust should be applied according to current best practice in the industry.<br>• Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.<br>• The ECO must then, during audits/site visits, make a concerted effort to look out for breeding activities of priority species, and such efforts may include the training of staff to identify such species, followed by regular questioning of staff as to the regular whereabouts on site of the species. If any priority species are confirmed to be breeding (e.g. if a nest site is found), activities within 500m of the breeding site must cease, and the avifaunal specialist will be contacted immediately for further assessment of the situation and instruction on how to proceed. | Moderate | Low | 4 | Medium |

**Table 9: Impact assessment summary table for cumulative impacts**

| Cumulative impacts | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct Impacts | | | | | | | | | | | | | |
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation/ Management (Residual Impact/ Risk) | | |
| Avifauna | Primarily displacement of priority species due to habitat transformation | Negative | Local | Long term | Substantial | Likely | High | Low | The mitigation measures listed below, or variations of them, are recommended at all the proposed renewable energy projects:<br>• The recommendations of the specialist ecological study must be strictly adhered to, to limit the habitat destruction.<br>• Maximum used should be made of existing access roads and the construction of new roads should be kept to a minimum.<br>• Following construction, rehabilitation of all areas disturbed (e.g. temporary access tracks and laydown areas) must be undertaken and to this end a habitat restoration plan is to be developed by a rehabilitation specialist. | Moderate | Moderate | 3 | Medium |

## 1.9 SUMMARY OF FINDINGS AND CONCLUSIONS

It is anticipated that the proposed Kuruman Phase 1 Wind Energy Facility will have a moderate impact on priority avifauna. The impacts are:

- Displacement due to habitat transformation during construction of the wind farm and associated infrastructure
- Displacement due to disturbance during construction (and dismantling) of the wind farm and associated infrastructure;
- Collision mortality on the wind turbines;

An estimated 201 species could potentially occur in the study area, of which 133 were recorded at the WEF development area during pre-construction monitoring. Of the 201 species that could occur at the site, 17 are classified as priority species for wind farm developments (Retief *et al.* 2012). The results of the transect counts indicate a moderate diversity of avifauna at both the WEF development area and the control site. While this is to be expected to some extent of a fairly arid area such as this, the very low numbers or absence of some species e.g. Northern Black Korhaan is an indication that the avian populations might be under pressure from external factors, e.g. hunting. Flight activity of priority species at the WEF development area was also very low, with a passage rate of 0.05 birds/hour.

Displacement of priority species due to habitat destruction during operational lifetime of the wind energy facility phase is likely to be a moderate negative impact and will remain at a moderate level even with the application of mitigation measures. Raptors are unlikely to be affected at all. Species most likely to be affected by the habitat fragmentation are the terrestrial species namely Grey-winged Francolin, Northern Black Korhaan, Kori Bustard and Secretarybird. The rehabilitation of disturbed areas will help to mitigate the impact of the habitat transformation to some extent, but the fragmentation of the habitat due to the construction of the internal road network cannot be mitigated and will remain an impact for the duration of the operational life-time of the facility.

Displacement of priority species due to disturbance during the construction (and dismantling) phases of the wind energy facility and associated infrastructure is likely to be a temporary, negative impact, but should be reduced to a low level with the application of mitigation measures. It is highly likely that most priority species will be temporarily displaced in the development area during the construction operations, due to the noise and activity. The risk of permanent displacement due to disturbance is bigger for large species such as Kori Bustard and Secretarybird.

Collisions of priority species with the turbines in the operational phase are likely to be a moderate negative impact and it could be reduced to a low negative level through the application of mitigation measures. Species most likely to be at risk of collision with the turbines are Lesser Kestrel, Verreaux's Eagle and Jackal Buzzard. Very little Verreaux's Eagle and Jackal Buzzard flight activity was recorded, but that does not exclude the potential for collisions. The impact is likely to persist for the operational life-time of the project. Implementation of the proposed mitigation measures should reduce the probability and severity of the impact on priority species to such an extent that the overall significance should be reduced to low.

There are currently no wind energy facilities planned within a 50km radius around the proposed WEF, but at least 11 solar PV facilities. The primary potential long-term impact of these solar facilities on avifauna, is displacement due to habitat transformation. The mitigation measures pertaining specifically to avifauna in the existing applications for solar plants do not address the issue of displacement due to habitat transformation, as this impact cannot be effectively mitigated at solar facilities for the majority of avifauna. The question is therefore to what extent the relatively moderate envisaged impact of displacement of priority species at the WEF will increase in significance when viewed collectively with the aggregate impact of displacement of all the renewable energy facilities combined. It should be borne in mind that the actual development footprint for all these applications is usually considerably smaller than the land parcel. The significance of the cumulative displacement impact of the WEF, viewed with the other potential renewable energy projects, is still relatively moderate. Mitigation measures will address the issue of avifauna displacement to some extent, but due to the inherent nature of the displacement impact, the significance of the impacts will likely remain at a moderate level, even after mitigation.

It is our opinion that the proposed development be approved, subject to the strict implementation of the proposed mitigation measures detailed in this report.

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# 1.11 APPENDICES

### APPENDIX 1: SPECIES THAT POTENTIALLY OCCUR AT THE WEF DEVELOPMENT AREA

**NT: Near threatened VU: Vulnerable EN: Endangered LC: Least concern**

| Species | Taxonomic name | Reporting rate | Global Status (IUCN) | Regional Status (Taylor *et al.* 2015) | Priority species |
|---|---|---|---|---|---|
| African Rock Pipit | *Anthus crenatus* | 1.49 | LC | NT | x |
| Black Harrier | *Circus maurus* | 0 | VU | EN | x |
| Black-chested Snake-Eagle | *Circaetus pectoralis* | 0 | | | x |
| Booted Eagle | *Hieraaetus pennatus* | 0 | | | x |
| Double-banded Courser | *Rhinoptilus africanus* | 1.49 | | | x |
| Greater Kestrel | *Falco rupicoloides* | 7.46 | | | x |
| Grey-winged Francolin | *Francolinus africanus* | 0 | | | x |
| Jackal Buzzard | *Buteo rufofuscus* | 4.48 | | | x |
| Kori Bustard | *Ardeotis kori* | 0 | NT | NT | x |
| Lanner Falcon | *Falco biarmicus* | 0 | LC | VU | x |
| Martial Eagle | *Polemaetus bellicosus* | 0 | VU | EN | x |
| Northern Black Korhaan | *Afrotis afraoides* | 4.48 | | | x |
| Secretarybird | *Sagittarius serpentarius* | 0 | VU | VU | x |
| Southern Pale Chanting Goshawk | *Melierax canorus* | 14.93 | | | x |
| Spotted Eagle-Owl | *Bubo africanus* | 7.46 | | | x |
| Steppe Buzzard | *Buteo vulpinus* | 4.48 | | | x |
| Verreaux's Eagle | *Aquila verreauxii* | 1.49 | LC | VU | x |
| Acacia Pied Barbet | *Tricholaema leucomelas* | 76.12 | | | |
| African Black Swift | *Apus barbatus* | 0 | | | |
| African Grey Hornbill | *Tockus nasutus* | 1.49 | | | |
| African Hoopoe | *Upupa africana* | 43.28 | | | |
| African Palm-Swift | *Cypsiurus parvus* | 25.37 | | | |
| African Paradise-Flycatcher | *Terpsiphone viridis* | 1.49 | | | |
| African Pipit | *Anthus cinnamomeus* | 13.43 | | | |
| African Purple Swamphen | *Porphyrio madagascariensis* | 2.99 | | | |
| African Quailfinch | *Ortygospiza atricollis* | 4.48 | | | |
| African Red-eyed Bulbul | *Pycnonotus nigricans* | 97.01 | | | |
| African Reed-Warbler | *Acrocephalus baeticatus* | 1.49 | | | |
| African Sacred Ibis | *Threskiornis aethiopicus* | 16.42 | | | |
| African Stonechat | *Saxicola torquatus* | 11.94 | | | |
| Alpine Swift | *Tachymarptis melba* | 1.49 | | | |
| Amethyst Sunbird | *Chalcomitra amethystina* | 0 | | | |
| Anteating Chat | *Myrmecocichla formicivora* | 40.3 | | | |

| Species | Taxonomic name | Reporting rate | Global Status (IUCN) | Regional Status (Martin *et al.* 2015) | Priority species |
|---|---|---|---|---|---|
| Ashy Tit | *Parus cinerascens* | 26.87 | | | |
| Banded Martin | *Riparia cincta* | 2.99 | | | |
| Barn Owl | *Tyto alba* | 11.94 | | | |
| Barn Swallow | *Hirundo rustica* | 19.4 | | | |
| Barred Wren-Warbler | *Calamonastes fasciolatus* | 4.48 | | | |
| Bearded Woodpecker | *Dendropicos namaquus* | 2.99 | | | |
| Black Cuckoo | *Cuculus clamosus* | 4.48 | | | |
| Black-chested Prinia | *Prinia flavicans* | 67.16 | | | |
| Black-collared Barbet | *Lybius torquatus* | 8.96 | | | |
| Black-crowned Night-Heron | *Nycticorax nycticorax* | 1.49 | | | |
| Black-faced Waxbill | *Estrilda erythronotos* | 25.37 | | | |
| Black-headed Heron | *Ardea melanocephala* | 2.99 | | | |
| Blacksmith Lapwing | *Vanellus armatus* | 17.91 | | | |
| Black-throated Canary | *Crithagra atrogularis* | 37.31 | | | |
| Black-winged Stilt | *Himantopus himantopus* | 2.99 | | | |
| Blue Waxbill | *Uraeginthus angolensis* | 4.48 | | | |
| Bokmakierie | *Telophorus zeylonus* | 35.82 | | | |
| Bradfield's Swift | *Apus bradfieldi* | 8.96 | | | |
| Brown-crowned Tchagra | *Tchagra australis* | 32.84 | | | |
| Brown-hooded Kingfisher | *Halcyon albiventris* | 2.99 | | | |
| Brown-throated Martin | *Riparia paludicola* | 2.99 | | | |
| Brubru | *Nilaus afer* | 13.43 | | | |
| Buffy Pipit | *Anthus vaalensis* | 7.46 | | | |
| Burchell's Coucal | *Centropus burchellii* | 1.49 | | | |
| Cape Bunting | *Emberiza capensis* | 17.91 | | | |
| Cape Crow | *Corvus capensis* | 1.49 | | | |
| Cape Glossy Starling | *Lamprotornis nitens* | 73.13 | | | |
| Cape Penduline-Tit | *Anthoscopus minutus* | 17.91 | | | |
| Cape Robin-Chat | *Cossypha caffra* | 31.34 | | | |
| Cape Shoveler | *Anas smithii* | 1.49 | | | |
| Cape Sparrow | *Passer melanurus* | 76.12 | | | |
| Cape Turtle-Dove | *Streptopelia capicola* | 43.28 | | | |
| Cape Wagtail | *Motacilla capensis* | 56.72 | | | |
| Cape White-eye | *Zosterops virens* | 4.48 | | | |
| Cardinal Woodpecker | *Dendropicos fuscescens* | 14.93 | | | |
| Cattle Egret | *Bubulcus ibis* | 19.4 | | | |
| Chat Flycatcher | *Bradornis infuscatus* | 8.96 | | | |
| Chestnut-vented Tit-Babbler | *Parisoma subcaeruleum* | 80.6 | | | |

| Species | Taxonomic name | Reporting rate | Global Status (IUCN) | Regional Status (Martin *et al.* 2015) | Priority species |
|---|---|---|---|---|---|
| Cinnamon-breasted Bunting | *Emberiza tahapisi* | 23.88 | | | |
| Common Fiscal | *Lanius collaris* | 52.24 | | | |
| Common Moorhen | *Gallinula chloropus* | 5.97 | | | |
| Common Myna | *Acridotheres tristis* | 14.93 | | | |
| Common Ostrich | *Struthio camelus* | 1.49 | | | |
| Common Quail | *Coturnix coturnix* | 1.49 | | | |
| Common Scimitarbill | *Rhinopomastus cyanomelas* | 22.39 | | | |
| Common Swift | *Apus apus* | 5.97 | | | |
| Common Waxbill | *Estrilda astrild* | 4.48 | | | |
| Crested Barbet | *Trachyphonus vaillantii* | 14.93 | | | |
| Crimson-breasted Shrike | *Laniarius atrococcineus* | 62.69 | | | |
| Crowned Lapwing | *Vanellus coronatus* | 25.37 | | | |
| Desert Cisticola | *Cisticola aridulus* | 16.42 | | | |
| Diderick Cuckoo | *Chrysococcyx caprius* | 17.91 | | | |
| Double-banded Sandgrouse | *Circaetus pectoralis* | 0 | | | |
| Dusky Sunbird | *Cinnyris fuscus* | 14.93 | | | |
| Eastern Clapper Lark | *Mirafra fasciolata* | 13.43 | | | |
| Egyptian Goose | *Alopochen aegyptiacus* | 2.99 | | | |
| European Bee-eater | *Merops apiaster* | 44.78 | | | |
| Fairy Flycatcher | *Stenostira scita* | 8.96 | | | |
| Familiar Chat | *Cercomela familiaris* | 65.67 | | | |
| Fawn-coloured Lark | *Calendulauda africanoides* | 16.42 | | | |
| Fiscal Flycatcher | *Sigelus silens* | 70.15 | | | |
| Fork-tailed Drongo | *Dicrurus adsimilis* | 13.43 | | | |
| Gabar Goshawk | *Melierax gabar* | 10.45 | | | |
| Glossy Ibis | *Plegadis falcinellus* | 2.99 | | | |
| Golden-breasted Bunting | *Emberiza flaviventris* | 38.81 | | | |
| Golden-tailed Woodpecker | *Campethera abingoni* | 25.37 | | | |
| Great Sparrow | *Passer motitensis* | 1.49 | | | |
| Greater Honeyguide | *Indicator indicator* | 1.49 | | | |
| Greater Striped Swallow | *Hirundo cucullata* | 50.75 | | | |
| Green-winged Pytilia | *Pytilia melba* | 40.3 | | | |
| Grey Heron | *Ardea cinerea* | 1.49 | | | |
| Grey-backed Cisticola | *Cisticola subruficapilla* | 11.94 | | | |
| Grey-backed Sparrowlark | *Eremopterix verticalis* | 1.49 | | | |
| Groundscraper Thrush | *Psophocichla litsipsirupa* | 47.76 | | | |
| Hadeda Ibis | *Bostrychia hagedash* | 34.33 | | | |
| Harlequin Quail | *Coturnix delegorguei* | 0 | | | |

| Species | Taxonomic name | Reporting rate | Global Status (IUCN) | Regional Status (Martin *et al.* 2015) | Priority species |
|---|---|---|---|---|---|
| Helmeted Guineafowl | *Numida meleagris* | 41.79 | | | |
| Hottentot Teal | *Anas hottentota* | 1.49 | | | |
| House Sparrow | *Passer domesticus* | 59.7 | | | |
| Jacobin Cuckoo | *Clamator jacobinus* | 2.99 | | | |
| Kalahari Scrub-Robin | *Cercotrichas paena* | 76.12 | | | |
| Karoo Eremomela | *Eremomela gregalis* | 0 | | | |
| Karoo Long-billed Lark | *Certhilauda subcoronata* | 8.96 | | | |
| Karoo Scrub-Robin | *Cercotrichas coryphoeus* | 4.48 | | | |
| Karoo Thrush | *Turdus smithi* | 34.33 | | | |
| Kurrichane Buttonquail | *Turnix sylvaticus* | 4.48 | | | |
| Large-billed Lark | *Galerida magnirostris* | 0 | | | |
| Lark-like Bunting | *Emberiza impetuani* | 25.37 | | | |
| Laughing Dove | *Streptopelia senegalensis* | 88.06 | | | |
| Laughing Dove | *Spilopelia senegalensis* | 0 | | | |
| Layard's Tit-Babbler | *Parisoma layardi* | 7.46 | | | |
| Lesser Grey Shrike | *Lanius minor* | 10.45 | | | |
| Lesser Kestrel | *Falco naumanni* | 0 | | | |
| Lesser Swamp-Warbler | *Acrocephalus gracilirostris* | 5.97 | | | |
| Levaillant's Cisticola | *Cisticola tinniens* | 1.49 | | | |
| Lilac-breasted Roller | *Coracias caudatus* | 7.46 | | | |
| Little Grebe | *Tachybaptus ruficollis* | 1.49 | | | |
| Little Swift | *Apus affinis* | 25.37 | | | |
| Long-billed Crombec | *Sylvietta rufescens* | 31.34 | | | |
| Long-billed Pipit | *Anthus similis* | 10.45 | | | |
| Mallard Duck | *Anas platyrhynchos* | 1.49 | | | |
| Marico Flycatcher | *Bradornis mariquensis* | 25.37 | | | |
| Marico Sunbird | *Cinnyris mariquensis* | 16.42 | | | |
| Mountain Wheatear | *Oenanthe monticola* | 2.99 | | | |
| Namaqua Dove | *Oena capensis* | 47.76 | | | |
| Namaqua Sandgrouse | *Pterocles namaqua* | 7.46 | | | |
| Neddicky | *Cisticola fulvicapilla* | 22.39 | | | |
| Orange River Francolin | *Scleroptila levaillantoides* | 14.93 | | | |
| Orange River White-eye | *Zosterops pallidus* | 13.43 | | | |
| Pale-winged Starling | *Onychognathus nabouroup* | 53.73 | | | |
| Pearl-spotted Owlet | *Glaucidium perlatum* | 4.48 | | | |
| Pied Crow | *Corvus albus* | 58.21 | | | |
| Pied Starling | *Spreo bicolor* | 2.99 | | | |
| Pink-billed Lark | *Spizocorys conirostris* | 1.49 | | | |

| Species | Taxonomic name | Reporting rate | Global Status (IUCN) | Regional Status (Martin *et al.* 2015) | Priority species |
|---|---|---|---|---|---|
| Plain-backed Pipit | *Anthus leucophrys* | 4.48 | | | |
| Pririt Batis | *Batis pririt* | 47.76 | | | |
| Purple Heron | *Ardea purpurea* | 1.49 | | | |
| Pygmy Falcon | *Polihierax semitorquatus* | 1.49 | | | |
| Red-backed Shrike | *Lanius collurio* | 5.97 | | | |
| Red-billed Firefinch | *Lagonosticta senegala* | 7.46 | | | |
| Red-billed Quelea | *Quelea quelea* | 29.85 | | | |
| Red-billed Teal | *Anas erythrorhyncha* | 1.49 | | | |
| Red-breasted Swallow | *Hirundo semirufa* | 1.49 | | | |
| Red-capped Lark | *Calandrella cinerea* | 2.99 | | | |
| Red-crested Korhaan | *Lophotis ruficrista* | 5.97 | | | |
| Red-eyed Dove | *Streptopelia semitorquata* | 29.85 | | | |
| Red-faced Mousebird | *Urocolius indicus* | 61.19 | | | |
| Red-headed Finch | *Amadina erythrocephala* | 23.88 | | | |
| Red-knobbed Coot | *Fulica cristata* | 4.48 | | | |
| Red-winged Starling | *Onychognathus morio* | 0 | | | |
| Reed Cormorant | *Phalacrocorax africanus* | 1.49 | | | |
| Rock Dove | *Columba livia* | 11.94 | | | |
| Rock Kestrel | *Falco rupicolus* | 16.42 | | | |
| Rock Martin | *Hirundo fuligula* | 74.63 | | | |
| Rufous-cheeked Nightjar | *Caprimulgus rufigena* | 7.46 | | | |
| Rufous-eared Warbler | *Malcorus pectoralis* | 2.99 | | | |
| Sabota Lark | *Calendulauda sabota* | 13.43 | | | |
| Scaly-feathered Finch | *Sporopipes squamifrons* | 56.72 | | | |
| Shaft-tailed Whydah | *Vidua regia* | 16.42 | | | |
| Short-toed Rock-Thrush | *Monticola brevipes* | 23.88 | | | |
| Sociable Weaver | *Philetairus socius* | 14.93 | | | |
| South African Shelduck | *Tadorna cana* | 1.49 | | | |
| Southern Grey-headed Sparrow | *Passer diffusus* | 25.37 | | | |
| Southern Masked-Weaver | *Ploceus velatus* | 85.07 | | | |
| Southern Red Bishop | *Euplectes orix* | 8.96 | | | |
| Southern Yellow-billed Hornbill | *Tockus leucomelas* | 4.48 | | | |
| Speckled Mousebird | *Colius striatus* | 1.49 | | | |
| Speckled Pigeon | *Columba guinea* | 50.75 | | | |
| Spike-heeled Lark | *Chersomanes albofasciata* | 5.97 | | | |
| Spotted Flycatcher | *Muscicapa striata* | 11.94 | | | |
| Spotted Thick-knee | *Burhinus capensis* | 10.45 | | | |
| Swallow-tailed Bee-eater | *Merops hirundineus* | 29.85 | | | |

| Species | Taxonomic name | Reporting rate | Global Status (IUCN) | Regional Status (Martin *et al.* 2015) | Priority species |
|---|---|---|---|---|---|
| Three-banded Plover | *Charadrius tricollaris* | 2.99 | | | |
| Tinkling Cisticola | *Cisticola rufilatus* | 4.48 | | | |
| Violet-eared Waxbill | *Granatina granatina* | 38.81 | | | |
| Wattled Starling | *Creatophora cinerea* | 1.49 | | | |
| White-backed Mousebird | *Colius colius* | 71.64 | | | |
| White-browed Scrub-Robin | *Cercotrichas leucophrys* | 0 | | | |
| White-browed Sparrow-Weaver | *Plocepasser mahali* | 34.33 | | | |
| White-fronted Bee-eater | *Merops bullockoides* | 5.97 | | | |
| White-rumped Swift | *Apus caffer* | 25.37 | | | |
| White-throated Canary | *Crithagra albogularis* | 1.49 | | | |
| White-throated Swallow | *Hirundo albigularis* | 1.49 | | | |
| Willow Warbler | *Phylloscopus trochilus* | 2.99 | | | |
| Yellow Canary | *Crithagra flaviventris* | 64.18 | | | |
| Yellow-bellied Eremomela | *Eremomela icteropygialis* | 22.39 | | | |
| Yellow-billed Duck | *Anas undulata* | 7.46 | | | |
| Zitting Cisticola | *Cisticola juncidis* | 2.99 | | | |

**APPENDIX 2: PRE-CONSTRUCTION MONITORING METHODOLOGY**

## 1. Objectives

The objective of the pre-construction monitoring at the proposed Kuruman Phase 1 Wind Project was to gather baseline data over a period of at least four seasons on the following aspects pertaining to avifauna:

- The abundance and diversity of birds at the WEF development area and a suitable control site to measure the potential displacement effect of the wind farm.
- Flight patterns of priority species at the wind farm sites to measure the potential collision risk with the turbines.

## 2. Methods

The monitoring protocol for the site was designed according to the latest version (2015) of *Jenkins A R; Van Rooyen C S; Smallie J J; Anderson M D & Smit H A. 2011. Best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa. Endangered Wildlife Trust and Birdlife South Africa.*

The monitoring surveys were conducted at the proposed WEF development area and a control site by four field monitors during the following periods:

- 22 – 26 September 2015
- 14 – 17 April 2016
- 11 – 15 September 2016
- 14 – 18 January 2017

Monitoring was conducted in the following manner:

- One drive transect was identified totalling 24.5km on the turbine site and one drive transect in the control site with a total length of 11.4km.
- Two observers travelling slowly (± 10km/h) in a vehicle recorded all birds on both sides of the transect. The observers stopped at regular intervals (every 500 m) to scan the environment with binoculars. Drive transects were counted three times per sampling session.
- In addition, four walk transects of 1km each were identified at the turbine site, and two at the control site, and counted 8 times per sampling season. All birds were recorded during walk transects.

- The following variables were recorded:
  - Species;
  - Number of birds;
  - Date;
  - Start time and end time;
  - Distance from transect (0-50 m, 50-100 m, >100 m);
  - Wind direction;
  - Wind strength (calm; moderate; strong);
  - Weather (sunny; cloudy; partly cloudy; rain; mist);
  - Temperature (cold; mild; warm; hot);
  - Behaviour (flushed; flying-display; perched; perched-calling; perched-hunting; flying-foraging; flying-commute; foraging on the ground); and
  - Co-ordinates (priority species only).

- Four vantage points (VPs) were identified from which the majority of the proposed turbine area could be observed (the "VP area"), to record the flight altitude and patterns of priority species. One VP was also identified on the control site. The following variables were recorded for each flight:
  - Species;
  - Number of birds;
  - Date;
  - Start time and end time;
  - Wind direction;
  - Wind strength (estimated Beaufort scale 1-7);
  - Weather (sunny; cloudy; partly cloudy; rain; mist);
  - Temperature (cold; mild; warm; hot);
  - Flight altitude (high i.e. >220m; medium i.e. 30m – 220m; low i.e. <30m);
  - Flight mode (soar; flap; glide; kite; hover); and
  - Flight time (in 15 second-intervals).

The aim with drive transects was primarily to record large priority species (i.e. raptors and large terrestrial species), while walk transects were primarily aimed at recording small passerines. The objective of the transect monitoring was to gather baseline data on the use of the site by birds in order to measure potential displacement by the wind farm activities. The objective of vantage point counts was to measure the potential collision risk with the turbines. Priority species were identified using the latest (November 2014) BLSA list of priority species for wind farms.

One potential focal point of bird activity, a small dam, was identified and was monitored. The power lines running through the study area were also inspected for raptor nests.

Figure 1 below indicates the WEF development area where monitoring is taking place.


**Figure 1**: The area where monitoring was conducted for Kuruman WEF Phase 1.

**APPENDIX 3: BIRD HABITAT**

**Figure 1: Open savanna habitat with scattered trees in the valleys between the ridges**

**Figure 2: An example of the habitat on the ridge tops, consisting of open shrub with a well-developed grass layer**


**Figure 3: A view of the steep slopes in the south-eastern part of the WEF development area**


**Figure 4: Another view of the steep slopes in the south-eastern part of the WEF development area**

**APPENDIX 4: STATISTICS**

## Kuruman WEF Phase 1, Vantage point surveys: Statistical analysis

This report is based on data captured in the Microsoft Excel file "*Kuruman 1 VP Sp_Au_Wi_Su_af 20180102 v1.xls*", containing records for each individual contact of priority species birds recorded at four vantage points set up at the Kuruman 1 wind farm. Observations were recorded in sampling units (SU) of time referred to as "watch periods", each of which was of three hours duration.

A group of birds flying or associating together is referred to as a "*contact"*, not counting the number of individuals in the group. The number of individual birds in a contact is referred to as the "*individuals*" count. When no birds were seen during a watch period, the species was identified by the label "*None*". Every species is categorised into a "*Contact Class".* In this survey two contact classes were recorded viz. "Soaring" and "Terrestrial".

There were *64 watch periods* of three hours each, spread over the four vantage points, equally allocated to each of the four seasons as set out in Table *1*. Environmental and other relevant information were also recorded (e.g. Temperature, Wind Direction, Wind Speed, categories of height at which the birds were observed, etc.).

**Table *1*. The survey dates.**

| Start Date | End Date | Season | Watch Periods | Hours Observed |
|---|---|---|---|---|
| 2015-09-22 | 2015-09-26 | Spring '15 | 16 | 48 |
| 2016-03-13 | 2016-03-17 | Autumn '16 | 16 | 48 |
| 2016-09-11 | 2016-09-15 | Winter '16 | 16 | 48 |
| 2017-01-14 | 2017-01-17 | Summer '16 | 16 | 48 |

Basic summary statistics concerning the data are presented in tables *A – G* in Section *A* of the Appendix at the end of this report. The matter of whether the data obtained are representative of the true occurrence of the priority species birds is investigated. The sample size (number of watch periods) is also considered to establish the validity of the estimates of the average number of birds observed.

Statistical terminology and other relevant statistical technical material are presented in Sections *B* - *D* of the Appendix.

# 1 Descriptive statistics

Several tables of descriptive statistics are presented. The watch periods were all of length three hours and counts, averages and variabilities are expressed per *3*-hour watch period.

The following statistics were computed and presented in Section *A* of the Appendix.

- A count of the total number of individual birds (by contact class and species) observed during the survey against the *Height* at which they were observed*.* These data are displayed as Table *A* in Section *A* of the *Appendix*.
- Table *B* shows the times that the soaring and terrestrial birds flew at medium height and at all heights. The times spent at medium height are expressed as a percentage of the total observed times at all heights. These percentages have to be interpreted with care and should always be seen together with the total flight time.

- Tables *C – G* provide summary statistics of the behaviour of the species observed w.r.t. their presence according to season and their occurrence profiles during various weather conditions such as temperature, wind direction and wind strength.
- Counts of the priority species, separately done for soaring and terrestrial birds, were collated from the raw data for each watch period by season and vantage point. These tables are used to construct the basic statistics and graphs for this report and are stored in a data folder for the Kuruman 1 data.

The computations were done using STATISTICA statistical software (Dell Inc., *2016*) and with routines developed for this purpose in "Statistica Visual Basic", the programming language of STATISTICA.

## 2 Estimation of the population mean

Average values (*Avge*) and standard deviations (*Std.Dev.*) from the available samples of the counts for soaring and terrestrial birds form the backbone of descriptive statistics for the true populations. These statistics alone provide an idea of the sizes and variabilities of the respective populations and are presented in Tables *3 – 4*. However, insight into the confidence that can be placed in these point estimates is only achieved by also presenting confidence intervals (with lower and upper limits, LCL and UCL) for the true mean count per watch period in each of the seasons and overall.

The computation of confidence intervals rests on certain assumptions to be met by the underlying distribution of counts. The counts distribution is investigated by starting with plotting the raw data counts for soaring and terrestrial contact counts per watch period in their time sequence (Figure *1*).

**Figure *1*: Sequential time plot (by consecutive watch period number) of soaring and terrestrial contact counts.**

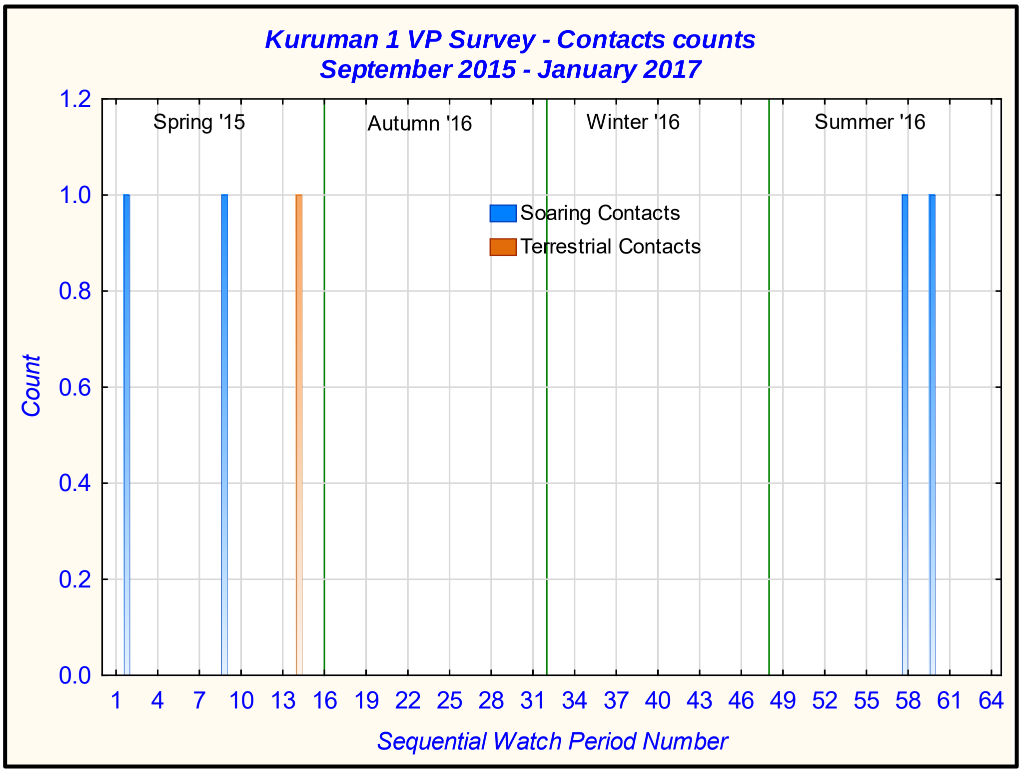
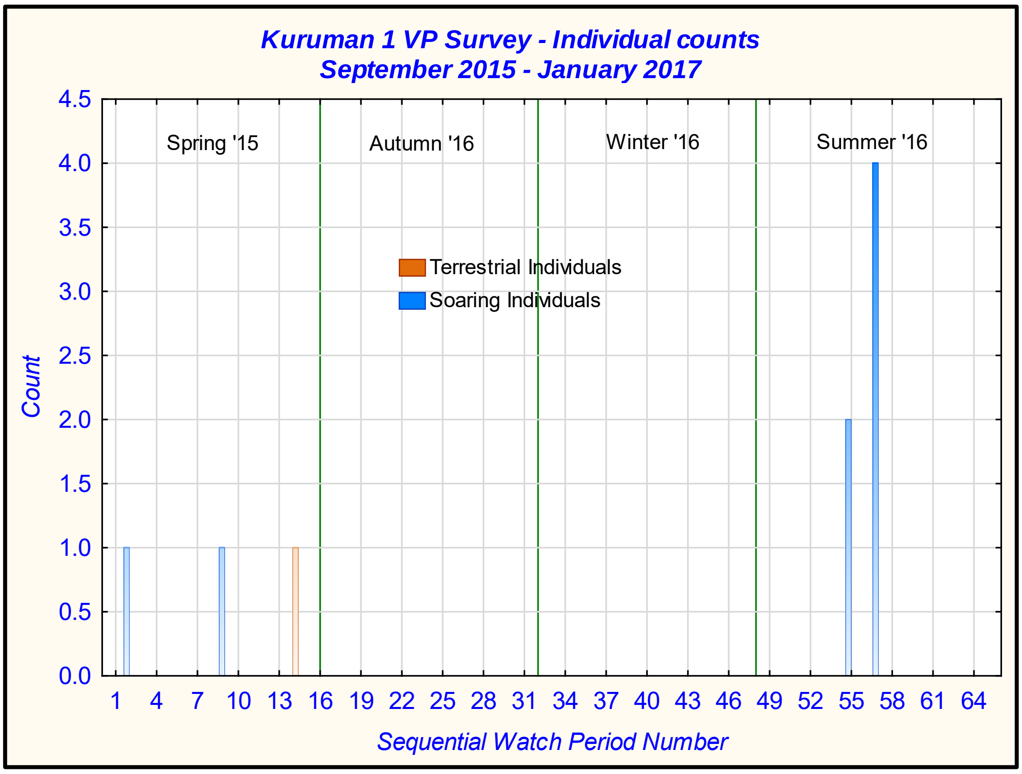



Figure 1, which plots both soaring and terrestrial contacts, shows that quite few priority species (and individuals) were encountered. The corresponding chart for individual counts, Figure 2, shows that the individual counts are equally low.

**Figure *2*:** **Sequential time plot (by consecutive watch period number) of soaring and terrestrial individual counts.**




Denote the probability of seeing a priority species bird (soaring or terrestrial), during a 3h sampling unit by p. If p is constant by season, then the probability of encountering such a bird in the Spring (for example) is estimated as 3/16 = 0.1875. A 95% confidence interval for p, using binomial theory (Zar, 2010, p. 543) is (0.04 to 0.46). That means that at best there is less than a 50:50 chance of encountering a priority species bird in a 3h watch period in Spring.

The distribution of the counts (separately for soaring and terrestrial birds) is the supporting information required for estimating the average number of birds with selected confidence. For this purpose it is contacts (rather than individual counts) that will be considered to investigate the counts distribution since contacts are thought to be the random events that materialise in each SU and thus enables the estimation of the distribution.

One possibility is to assume it to be the normal distribution which is the default standard for such computations in statistical software packages for data in general, but not necessarily for counts. In general, for situations where *counts* are made per fixed SU (in this case a watch period of 3*h*) the Poisson distribution is often found to fit reasonably well. The Poisson process is a probability model in which events (e.g. the sighting of a contact of birds) occur randomly and uniformly in time or space. The assumptions supporting such a model are independence of the events, individuality of each event and the uniform arrival of events over the time period of the sampling unit. Details of this are discussed by Kalbfleisch, 1985, pp. *128 – 133*. There may be arguments against the validity of this family of distributions underlying bird counts but they are probably as close to reality as can be hoped for. One way to recognise the Poisson distribution is that its average value and variance are identical (see Kalbfleisch, *1985*, p. *172*). This property is not unique to the Poisson - other distributions may also possess it.

Even though the bird counts are very low for both contact classes we consider the distribution of *soaring* birds. There are 64 sampling units of 3h each and they are taken to be randomly distributed over the four seasons. A (single) contact of soarers were recorded in only 4 of these. In the 60 others none (zero contacts) were observed. The average number of soaring contacts is thus estimated as 4/64 = 0.0625 per SU. The variance of the 64 data counts for soaring contacts (computed from the raw data) is 0.0595 which closely approximates the mean value which points to the possibility of a Poisson distribution.

Table 2 assumes a Poisson distribution with mean value $\lambda$ = 0.0625 and calculates the expected number of times that 0, 1, 2, … contacts are expected to occur if that distribution was the underlying distribution and compares it to the number of contacts that actual occurred.

**Table 2. Probability for a Poisson distribution with $\lambda$ = 0.0625 to have a count of X as well as the expected counts from observing 64 SUs.**

| X | 0 | 1 | 2 | 3 |
|---|---|---|---|---|
| Probability | 0.9394 | 0.0587 | 0.0018 | 0.00004 |
| Expected count (out of 64 SUs) | 60.12 | 3.76 | 0.12 | 0.003 |
| Observed count | 60 | 4 | 0 | 0 |

Thus it is expected to find 60.12 counts of zero contacts from 64 SUs, etc. This shows that the Poisson provides a good fit to the data for contact counts of soarers. Accordingly the estimation of accuracy and precision will be based on the Poisson as underlying distribution.

## 3 Basic statistics and Precision

A sample estimate (such as the average count per SU) has to be *accurate* (close to its true value) as well as *precise* (small variability). For definition of precision, see section B in the Appendix). Sample size influences the estimation of both accuracy and precision – the larger the sample size, the better both accuracy and precision.

Basic statistics originating from the raw data are presented in Tables *3 – 4* and those enable estimates of precision. These computations are done for the *individuals* counts only as there is little difference between the number of contacts and the number of individuals in this survey. The mathematical details of computing the confidence intervals and precisions, based on the Poisson distribution, are presented in section *C* of the Appendix.

**Table *3*. Soaring birds, Individual counts: basic statistics with *95%* confidence interval and precision for the number of contacts per *3*h watch period.**

| Season | Watch periods | Soaring birds: Individual counts | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Count | Avge | Variance | Std.Dev. | 95% LCL | 95% UCL | Precision |
| Spring '15 | 16 | 2 | 0.13 | 0.12 | 0.34 | 0.02 | 0.45 | 0.22 |
| Autumn '16 | 16 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.23 | 0.12 |
| Winter '16 | 16 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.23 | 0.12 |
| Summer '16 | 16 | 6 | 0.38 | 1.18 | 1.09 | 0.14 | 0.82 | 0.34 |
| All Seasons | 64 | 8 | 0.13 | 0.33 | 0.58 | 0.05 | 0.25 | 0.10 |

The data in Table *3* are to be interpreted typically as follows. The *95%* confidence interval for the average count in the Spring survey, for example, is (*0.02 – 0.45*). The precision for that season, which is a summary statistic for the quality of the estimate of the mean, is *0.22*. This means that the true mean per watch period is expected (with 95% certainty) to deviate by not more than a count of *0.22* birds from the sample estimate. The other entries and those in Table *4* are interpreted similarly.

**Table *4*. Terrestrial birds, Individual counts: basic statistics with *95%* confidence interval and precision for the number of individuals per *3*h watch period.**

| Season | Watch periods | Terrestrial birds: Individual counts | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | Count | Avge | Variance | Std.Dev. | 95% LCL | 95% UCL | Precision |
| Spring '15 | 16 | 1 | 0.06 | 0.06 | 0.25 | 0.00 | 0.35 | 0.17 |
| Autumn '16 | 16 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.23 | 0.12 |
| Winter '16 | 16 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.23 | 0.12 |
| Summer '16 | 16 | 0 | 0.00 | 0.00 | 0.00 | 0.00 | 0.23 | 0.12 |
| All Seasons | 64 | 1 | 0.02 | 0.02 | 0.13 | 0.00 | 0.09 | 0.04 |

The largest (poorest) precision for the estimate of the average count per watch period (for both soaring and terrestrial individual counts) that occurs in Tables *3* and *4* is $d = 0.34$ (Summer survey, soaring individual counts). Thus the estimated average for that data set may be approximated by $0.38 \pm 0.34$. This means, at worst over the entire survey, that the true mean per watch period is expected (with 95% certainty) to deviate by less than ½ a bird from the sample estimate.

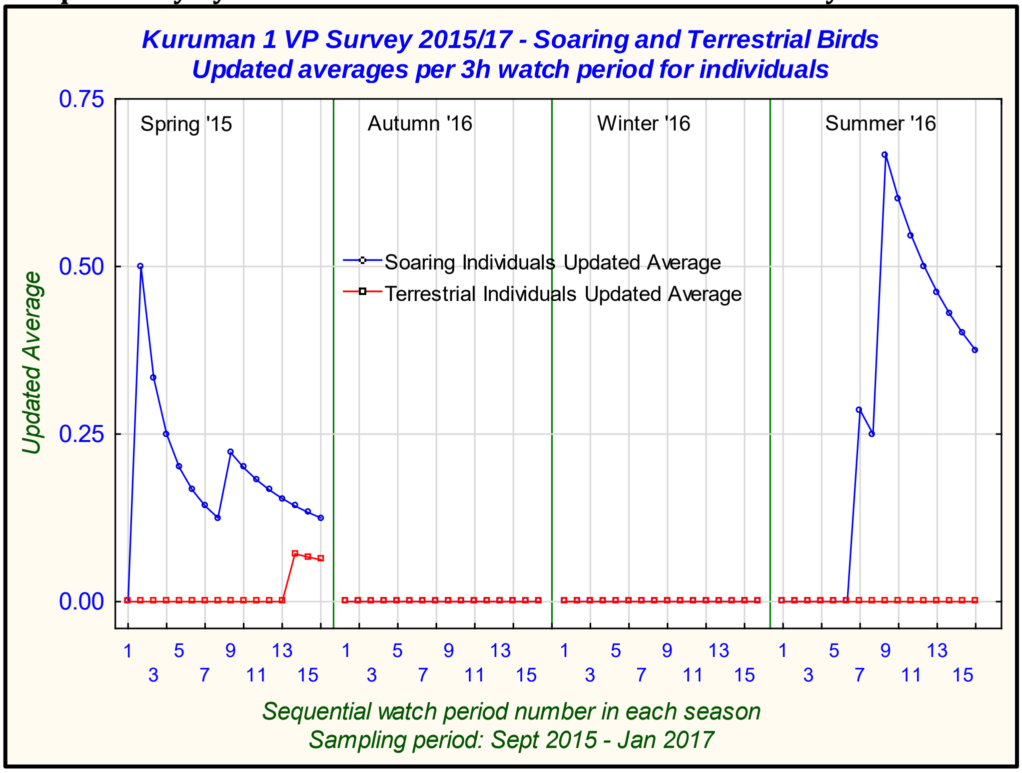
Thus, the estimates achieved in the survey over all seasons are believed to be of adequate precision.

## 4 Accuracy and Sample Size

Insight into the accuracy (i.e. closeness to the true value), as well as representativeness and stability of the counting process may be obtained by noting that as the counts data are gathered watch period by watch period an improved estimate of the average number of birds occurring in the area will be achieved for each added count. The more data are gathered the more accurate the estimate will become.

To investigate the behaviour of this process the average *individual* count per *3*h watch period is computed from all preceding data at the end of each consecutive 3h watch period. These *updated averages* are expected to vary to some extent in the initial stages of sampling but to stabilise as more data become available. The counts may vary substantially from season to season (as can be seen from Tables *3 – 4*). This means that the assumed Poisson distributions for the counts will have differing parameters (mean values) for each season, as is seen in the mentioned tables. The updated averages are thus computed *separately* for each season. These are plotted by season in Figure *3* (for soaring and terrestrial birds together).

**Figure 3. Updated averages for soaring and terrestrial individual counts sequentially by watch number over the seasons of the survey.**




The small number of individuals (both for soarers and terrestrials) has the effect that the updated averages stabilise quite well. This is an indication of good accuracy. It can also be concluded that the seasonal averages would not differ by much from those achieved by allocating more watch periods. Thus it is judged that the sample size of 16 watch periods per season is sufficiently large for the purpose.

## 5 Conclusion

The statistics exhibited in the tables and graphs show that there is only a small population of priority species birds present in the area. Also, the survey may be taken to be statistically representative of the soaring and terrestrial priority species birds that occur in the area. It is also concluded that more samples are not likely to yield a meaningful improvement in the accuracy and precision of estimating the average number of birds per watch period.

## 6 References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# APPENDIX

## Additional Statistics

**Table A. Number of individual priority species birds recorded during the survey by Contact Class, Species and Flying Height distribution.**

| Contact Class | Species | Flying Height | | | Row Totals |
|---|---|---|---|---|---|
| | | Low | Medium | High | |
| Soaring | Jackal Buzzard | 1 | 0 | 0 | 1 |
| | Lesser Kestrel | 0 | 6 | 0 | 6 |
| | Verreaux's' Eagle | 0 | 1 | 0 | 1 |
| Soaring Total | | 1 | 7 | 0 | 8 |
| Terrestrial | Grey-winged Francolin | 1 | 0 | 0 | 1 |
| Terrestrial Total | | 1 | 0 | 0 | 1 |
| Column Total | | 2 | 7 | 0 | 9 |

**Table B. Number of individual priority species birds recorded during the survey by Contact Class, Species, the number (N) that flew at medium / all heights and Individuals Contact Duration (minutes) at medium / all heights. The time at medium height is expressed as a percentage of the time at all heights.**

| Contact Class | Species | Medium Height (N) | Medium Heigh (Minutes) | All Height (N) | All Heights (Minutes) | % Time at Medium Ht |
|---|---|---|---|---|---|---|
| Soaring | Jackal Buzzard | 0 | 0 | 1 | 1 | 0% |
| | Lesser Kestrel | 6 | 18 | 6 | 18 | 100% |
| | Verreaux's' Eagle | 1 | 4 | 1 | 4 | 100% |
| Soaring Total | | 7 | 22 | 8 | 23 | 96% |
| Terrestrial | Grey-winged Francolin | 0 | 0 | 1 | 0.75 | 0% |
| Terrestrial Total | | 0 | 0 | 1 | 0.75 | 0% |
| Overall Total | | 7 | 22 | 9 | 23.75 | 93% |

**Table C: Number of individual priority species birds recorded by Contact Class, Species and Season.**

| Contact Class | Species | Season | | | | Row Totals |
|---|---|---|---|---|---|---|
| | | Spring '15 | Autumn '16 | Winter '16 | Summer '16 | |
| Soaring | Jackal Buzzard | 1 | 0 | 0 | 0 | 1 |
| | Lesser Kestrel | 0 | 0 | 0 | 6 | 6 |
| | Verreaux's' Eagle | 1 | 0 | 0 | 0 | 1 |
| Soaring Total | | 2 | 0 | 0 | 6 | 8 |
| Terrestrial | Grey-winged Francolin | 1 | 0 | 0 | 0 | 1 |
| Terrestrial Total | | 1 | 0 | 0 | 0 | 1 |
| Column Total | | 3 | 0 | 0 | 6 | 9 |

**Table D: Number of individual priority species birds recorded by Contact Class, Species and Temperature.**

| Contact Class | Species | Temperature Cold | Temperature Mild | Temperature Hot | Row Totals |
|---|---|---|---|---|---|
| Soaring | Jackal Buzzard | 0 | 1 | 0 | 1 |
| | Lesser Kestrel | 4 | 2 | 0 | 6 |
| | Verreaux's' Eagle | 0 | 1 | 0 | 1 |
| Soaring Total | | 4 | 4 | 0 | 8 |
| Terrestrial | Grey-winged Francol | 0 | 0 | 1 | 1 |
| Terrestrial Total | | 0 | 0 | 1 | 1 |
| Column Total | | 4 | 4 | 1 | 9 |

**Table E: Number of individual priority species birds, by Contact Class, Species and Weather Condition.**

| Contact Class | Species | Cloudy | Partly Cloudy | Sunny | Row Totals |
|---|---|---|---|---|---|
| Soaring | Jackal Buzzard | 0 | 0 | 1 | 1 |
| | Lesser Kestrel | 0 | 4 | 2 | 6 |
| | Verreaux's' Eagle | 0 | 0 | 1 | 1 |
| Soaring Total | | 0 | 4 | 4 | 8 |
| Terrestrial | Grey-winged Francolin | 0 | 1 | 0 | 1 |
| Terrestrial Total | | 0 | 1 | 0 | 1 |
| Column Total | | 0 | 5 | 4 | 9 |

**Table F: Number of individual priority species birds recorded by Species and Wind Direction.**

| Contact Class | Species | Wind Direction | | | | | | | | | Row Totals |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | None | N | NE | E | SE | S | SW | W | NW | |
| Soaring | Jackal Buzzard | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| | Lesser Kestrel | 0 | 0 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 6 |
| | Verreaux's' Eagle | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| Soaring Total | | 0 | 2 | 0 | 6 | 0 | 0 | 0 | 0 | 0 | 8 |
| | Grey-winged Francolin | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Terrestrial Total | | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 1 |
| Column Total | | 0 | 2 | 0 | 6 | 0 | 0 | 0 | 0 | 1 | 9 |

**Table G: Number of individual priority species birds recorded by Contact Class, Species and wind strength (Beaufort scale)**

| Contact Class | Species | Beaufort Scale | | | | Row Totals |
|---|---|---|---|---|---|---|
| | | Light Air | Light Breeze | Fresh Breeze | Strong Breeze | |
| Soaring | Jackal Buzzard | 0 | 0 | 0 | 1 | 1 |
| | Lesser Kestrel | 2 | 0 | 4 | 0 | 6 |
| | Verreaux's' Eagle | 0 | 1 | 0 | 0 | 1 |
| Soaring Total | | 2 | 1 | 4 | 1 | 8 |
| | Grey-winged Francolin | 0 | 0 | 1 | 0 | 1 |
| Terrestrial Total | | 0 | 0 | 1 | 0 | 1 |
| Column Total | | 2 | 1 | 5 | 1 | 9 |

## Definition of terms

These notes explain some of the terminology used in the report.

**Average:** The *average value* (also referred to as the *mean value*) is a measure of the location of the centre of gravity of a data distribution.

**Variability:** The *variance* is a measure of the variability of the observed data (e.g. counts per *3*h) around the mean value of the data. Its square root, the *standard deviation*, does the same but is scaled to the same units as those of the observed data.

**Confidence Interval:** A *confidence interval* for the true mean of a population (e.g. the true mean of the number of terrestrial birds occurring in an area) is an interval, computed from a random sample, that reflects the uncertainty of the estimate based on a single sample. If it were possible to take the infinite number of all possible samples of size *N* per season (in the present case of sampling) and a *95%* confidence interval for the mean is computed in each case, then *0.95*N* of those intervals will contain the true mean value. The larger the sample size, the narrower the confidence interval. On the other hand, the larger the standard deviation of a distribution, the wider the confidence interval for the mean. The lower limit of the confidence interval is denoted by LCL and the upper limit by UCL.

**Accuracy and Precision:** A sample *estimate* of a parameter that describes a population (e.g. its true mean) depends on the sample size and is desired to be close to the true value of the parameter. The closeness of such an estimate to the true value is known as its *accuracy*. The precision of an estimate relates to the variability of the measurements. The closer together the data, the more precise the estimate. Half the width of the confidence interval for the parameter is defined as the *precision* (denoted by *d*) of its estimate. This means that the estimated confidence interval for the true mean can be stated to be $\overline{X} \pm d$, where $\overline{X}$ is the sample mean. The larger the sample size the better (smaller) the precision.

**Distribution of counts:** It is recognised that counts of events (randomly distributed over space or time) that took place, for example, in a fixed time period (e.g. the count of birds in a watch period of fixed length) may have a *Poisson distribution* when the events occur randomly over time. The mean value and variance (the squared standard deviation) of a Poisson distribution are identical. This means that large mean values (of counts per SU) imply poorer precision.

## Poisson distribution – confidence interval

If the count of birds per sampling unit (SU) [i.e. a watch period] is assumed to have a Poisson distribution with an (unknown) average value of $\lambda$ and if *N* SUs were sampled (for example 2h watch periods are sampled *N = 30* times) the sum of the *N* counts also has a Poisson distribution (with true average $\lambda N$), see Brownlee, *1960*, p. *141*.

The Poisson probability (which is characterised uniquely by its average parameter (in this case $\lambda N$) for finding a count of X = x birds from the *N* SUs is given by: $P(X = x) = e^{-\lambda N}(\lambda N)^x \,/\, x!$, for values of $x = 0, 1, 2, \ldots$ .

A ($1 - \beta$) confidence interval for the mean value, $\lambda N$, of this Poisson is determined by a lower limit $L_1 = \frac{1}{2}\chi^2_{\beta/2}(2X)$ and an upper limit $L_2 = \frac{1}{2}\chi^2_{1-\beta/2}(2X+2)$, see Zar (2010), pp. 587 – 589. Here $\chi^2_\alpha(\nu)$ is the $\alpha$-point of the chi-squared distribution with $\nu$ degrees of freedom, i.e. the $\chi^2$-value with cumulative probability of $\alpha$ up to that value. *X* denotes the count of the number of birds over *N* SUs.

This means that the coverage probability for $\lambda N$, based on a count of $X$ birds per $N$ SUs is $P(L_1 \le \lambda N \le L_2) = 1 - \beta$. Thus a $1 - \beta$ confidence interval for $\lambda$ (the expected average value per SU) is given by the interval $(L_1 / N;\quad L_2 / N)$.

These formulas were used to determine the confidence intervals in the Tables in Section *3* of the report.

## Poisson distribution – Sample Size

Consider the question of how many watch periods (i.e. sampling units, *N*) must be sampled in order to obtain an estimate of the true count per SU with *precision* of “*d”* units with prescribed probability, e.g. 95%. Thus, what must *N* be so that the true mean count per SU lies in an interval of half-width *d* with certainty of $1 - \beta$ ?

As was indicated in the previous section, this interval is $(L_1 / N;\quad L_2 / N)$ and thus the precision is $d = \frac{1}{2}(L_2 - L_1) / N$. The true average is estimated from the observed total count, *X*, and is given by $\hat{\lambda} = X / N$. This estimate is NOT in the centre of the confidence interval, but even so, we shall take half of the width of the confidence interval and call it the *1 – β precision*. A sample size that will be sufficiently large to provide an estimate of the true mean count per SU with an acceptable value for its precision (say $d = d_0$) must thus satisfy the inequality: $\frac{1}{2}(L_2 - L_1) / N \le d_0$ or, solving for *N*:

(1) $$N \ge \tfrac{1}{2}(L_2 - L_1) / d_0 = \left( \chi^2_{1-\beta/2}(2X + 2) - \chi^2_{\beta/2}(2X) \right) / 4d_0.$$

From a practical point of view, if it is expected that the average value per SU is $\mu$, then (with *N* SU’s taken) an estimate for the count that is expected to be seen is $X \approx N\mu$. From equation (1) it then follows that the estimated number of SU’s to be taken should satisfy the equation

(2) $$4d_0 N - \left( \chi^2_{1-\beta/2}(2N\mu + 2) - \chi^2_{\beta/2}(2N\mu) \right) \ge 0.$$

This means that if some knowledge of the average number of birds per SU for a given site is available, and this has to be estimated with prescribed precision from a sample of SU’s, then that sample size is the smallest value of *N* satisfying (2).

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

# Bat Specialist Scoping Assessment:

## for the Proposed Development of the Phase 1 Kuruman Wind Farm Facility, Kuruman, Northern Cape Province: SCOPING REPORT

| *Report prepared for:* | *Report prepared by:* |
| --- | --- |
| CSIR – Environmental Management Services | Werner Marais |
| | Animalia Consultants (Pty) Ltd |
| P O Box 320 | Heldervue, Somerset West |
| Stellenbosch | Cape Town, 7130 |
| 7600 | werner@animalia-consult.co.za |

21 April 2018

Report ref: R-1804-12

# SPECIALIST EXPERTISE

**Summary of qualifications**

2008 *University of Johannesburg*
**MSc (Biodiversity and Conservation) – Cum laude**

2006 *University of Johannesburg*
**Hons (Biodiversity and Conservation)**

2005 *University of Johannesburg*
**BSc (Zoology and Botany)**

**Affiliations to professional bodies and societies**

- Pr.Sci.Nat.– SACNASP (Zoological Science; registration number 400169/10)
- Resigned steering committee panel member of the SABAA (South African Bat Assessment Association).
- Served on the research committee of the Gauteng and Northern Regions Bat Interest Group (GNoRBIG).
- Served on the steering committee of the Zoological Society of the University of Johannesburg.

**Experience**

i. 2008 – Current Founder of Animalia Consultants (Pty) Ltd (previously a Close Corporation). Animalia has completed more than **440 specialist reports and numerous large-scale projects** under the supervision and lead of Werner Marais.

i. 2008 University of Johannesburg

- Sensitivity and biodiversity surveys of five caves in the Cradle of Humankind World Heritage Site (COHWHS) and Pretoria areas.
- Preliminary survey to investigate the correlation between insectivorous bats and prey insects in the Krugersdorp Game Reserve.

i. 2007, 2008 Bertie van Zyl (Pty) Ltd.(ZZ2 Tomato Farms), University of Johannesburg

Two-year project to research the biological pest control method of utilizing insectivorous bats in agriculture. Required to conduct an in-depth study of bat (Microchiroptera) behavior and ecologically important factors.

/. 2006 University of Johannesburg

Six-month survey of cave dwelling arthropods in the Cradle of Humankind World Heritage Site.

***Additional:***

***Invited by the EWT (Endangered Wildlife Trust) and ESSA (Exploration Society of Southern Africa) to deliver presentations on current ecological issues regarding bats and wind energy.***

***Co-author for the: "South African Bat Fatality Threshold Guidelines for Operational Wind Energy Facilities – ed 1. South African Bat Assessment Association. Sept 2017"***

***Co-author for the: "South African Good Practice Guidelines for Operational Monitoring of Bats at Wind Energy Facilities. First Edition July 2014"***

***Contributing editor for the: "South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments – Pre-construction; Edition 4.1, 2017"***

***As a co-author, received the Dow Greeff price for best annual scientific publication: "Die karst-ekologie van die Bakwenagrot (Gauteng)" published in the Suid-Afrikaanse Tydskrif vir Natuurwetenskap en Tegnologie, Vol. 31(1), 2012.***

***Presented the following papers at conferences:***

- ***The potential of using insectivorous bats (Microchiroptera) as a means of insect pest control in agricultural areas. The Zoological Society of Southern Africa's 50th Anniversary Conference. July 2009.***

- ***Inseketende vlermuise (Microchiroptera) en vlermuishuise in landbougebiede. Suid Afrikaanse Akademie vir Wetenskap en Kuns se 100 jaar Eufees kongres. October 2009.***

***Interviewed for two popular magazine articles on ecological aspects of biological pest control utilising bats; published in two consecutive issues of Farmers Weekly.***

# SPECIALIST DECLARATION

I, ..Werner Marais........................, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- I act as the independent specialist in this application;
- I 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;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- 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 have no vested interest in the proposed activity proceeding;
- 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;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist: ________________________________

Name of Specialist: ____Werner Marais__________________________________

Date: __________21 April 2018________________________________________

# LIST OF ABBREVIATIONS

| | |
|---|---|
| DEA | Department of Environmental Affairs |
| EIA | Environmental Impact Assessment |
| WEF | Wind Energy Facility |
| SM | Short Mast |
| Met Mast | Meteorological mast |
| | |
| | |

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# TABLES AND FIGURES

# Bat Specialist Scoping Assessment

## 1.1. INTRODUCTION AND METHODOLOGY

### *1.1.1. Scope and Objectives*

This is a Scoping Phase report, considering a significant portion of the passive data gathered up to date by the long-term preconstruction assessment. The Scoping Report serves to inform the project of any fatal and significant flaws, as well as predicted impacts prior to the conclusion of the entire EIA assessment.

### *1.1.2. Terms of Reference*

- A description of the baseline characteristics and conditions of the receiving environment (e.g. site and/or surrounding land uses including urban and agricultural areas).
- An evaluation of the predicted impacts of the project on the receiving environment.
- Compilation of a bat sensitivity map.
- An assessment of the probability of each impact occurring, the reversibility of each impact and the level of confidence in each potential impact.
- Consider and evaluate the cumulative impacts in terms of the current and proposed activities in the area.
- Recommendations to avoid negative impacts, as well as feasible and practical mitigation, management and/or monitoring options to reduce negative impacts that can be included in the Environmental Management Programme.
- A reasoned opinion as to whether the proposed activity, or portions of the activity should be authorised.

### *1.1.3. Approach and Methodology*

The study originally started in January 2016, when the two Short Mast systems was set up and a passive bat detector was installed on Met Mast K1. The study was then put on hold until September 2016 by the proponent, and it was put on hold again in December 2016. These months gathered some limited passive bat activity data, but the systems encountered many problems, and some recording parameters were different from current practices. Therefore, the data set from the 4$^{th}$ visit in May 2017 will be included in this assessment. The study resumed in May 2017 with a site visit where all the passive systems were overhauled and repaired (referred to as the 4$^{th}$ site visit) and will continue until May 2018 in order to have gathered a 12-month data set.

Three factors need to be present for most South African bats to be prevalent in an area: availability of roosting space, food (insects/arthropods or fruit), and accessible open water sources. However, the dependence of a bat on each of these factors depends on the species, its behaviour and ecology. Nevertheless, bat activity, abundance and diversity are likely to be higher in areas supporting all three above mentioned factors.
The site is evaluated by comparing the amount of surface rock (possible roosting space), topography (influencing surface rock in most cases), vegetation (possible roosting spaces and foraging sites), climate (can influence insect numbers and availability of fruit), and presence of surface water (influences insects and acts as a source of drinking water) to identify bat species that may be impacted by wind turbines. These comparisons are done chiefly by briefly studying the geographic literature of the site, available satellite imagery and by groundtruthing with site visits. Species probability of occurrence based on the above-mentioned factors are estimated for the site and the surrounding larger area, but also considers species already confirmed on site as well as surrounding areas.

Bat activity is monitored using active and passive bat monitoring techniques. Active monitoring is carried out on site visits by the means of driven transects. A bat detector mounted on a vehicle is used and transect routes are chosen based on road accessibility. Sampling effort and prevalent weather conditions are considered for each transect.

Passive detection is continuing by means of passive bat monitoring systems on the meteorological masts and short masts on site (**Figures 1.1-1 and 1.1-2**). The data of the passive systems from both Kuruman Phases 1 and 2 will be considered in the scoping study report of each phase, as they are located in terrain and habitat applicable to both phases and will provide insight into the terrain of both.

During each site visit the passive data of the bat activity are downloaded from the monitoring systems. The data is analysed by classifying (as near to species level as possible) and counting positive bat passes detected by the systems. A bat pass is defined as a sequence of ≥1 echolocation calls where the duration of each pulse is ≥2ms (one echolocation call can consist of numerous pulses). A new bat pass is identified by a >500ms period between pulses. These bat passes are summed into hourly intervals which are used to calculate nocturnal distribution patterns over time. Times of sunset and sunrise are automatically adjusted with the time of year. The **Table 1.1 - 1** below summarizes the equipment setup.

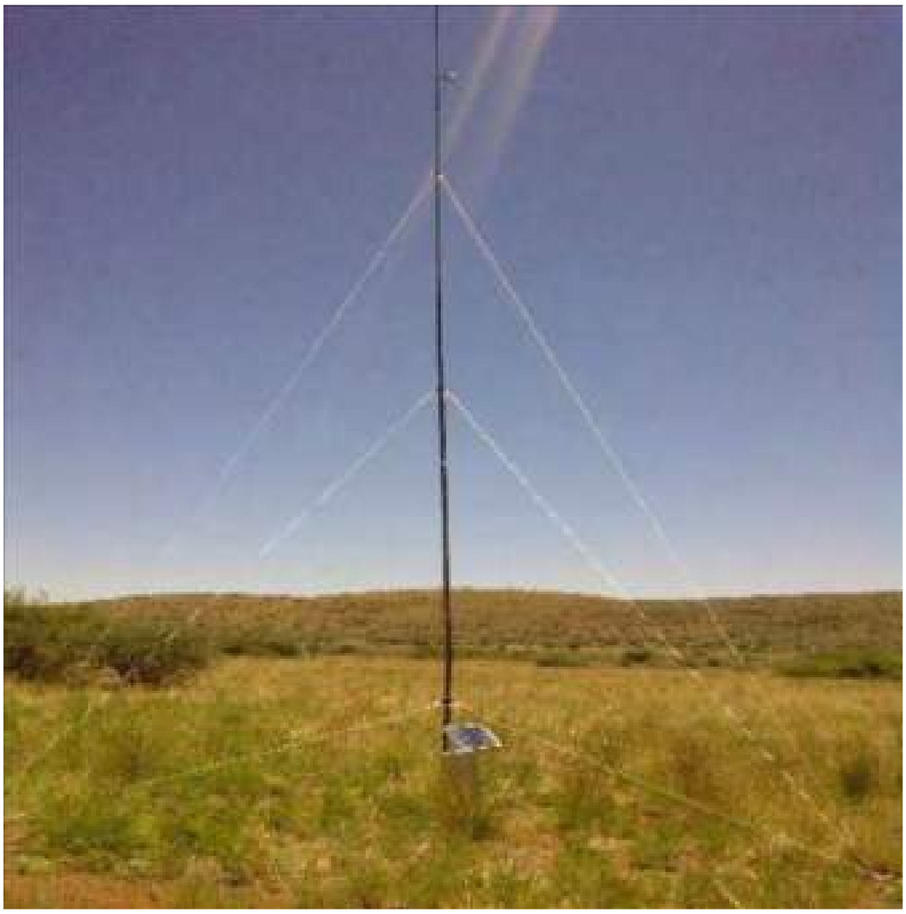


**Figure 1.1-1:** Short mast monitoring system set up.

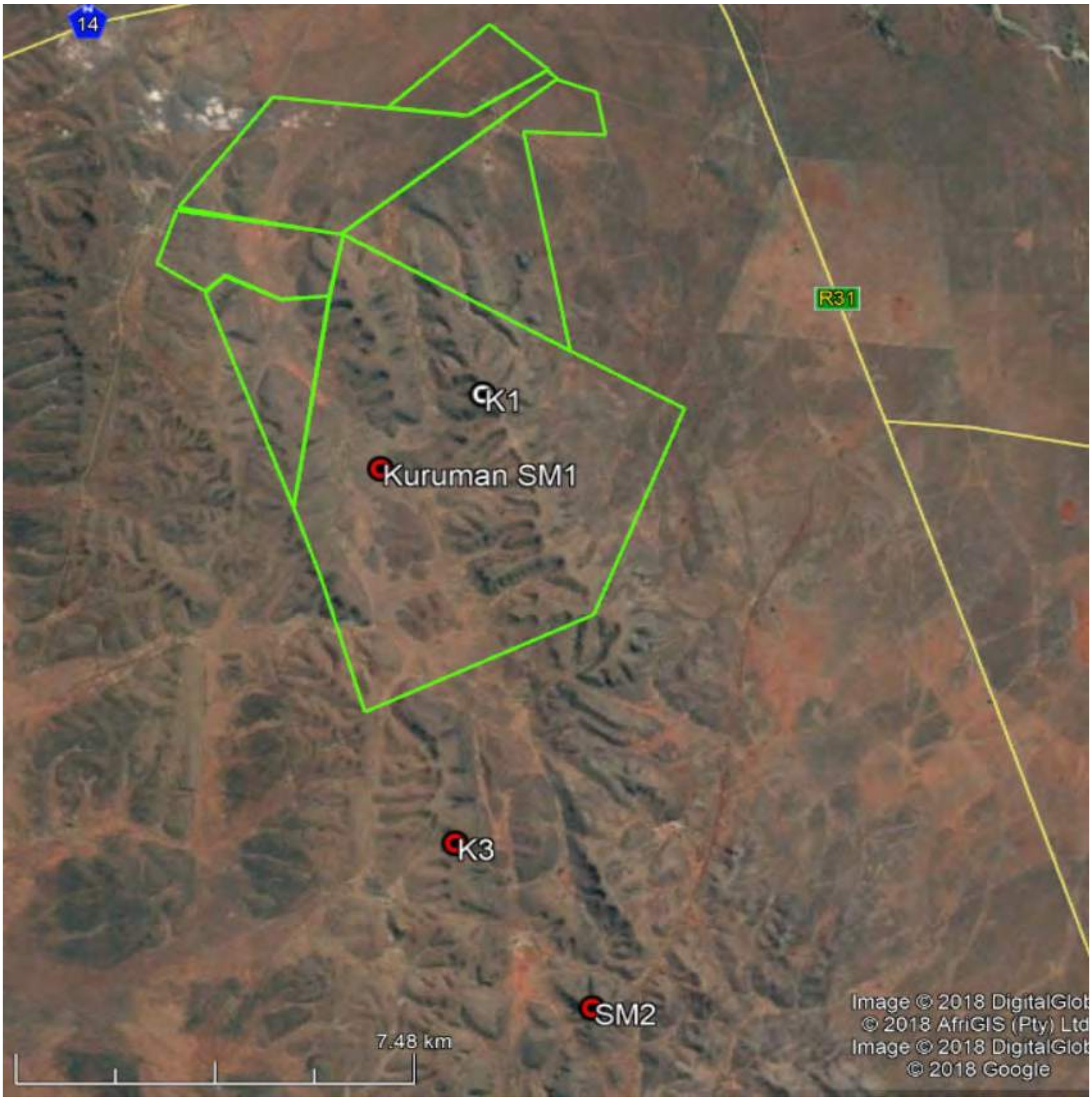



**Figure 1.1-2**: Locations of the passive systems on site.

**Table 1.1-1:** Equipment setup and site visit information.

<table>
<tr><td colspan="2" rowspan="8">Site visit dates</td><td>First Visit</td><td>22 – 26 January 2016 (Installation of systems)</td></tr>
<tr><td>Second Visit</td><td>12 – 16 September 2016</td></tr>
<tr><td>Third Visit</td><td>11 – 14 December 2016</td></tr>
<tr><td>Fourth Visit</td><td>15 – 19 May 2017</td></tr>
<tr><td>Fifth Visit</td><td>1 – 4 August 2017</td></tr>
<tr><td>Sixth Visit</td><td>27 – 30 October 2017</td></tr>
<tr><td>Seventh Visit</td><td>22 – 25 January 2018</td></tr>
<tr><td>Eight Visit</td><td>To be conducted in May 2018</td></tr>
<tr><td rowspan="3">Met mast passive bat detection systems</td><td>Amount on site</td><td colspan="2">2<br>(Met K3 was only ready for the passive bat detector by approximately May 2017, therefore no data exist for K3 prior to May 2017).</td></tr>
<tr><td>Microphone heights</td><td colspan="2">10m; 60m (K1)<br>10m; 80m (K3)</td></tr>
<tr><td>Coordinates</td><td colspan="2">Met K1: 27° 33.177'S; 23° 24.100'E<br>Met K3: 27° 37.922'S; 23° 23.782'E</td></tr>
<tr><td rowspan="3">Short mast passive bat detection systems</td><td>Amount on site</td><td colspan="2">2</td></tr>
<tr><td>Microphone height</td><td colspan="2">10m</td></tr>
<tr><td>Coordinates</td><td colspan="2">SM1: 27° 33.957'S; 23° 22.913'E<br>SM2: 27° 39.668'S; 23° 25.307'E</td></tr>
<tr><td colspan="4">Replacements/ Repairs/ Comments</td></tr>
<tr><td colspan="2">First Site Visit</td><td colspan="2">The microphones were mounted such that they pointed approximately 30 degrees downward to avoid excessive water damage. Measures were taken for protection against birds, without compromising effectiveness significantly. Crows have been found to peck at microphones and damage them.<br>The bat detectors were mounted inside weather-proof boxes together with all peripherals, to provide protection against the elements.</td></tr>
<tr><td colspan="2">Second Site Visit</td><td colspan="2">All detectors were operational even after they have been unattended for nearly a year, although microphone quality degraded. The Met Mast K3 has not been constructed yet.</td></tr>
<tr><td colspan="2">Third Site Visit</td><td colspan="2">The Met Mast K1 shows indication that the microphones require replacing due to a lack of data on the memory cards. SM1 mast has broken in half and the microphone was on ground level. The Met Mast K3 has not been constructed yet.</td></tr>
<tr><td colspan="2">Fourth Visit</td><td colspan="2">All the passive systems were overhauled and repaired, which included battery and microphone replacements. Met Mast K3 was constructed and the microphones were installed at 10m and 80m on this mast.</td></tr>
<tr><td colspan="2">Fifth Visit</td><td colspan="2">Short masts were serviced, and guy ropes tightened. All systems had</td></tr>
</table>

| | |
|---|---|
| | good quality data on their SD cards. |
| **Sixth Visit** | Short masts were serviced, and guy ropes tightened. All systems had good quality data on their SD cards. |
| **Seventh Visit** | Short masts were serviced, and guy ropes tightened. All systems had good quality data on their SD cards. |
| **Eight Visit** | To be conducted in May 2018 |
| **Type of passive bat detector** | SM2BAT+, Real Time Expansion (RTE) type.<br>SM3BAT, Real Time Expansion (RTE) type. |
| **Recording schedule** | Each detector was set to operate in continuous trigger mode from dusk each evening until dawn (times were automatically adjusted with latitude, longitude and season). |
| **Trigger threshold** | >16KHz, 18dB |
| **Trigger window (time of recording after trigger ceased)** | 500 ms |
| **Microphone gain setting** | 12dB (SM2BAT+) |
| **Compression** | WAC0 |
| **Single memory card size (each system uses 4 cards)** | 32GB |
| **Battery size** | 17Ah; 12V |
| **Solar panel output** | 20 Watts |
| **Solar charge regulator** | 6 - 8 Amp with low voltage/deep discharge protection |
| **Other methods** | Terrain was investigated during the day for general characteristics. |

### *1.1.4. Assumptions and Limitations*

- Distribution maps of South African bat species still require further refinement, thus the bat species proposed to occur on the site (and not detected in the area yet) should be considered precautionary. If a species has a distribution marginal to the site, it was assumed to occur in the area.
- The migratory paths of bats are largely unknown, thus limiting the ability to determine if the wind farm will have a large-scale effect on migratory species. This limitation however should be partly overcome with the long-term sensitivity assessment.
- The sensitivity map is based partially on satellite imagery, and there is always the possibility that what has been mapped may differ slightly to what is on the ground.
- Species identification with the use of bat detection and echolocation is less accurate when compared to morphological identification, nevertheless it is a very certain and accurate indication of bat activity and their presence with no harmful effects on bats being surveyed.
- Automated species identification by the Kaleidoscope software may produce a smaller portion of incorrect identifications or unknown identifications. In last mentioned case the dominant frequency of the unknown call was simply used to group the bat into a family or genus group, using dominant frequency only as the determining factor. However, the

automated software is very effective at distinguishing bat calls from ultrasonic noise, therefore the number of bat passes will not significantly be overestimated.

- It is not possible to determine actual individual bat numbers from acoustic bat activity data, whether gathered with transects or the passive monitoring systems. However, bat passes per night are internationally used and recognized as a comparative unit for indicating levels of bat activity in an area.
- Spatial distribution of bats over the study area cannot be accurately determined by means of transects, although the passive systems can provide comparative data for different areas of the site. Transects may still possibly, in rare cases, uncover high activity in areas where it is not necessarily expected and thereby increase insight into the site.
- Exact foraging distances from bat roosts or exact commuting pathways cannot be determined by the current methodology. Radio telemetry tracking of tagged bats is required to provide such information, if needed.

## 1.2. APPLICABLE LEGISLATION AND GUIDELINES

Legislation dealing with biodiversity applies to bats and includes the following:

NATIONAL ENVIRONMENTAL MANAGEMENT: BIODIVERSITY ACT, 2004 (ACT 10 OF 2004; Especially sections 2, 56 & 97)

The act calls for the management and conservation of all biological diversity within South Africa. Bats constitute an important component of South African biodiversity and therefore all species receive additional attention to those listed as Threatened or Protected.

Applicable guidelines that informs the methodology and mortality threshold numbers are:
Sowler, S., Stoffberg, S., MacEwan, K., Aronson, J., Ramalho, R., Forssman, K., Lötter, C. 2017. **South African Good Practice Guidelines for Surveying Bats at Wind Energy Facility Developments - Pre-construction: Edition 4.1**. South African Bat Assessment Association.

MacEwan, K., Aronson, J., Richardson, E., Taylor, P., Coverdale, B., Jacobs, D., Leeuwner, L., Marais, W., Richards, L. September 2017. **South African Bat Fatality Threshold Guidelines for Operational Wind Energy Facilities – ed 1**. South African Bat Assessment Association.

## 1.3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

### *1.3.1. Baseline description of the receiving environment*

#### *1.3.1.1. Land Use, Vegetation, Climate and Topography*

The site is situated in two vegetation units: Kuruman Thornveld and Kuruman Mountain Bushveld. Kuruman Mountain Bushveld occupies the largest part of the site with the Kuruman Thornveld mostly appearing on the edges and in a valley (**Figure 1.3 – 1)**. Proposed turbine locations are all inside the Kuruman Mountain Bushveld.

The Kuruman Mountain Bushveld vegetation unit consists of rolling hills with generally gentle to moderate slopes and hill pediment areas with an open shrubveld with Lebeckia macrantha prominent in places. Grass layer is well developed. The Kuruman and Asbestos Hills consist of banded iron formation with jaspilite, chert and riebeckite-asbestos of the Asbestos Hills subgroup of the Griqualand West Supergroup. The area has summer and autumn rainfall with very dry winters. The incidence of frost is frequent in winter. MAP about 250-500mm. The unit corresponds in part to cluster 17 of the 27 in the physio-climatic classification of South Africa's woodland areas with summer rainfall. Conservation is least threatened with a target of 16%. None of the unit is conserved. Very little of the unit is conserved and erosion is very low to low. Some parts in the north are heavily utilised for grazing. (Mucina and Rutherford 2006).

The Kuruman Thornveld vegetation unit consists of flat rocky plains and some sloping hills with very well-developed, closed shrub layer and well-developed open tree stratum consisting of Acacia erioloba. The geology of the area consists of Campbell Group dolomite and chert and mostly younger, superficial Kalahari Group sediments with red wind-blown sand. Locally rocky pavements are formed in places. The area has summer and autumn rainfall with very dry winters. MAP about 300-450mm. Temperatures in the area range from a maximum of 35.9° in January and a minimum of -3.3° in July. There is frequent frost in winter. Target 16%. None of the unit is conserved. Only 2% already transformed. Erosion is very low.

Vegetation units and geology are of great importance as these may serve as suitable sites for the roosting of bats and support of their foraging habits (Monadjem et al. 2010). Houses and buildings may also serve as suitable roosting spaces (Taylor 2000; Monadjem et al. 2010). The importance of the vegetation units and associated geomorphology serving as potential roosting and foraging sites have been described in **Table 1.3 - 1**.

The site is predominantly utilised as a game farm, and infrastructure as well as anthropogenic impacts are low. Natural habitats are dominating the site.

**Table 1.3-1**: Potential of vegetation to serve as suitable roosting and foraging spaces for bats.

| Vegetation Unit | Roosting Potential | Foraging Potential | Comments |
|---|---|---|---|
| Kuruman Thornveld | Moderate - High | Moderate - High | The abundance of trees provides roosting and foraging of several insectivorous bat species. |
| Kuruman Mountain Bushveld | Moderate - High | Moderate | The landscape features provide roosting space for bat species inhabiting rock crevices and hollows. The grassland provides opportunities for open-air foraging bat species. |

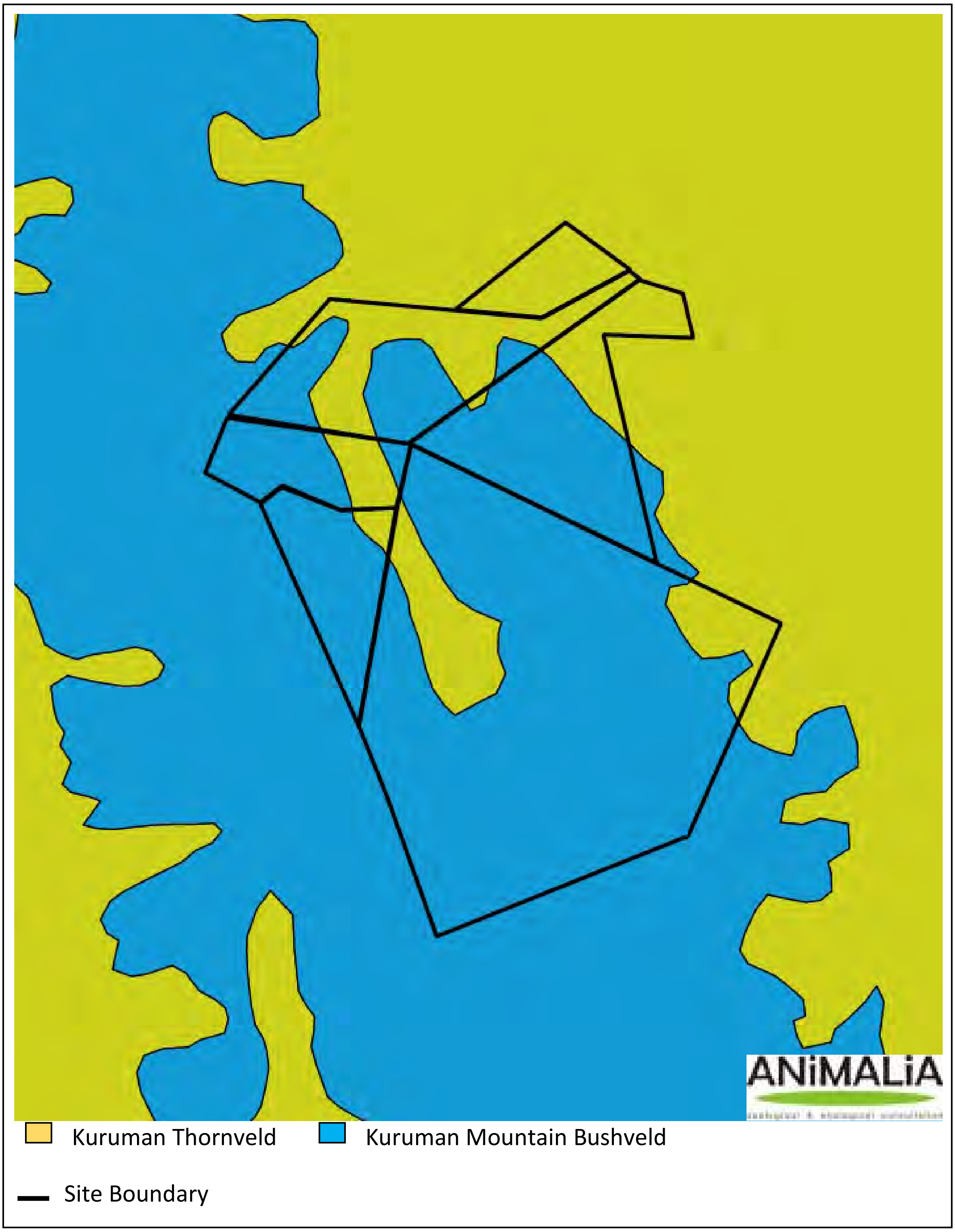



**Figure 1.3-1**: Vegetation units present on the site (Mucina and Rutherford 2006).

#### *1.3.1.2. Currently Confirmed, Previously Recorded as well as Literature Based Species Probability of Occurrence*

"Probability of Occurrence" is assigned based on consideration of the presence of roosting sites and foraging habitats on the site, compared to literature described preferences, species records from nearby and adjacent WEF's, and species currently confirmed on site. The probability of occurrence is also influenced by the likelihood of encountering the bat species on site (e.g. it's scarcity in general, or if the distribution is marginal to the site location).

The column of "Likely risk of impact" describes the likelihood of risk of fatality from direct collision or barotrauma with wind turbine blades for each bat species. The risk was assigned by Sowler et al. (2017) based on species distributions, altitudes at which they fly and distances they traverse; and assumes a 100% probability of occurrence.

**Table 1.3-2**: Table of species that are currently confirmed on site, have been previously recorded in the area and may be occurring based on literature. Roosting or foraging in the study area based, the possible site-specific roosts, and their probability of occurrence based on literature as well as recordings and observations in the surrounding area, is also briefly described (Monadjem et al. 2010; ACR, 2016).

| **Species** | **Common name** | **Probability of occurrence (%)** | **Conservation status** | **Possible roosting habitat on site** | **Possible foraging habitat utilised on site** | **Likelihood of risk of fatality (Sowler, *et al.*, 2017)** |
|---|---|---|---|---|---|---|
| *Tadarida aegyptiaca* | Egyptian free-tailed bat | Confirmed on site | Least Concern | Roosts in rock crevices, hollows in trees, and behind the bark of dead trees. The species has also taken to roosting in roofs of buildings. | It forages over a wide range of habitats; its preferences of foraging habitat seem independent of vegetation. It seems to forage in all types of natural and urbanised habitats. | High |
| *Sauromys petrophilus* | Robert's flat-headed bat | Confirmed on site | Least Concern | Roosts in rock crevices that may be found on site. | Open air forager that will fly over vast areas of flat terrain. | High |
| *Miniopterus natalensis* | Natal long-fingered bat | Confirmed on site | Least Concern (2016 Regional Listing) Near Threatened (2004 National Listing) | Cave and hollow dependent, closest cave approximately 5km from site. Will also roost in small groups or individually in culverts and other hollows. | Clutter-edge forager. May forage in more open terrain during suitable weather. | Medium - High |
| *Neoromicia capensis* | Cape serotine | Confirmed on site | Least Concern | Roosts in the roofs of houses and buildings, and also under the bark of trees. | It appears to tolerate a wide range of environmental conditions from arid semi-desert areas to montane grasslands, forests, and savannahs. But is predominantly a medium height clutter edge forager. | Medium - High |
| *Eptesicus hottentotus* | Long-tailed serotine | Confirmed on site | Least Concern | It is a crevice dweller roosting in rock crevices, as well as other crevices in buildings. Rock crevices in valleys on site. | It generally seems to prefer woodland habitats, and forages on the clutter edge. But may still forage over open terrain occasionally. | Medium |
| *Rhinolophus denti* | Dent's horseshoe bat | 70-80 | Near Threatened | Roosts in caves and mine adits, closest cave approximately 5km from site. May | Clutter forager, will be more prevalent in valleys and low-lying | Low |

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | (2004 National Listing; 2016 Regional Listing) | utilise man made hollows. | areas with thickets. | |
| *Rhinolophus clivosus* | Geoffroy's horseshoe bat | 80-90 | Least Concern (2016 Regional Listing) Near Threatened (2004 National Listing) | Roosts in caves and mine adits, closest cave approximately 5km from site. May utilise man made hollows. | Clutter forager, will be more prevalent in valleys and low-lying areas with thickets. | Low |
| *Rhinolophus darlingi* | Darling's horseshoe bat | 70-80 | Least Concern (2016 Regional Listing) Near Threatened (2004 National Listing) | Roosts in caves and old mines, closest cave approximately 5km from site. | Clutter forager, will be more prevalent in valleys and low-lying areas with thickets. | Low |
| *Nycteris thebaica* | Egyptian slit-faced bat | 50-60 | Least Concern | Roosts in hollows, aardvark burrows, culverts under roads and the trunks of dead trees. | It appears to occur throughout the savannah and Karoo biomes but avoids open grasslands. May possibly occur in the thickets of low-lying valleys and drainage areas. | Low |

#### *1.3.1.3. Ecology of bat species that may be impacted the most by the Kuruman WEF Phase 1*

There are several bat species in the vicinity of the site that occur commonly in the area. Some of these species are of special importance based on their likelihood of being impacted by the proposed WEF, due to high abundances and certain behavioural traits. The relevant species are discussed below.

***Tadarida aegyptiaca***

The Egyptian Free-tailed Bat, *Tadarida aegyptiaca*, has a wide distribution and high abundance throughout South Africa and is part of the Free-tailed bat family (Molossidae). It occurs from the Western Cape of South Africa, north through to Namibia and southern Angola; and through Zimbabwe to central and northern Mozambique (Monadjem et al. 2010). This species is protected by national legislation in South Africa (ACR 2010).

They roost communally in small (dozens) to medium-sized (hundreds) groups in caves, rock crevices, under exfoliating rocks, in hollow trees and behind the bark of dead trees. *Tadarida aegyptiaca* has also adapted to roosting in buildings, in particular roofs of houses (Monadjem et al. 2010). Thus, man-made structures and large trees on the site would be important roosts for this species.
*Tadarida aegyptiaca* forages over a wide range of habitats, flying above the vegetation canopy. It appears that the vegetation has little influence on foraging behaviour as the species forages over desert, semi-arid scrub, savannah, grassland and agricultural lands. Its presence is strongly associated with permanent water bodies due to concentrated densities of insect prey (Monadjem et al. 2010).

The Egyptian Free-tailed bat is considered to have a High likelihood of risk of fatality due to wind turbines (Sowler et al. 2017). Due to the high abundance and widespread distribution of this species, high mortality rates due to wind turbines would be a cause of concern as these species have more significant ecological roles than the rarer bat species.

After a gestation of four months, a single young is born, usually in November or December, when females give birth once a year. In males, spermatogenesis occurs from February to July and mating occurs in August. Maternity colonies are apparently established by females in November.

***Neoromicia capensis***

*Neoromicia capensis* is commonly called the Cape serotine and it is found in high numbers and is widespread over much of Sub-Saharan Africa. High mortality rates of this species due to wind turbines would be a cause of concern as *N. capensis* is abundant and widespread and as such has a more significant role to play within the local ecosystem than the rarer bat species. They do not undertake migrations and thus are considered residents of the site.

It roosts individually or in small groups of two to three bats in a variety of shelters, such as under the bark of trees, at the base of aloe leaves, and under the roofs of houses. They will use most man-made structures as day roosts which can be found throughout the site and surrounding areas (Monadjem et al. 2010).

They are tolerant of a wide range of environmental conditions as they survive and prosper within arid semi-desert areas to montane grasslands, forests, and savannas; indicating that they may occupy several habitat types across the site, and are amenable towards habitat changes. They are however clutter-edge foragers, meaning they prefer to hunt on the edge of vegetation clutter mostly, but can occasionally forage in open spaces. They are thought to have a Medium-High likelihood of risk of fatality due to wind turbines (Sowler et al. 2017).

Mating takes place from the end of March until the beginning of April. Spermatozoa are stored in the uterine horns of the female from April until August, when ovulation and fertilisation occurs. They give birth to twins during late October and November but single pups, triplets and quadruplets have also been recorded (van der Merwe 1994 and Lynch 1989).

***Miniopterus natalensis***

*Miniopterus natalensis*, also commonly referred to as the Natal long-fingered bat, occurs widely across the country but mostly within the southern and eastern regions.

This bat is a cave-dependent species and identification of suitable roosting sites may be more important in determining its presence in an area than the presence of surrounding vegetation. It occurs in large numbers when roosting in caves with approximately 260 000 bats observed making seasonal use of the De Hoop Guano Cave in the Western Cape, South Africa. Culverts and mines have also been observed as roosting sites for either single bats or small colonies. Separate roosting sites are used for winter hibernation activities and summer maternity behaviour, with the winter hibernacula generally occurring at higher altitudes in more temperate areas and the summer hibernacula occurring at lower altitudes in warmer areas of the country (Monadjem et al. 2010).

Mating and fertilisation usually occur during March and April and is followed by a period of delayed implantation until July/August. Birth of a single pup usually occurs between October and December as the females congregate at maternity roosts (Monadjem et al. 2010 & Van Der Merwe 1979).

The Natal long-fingered bat undertakes short migratory journeys between hibernaculum and maternity roosts. Due to this migratory behaviour, they are considered to be at high risk of fatality from wind turbines if a wind farm is placed within a migratory path (Sowler et al. 2016). The mass movement of bats during migratory periods could result in mass casualties if wind turbines are positioned over a mass migratory route and such turbines are not effectively mitigated. Very little is known about the migratory behaviour and paths of *M. natalensis* in South Africa with migration distances exceeding 150 kilometers. If the site is located within a migratory path the bat detection systems may possibly detect high numbers and activity of the Natal long-fingered bat, this will be examined over the course of the 12-month monitoring survey.

A study by Vincent et al. (2011) on the activity and foraging habitats of Miniopteridae found that the individual home ranges of lactating females were significantly larger than that of pregnant females. It was also found that the bats predominately made use of urban areas (54%) followed by open areas (19.8%), woodlands (15.5%) orchards and parks (9.1%) and water bodies (1.5%) when selecting habitats. Foraging areas were also investigated with the majority again occurring in urban areas (46%), however a lot of foraging also occurred in woodland areas (22%), crop and vineyard areas (8%), pastures, meadows and scrubland (4%) and water bodies (4%).

Sowler et al. (2017) advise that *M. natalensis* faces a medium to high risk of fatality due to wind turbines. This evaluation was based on broad ecological features and excluded migratory information.

### *1.3.2. Results of the Field Study*

#### *1.3.2.1. Passive Data*

***Abundances and Composition of Bat Assemblages***

Average hourly bat passes detected per night and total number of bat passes detected over the monitoring period by the systems are displayed in **Figures 1.3-2 to 1.3-9**. Five bat species were detected namely *Eptesicus hottentotus, Tadarida aegyptiaca, Sauromys petrophilus, Neoromicia capensis* and *Miniopterus natalensis.* Some less identifiable calls were grouped in their families: Miniopteridae is the family for cave bats from the genus *Miniopterus*, Vespertilionidae includes many species of which *N. capensis* is part of, Molossidae is the Free-tailed bat family of which *T. aegyptiaca* is part of, and Rhinolophidae is the horseshoe bat family whose members are clutter foragers.

*Tadarida aegyptiaca* were most commonly detected by all the monitoring systems on site, for all heights. Such abundant species are of a large value to the local ecosystems as they provide a greater contribution to most ecological services than the rarer species, due to their higher numbers. Short Mast 1 had the highest bat activity levels, probably due to it being located in a low-lying area, different vegetation unit and inside a high sensitivity area.

*Neoromicia capensis* had the second highest occurrence rate, especially at 10m monitoring height. Activity levels and diversity at 10m were significantly higher than at 60m or 80m.

The monitoring systems detected the migratory species, *Miniopterus natalensis*. The temporal distribution of this species will be examined when a full course of the 12-month study data is available, for evidence of migratory events. In the case of a migratory event, a mitigation schedule will be drawn up specifically for the event.

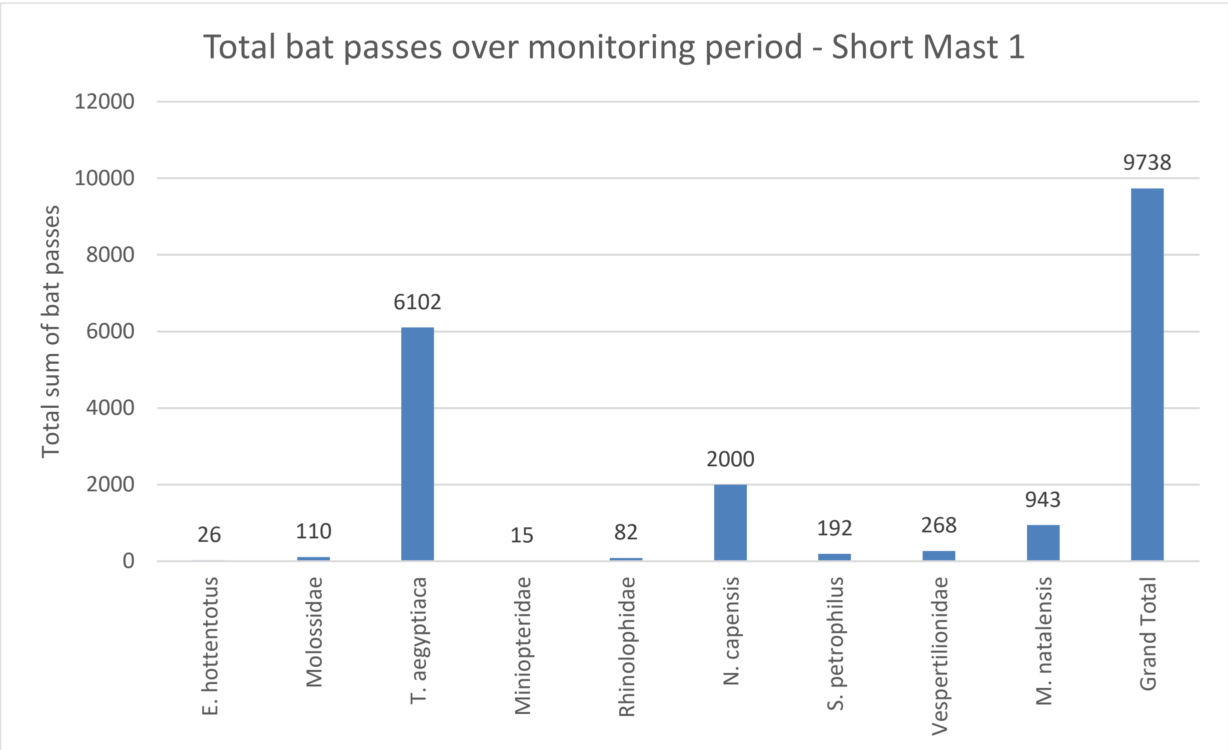



**Figure 1.3-2:** Total bat passes recorded over the monitoring period by SM1.

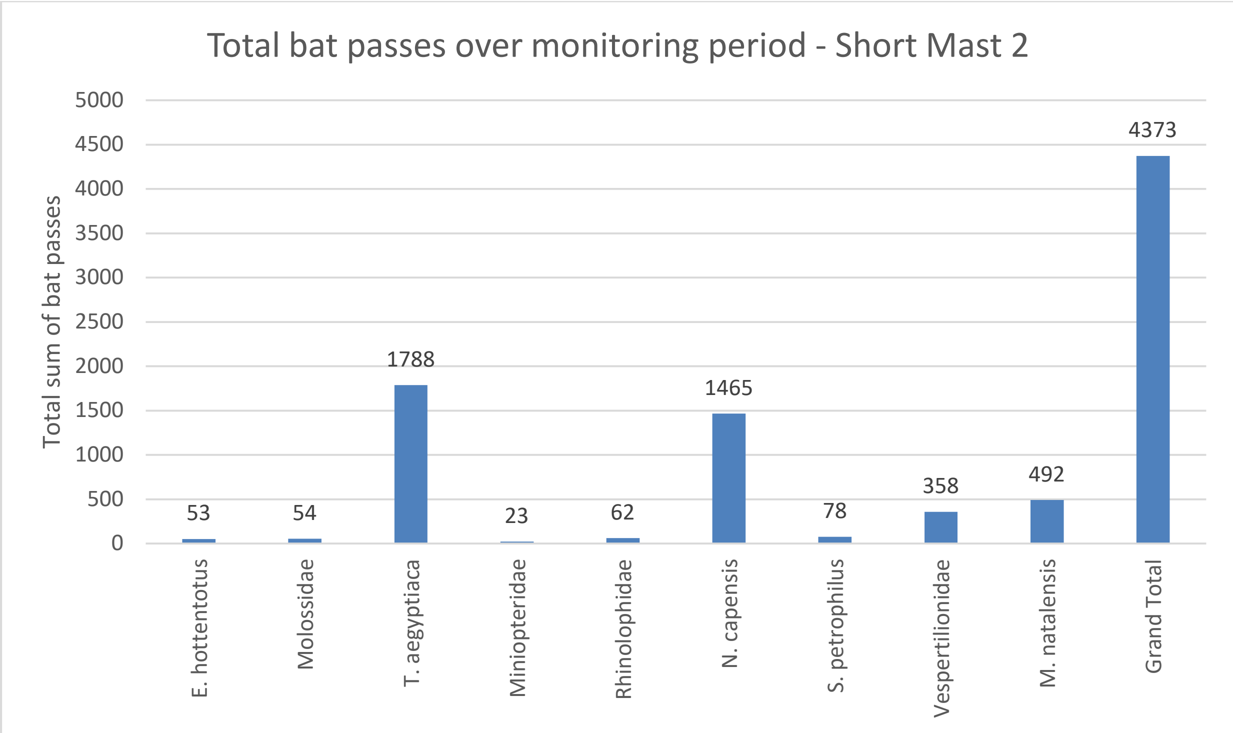



**Figure 1.3-3**: Total bat passes recorded over the monitoring period by SM2.

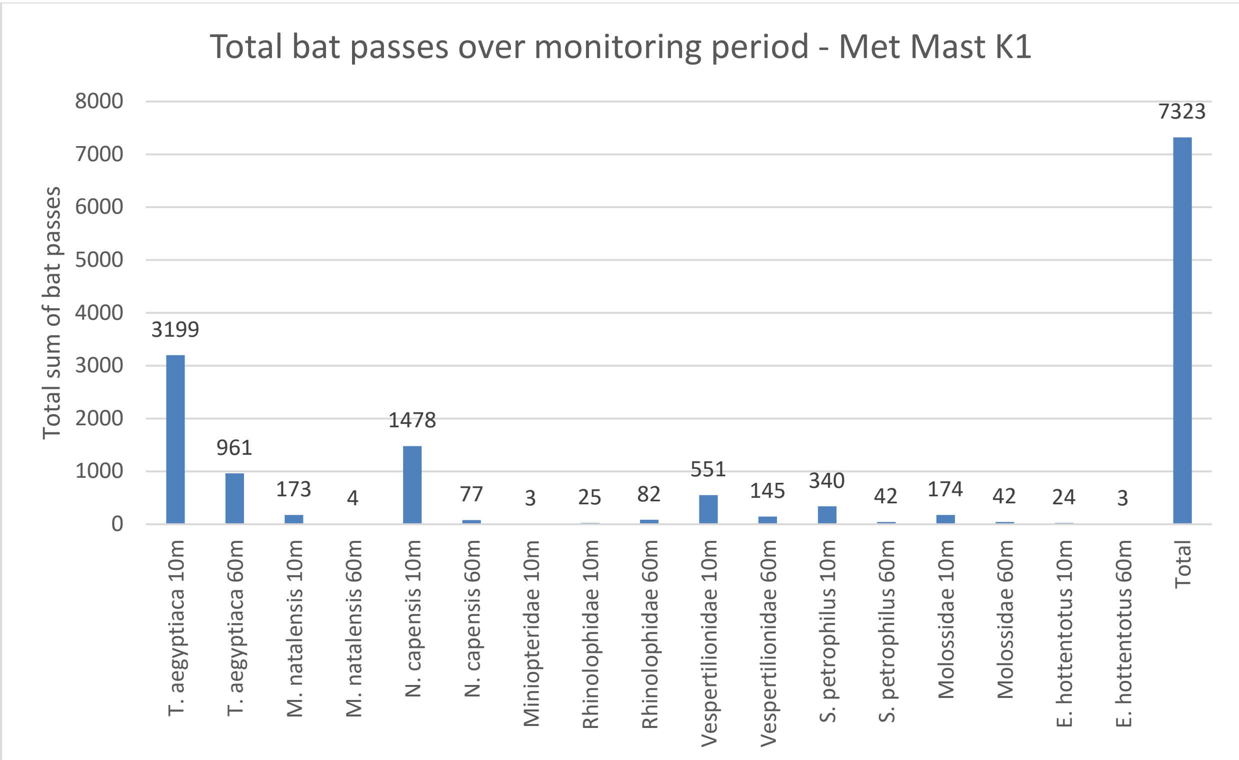



**Figure 1.3-4:** Total bat passes recorded over the monitoring period by Met Mast K1.

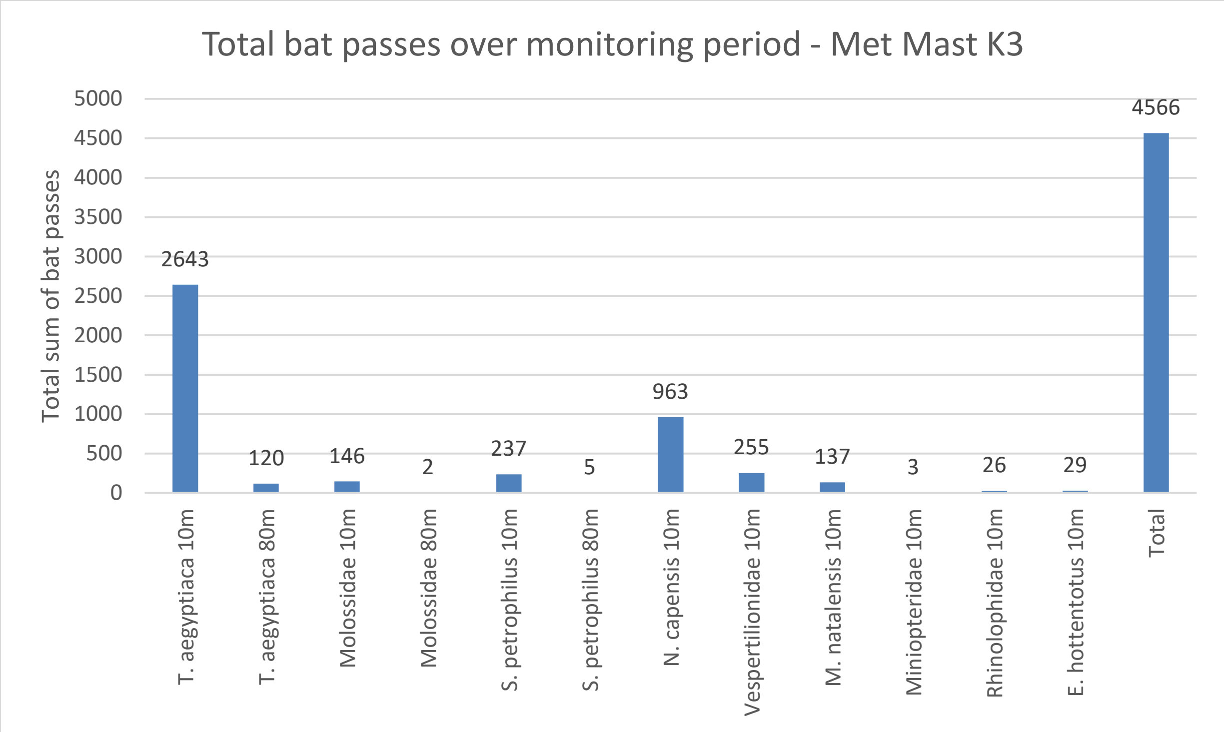



**Figure 1.3-5**: Total bat passes recorded over the monitoring period by Met Mast K3.

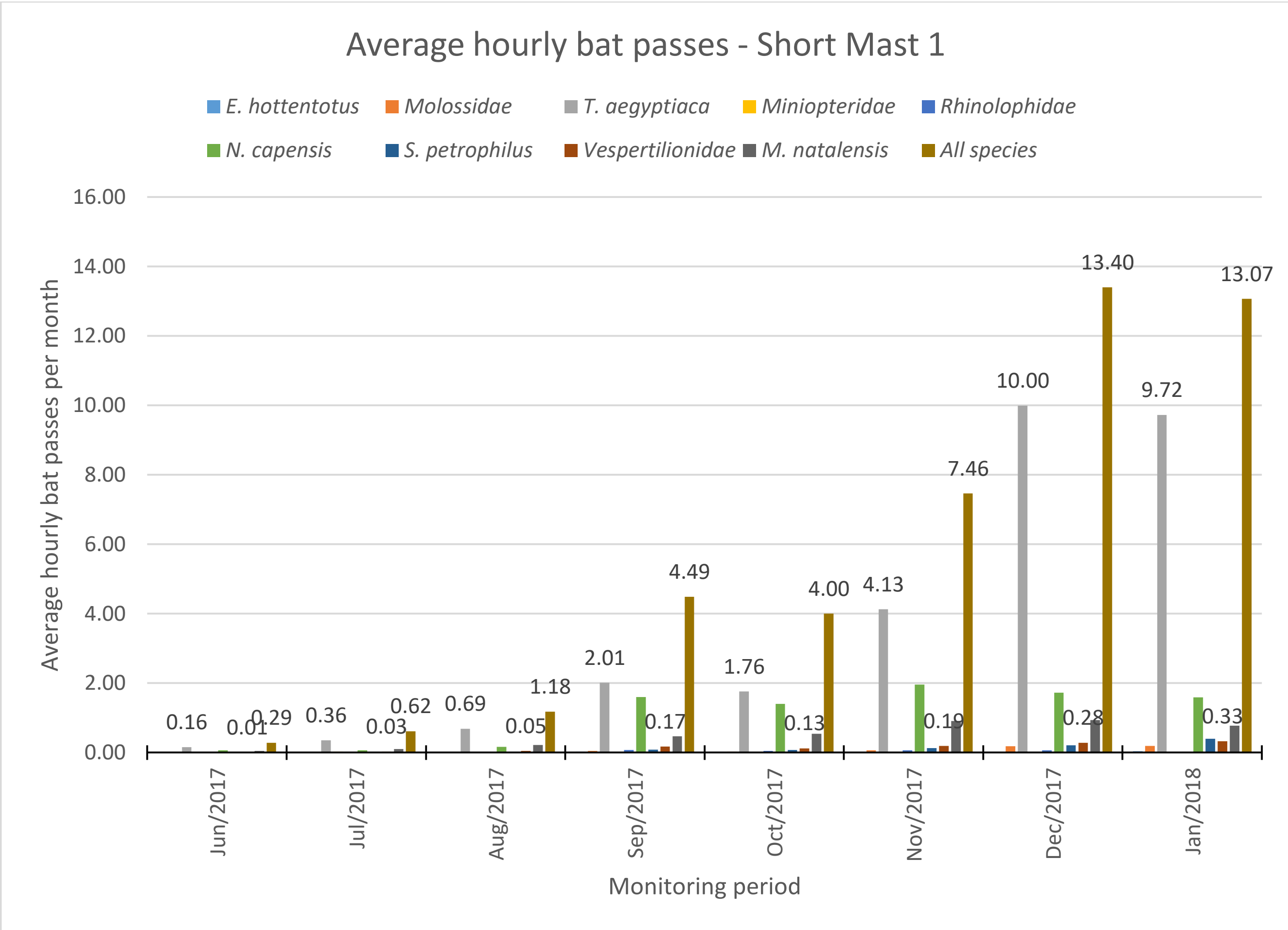



**Figure 1.3-6**: Average hourly bat passes recorded per month by SM1.

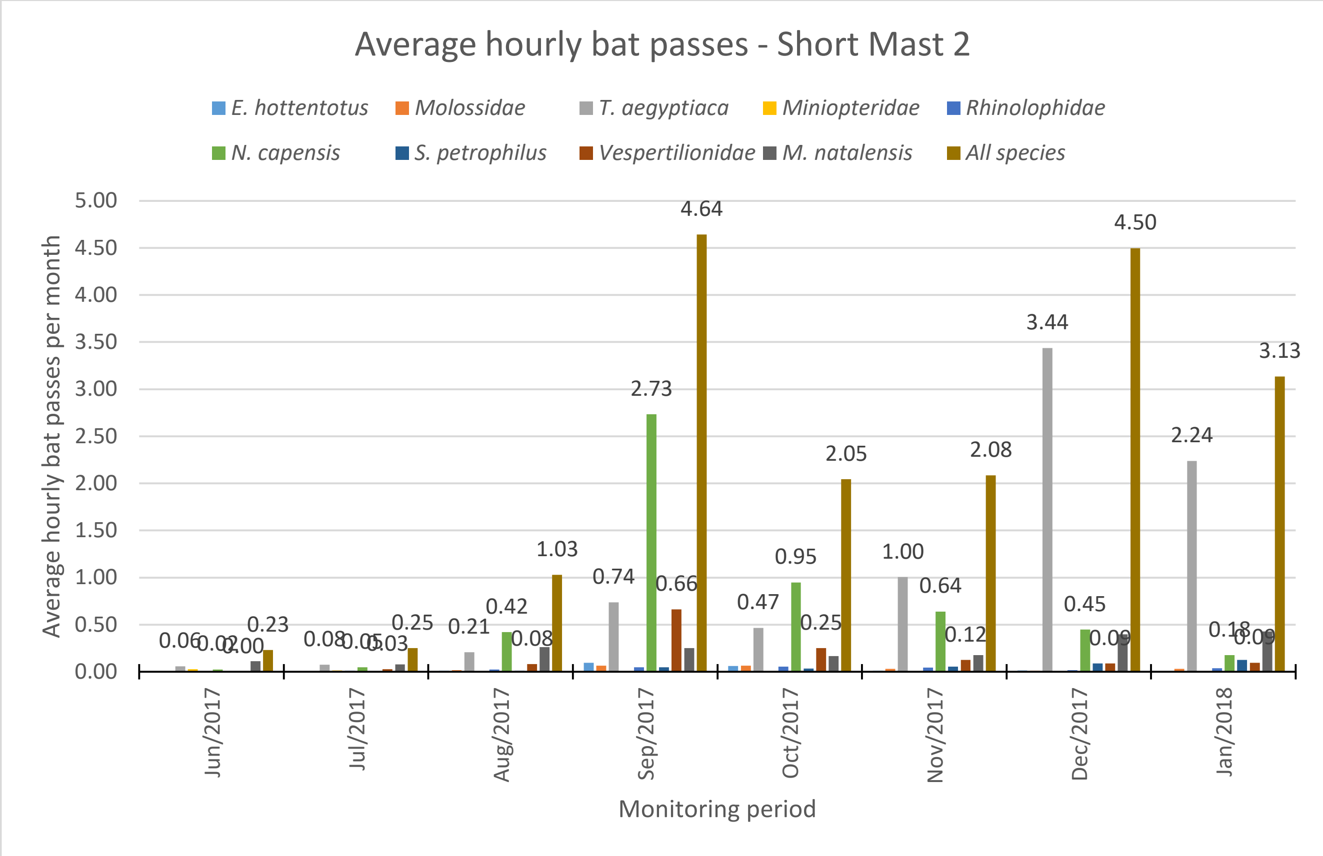



**Figure 1.3-7**: Average hourly bat passes recorded per month by SM2.

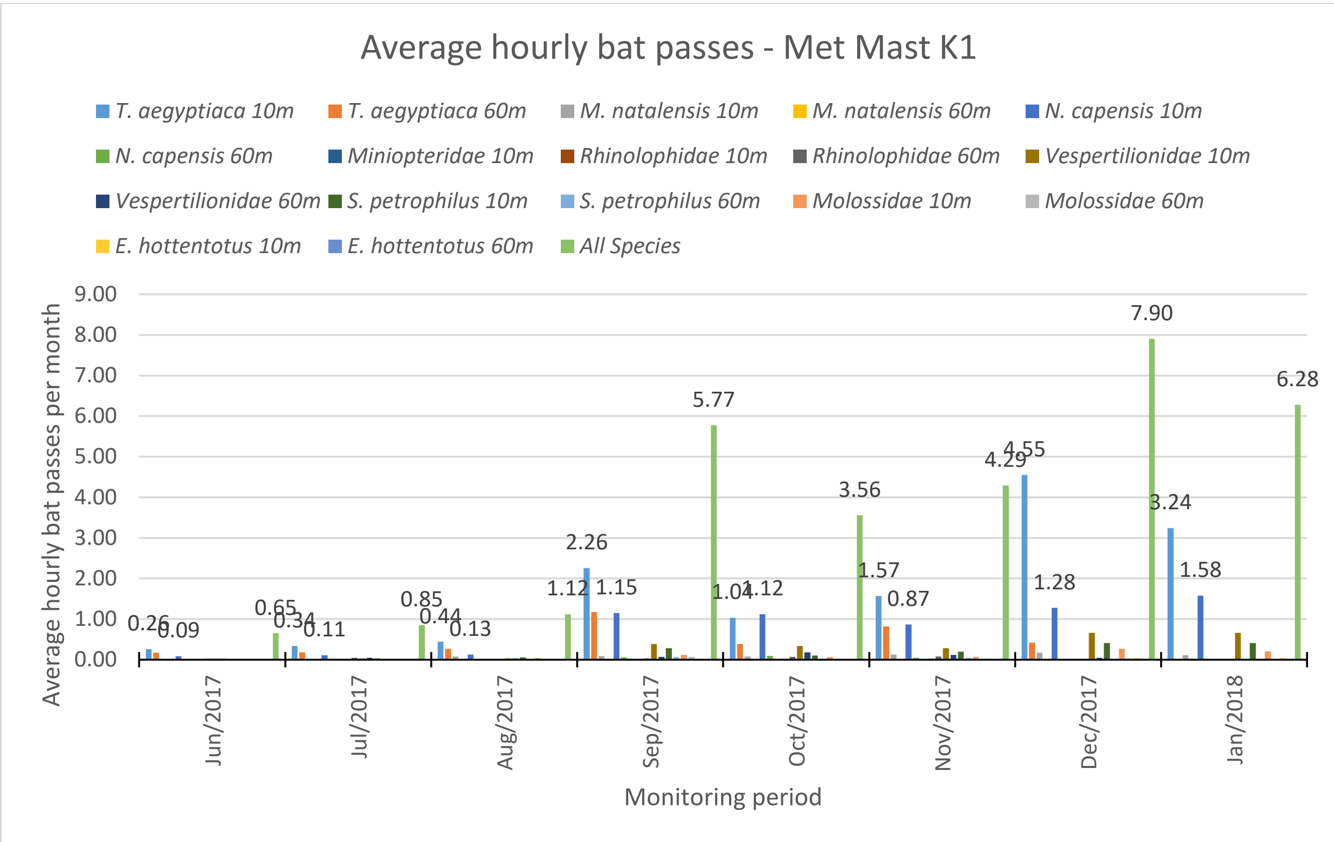



**Figure 1.3-8**: Average hourly bat passes recorded per month by Met Mast K1.

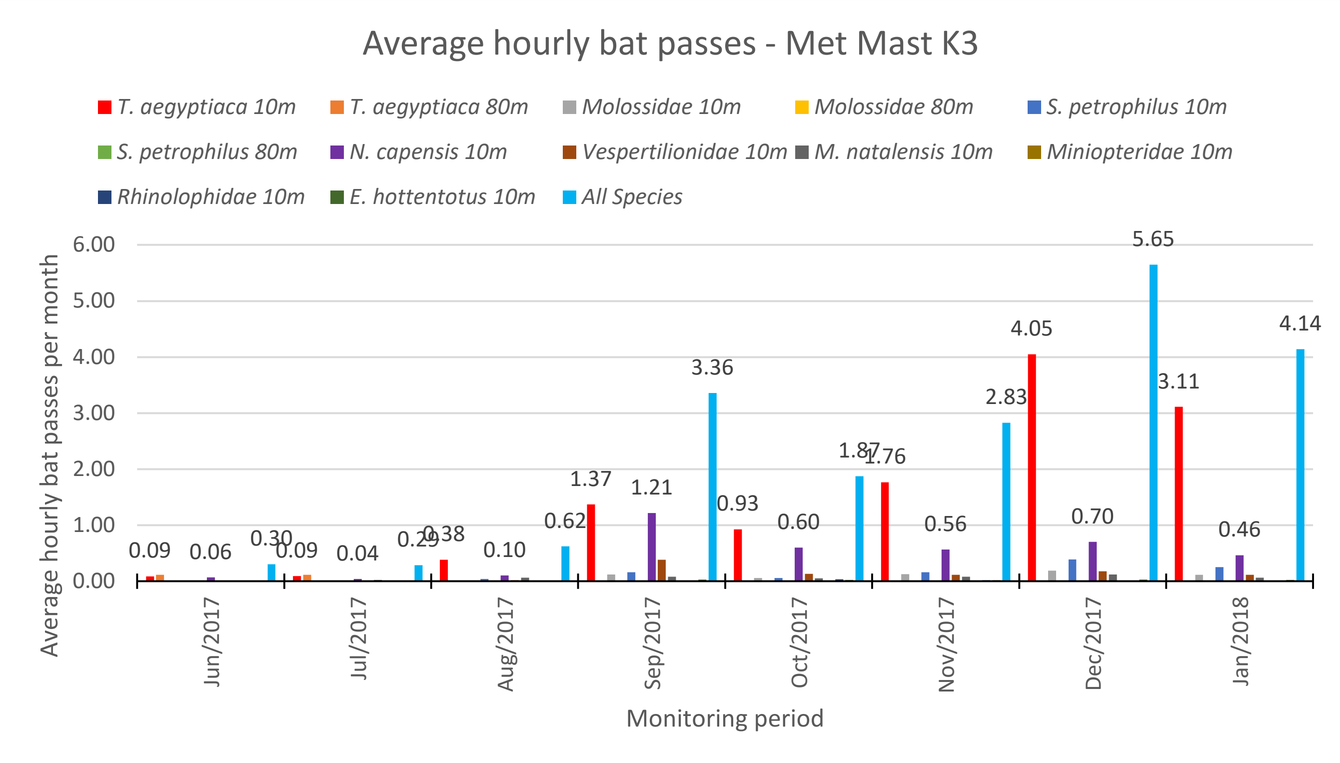



**Figure 1.3-9**: Average hourly bat passes recorded per month by Met Mast K3.

***Temporal Distribution of Bat Activity***

The sum of all bat passes recorded by the monitoring systems are displayed per night over the monitoring period so far (**Figures 1.3-10 to 1.3-13**). This information is useful to graphically compare seasonal differences and indicate peak activity periods that occurred. It can also be used at the conclusion of the pre-construction study to inform a schedule for mitigation measures, if mitigation measures are found to be required.

For all systems the higher bat activity was in two clear peaks in the periods of spring and summer, with very low activity in winter months. Once a full 12 months data set is available, the periods with the relative highest bat activity can be identified.

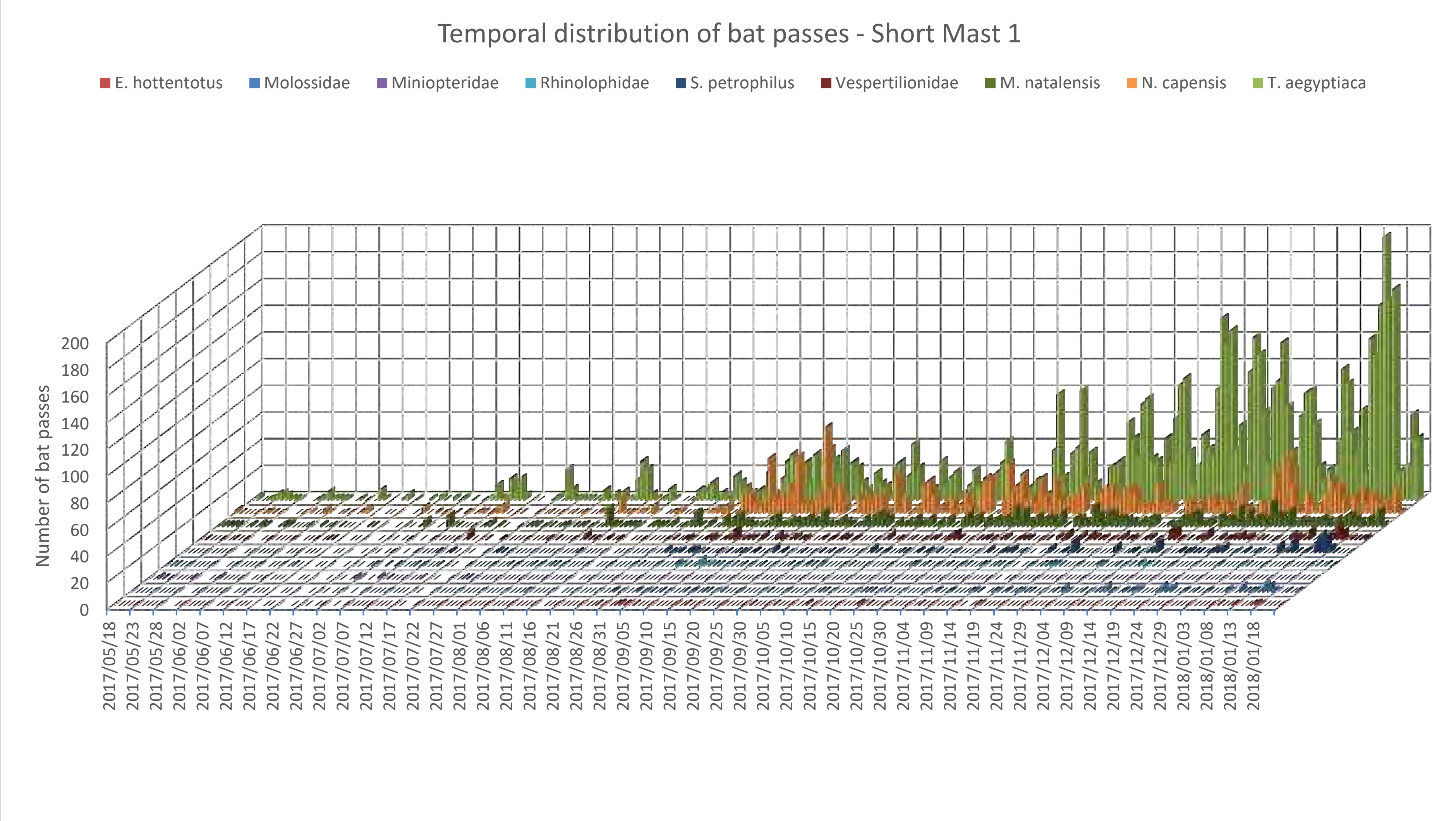



**Figure 1.3-10**: Temporal distribution of bat passes detected by SM1.

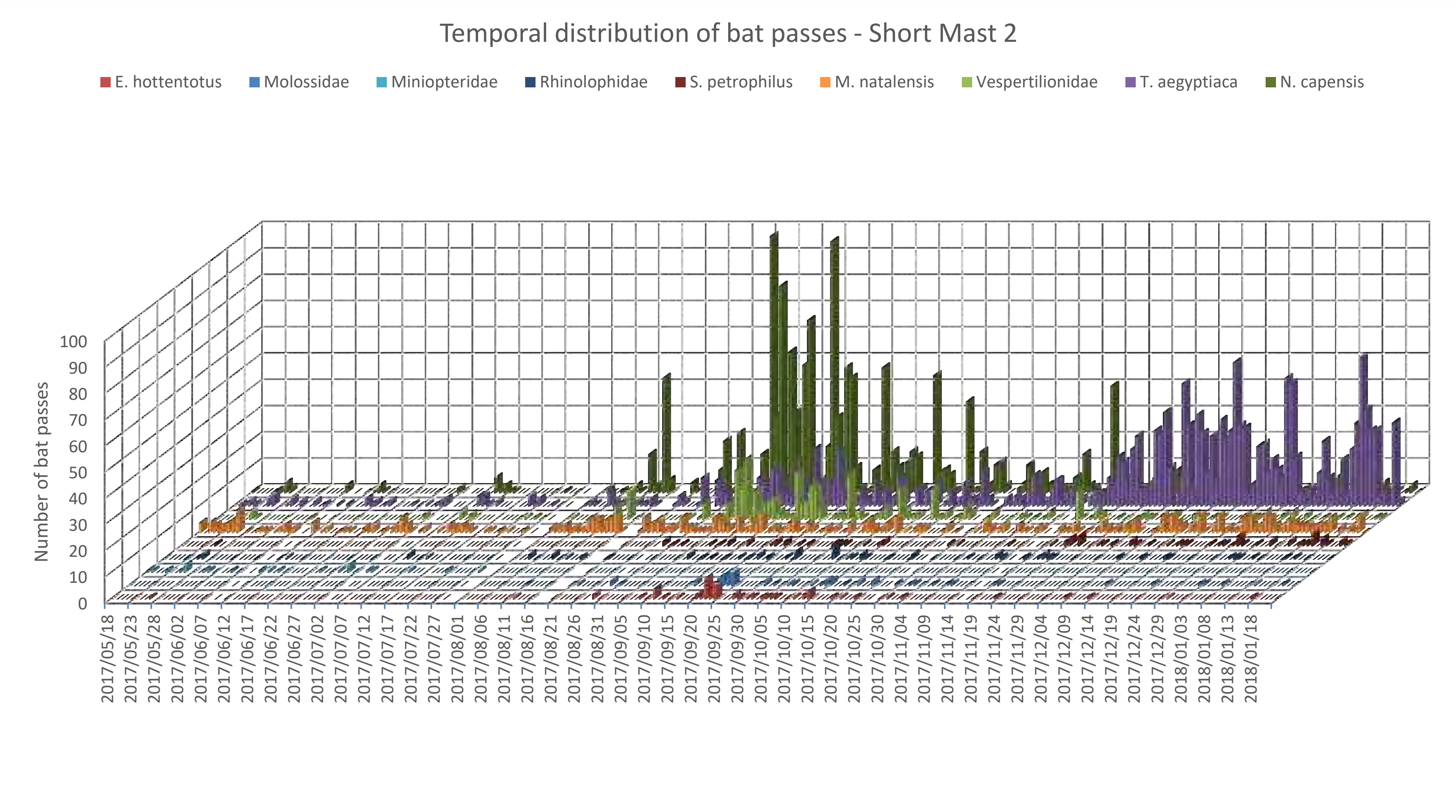



**Figure 1.3-11:** Temporal distribution of bat passes detected by SM2.

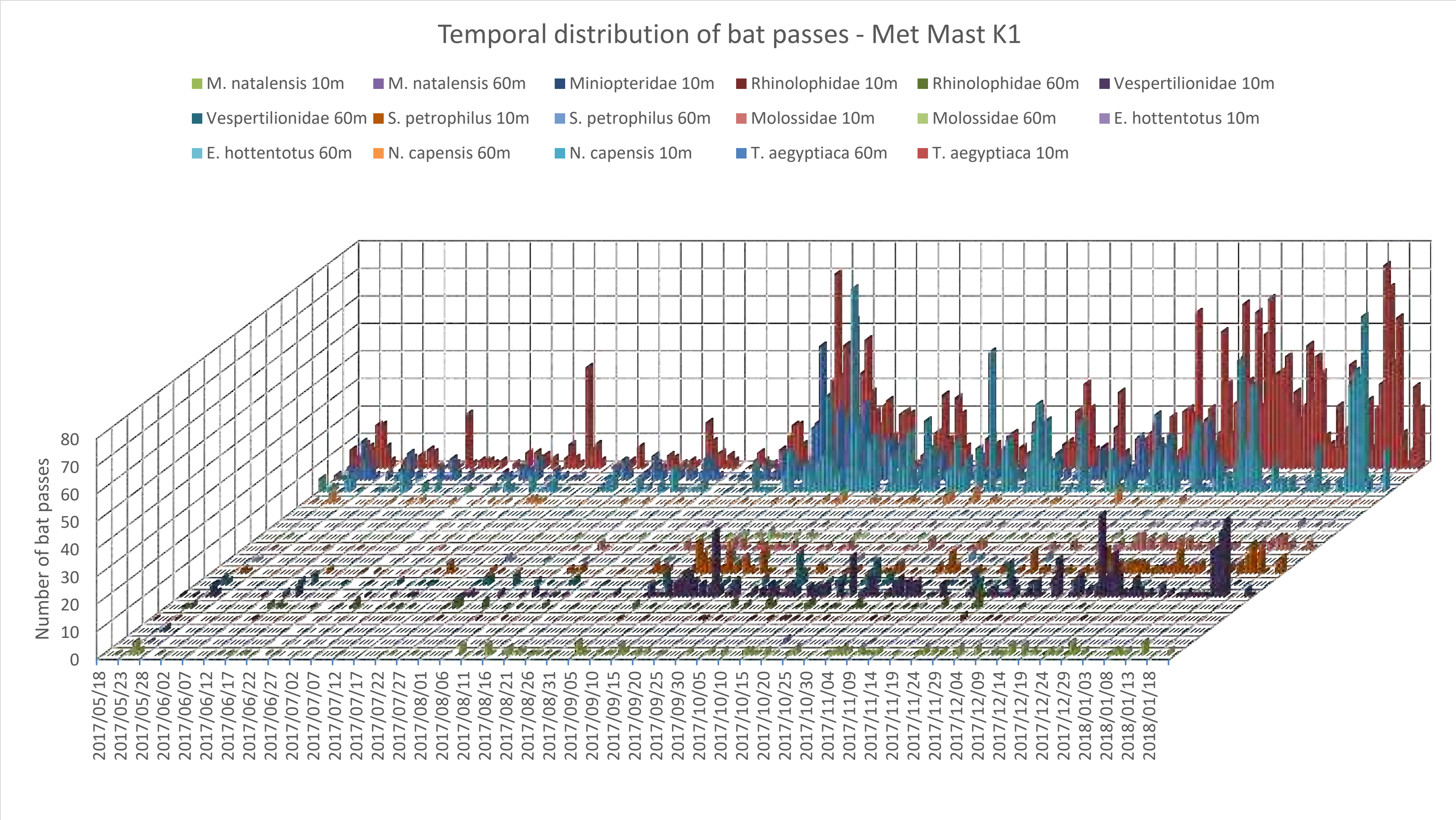



**Figure 1.3-12:** Temporal distribution of bat passes detected by Met Mast K1.

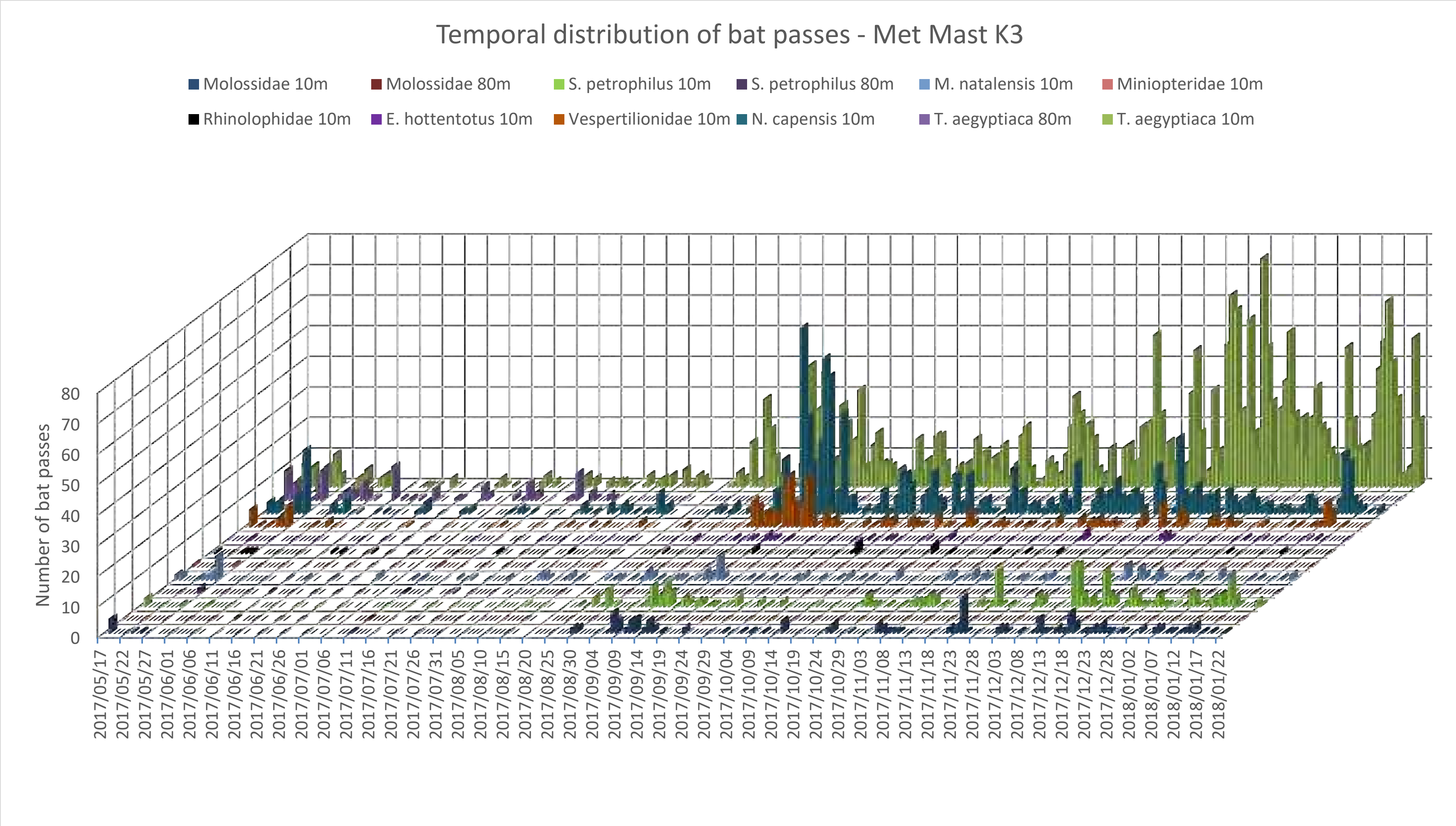



**Figure 1.3-13**: Temporal distribution of bat passes detected by Met Mast K3.

#### *1.3.2.2. Presence of caves*

Several caves and one mine are located in the vicinity of the site, ranging from 5km to 115km from the site (**Figure 1.3-14**). The closest is the Eye of Kuruman cave at 5km, and the second closest is Wonderwerk cave at 31km. This very important since these caves may support migration routes between them and/or elevated levels of cave bats foraging in the area around the cave. Impacts on such colonies of cave bats will also negatively impact the ecosystem inside the cave/mine roost, since the guano of the bats are the only source of energy input into such a subterranean ecosystem.

However, the activity levels of bats from the family Miniopteridae, and especially *M. natalensis*, were relatively well dispersed over the timeline and not indicative of any migration events that may be visible by a very prominent peak in activity over the timeline.

The general activity levels of *M. natalensis* were also not particularly high throughout the monitoring period so far, with SM1 recording the most and SM2 recording the second most bat passes of this species. It's important to note that SM1 is in a low-lying area that's inside a high bat sensitivity area. The Met Mast K1 which is on a hill and the closest to the Eye of Kuruman, also did not record elevated levels of this species. SM2 however, is elevated on a hill in the south and in almost similar terrain as the Met Masts, presuming that it may be located closer to the foraging ranges of *M. natalensis*.

Dolomite geology increases the likelihood of undiscovered caves and in general subterranean caverns and karst environments, **Figure 1.3-15** indicates the presence of dolomite in relation to the site. There are several non-operational asbestos mines in the area of the site, most of these are small and tend to be open cast or shallow declines with some possibility of adits. The probability of them being utilised by cave dwelling bats are low.

**Figure 1.3-14**: Caves and a mine that are located in the vicinity of the site (green polygon)

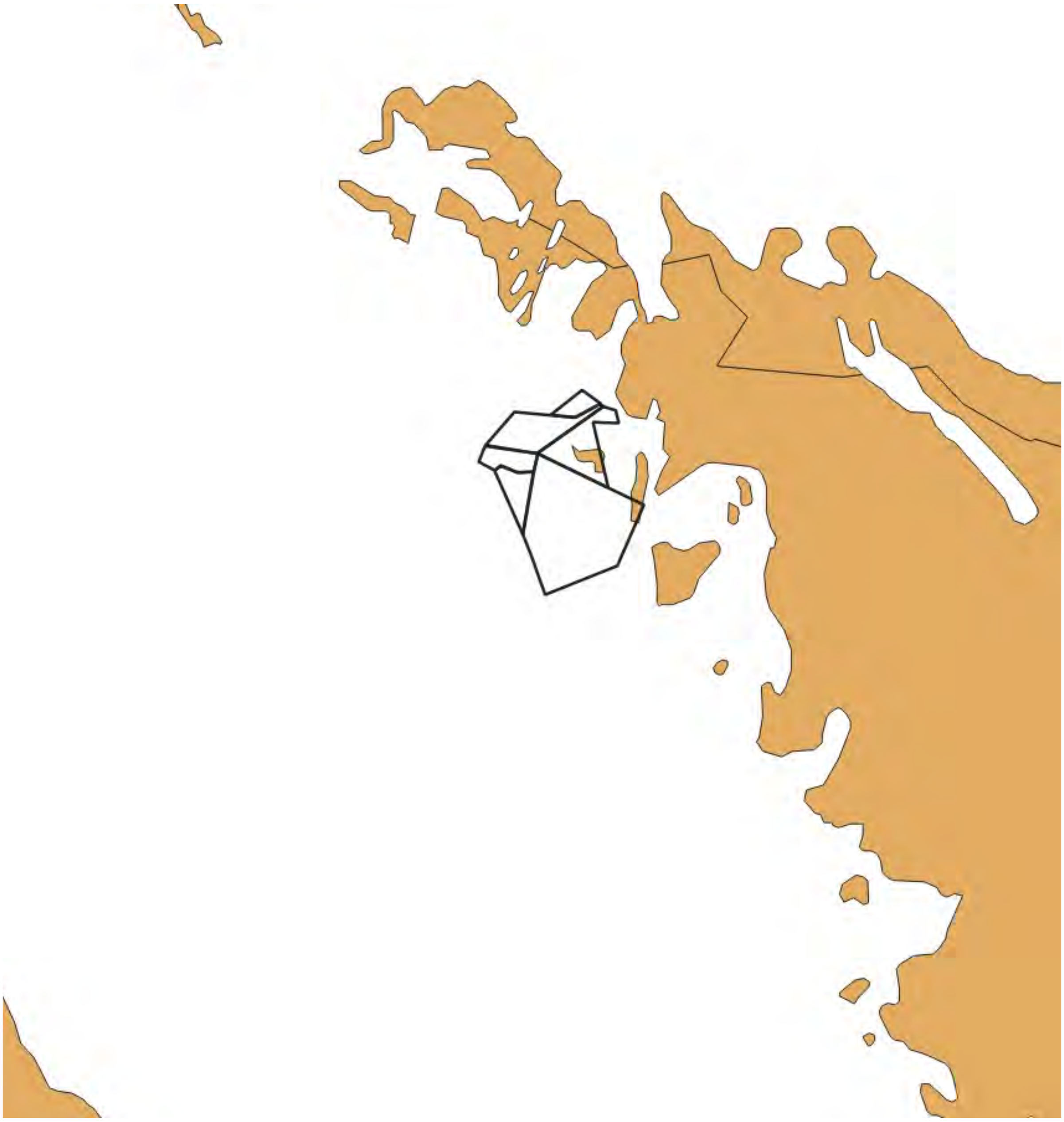


**Figure 1.3-15:** The location of dolomite geology in relation to the site.

### *1.3.3. Environmental Sensitivity Map*

**Figure 1.3-16** depicts the sensitive areas of the site, based on features identified to be important for foraging and roosting of the most prevalent species occurring on site, and which have the highest likelihood of being impacted on by the WEF. Thus, the sensitivity map is based on species ecology and habitat preferences. This map can be used as a pre-construction mitigation in terms of improving turbine placement with regards to bat preferred habitats on site.

The area marked as Non-permanent high bat sensitivity is an open water source from a man-made cement dam. This feature will attract bats and is therefore treated as high sensitive, but it can also be relocated or closed at its top and thereby be downgraded to Moderate or Low sensitivity.

**Table 1.3-3**: Description of parameters used in the construction of the sensitivity map.

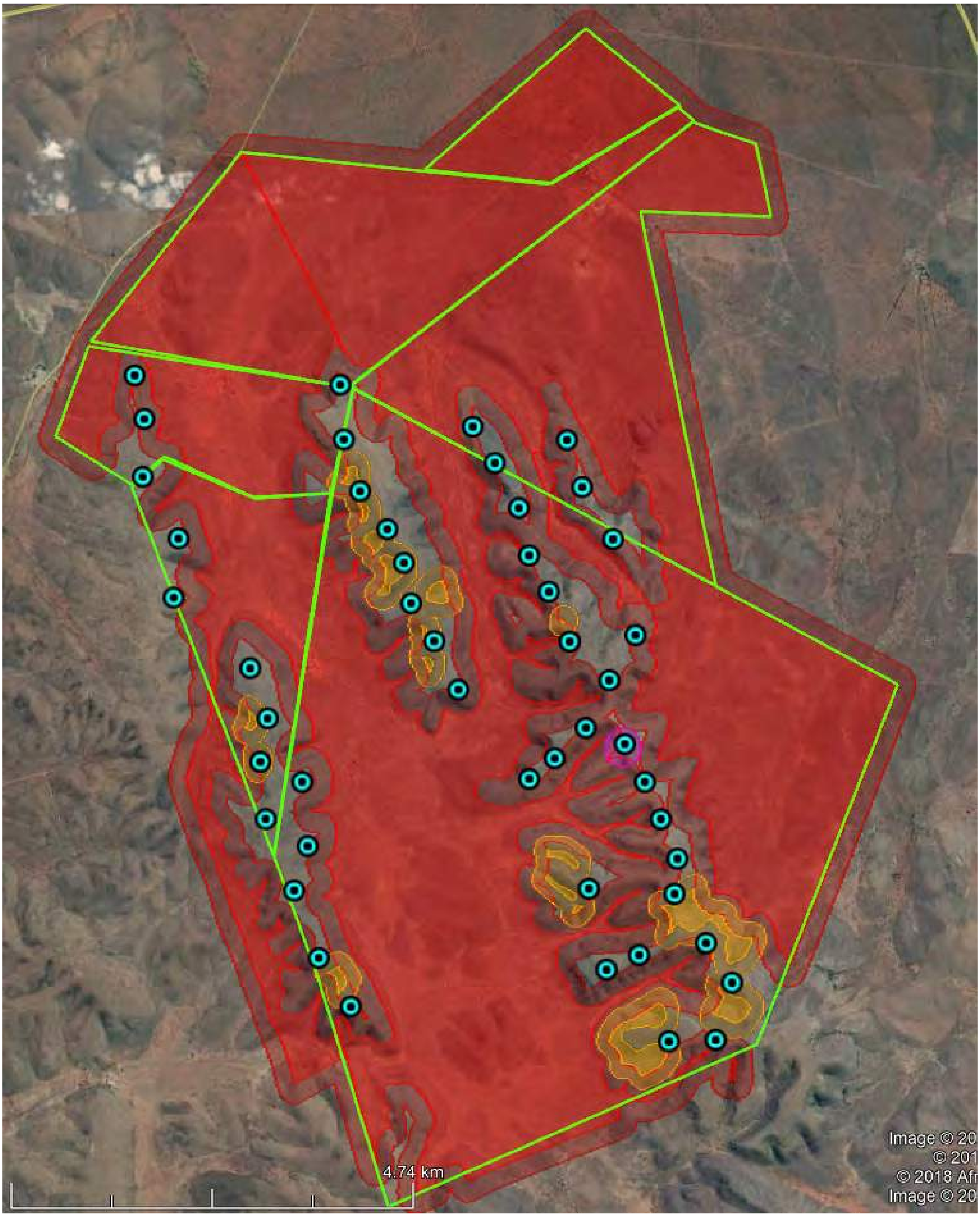
| | |
|---|---|
| **Last revision** | April 2018 |
| **High sensitivity buffer** | 200m radial buffer |
| | |
| | |
| **Moderate sensitivity buffer** | 150m radial buffer on all Moderate sensitivities |
| **Features used to develop the sensitivity map** | Manmade structures, such as buildings, houses, barns and sheds. These structures provide easily accessible roosting sites. |
| | Altitude appears to play a significant role in bat activity levels on this site, lower lying areas have therefore been deemed as sensitive. |
| | The different vegetation types and landform. Valleys and slopes can offer airspace sheltered from wind for insect prey and subsequently attract insectivorous bats. Larger woody shrubs or small trees can offer similar sheltered airspace or offer some roosting spaces. |
| | Open water sources, be it man-made farm dams or seasonal natural areas. They are important sources of drinking water and provide habitat that host insect prey. |

**Table 1.3-4**: Description of sensitivity categories and their significance in the sensitivity map.

| Sensitivity | Description |
|---|---|
| Moderate Sensitivity and its buffers | Areas of foraging habitat or roosting sites considered to have significant roles for bat ecology. Turbines within these areas and their buffers may acquire priority (not excluding all other turbines) during post-construction studies, and in some instances, there is a higher likelihood that mitigation measures may need to be applied to them. Turbines in these areas may remain, but at a higher risk of costly mitigations. |
| High Sensitivity and its buffers | Areas that are deemed critical for bat populations, capable of elevated levels of bat activity and support greater bat diversity/activity than the rest of the site. These areas are 'no-go' zones and turbines may not be placed in these areas and their buffers. |

**Table 1.3-5**: Turbines location within bat sensitive areas and their buffers.

| Bat sensitive area | Proposed turbine layout |
|---|---|
| High bat sensitivity area | None |
| High bat sensitivity buffer | A total of 12 turbines are inside these buffers, some of them are marginally inside the buffer. |
| Moderate bat sensitivity area | None |
| Moderate bat sensitivity buffer | A total of 8 turbines are inside these buffers, some of them are marginally inside the buffer. |




High bat sensitivity area
Non-permanent high bat sensitivity area
Moderate bat sensitivity area
High bat sensitivity buffer 200m
Non-permanent high bat sensitivity buffer 200m
Moderate bat sensitivity buffer 150m

**Figure 1.3-6**: Bat sensitivity map for the proposed Kuruman Phase 1 WEF

## 1.4. DESCRIPTION OF PROJECT ASPECTS RELEVANT TO THE BAT SCOPING SPECIALIST ASSESSMENT

Although most bats are highly capable of advanced navigation through the use of echolocation and excellent sight, they are still at high risk of physical impact with the blades of wind turbines. The corpses of bats have been found in close proximity to wind turbines and, in a case study conducted by Johnson et al. (2003), were found to be directly related to collisions. Despite the high incidence of deaths caused by direct impact with the blades, many bat mortalities have been found to be caused by barotrauma (Baerwald et al. 2008). This is a condition where low air pressure found around the moving blades of wind turbines, causes the lungs of a bat to collapse, resulting in fatal internal haemorrhaging (Kunz et al. 2007). Baerwald et al. (2008) found that 90% of bat fatalities around wind turbines involved internal haemorrhaging consistent with barotrauma.

The presence of lights on wind turbines have also been identified as possible causes for increased bat fatalities for non-cave roosting species. This is thought to be due to increased insect densities that are attracted to the lights and subsequently encourage foraging activity of bats (Johnson et al. 2003).

South African operational monitoring studies currently point to South African bats being just as vulnerable to mortality from turbines as international studies have previously indicated. The main species of concern are *Neoromicia capensis*, *Tadarida aegyptiaca* and *Miniopterus natalensis*. These species roost in crevices and last-mentioned species in caves and other hollows. They will be foraging more actively in low-lying areas with less wind, as well as the slopes of hills that are well sheltered and rocky. Such as the ‘amphitheater’ topography found at some valley hill slopes on the site.

There’s a marked decrease in bat activity with an increase of altitude on site (e.g. low-lying areas vs. hilltops), therefore larger turbines with a higher minimum rotor swept height will decrease the probability of bat mortalities due to moving blades.

## 1.5. IDENTIFICATION OF IMPACTS

### *1.5.1. Identification of Potential Impacts*

The potential impacts to be further assessed during the EIA assessment are:

#### *1.5.1.1. Construction Phase*

- Potential impact 1: Destruction of foraging habitat during infrastructure clearance and other related activities.

#### *1.5.1.2. Operational Phase*

- Potential impact 2: Bat mortalities due to moving turbine blades (resident populations).
- Potential impact 3: Bat mortalities due to moving turbine blades (migrating populations).
- Potential impact 4: Indirect impact: Cave ecosystem collapse due to bat mortalities of cave dwelling bat populations.
- Potential impact 5: Light pollution causing increased bat mortalities due to moving turbine blades.

#### *1.5.1.3. Decommissioning Phase*

- No impacts identified for the decommissioning phase.

#### *1.5.1.4. Cumulative impacts*

- Cumulative impact 1: Increased area of potential bat mortality impact by turbine blades, due to proposed neighbouring Kuruman Phase 2 WEF.

## 1.6. ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

### *1.6.1. Potential Impact 1 (Construction Phase): Destruction of foraging habitat during infrastructure clearance and other related activities.*

- **Nature of the impact**
  During construction some very limited foraging habitat will inevitably be destroyed to clear ground for the WEF. Apart from the hardstands this includes roads, substations, laydown areas, etc. However, this impact is not considered to have a significant effect on bat populations due to the small overall area of vegetation cleared.

- **Significance of impact without mitigation measures**
  The impact has a low significance even without mitigations, since the areas affected is relatively small and bats are flying animals that can readily forage around the affected areas.

- **Proposed mitigation measures**
  Adhere to the planned footprint areas and attempt to re-use all pathways and laydown/storage areas.

- **Significance of impact with mitigation measures**
  The impact has a very low significance after mitigations are applied, due to the reasons described above.

### *1.6.2. Potential Impact 2 (Operational Phase): Bat mortalities due to moving turbine blades (resident populations).*

- **Nature of the impact**
  Foraging bats can be killed by moving turbine blades, this happens either by direct impact or due to barotrauma (see Section 1.4)

- **Significance of impact without mitigation measures**
  The impact has a moderate significance without mitigation since the continuous killing of bats can have detrimental long-term effects on the local bat populations.

- **Proposed mitigation measures**
  Turbine layout adjustments where turbines in High sensitivity buffers need to be moved outside of these buffers. And where needed reducing blade movement at selected turbines and high-risk bat activity times/weather conditions (curtailment). Acoustic deterrents are developed well enough to be experimented with if needed.

- **Significance of impact with mitigation measures**
  The impact has low significance after mitigations are applied, since the mitigations can be effective when applied correctly. Although excessive curtailment can be costly and therefore proper turbine layout (out of sensitivity buffers) is the preferred primary mitigation.

### *1.6.3. Potential impact 3 (Operational Phase): Bat mortalities due to moving turbine blades (migrating populations).*

- **Nature of the impact**
  Migrating bats can be killed by moving turbine blades, this happens either by direct impact or due to barotrauma (see Section 1.4)

- **Significance of impact without mitigation measures**
  The impact has a moderate significance without mitigation since the continuous killing of migrating bats can have detrimental long-term effects on various bat populations in a larger region. The consequence is identified as Severe, but the probability as Unlikely since no migration routes are known in the area.

- **Proposed mitigation measures**
  Turbine layout adjustments where turbines in High sensitivity buffers need to be moved outside of these buffers. And where needed reducing blade movement at selected turbines and high-risk bat activity times/weather conditions when bats may be migrating (curtailment). Acoustic deterrents are developed well enough to be experimented with if needed.

- **Significance of impact with mitigation measures**
  The impact has low significance after mitigations are applied, since the mitigations can be effective when applied correctly. Although curtailment can be costly, for migration events it will be applied for a short time period only at select turbines. However, proper turbine layout (out of sensitivity buffers) is still the preferred primary mitigation.

#### *1.6.4. Potential impact 4 (Operational Phase): Indirect impact: Cave ecosystem collapse due to bat mortalities of cave dwelling bat populations.*

- **Nature of the impact**
  Cave ecosystems can collapse if the resident bat colony that inhabits the cave is killed. This is due to the fact that the bat guano is the primary source of energy input into the cave ecosystem.

- **Significance of impact without mitigation measures**
  The impact has a moderate significance without mitigation. The consequence is identified as Severe, but the probability as Unlikely since no migration routes are known in the area and the cave ecology of the area is not well known.

- **Proposed mitigation measures**
  Turbine layout adjustments where turbines in High sensitivity buffers need to be moved outside of these buffers. And where needed reducing blade movement at selected turbines and high-risk bat activity times/weather conditions when bats may be migrating (curtailment). Acoustic deterrents are developed well enough to be experimented with if needed.

- **Significance of impact with mitigation measures**
  The impact has low significance after mitigations are applied, since the mitigations can be effective when applied correctly. Although curtailment can be costly, for migration events it will be applied for a short time period only at select turbines. However, proper turbine layout (out of sensitivity buffers) is still the preferred primary mitigation.

#### *1.6.5. Potential impact 5 (Operational Phase): Light pollution causing increased bat mortalities due to moving turbine blades.*

- **Nature of the impact**
  Security and/or operational lights used close to or on turbines will attract high insect numbers and thereby attract additional insectivorous bat activity. This will significantly increase the likelihood of impacts by turbine blades. This is not applicable to red aviation lights.

- **Significance of impact without mitigation measures**
  The impact has a moderate significance without mitigation since permanent light sources will create regular insect pooling spots and thereby nightly foraging hotspots in the dangerous rotor swept zone.

- **Proposed mitigation measures**
  Only use lights with low sensitivity motion sensors that switch off automatically when no persons are nearby, to prevent the creation of regular insect gathering pools.

- **Significance of impact with mitigation measures**
  The impact has low significance after mitigations are applied, since the mitigations can be very easily applied and will be very effective when applied.

#### *1.6.6. Cumulative impact 1: Increased area of potential bat mortality impact by turbine blades, due to proposed neighbouring Kuruman Phase 2 WEF.*

- **Nature of the impact**
  Foraging bats can be killed by moving turbine blades, this happens either by direct impact or due to barotrauma (see Section 1.4). If more turbines are present in the area the likelihood of mortalities can increase.

- **Significance of impact without mitigation measures**
  The impact has a moderate significance without mitigation since the continuous killing of bats can have detrimental long-term effects on the local bat populations. It should be noted that apart from the proposed Kuruman Phase 2 WEF, there are no other proposed or existing WEF's in 100km radius of the site.

- **Proposed mitigation measures**
  Mitigations must be applied, when needed, for all phases of the Kuruman WEF's and all turbine layout adjustments must respect sensitivity maps. Where needed reducing blade movement at selected turbines and high-risk bat activity times/weather conditions (curtailment). Acoustic deterrents are developed well enough to be experimented with if needed.

- **Significance of impact with mitigation measures**
  The impact has low significance after mitigations are applied, since the mitigations can be effective when applied correctly. Although excessive curtailment can be costly and therefore proper turbine layout (out of sensitivity buffers) of all nearby turbines the preferred primary mitigation.

## 1.7. IMPACT ASSESSMENT SUMMARY

**Table 1-7-1** Impact assessment summary table for the Construction Phase

| Construction Phase | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct Impacts | | | | | | | | | | | | |
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation/ Management (Residual Impact/ Risk) | | |
| Clearing of vegetation | Foraging habitat loss | Negative | Site | Long-Term | Moderate | Very likely | Moderate | Low | Adhere to planned impact footprint | Low | Very low | 5 | High |

**Table 1-7-2** Impact assessment summary table for the Operational Phase

| Operational Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct Impacts | | | | | | | | | | | | | |
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation/ Management (Residual Impact/ Risk) | | |
| Moving turbine blades | Bat mortalities (resident) | Negative | Local | Long-Term | Substantial | Likely | Moderate | Moderate | Layout, curtailment, acoustic deterrents. | Moderate | Low | 4 | High |
| Moving turbine blades | Bat mortalities (migrating) | Negative | Regiona l | Long-Term | Severe | Unlikely | Moderate | Moderate | Layout, curtailment, acoustic deterrents. | Moderate | Low | 4 | Low |
| Light pollution | Increased mortality probability | Negative | Local | Long-Term | Substantial | Likely | Moderate | Moderate | Motion sensor lights | Moderate | Low | 4 | High |

**Table 1-7-3** Impact assessment summary table for the Operational Phase (Indirect impact)

| Operational Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Indirect Impacts | | | | | | | | | | | | | |
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation/ Management (Residual Impact/ Risk) | | |
| Mortalities of cave bat population | Cave ecosystem collapse | Negative | Regiona l | Long-Term | Severe | Unlikely | Low | High | Layout, curtailment, acoustic deterrents. | Moderate | Low | 4 | Low |

**Table 1-7-4** Cumulative impact assessment summary table

| Cumulative Impacts | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation/ Management (Residual Impact/ Risk) | | |
| Increased number of turbines | Increased mortality probability | Negative | Regiona l | Long-Term | Substantial | Likely | Moderate | Moderate | Layout, curtailment, acoustic deterrents. | Moderate | Low | 4 | High |

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Werner Marais

**Zoologist and Ecologist**

**MSc Biodiversity & Conservation**

**Pr.Sci.Nat. – SACNASP registration no. 400169/10**

**(Zoological Science)**

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# SPECIALIST FRESHWATER ASSESSMENT FOR THE PROPOSED DEVELOPMENT OF PHASE 1 OF THE KURUMAN WIND ENERGY FACILITY, NORTHERN CAPE PROVINCE

# SCOPING REPORT


| *Report prepared for:* | *Report prepared by:* |
|---|---|
| **CSIR – Environmental Management Services** | **EnviroSwift (Pty) Ltd** |
| **P O Box 320** | **22 Leiden Crescent** |
| **Stellenbosch** | **Cape Town** |
| **7600** | **7550** |


**February 2018**

# SPECIALIST EXPERTISE

**Natasha van de Haar**

**SACNASP Professional Natural Scientist (Registration number: 400229/11)**
Natasha is a registered Professional Natural Scientist (Pr.Sci.Nat) with the South African Council for Natural Scientific Professions (SACNASP). She also holds a Masters Degree in Science (M.Sc.) in the field of Botany. Over the course of Natasha's career, she completed a number of floral identification short courses and also obtained a certificate of competence for wetland assessments from Rhodes University. She is also a member of the South African Wetland Society, Botanical Society of SA as well as the Western Cape Wetlands Forum.

Her career kicked off as a field ecologist in 2009, focusing on floral biodiversity and ecological functioning, with special mention of wetland ecology and functioning within South Africa (all provinces). She further worked as a specialist project member in Mauritius, Lesotho and Ghana. During the course of her career she obtained extensive experience in conducting terrestrial as well as wetland related surveys in the mining, residential and infrastructure development industries as well as development of several alternative energy facilities. Natasha also gained experience in Biodiversity Offset Initiatives as well as RDL/protected plant permit applications. Presently her main focus is wetland assessments including delineation as well as present ecological state and function assessments

**Louise Zdanow**

**SACNASP Professional Natural Scientist (Registration number:114072)**
Louise is the Managing Director of EnviroSwift KZN (Pty) Ltd. She has a BSc Honours degree in Botany from the University of Cape Town. She began working as an environmental specialist in 2012 and has since gained extensive experience in conducting freshwater as well as botanical assessments in the residential, mining and infrastructure development industries. Louise is a registered Professional Natural Scientist (Pr. Sci. Nat.) with the South African Council for Natural Scientific Professions (SACNASP, Reg. no. 114072), and is an accredited SASS5 practitioner. She is a member of the South African Wetland Society and the International Association of Impact Assessments South Africa. She has received a certificate of competence for the Tools for Wetland Assessments course attended at Rhodes University, and has attended a soil classification course presented by Jon Atkinson of the KZN Department of Agriculture and Rural Development.

# SPECIALIST DECLARATION

I, Natasha van de Haar, as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

I act as the independent specialist in this application;
I 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;
regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
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 have no vested interest in the proposed activity proceeding;
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;
I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
all the particulars furnished by me in this specialist input/study are true and correct; and
I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the specialist: ____________________

Name of Specialist: ___Natasha van de Haar_________________

Date: __2018/01/31______________________________________

# LIST OF ABBREVIATIONS

**Table 1: Abbreviations.**

| | |
|---|---|
| ASL | Above Sea Level |
| BGIS | Biodiversity Geographic Information System |
| DAFF | Department of Agriculture, Forestry and Fisheries |
| DEA | Department of Environmental Affairs |
| DWAF | Department of Water Affairs and Forestry |
| DWS | Department of Water and Sanitation |
| ECO | Environmental Control Officer |
| EI | Ecological Importance |
| EIA | Environmental Impact Assessment |
| EIS | Ecological Importance and Sensitivity |
| EMP | Environmental Management Programme |
| EMPr | Environmental Management Programme (EMPr) |
| EO | Environmental Officer |
| ES | Ecological Sensitivity |
| FEPA | Freshwater Ecosystem Priority Area |
| GPS | Global Positioning System |
| LUDS | Land Use Decision Support Tool |
| MAP | Mean Annual Precipitation |
| NEMA | National Environmental Management Act |
| NEMBA | National Environmental Management Biodiversity Act |
| NFA | National Forest Act |
| NFEPA | National Freshwater Ecosystem Priority Areas |
| NPAES | National Protected Areas Expansion Strategy |
| NWA | National Water Act |
| PES | Present Ecological State |
| PSDF | Provincial Spatial Development Framework |
| WEF | Wind Energy Facility |
| WMA | Water Management Area |
| WMS | Water Management Systems |
| WUL | Water Use License |

# GLOSSARY

**Table 2: Glossary.**

| | |
|---|---|
| Active channel bank | The bank of the channel(s) that has been inundated at sufficiently regular intervals to maintain channel form and to keep the channel free of established terrestrial vegetation. |
| Alluvial Fan | An alluvial deposit that is typically fan-shaped that is formed by a stream or watercourse where its velocity is abruptly decreased, as at the mouth of a ravine or at the foot of a slope. |
| Alluvial Material / Deposits | Deposit of sand, mud, etc. formed by flowing water, or the sedimentary matter deposited thus within recent times, especially in the valleys of large rivers. |
| Baseflow | Long-term flow in a river that continues after storm flow has passed. |
| Biodiversity | The number and variety of living organisms on earth, the millions of plants, animals, and micro-organisms, the genes they contain, the evolutionary history and potential they encompass, and the ecosystems, ecological processes, and landscapes of which they are integral parts. |
| Buffer | Strip of land surrounding a wetland or riparian area in which activities are controlled or restricted, in order to reduce the impact of adjacent land uses on the wetland or riparian area. |
| Catchment | The area contributing to runoff at a particular point in a river system. |
| Chroma | The relative purity of the spectral colour, which decreases with increasing greyness. |

| | |
|---|---|
| Cumulative impact | The impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area. |
| Delineation | (of a wetland or riparian zone): to determine the boundary of a water resource (wetland or riparian area) based on soil and vegetation (wetland) or geomorphological and vegetation (riparian zone) indicators. |
| Environmental Impact Assessment (EIA) | In relation to an application to which scoping must be applied, means the process of collecting, organising, analysing, interpreting and communicating information that is relevant to the consideration of that application as defined in National Environmental Management Act. |
| Ephemeral | A river or watercourse that only flows at the surface periodically, especially those drainage systems that are only fed by overland flow (runoff). |
| Episodic | Relating to rivers and watercourses typically located within arid or semi-arid environments that only carry flow in response to isolated rainfall events. |
| Fluvial | Pertaining to rivers and river flow and associated erosive activity. |
| Gleying | A soil process resulting from prolonged soil saturation, which is manifested by the presence of neutral grey, bluish or greenish colours in the soil matrix. |
| Hydric Soils | (= Hydromorphic soils) Soils formed under conditions of saturation, flooding or ponding for sufficient periods of time for the development of anaerobic conditions and thus favouring the growth of hydrophytic vegetation. |
| Hydrology | The study of the occurrence, distribution and movement of water over, on and under the land surface. |
| Hydromorhpy | A process of gleying and mottling resulting from the intermittent or permanent presence of excess water in the soil profile. |
| Intermittent flow | Flows only for short periods. |
| Phreatophyte | A plant with a deep root system that draws its water supply from near the water table. |
| Reach | A portion of a river. |
| Riparian Area | (as defined by the National Water Act): includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils (deposited by the current river system), and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of adjacent land areas. |
| Stream Order | A morphometric classification of a drainage system according to a hierarchy or orders of the channel segments. Within a drainage network the un-branched channel segments which terminate at the stream head are termed as "first order streams" |
| Understorey | The part of the forest / woodland which grows at the lowest height level below the canopy |

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# KURUMAN WIND ENERGY FACILITY: PHASE 1

## 1.1. INTRODUCTION AND METHODOLOGY

### *1.1.1. Scope and Objectives*

Mulilo Renewable Project Developments (Pty) Ltd (hereafter, "Mulilo") has appointed EnviroSwift (PTY) Ltd (hereafter, "EnviroSwift") to undertake a specialist assessment of the impact that the development of Phase 1 of the proposed Kuruman Wind Energy Facility (WEF) will have on freshwater features. The farms earmarked for the development of Phase 1 include:

- Portion 2 and 4 of the Farm Carrington 440;
- Portion 1 of the Farm Hartland 381;
- Remaining Extent of Woodstock Farm 441; and
- Remaining Extent of Rossdale Farm 382.

Jointly, all the properties above will be referred to as the 'study area' in this report. The study area is situated in the north-eastern parts of the Northern Cape Province, near the town Kuruman within the Ga-Segonyana Local Municipality. Kuruman is located approximately 236km (by road) to the north-west of the provincial capital, Kimberley (Figure 1 and 2).


**Figure 1: Location of the study area indicated with a red circle.**


**Figure 2: Locality of the various farm portions proposed for development of Phase 1 of the WEF in relation to the town Kuruman.**

47 Turbines are proposed as part of Phase 1, and additional infrastructure required includes:

- Roads:
    - New roads will be constructed with a width of 5m and will connect all turbines;
    - Existing roads to be used will be extended to a width of 5m.
- Distribution lines will consist of 33kV underground lines;
- Collector substation extending over 20ha with a height of 30m;
- One concrete tower plant extending over approximately 6ha; and
- One laydown area / construction yard extending over approximately 6ha.

This report serves as the Freshwater scoping report of Phase 1. The study area will be refined during the impact assessment during which the actual footprint areas as well as zone of influence of the development will be assessed in more detail.

### *1.1.2. Terms of Reference*

The terms of reference as part of the scoping phase included the following:

- Gathering of background information retrieved from provincial (available fine scale plans) and national databases (National Freshwater Ecosystem Priority Areas; NFEPA, 2011);
- Delineation of freshwater features within the study area with the use of background information and digital satellite imagery (Google Earth Pro, 2017);
- On-site screening of pre-selected areas within the study area;
- Provision of maps presenting the desktop delineated watercourses as well as any applicable regulatory areas;
- Provision of a sensitivity map indicating areas with a perceived higher Ecological Importance and Sensitivity (EIS);
- Identification of any potential fatal flaws, impacts and cumulative impacts; and
- Compilation of a report presenting results, recommendations and conclusions.

### *1.1.3. Approach and Methodology*

Available national and provincial databases were utilised in order to determine the high level conservation significance of wetlands and rivers located within each of the farms earmarked for Phase 1. Primary resources which were utilised are listed within Section 1.1.5.

The information obtained from the various databases was used in combination with Google Earth Pro (2017) digital satellite imagery to desktop delineate all watercourses[1]. Due to the size of the study area it was not considered practical to do a walkdown of each watercourse. Areas of interest were therefore carefully selected within the study area, as well as within 500m of the study area boundary. The site selection process ensured that at least three representative areas of all variable freshwater habitat, degree of transformation as well as Hydrogeomorphic (HGM) Unit were included.

The desktop assessment was followed by a physical site survey undertaken on the 17th of January 2018 during which each of the areas of interest was investigated in order to groundtruth the accuracy of the desktop delineations, as well as to verify the perceived level of sensitivity. Collected data could then be used to accurately assign sensitivity levels to the remaining freshwater features.

The single site survey took place in summer during the rainfall season; following relatively low rainfall in the preceding weeks. There is therefore the possibility that some aspects and species may have been missed, however general findings and results were considered sufficient to inform the assessment.

All results including supplementary maps produced with the use of QGIS and the preliminary impact assessment were captured in the scoping report. The scoping report was prepared in line with the requirements of the National Environmental Management Act (NEMA) Environmental Impact Assessment (EIA) Regulations (2014 as amended in 2017) for specialists.

### *1.1.4. Assumptions and Limitations*

Time constraints as well as the extent of the study area (7 333ha) did not allow for the physical on-site delineation of all watercourses. Desktop delineations were therefore undertaken with the use of background information and digital satellite imagery (Google Earth Pro, 2017). As a result, some discrepancies relating to the extent of the watercourse boundaries may be possible. However, pre-selected areas of interest were groundtruthed in order to determine accuracy of the desktop delineations, and the findings as presented within this report were considered sufficient in order to inform the outcomes of the scoping phase.

Only digital satellite imagery (Google Earth Pro, 2017) was utilised in inaccessible areas where new road infrastructure has been proposed. However, only a small selection of areas was entirely inaccessible, and the digital satellite imagery was considered sufficient to surmise the impact potential on watercourses.

The accuracy of the Global Positioning System (GPS) utilised at pre-selected areas of interest will affect the accuracy of the delineation. A Garmin GPSMap 64 was used which has an estimated accuracy rating of 3-5 meters. EnviroSwift is of the opinion however that this limitation is of no material significance and that the freshwater-related constraints have been adequately identified.

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[1] The National Water Act (Act No. 36 of 1998) defines a watercourse as -
*(a)* a river or spring;
*(b)* a natural channel in which water flows regularly or intermittently;
*(c)* a wetland, lake or dam into which, or from which, water flows; and
*(d)* any collection of water which the Minister may, by notice in the *Gazette,* declare to be a watercourse,
and a reference to a watercourse includes, where relevant, its bed and banks;

The assessment was confined to the top 50 cm of soil, in line with the delineation guideline provided by Department of Water Affairs and Forestry (DWAF, updated 2008). Therefore, groundwater was not considered as part of this assessment.

A single field survey was undertaken in January 2018[2]. Therefore, the field survey was undertaken within the optimum season for Freshwater Assessments as prescribed by DWAF (updated 2008). However, seasonal variation in watercourses and vegetation characteristics was not considered as part of this assessment. There is therefore the possibility that some aspects and species may have been missed, however general findings and results were considered sufficient to inform the assessment of the freshwater features.

All watercourses which were groundtruthed are intermittent systems, therefore no instream ecological assessment (South African River Health Programme protocols) and on-site collection and testing of water samples were undertaken.

In assessing the identified potential construction phase impacts, it has been assumed that good housekeeping measures (listed below) will be implemented through adherence to the Environmental Management Programme (EMPr):

- Clean up any spillages (e.g. concrete, oil, fuel), immediately. Remove contaminated soil and dispose of it appropriately;
- Service vehicles and machinery within demarcated areas, preferably off-site;
- Use bunded surfaces within designated areas for re-fuelling vehicles. Direct runoff from these areas towards a collection area and dispose contaminated water and soil at an appropriate registered facility. Vehicles should preferably be refueled off site;
- Provide adequate temporary toilets for the duration of the construction phase, these should be located at least 30 m from all delineated watercourse boundaries;
- Prohibit the washing of vehicles, tools or machinery in watercourses or associated buffer areas;
- Store fuel, chemicals and other hazardous substances in suitable, secure, weather-proof containers and within an area with impermeable and bunded floors, preferably within areas earmarked for construction at least 30 m from the delineated edge of any watercourse and within an already disturbed area, as far as practically possible.
- Inspect all storage facilities and vehicles on a regular basis for the early detection of deterioration or leaks;
- Locate fuel and chemical storage facilities outside areas prone to flooding;
- Protect stockpiles, if required, from erosion using tarp or erosion blankets;
- Ensure that no standing water gathers at stockpile sites, to reduce erosion as well as the contamination of the water by nutrients/ toxics;
- Cover storage piles to limit dust generation;
- Restrict the dumping or storage of construction material to the footprint of construction areas. These areas should be located at least 30 m from all delineated watercourse boundaries;
- Dispose of used oils, wash water from cement and other pollutants at an appropriately licensed landfill site;
- Remove all construction material and waste upon completion of the project; and
- Remove all contaminated soil from storage and maintenance areas, thereafter rip, profile and monitor until indigenous vegetation has established.

[2] The region receives most of it's rainfall during summer and autumn. However, rainfall prior to the field survey was low.

### *1.1.5. Source of Information*

Primary information sources used to inform the scoping assessment included:

- Northern Cape Provincial Spatial Development Framework; PSDF (2012);
- The South African National Biodiversity Institute - Biodiversity GIS (BGIS) [online]. URL: http://bgis.sanbi.org;
- The NFEPA project (2011);
- Google Earth Pro (2017) and Vector data received from the Chief Directorate Surveys and Mapping (2015); and
- The vegetation of South Africa, Lesotho and Swaziland as compiled by Mucina and Rutherford (2006).

## 1.2. APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

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

Any development within the extent of a watercourse may require Environmental Authorisation in terms of the NEMA 107 of 1998 and subsequent amendments to the Act.

A watercourse is defined in the Act as:
(a) River or spring;
(b) A natural channel in which water flows regularly or intermittently;
(c) A wetland, pan, 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 as defined in the National Water Act (NWA, 1998) (Act No. 36 of 1998).

Note that a reference to a watercourse includes, where relevant, its bed and banks; and

"wetland" means land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.

"dam" when used in these Regulations means any barrier dam and any other form of impoundment used for the storage of water, excluding reservoirs.

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

The crossing of watercourses e.g. roads and cables is considered to be a water use as defined within the NWA and would require the authorisation from the Department of Water and Sanitation (DWS). In terms of the proposed project, water uses listed within Section 21 that will most likely require authorisation include -
(c) impeding or diverting the flow of water in a watercourse; and
(i) altering the bed, banks, course or characteristics of a watercourse.

It is important to note that "Altering the beds, banks, course or characteristics of a watercourse" means any change affecting the resource quality within the riparian habitat or 1:100 year flood line, whichever is the greater distance.

### 1.2.3. National Forest Act (Act No 84 of 1998)

The removal of *Acacia erioloba* or any other tree listed within the National Forest Act (NFA) 84 of 1998 at watercourse crossing points will require a tree removal permit which can be obtained from the Department of Agriculture, Forestry and Fisheries (DAFF).

### 1.2.4. National Environmental Management Biodiversity Act (Act No. 10 of 2004) Alien and Invasive Species Regulations (GN R598 of 2014)

According to the National Environmental Management Biodiversity Act (NEMBA, Act No. 10 of 2004) Alien and Invasive Species Regulations (GN R598 of 2014) alien and invasive species must be eradicated and managed according to the category and criteria specified.

## 1.3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

### 1.3.1. Baseline Description of the Receiving Environment

The study area is situated in the north-eastern parts of the Northern Cape Province, near the town Kuruman within the Ga-Segonyana Local Municipality. Kuruman is located approximately 236km (by road) to the north-west of the provincial capital, Kimberley. The Northern Cape Province can be described as being semi-arid in the east, to arid in the central region, to hyper-arid in the far western parts of Namaqualand (PSDF, 2012).

Approximately 97,69% of the Ga-Segonyana Local Municipality has been classified as 'remaining natural habitat' and the applicable terrestrial ecosystems have been listed as Least Threatened (information retrieved from The Land Use Decision Support Tool (LUDS, 2014) available on www.bgis.co.za).

The study area is located within a transitional zone of the Kuruman Thornveld and Kuruman Mountain Bushveld vegetation types (Figure 3) at a varying altitude of between 1 300 to 1 600m above sea level (ASL). Both vegetation types are known for summer and autumn rainfall with very dry winters. The Mean Annual Precipitation (MAP) documented for the Kuruman Mountain Bushveld is between 250 to 500mm and for the Kuruman Thornveld 300 to 450mm (Mucina and Rutherford, 2006, updated 2012). Additional attributes of the region are provided in Table 3.

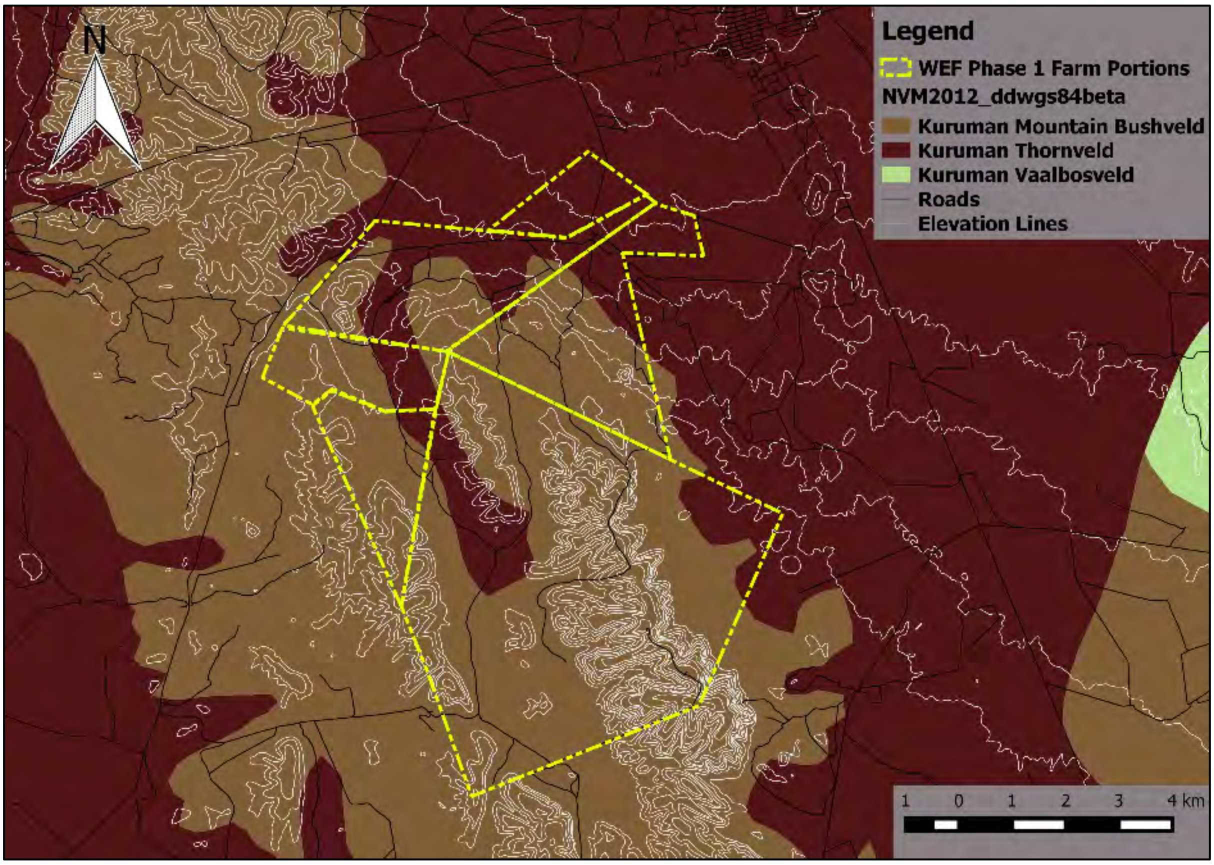


**Figure 3: Vegetation types applicable to the study area (Mucina and Rutherford, 2006).**

Undisturbed Kuruman Mountain Bushveld is characterised by rolling hills with gently to moderately steep slopes, and hill pediment areas with a well-developed grass layer and patches of open shrubveld dominated by *Lebeckia macrantha.* In contrast, undisturbed Kuruman Thornveld is characterised by flat rocky plains and some sloping hills with a very well developed closed shrub layer and well developed open tree stratum consisting of *Acacia erioloba* (Mucina and Rutherford, 2006).

The quaternary catchments indicated for the study area are D41L and D41K and the study area falls within the Southern Kalahari Ecoregion (Figure 4) and within the Lower Vaal Water Management Area (WMA) (Figure 5) and the Molopo sub-Water Management Area (sub-WMA) as defined by NFEPA (2011).

**Table 3: Main attributes of the region (Macfarlane and Bredin, 2016 and Mucina and Rutherford, 2006).**

| Main Attributes | |
|---|---|
| Inherent erosion potential (K factor) of catchment soils | 0.62 – 0.63 (moderately high) |
| Rainfall seasonality | Summer to autumn |
| Mean annual precipitation (mm) | 400 - 600 mm |
| Mean annual temp. (°C) | 24 °C |
| Rain intensity | High |

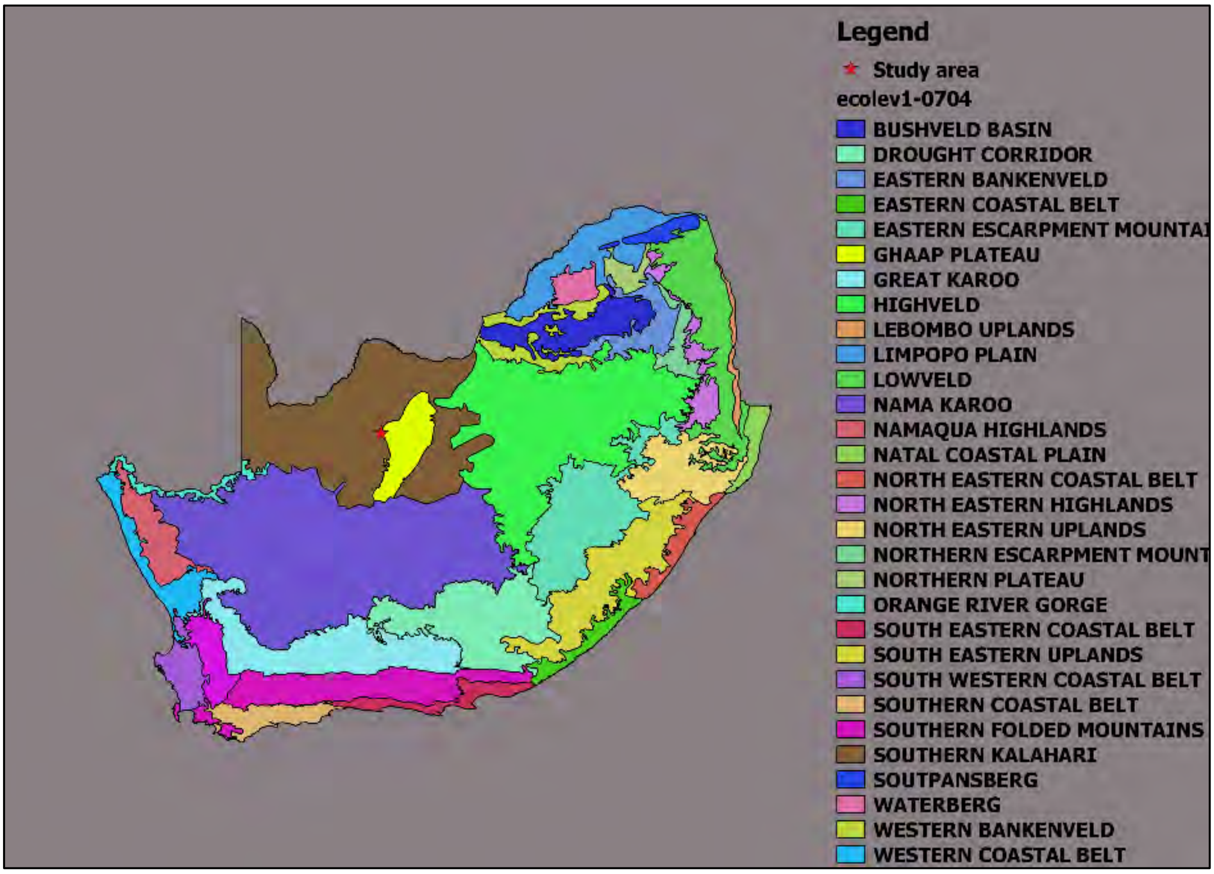


**Figure 4: South African Ecoregions in relation to the study area.**

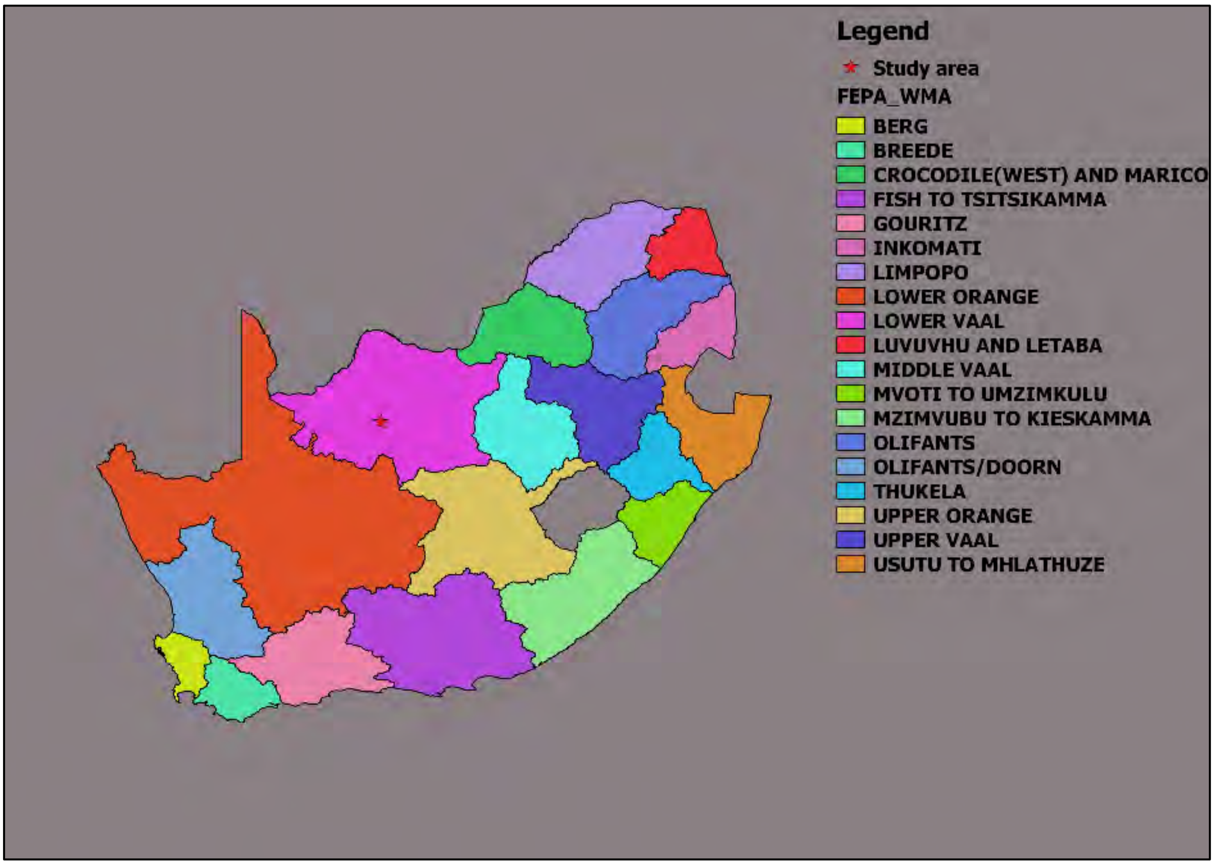


**Figure 5: NFEPA WMA in relation to the study area.**

Only the Kuruman River and one of its larger tributaries, the Ga-Mogara River, traverse the Ga-Segonyana Local Municipality. The Kuruman River originates east of Kuruman where it receives water from several springs of which the Great Koning Eye, Little Koning Eye and the Kuruman Eye are the largest (Zitholile, 2015). The confluence of the Kuruman River with the Molopo River is situated approximately 360km upstream of the study area. Both the Kuruman River and the Ga-Mogara River are usually dry, flowing only for short periods following sufficient rainfall.

The nearest river system is a tributary of the Kuruman River located approximately 4km north east of the study area, with the Kuruman River itself located approximately 6,6km from the study area boundary. The Kuruman River as well as the tributary are ephemeral watercourses indicated to be within a Class B (largely natural) Present Ecological State (PES; NFEPA, 2011). The Ga-Mogara River with its associated tributaries are located south west of the study area, the closest of which is the Vlermuisleegte tributary approximately 25km from the boundary of the study area. The tributaries of the Kuruman River located within the catchment of the study area have been classified as Class C (moderately modified) (Northern Cape PSDF, 2012) (Figure 6).

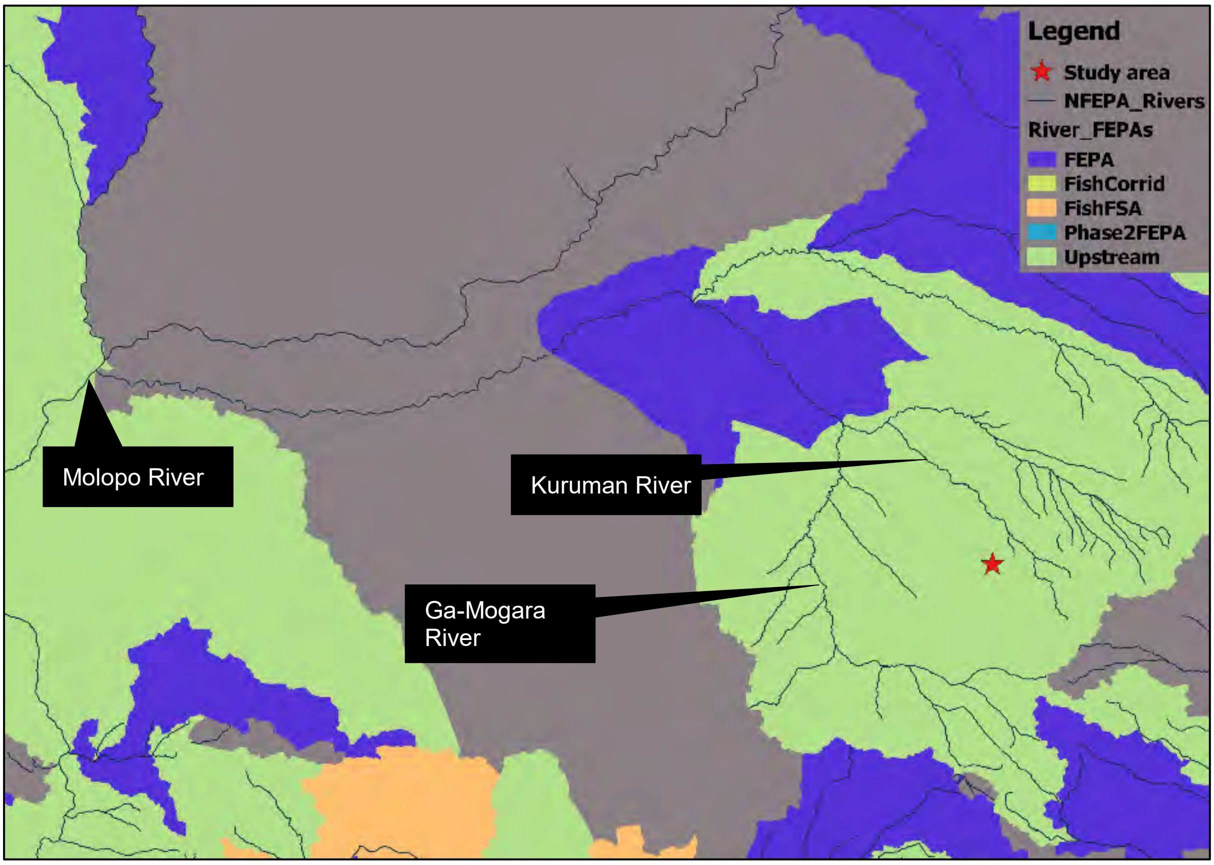


**Figure 6: Freshwater Ecosystem Priority Areas and major rivers.**

The sub-quaternary catchment in which the study area is located was selected as an Upstream Management Area (Figure 6). Upstream Management Areas, are sub -quaternary catchments in which human activities need to be managed to prevent degradation of downstream river Freshwater Ecosystem Priority Areas (FEPAs) and Fish Support Areas (FSAs). The sub-quaternary catchment located downstream of the confluence of the Ga-Mogara River with the Kuruman River was selected as a river FEPA and therefore requires adequate protection. River FEPAs achieve biodiversity targets for river ecosystems and fish species, and are identified in rivers that are currently in a good condition (A or B ecological category).

The applicable wetland vegetation units for seeps and depressions, which is the only wetland habitat within the study area indicated by background information, is the Eastern Kalahari Bushveld Group 3 and 4 (Figure 7) both listed as 'Least Threatened' (NFEPA, 2011). A single natural seep wetland extending over approximately 13ha is located within the study area, indicated to fall within an AB wetland condition (natural or good) and only one smaller artificial feature, approximately 0.38ha, is located within 500m of the study area boundary (Northern Cape Critical Biodiversity Areas, 2016 and NFEPA, 2011). The topography has however resulted in the formation of numerous small ephemeral drainage lines throughout the study area (Figure 7; Chief Directorate Surveys and Mapping August 2015).

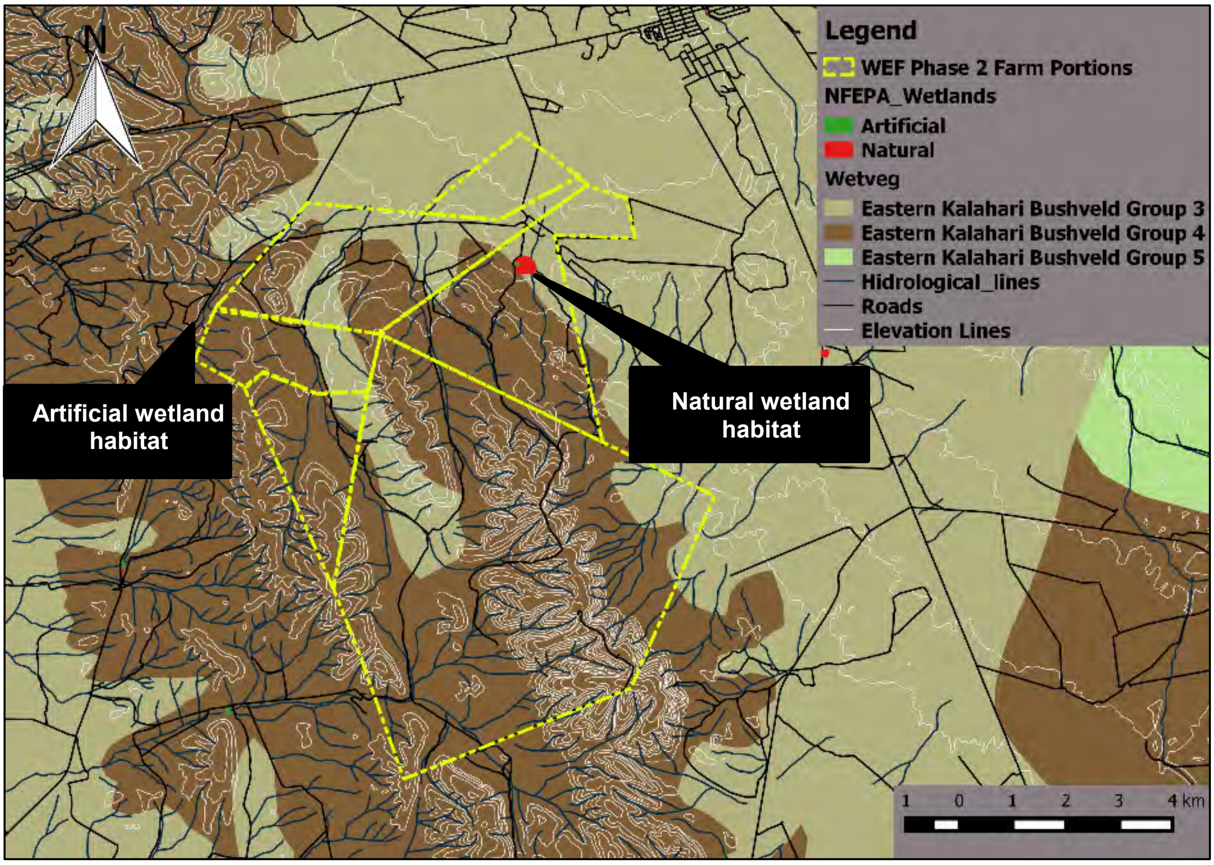


**Figure 7: Wetland vegetation units and wetland habitat (NFEPA, 2011) as well as hydrological lines[3].**

### 1.3.2. Results of the Field Study

The primary surrounding land use is stock farming (cattle and sheep) and the study area itself is currently utilised as a game farm. The low regional rainfall in combination with the absence of perennial rivers near the study area is not favorable for extensive crop cultivation. As a result, natural vegetation has remained in a good condition within most of the study area, with the exception of isolated areas near watering points, roads and fences where natural vegetation cover decreases. The most noteworthy present impact on watercourses are erosion.

Two ridges run along the center of the study area in a north-south direction. Multiple ephemeral drainage lines originate at the crests along the length of the ridges. Some of these drainage lines steadily increase in size as they confluence with each other. However, drainage lines were also encountered which do not accumulate sufficient water volumes and which dissipate at the base of the ridge.

The lack of sufficient surface water flow within the majority of the ephemeral drainage lines in combination with the absence of shallow groundwater resources (pers. communication with Mr. du

[3] Vector data received from the Chief Directorate Surveys and Mapping August 2015.

Plessis) is not conducive for the formation of vegetation corridors known as ''riparian zones[4]''. Poorly defined riparian zones are only associated with isolated areas along some of the larger drainage lines extending through the valleys at the base of hillslopes. Although the tree community is sparse, trees such as *Vachellia erioloba* (Camel thorn) and *Ziziphus mucronata* (Buffalo thorn) provide shelter for avifauna as well as nutrient concentrations that enable the persistence of understory's which in turn provide foraging and breeding habitat for ground dwelling faunal species (van Rooyen, 2001).

The natural seep wetland, indicated by NFEPA (Figure 7) was also investigated during the field survey. It was found to be a small artificial pond used for recreational purposes. Considering the terrain unit and soil matrix[5] it is considered possible that this seep existed historically. However, no additional wetland characteristics as defined by DWAF (2008) were identified within the immediate surroundings of the pond or any other area of interest during the field survey. No infrastructure is proposed near the natural seep wetland; therefore, no impact to this feature is expected should, WEF Phase 1 be authorised.

The PES and EIS of the drainage lines will be assessed in detail within the environmental impact phase.

**Figure 8: Representative photos of the isolated areas along some of the larger drainage lines with ill-defined riparian zones.**

**Figure 9: Representative photos of the majority drainage lines.**

[4] A riparian zone is defined as a strip of vegetation along the banks of watercourses with distinct difference in composition and structure from the surrounding terrestrial vegetation (DWAF, 2008).

[5] Soil matrix is the portion of the soil layer (usually more than 50%) which has the predominant colour.

### *1.3.3. Environmental Sensitivity Map*

All the drainage lines are considered 'A Section' channels as defined by DWAF (2005). 'A Section' channels are headward channels situated above the zone of saturation and therefore do not carry baseflow. Due to the absence of baseflow these channels only flow for short intervals after sufficient rainfall. Many of these channels are located at gradients too steep to allow deposition of alluvial soil or overtopping of banks which in turn would be conducive of the formation of riparian zones (DWAF, 2005).

'A Section' channels are considered to be the least sensitive in terms of water yield and quality (Macfarlane *et. al*., 2014). However, these channels do still provide valuable functions such as attenuation of floodwaters and retention of excess sediments.

An in-depth discussion of the EIS of the drainage lines within the study area will be provided as part of the freshwater assessment to be undertaken as part of the EIA phase. The preliminary sensitivity may be refined according to these results.

The preliminary sensitivity map provided as part of the scoping phase took into consideration the main functions provided by ephemeral drainage lines as well as most significant impacts posed by the proposed WEF. In the absence of a determined 1 in 100 year flood line or riparian area the area within 100m from the edge of a watercourse[6] is considered the regulated area for Section 21(c) or (i) of the NWA water uses in terms of General Notice 509 of 2016.

The most recent guideline for buffer allocation in South Africa does not apply to 'A Section' channels (Macfarlane *et. al*., 2014). The minimum buffer zone requirements for electricity generation works is 20m (Macfarlane and Bredin, 2017). It is however the opinion of the specialist that an initial buffer of at least 30m be provided for all drainage lines in order to reduce the risk of erosion. Preferably, no turbine footprints, laydown areas or tower plants should be sited within any of the 30m buffers. In addition, the advocated buffers should be designated ''No Go'' zones within the study area wherein only essential activities should be allowed during construction or upgrading of roads and placement of distribution lines.

[6] Due to the ephemeral nature of the drainage lines, all the features will not have identifiable annual bank fill flood bench.

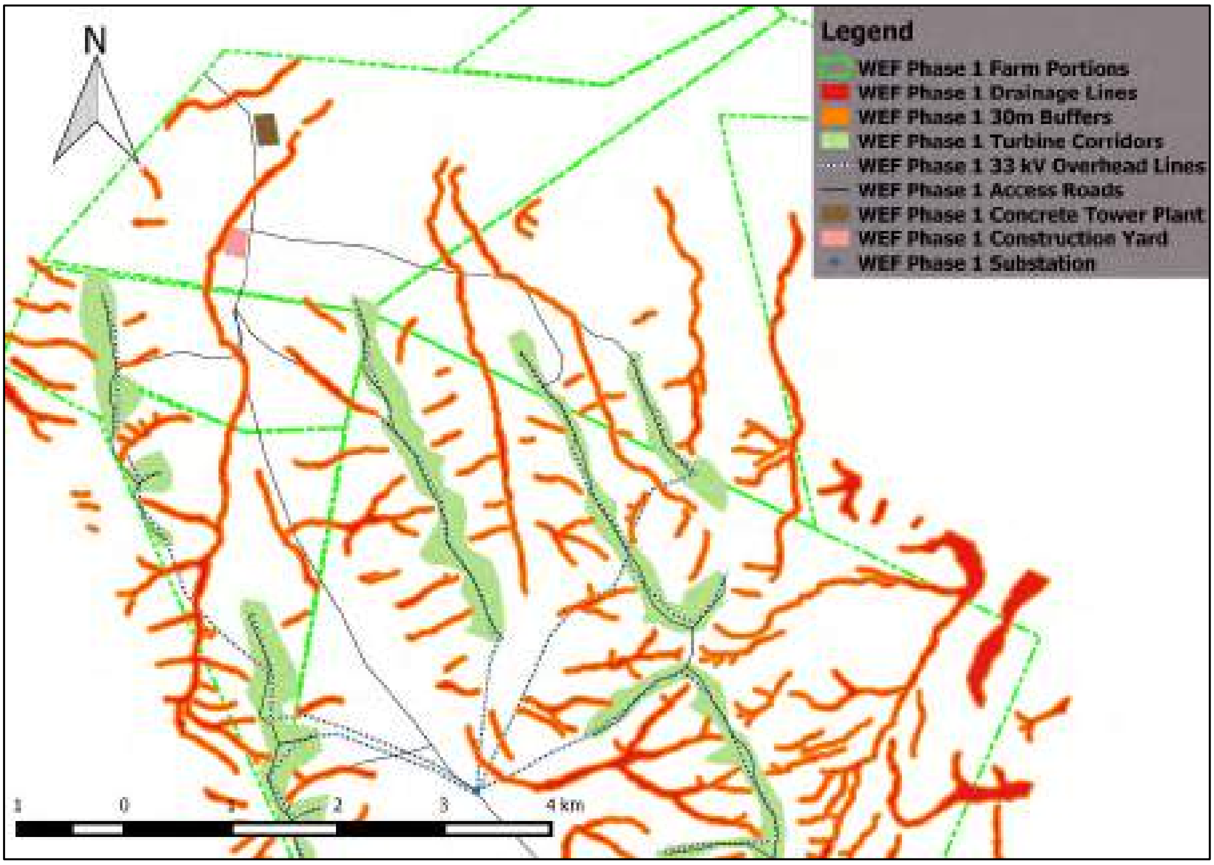


**Figure 10: Preliminary sensitivity map for the northern portion of Phase 1 of the Kuruman WEF.**

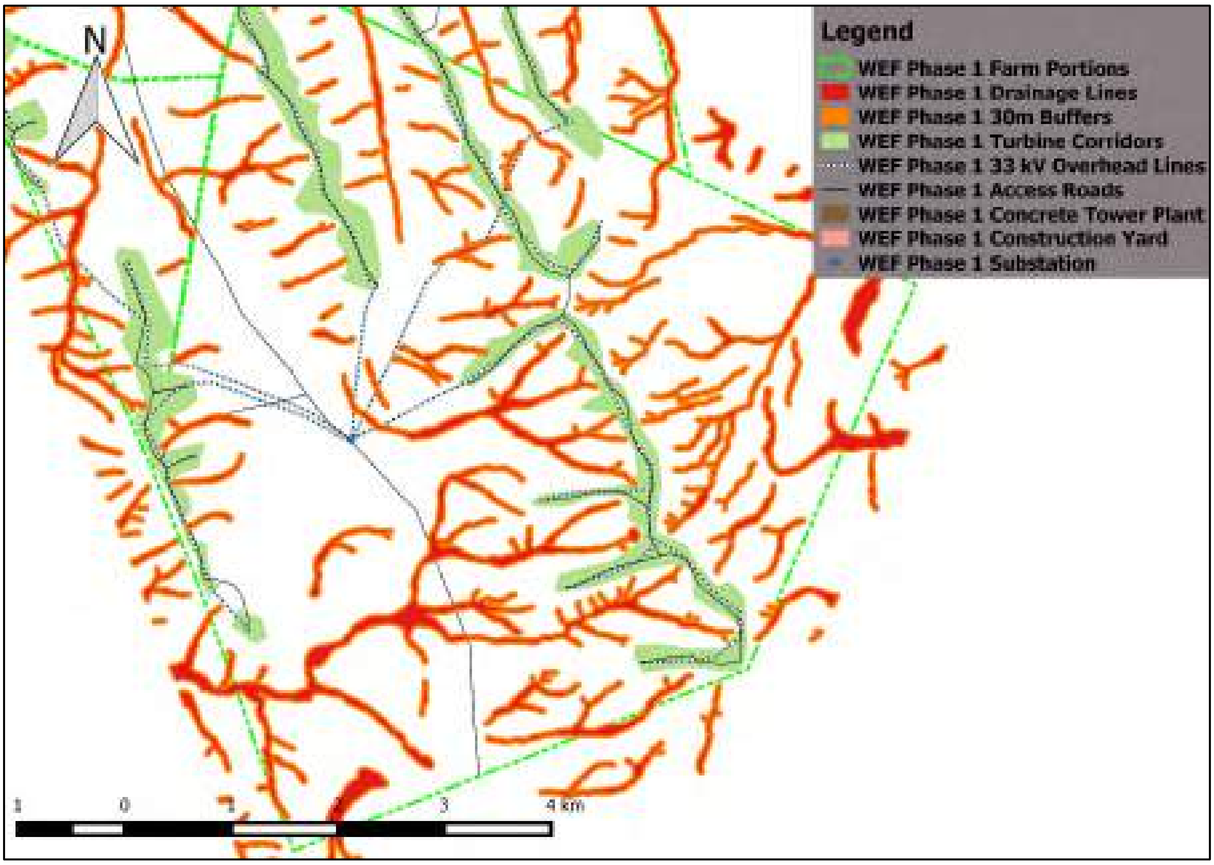


**Figure 11: Preliminary sensitivity map for the southern portion of Phase 1 of the Kuruman WEF.**

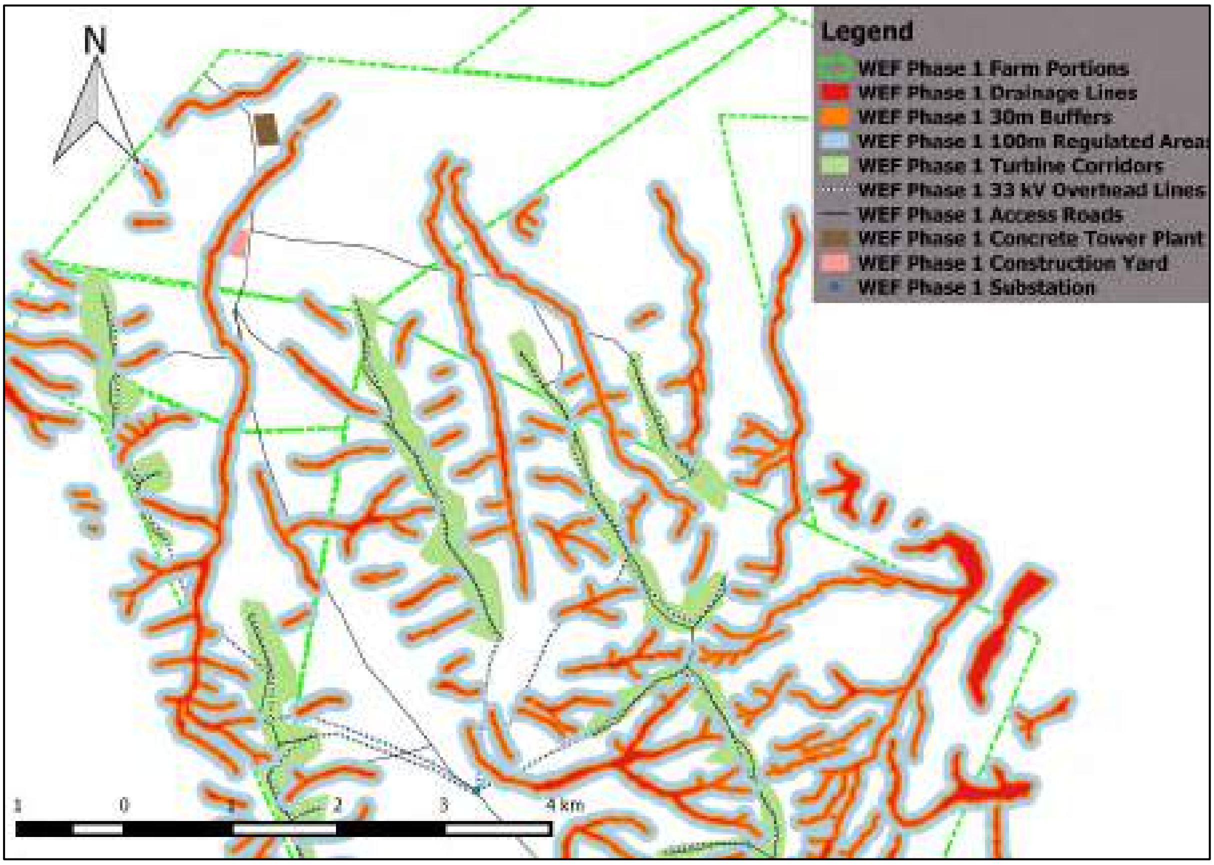


**Figure 12: 100m Regulated Areas for the northern portion of Phase 1 of the Kuruman WEF.**

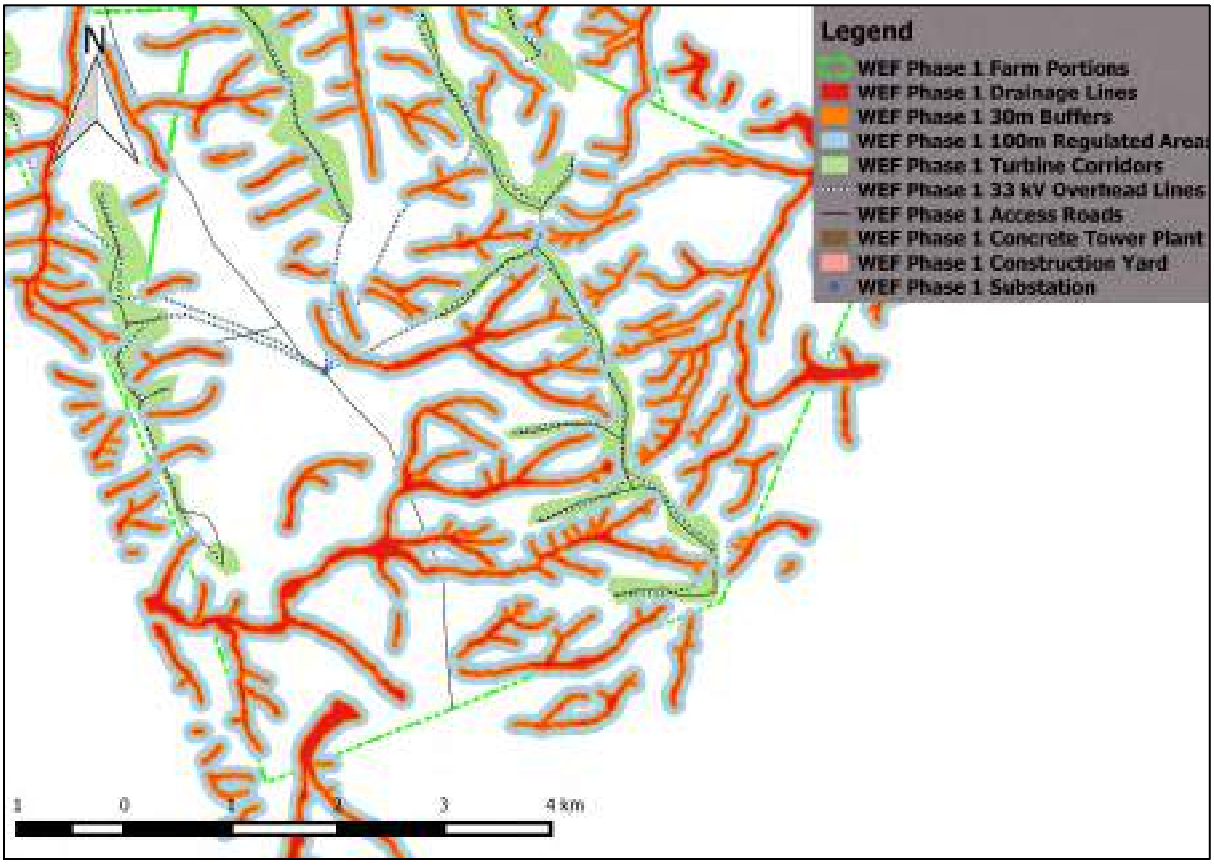


**Figure 13: 100m Regulated Areas for the southern portion of Phase 1 of the Kuruman WEF.**

## 1.4. DESCRIPTION OF PROJECT ASPECTS

**WEF construction related aspects (activities) that could result in the identified direct and cumulative impacts discussed in Section 1.5.1 include:**

1) Clearance of vegetation within drainage lines and the recommended buffer zones prior to the construction of new road crossings or widening of existing roads and placement of underground distribution lines; vegetation clearing for the construction yard, tower plant substation, and for each of the sites earmarked for the turbines.

2) Disturbance of vegetation e.g. edge effects as well as indiscriminate driving.

3) Site preparation following the removal of vegetation such as levelling and compacting of soil, stripping of soil and stockpiling.

4) Construction or upgrading of the watercourse crossings.

5) Use of concrete during construction of watercourse crossings as well as accidental spillage of hazardous chemicals.

**WEF operation related aspects (activities) that could result in the identified direct and cumulative impacts discussed in section 1.5.2. include:**

1) Inadequate maintenance of watercourse crossings.

2) Lack of ongoing eradication of alien and invasive vegetation.

**Decommissioning related aspects (activities) that could result in the identified direct and cumulative impacts discussed in section 1.5.3. and section 1.5.4, respectively, include:**

1) Earth moving activities in the vicinity of drainage lines or associated buffer zones.

2) Lack of follow-up monitoring and erosion control where needed.

2) Lack of follow-up management of alien and invasive vegetation within disturbed areas.

***No aspect that could potentially result in a fatal flaw or indirect impact were identified as part of the scoping phase.***

## 1.5. IDENTIFICATION OF IMPACTS

Section 21 (c) and (i) of the NWA, refers to the physical changes that are made to a watercourse. Watercourses in context to this project include all delineated drainage lines presented in Figure 10 and Figure 11. It is a requirement of the WUL application process that potential impact on the following characteristics be determined:

- Impact on the flow regime;
- Impact on the water quality;
- Impact on biota - the animal and plant life of a particular region or habitat; and
- Impact on riparian habitat.

These four direct impacts therefore formed the foundation of the freshwater impact assessment however, any additional potential impacts were also identified and assessed. The proponent did not provide an alternative layout plan for Phase 1 of the proposed WEF and therefore only the impact significance for the layout plan provided was assessed.

Impacts considered to be likely during the construction, operational and decommissioning phase of the WEF include:

### *1.5.1. Construction Phase*

- Potential **direct** impact 1 – Disturbance of drainage lines;
- Potential **direct** impact 2 – Alteration of flow patterns; and
- Potential **direct** impact 3 – Impairment of water quality.

### *1.5.2. Operational Phase*

- Potential **direct** impact 1 – Degradation of drainage lines; and
- Potential **direct** impact 2 – Alteration of the natural hydrological regime.

### *1.5.3. Decommissioning Phase*

- Potential **direct** impact 1 – Degradation of drainage lines; and
- Potential **direct** impact 2 – Impairment of water quality.

Cumulative impacts considered to be likely following authorisation of Phase 1 of the WEF include:

### *1.5.4. Cumulative impacts*

- Cumulative impact 1 – Proliferation of alien and invasive species; and
- Cumulative impact 2 – Erosion of drainage lines.

***It is the opinion of the specialist that any potential indirect impact can be avoided with strict adherence to mitigation measures provided for direct impacts. No indirect impacts were identified as part of the scoping phase assessment.***

## 1.6. ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

***Note: the assessment of impacts and associated measures to mitigate provided as part of the scoping phase are subject to change according to results obtained for the detailed freshwater assessment to be undertaken as part of the EIA phase.***

In assessing the identified potential construction phase impacts, it has been assumed that good housekeeping measures (listed in Section 1.1.4.) will be implemented through adherence to the EMPr.

### *1.6.1. Construction Phase Impact*

#### 1.6.1.1. Potential Impact 1 - Disturbance of drainage lines

a) Nature of the impact:

Removal of larger trees, will result in a change in the composition of the understory vegetation assemblage due to increased sunlight as well as proliferation of pioneer and invasive species.

Removal of larger trees and shrubs along drainage lines will also increase accessibility to livestock, leaving banks vulnerable to trampling and erosion.

Construction of drainage line crossings will result in disturbance of the bed and banks.

Edge effects and indiscriminate, driving, fires and dumping of construction material and spoil will also result in disturbance, it is therefore important that access into areas bordering the designated crossings be strictly prohibited.

Proliferation of alien vegetation as well as bush encroachment are also considered highly likely if not adequately managed.

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

c) Proposed mitigation measures:

- Demarcate each construction footprint located within each drainage line, clearly. All material used for demarcation purposes should be removed after construction has been completed;
- Allow only essential construction related activities within the demarcated areas;
- Strictly prohibit any construction related activity outside the demarcated areas;
- Develop road crossings at 90 degree angles to the drainage lines to decrease the extent of the vegetation disturbed. Where possible, proposed new roads running along the lengths of drainage lines should be relocated to areas outside of the drainage lines and associated buffer zones;
- Limit the number of trees and shrubs removed as far as practically possible;
- Limit the extent of the construction footprint area to avoid unnecessary disturbance;
- Limit access into drainage lines to existing access roads where possible and any turning areas required must be located outside of the buffer zone;
- Minimise the extent of infilling within the drainage lines as far as possible;
- Prevent excessive disturbance of the bed and banks during culvert development (if used);
- Prohibit the dumping of excavated material within the channel. Spoil material must be appropriately disposed of at a registered waste disposal facility;
- Store topsoil and vegetation removed from the construction footprint at the designated stockpile area for use in rehabilitation activities;
- Stockpile topsoil and subsoil removed during construction separately for future rehabilitation;
- Appoint an Environmental Control Officer (ECO) to inspect the crossings on a weekly basis (at least) and take measures to address unforeseen disturbances to the ephemeral drainage lines;
- Rehabilitate any areas **outside** of the direct construction footprint which have been disturbed as a result of construction related activities. A rehabilitation plan must be developed including rehabilitation measures such as:
  - Reshape and reprofile the banks of the drainage line to either side of each crossing so that they tie in with the surrounding channel banks both longitudinally and perpendicularly (height, slope and structure);
  - Rip and loosen compacted soils associated with the bank to a depth of 100mm in order to aid in the establishment of vegetation;
  - Redistribute stockpiled topsoil across the banks;
  - Prevent erosion of the channel banks by covering and stabilizing any steep or unstable reshaped channel banks with a geotextile such as Geojute or BioJute, or with the use of sandbags or silt fences at the break in slope;

- Revegetate disturbed areas with vegetation assemblages reflecting the general species composition of the area as soon as possible after the application of topsoil and stabilizing of soils; and
- Strictly prohibit the use of alien vegetation during rehabilitation activities.

- Alien and Invasive species control:
  - Appoint an ECO to check the construction footprint and immediately adjacent areas for alien and invasive species weekly and alien species noted must be removed;
  - Remove alien species manually, by hand as far as possible. The use of herbicides should be avoided. Should the use of herbicides be required, only herbicides which have been certified safe for use in aquatic environments by an independent testing authority may be considered;
  - Dispose of removed alien plant material at a registered waste disposal site or burn on a bunded surface where no stormwater runoff is expected;
  - Remove vegetation before seed is set and released;
  - Cover removed alien plant material properly when transported, to prevent it from being blown from vehicles; and
  - Appoint an Environmental Officer (EO) to monitor the site, twice a year for three consecutive years once construction has been finalised, in order to determine whether any additional alien vegetation control measures will be required.
- Prohibit fires.

d) Significance of impact with mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

#### 1.6.1.2. Potential Impact 2 - Alteration of flow patterns

a) Nature of the impact:

Due to the ephemeral nature of the drainage lines over which crossings will be required, water flow will likely be restricted to the rainfall season, directly after sufficient rainfall events. Obstruction of surface and subsurface waterflow during construction can therefore be largely avoided if construction of the watercourse crossings take place outside of the rainfall season.

Reduction of infiltration capacity and increase in runoff volume and intensity from areas earmarked for buildings, turbine foundations and support structures will result in an increase in the volume of water reaching the ephemeral drainage lines.

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Moderate (negative) significance.

c) Proposed mitigation measures:

- Prohibit any vehicle or activity outside of the demarcated construction footprint area;
- Limit the footprint of construction activities required as far as practically possible;
- Strategically divert stormwater runoff from the construction footprint, in order to dissipate stormwater runoff before entering drainage lines;
- Erosion control measures at each crossing should be adapted to the velocity and volume of water expected within each drainage line during the operational phase;
- Allowance should be made for the movement of surface flow; and
- Ensure that the crossings are stable and appropriately protected so as to withstand flood events.

d) Significance of impact with mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

#### 1.6.1.3. Potential Impact 3 - Impairment of water quality

a) Nature of the impact:

The term water quality is used to describe the concentration of dissolved salts (solutes) and of particulate (clastic) sediment (Macfarlane *et. al*., 2007). Therefore, accidental spillage of hazardous material including chemicals and hydrocarbons such as fuel, and oil, the use of cement within watercourses as well as sediment originating from disturbed areas, were all considered contributors to this impact. Construction areas located outside of the delineated drainage lines may also be a source of sedimentation, if the buffer zones[7] are not kept intact.

It has been assumed that all housekeeping measures listed for the construction phase will be implemented through adherence to the EMPr, by so doing impact resulting from solutes will largely be addressed. However, construction material required at crossings and sediment laden runoff will still need to be adequately managed.

Due to the presence of permeable substratum along ephemeral drainage lines, impairment of the quality of surface water may also pose a risk to groundwater resources.

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Moderate (negative) significance.

c) Proposed mitigation measures:

Solutes:

- Avoid the use of infill material or construction material with pollution / leaching potential when constructing or widening roads across drainage lines;
- Dispose of concrete and cement-related mortars in an environmental sensitive manner (can be toxic to aquatic life). Washout should not be discharged into drainage lines. A washout area should be designated at least 30m from any buffer zone. A washout area should be designated, and wash water should be treated on-site;
- Prohibit the mixing of concrete on exposed soils. Concrete must be mixed on an impermeable surface in an area of low environmental sensitivity identified by the ECO outside of the buffer area;
- Construct temporary bunds around areas within drainage lines where cement is to be cast in-situ; and
- Develop a construction method statement which indicates how the contractor will minimise the passage of contaminants such as fuel and cement into the watercourses at crossings and ensure it is signed off by the ECO.

Sediment:

- Minimise the area of disturbance and the amount of earthworks;
- Construct silt fences and earthen dikes / diversions at operation footprint areas where sheet flow is expected, to retain and divert sediment-laden runoff;
- Place silt fences / traps strategically on the periphery of the construction footprint area including the construction camp, cleared areas, storage areas, soil stockpile areas and laydown areas. Ensure it is not channeled directly into the drainage lines;

[7] Buffer zones will intercept sediment laden stormwater and decrease runoff velocities.

- Install silt fences / traps downstream of crossings, if construction takes place during the rainfall season, to trap any sediment produced during construction activities. The ECO must be consulted on the number and location of silt fences, and silt fences must not result in any unnecessary disturbance to the stream channel and banks;
- Appoint an ECO to check all sediment trapping devices weekly and to ensure devices are cleared and repaired when needed;
- The contractor / ECO must check each crossing for erosion damage and sedimentation after every heavy rainfall event for the duration of the construction phase. Should erosion or sedimentation be noted, immediate corrective measures must be undertaken. Rehabilitation measures may include the filling of erosion gullies and rills and the stabilization of gullies with silt fences;
- Use gabion baskets / reno mattresses strategically for erosion protection, as required;
- Use excavators instead of bulldozers where watercourse crossings are constructed / upgraded to reduce sedimentation and consolidate the entry and exit points to reduce scouring; and
- Engineer disturbed areas to coincide as close as possible to original contours. Ensure that excavated vegetation and soil mounds are not left unattended (recreate original contours).

d) Significance of impact with mitigation measures:

Impact significance was assessed to be of Very Low (negative) significance.

### *1.6.2. Operational Phase Impact*

#### 1.6.2.1. Potential Impact 1 - Degradation of drainage lines

a) Nature of the impact:

Degradation of natural vegetation due to alien vegetation encroachment and erosion of banks both related to lack of effective management will result in ongoing degradation of drainage lines.

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Moderate (negative) significance.

c) Proposed mitigation measures:

- Eradicate alien and weed vegetation at each crossing as well as any areas accidentally disturbed:
  - Remove alien species manually, by hand as far as possible. The use of herbicides should be avoided. Should the use of herbicides be required, only herbicides which have been certified safe for use in aquatic environments by an independent testing authority may be considered;
  - Dispose of removed alien plant material at a registered waste disposal site or burn on a bunded surface where no stormwater runoff is expected;
  - Remove vegetation before seed is set and released; and
  - Cover removed alien plant material properly when transported, to prevent it from being blown from vehicles.
- Appoint an EO to monitor each crossing after the first major flood event and each year after construction has been completed for at least 3 consecutive years, in order to determine whether any additional alien vegetation or erosion control measures are required. Erosion measures will need to be adapted according to each concern.

d) Significance of impact with mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

#### 1.6.2.2. Potential Impact 2 - Alteration of the natural hydrological regime

a) Nature of the impact:

It is considered likely that watercourse crossings could result in long term obstruction of surface and subsurface flow, if not appropriately catered for as part of design. In addition, culverts/pipes (if needed) not cleared of debris would also hamper the surface flow following adequate rainfall. The impact would not be restricted to the watercourse crossing and could potentially impact downstream riparian habitat.

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

c) Proposed mitigation measures:

- Rehabilitated the bed and the banks of the drainage lines to as close to their original condition as possible. Ensure that the bed of the drainage line is restored to the natural base level in order to prevent erosion or upstream ponding (i.e. the base of the culverts/pipes must tie in with the natural base level of the stream); and
- Appoint an EO to inspect the crossings twice a year for three consecutive years once construction has been completed as well as after heavy rainfall events for the build-up of debris and sediment. Any debris noted must be removed.

d) Significance of impact with mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

### *1.6.3. Decommissioning Phase Impact*

#### 1.6.3.1. Potential Impact 1 - Degradation of drainage lines

a) Nature of the impact:

Any disturbed area, not adequately rehabilitated, will result in proliferation of alien and weed vegetation and erosion.

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

c) Proposed mitigation measures:

- Demarcate each decommissioning footprint within a drainage line or buffer zone, clearly. All material used for demarcation purposes should be removed after decommissioning has been completed;
- Allow only essential activities within the demarcated areas;
- Remove all foreign material from each drainage line or buffer zone before moving to the next area;
- Undertake rehabilitation concurrently with decommissioning activities, as far as practically possible;

- Rehabilitate all areas disturbed during decommissioning activities. A rehabilitation plan must be developed including rehabilitation measures such as:
  - o Reshape and reprofile the banks of drainage lines to either side of each crossing so that they tie in with the surrounding channel banks both longitudinally and perpendicularly (height, slope and structure);
  - o Rip and loosen compacted soils of the banks of the drainage lines to a depth of 100mm in order to aid in the establishment of vegetation;
  - o Redistribute stockpiled topsoil across the banks;
  - o Prevent erosion of the banks by covering and stabilizing any steep or unstable reshaped channel banks with a geotextile such as Geojute or BioJute, or with the use of sandbags or silt fences at the break in slope;
  - o Revegetate disturbed areas with vegetation assemblages reflecting the general species composition of the area as soon as possible after the application of topsoil and stabilizing of soils; and
  - o Strictly prohibit the use of alien vegetation during rehabilitation activities.
- Eradicate alien and weed vegetation within the drainage lines as well as within any additionally disturbed areas. Follow-up clearing must be done until indigenous vegetation returns to the site:
  - o Remove alien species manually, by hand as far as possible. The use of herbicides should be avoided. Should the use of herbicides be required, only herbicides which have been certified safe for use in aquatic environments by an independent testing authority may be considered;
  - o Dispose of removed alien plant material at a registered waste disposal site or burn on a bunded surface where no stormwater runoff is expected;
  - o Remove vegetation before seed is set and released; and
  - o Cover removed alien plant material properly when transported, to prevent it from being blown from vehicles.
- Appoint an ECO to monitor disturbed areas within drainage lines and buffers, after the first major flood event and each year after construction for at least 3 consecutive years, in order to determine whether any additional alien vegetation or erosion control measures are required. Erosion measures will need to be adapted according to each concern.

d) Significance of impact with mitigation measures:

Impact significance was assessed to be of Very Low (negative) significance.

### 1.6.3.2. Potential Impact 2 – Impairment of water quality

a) Nature of the impact:

It has been assumed that all good housekeeping measures listed for the construction phase will be implemented in the decommissioning phase as well. Therefore, sediment originating from areas where infrastructure is removed is the main concern associated with impairment of water quality during the decommissioning phase.

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

c) Proposed mitigation measures:

- Minimise the area of disturbance and the amount of earthworks;
- Divert storm water runoff from disturbed areas into a sediment trapping device. Ensure it is not channeled directly into a drainage line;

- Construct silt fences and earthen dikes / diversions at areas where sheet flow is expected, to retain and divert sediment-laden runoff;
- Construct silt fences / traps in areas prone to erosion, to retain sediment-laden runoff;
- Appoint an ECO to check all sediment trapping devices weekly to ensure devices are cleared and repaired when needed;
- The contractor/ECO must check each area where decommission has taken place within a watercourse or associated buffer zone for erosion damage and sedimentation after every heavy rainfall event, until an indigenous vegetation cover of at least 50% has been reached within disturbed areas. Should erosion or sedimentation be noted, immediate corrective measures must be undertaken. Rehabilitation measures may include the filling of erosion gullies and rills and the stabilization of gullies with silt fences;
- Use excavators instead of bulldozers where required to remove construction material from drainage lines; consolidate the entry and exit points to reduce scouring; and
- Engineer disturbed areas to coincide as close as possible to original contours. Ensure that excavated vegetation and soil mounds are not left unattended (recreate original contours).

d) Significance of impact with mitigation measures:

Impact significance was assessed to be of Very Low (negative) significance.

### *1.6.4. Cumulative Impact*

#### 1.6.4.1. Impact 1 - Proliferation of alien and invasive species

a) Nature of the impact:

The abundance and diversity of alien and weed species within the study area is currently not considered to be high. However, with increased vehicle access and disturbance it is considered highly likely that it will worsen over time.

The significance of the encroachment of *Prosopis* spp. into watercourses was already documented by Henderson in 1991, at the time both the Molopo and Kuruman Rivers were invaded almost exclusively by *Prosopis* spp., which have formed extensive stands in places. Areas identified to be of increased risk to invasion included road transects and ephemeral drainage lines. The risk posed due to water abstraction by extensive stands is considered significant and could result in destruction of riparian ecosystems if not successfully managed (Van den Berg, 2010).

Mitigation measures have been provided in an attempt to limit alien vegetation proliferation within disturbed areas. It is however considered unlikely to be entirely successful, this project would therefore contribute to the cumulative impact posed by alien and invasive species along drainage lines.

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

c) Proposed mitigation measures:

- No mitigation measures in addition to those advocated for the construction and operational phase are available.

d) Significance of impact with mitigation measures:

N/A

### 1.6.4.2. Impact 1 – Erosion of drainage lines

a) Nature of the impact:

Inherent erosion potential (K factor) of catchment soils were documented as moderately high (refer to Section 1.3.1.) and present erosion within disturbed areas along drainage lines were considered significant at the time of the field survey. Exacerbation of erosion in already eroded areas as well as additional erosion of disturbed drainage lines would most likely add to the cumulative impact within the erosion prone region.

b) Significance of impact without mitigation measures:

Impact significance was assessed to be of Low (negative) significance.

c) Proposed mitigation measures:

- No mitigation measures in addition to those advocated for the construction and operational phase are available.

d) Significance of impact with mitigation measures:

N/A

## 1.7. IMPACT ASSESSMENT SUMMARY

The assessment of impacts and recommendation of mitigation measures as discussed above are collated in Table 4 to 7 below. It should be noted that significance ratings may change as information of the specifics of the project becomes available.

**Table 4: Impact assessment summary table for the Construction Phase.**

| Construction Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct Impacts | | | | | | | | | | | | | |
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation/ Management (Residual Impact/ Risk) | | |
| General edge effects as well as indiscriminate driving and removal of vegetation | Disturbance of drainage lines | Negative | Local | Long-term | Moderate | Likely | Moderate | Moderate | Refer to Section 1.6.2.1 | Low | | 4 | High |
| | | Negative | Local | Short-term | Moderate | Very unlikely | High | Moderate | | | Low | 4 | Medium |
| Construction or upgrading of the watercourse crossings as well as compacting soil within other construction footprints | Alteration of flow patterns | Negative | Local | Long-term | Substantial | Very Likely | Low | Moderate | Refer to Section 1.6.2.2 | Moderate | | 4 | Medium |
| | | Negative | Local | Long-term | Moderate | Very Likely | Moderate | Moderate | | | Low | 4 | Medium |
| Use of concrete and accidental spillage of hazardous chemicals, generation of sediment | Impairment of water quality | Negative | Local | Short-term | Moderate | Very Likely | High | Moderate | Refer to Section 1.6.2.3 | Moderate | | 4 | High |
| | | Negative | Local | Very short-term | Slight | Unlikely | High | Moderate | | | Very Low | 5 | High |

**Table 5: Impact assessment summary table for the Operational Phase.**

| Operational Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct Impacts | | | | | | | | | | | | | |
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation/ Management (Residual Impact/ Risk) | | |
| Inadequate maintenance and monitoring | Degradation of drainage lines | Negative | Local | Long-term | Substantial | Very likely | Moderate | Moderate | Refer to Section 1.6.3.1 | Moderate | | 3 | High |
| | | Negative | Site | Medium-term | Moderate | Unlikely | Moderate | Moderate | | | Low | 3 | Medium |
| Inadequate maintenance and monitoring | Alteration of the natural hydrological regime | Negative | Local | Long-term | Moderate | Very likely | High | Moderate | Refer to Section 1.6.3.2 | Low | | 4 | High |
| | | Negative | Local | Short-term | Moderate | Unlikely | High | Moderate | | | Low | 4 | Medium |

**Table 6: Impact assessment summary table for the Decommissioning Phase.**

| Decommissioning Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct Impacts | | | | | | | | | | | | | |
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation/ Management (Residual Impact/ Risk) | | |
| Inadequate rehabilitation | Degradation of drainage lines | Negative | Local | Permanent | Moderate | Very Likely | Low | Moderate | Refer to Section 1.6.5.1 | Low | | 4 | High |
| | | Negative | Local | Medium-term | Slight | Likely | Moderate | Moderate | | | Very Low | 4 | High |

| Decommissioning Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct Impacts | | | | | | | | | | | | | |
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation/ Management (Residual Impact/ Risk) | | |
| Removal of infrastructure | Impairment of water quality | Negative | Site | Permanent | Moderate | Very Likely | High | Moderate | Refer to Section 1.6.5.2 | Low | | 5 | Medium |
| | | Negative | Site | Short-term | Slight | Unlikely | High | Moderate | | | Very Low | 5 | Medium |

**Table 7: Cumulative impact assessment summary table.**

| Cumulative Impacts | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation/ Management (Residual Impact/ Risk) | | |
| Authorisation of Phase 1 | Proliferation of alien and invasive species | Negative | Local | Long-term | Moderate | Likely | Moderate | Moderate | N/A | Low | N/A | N/A | Low |
| Authorisation of Phase 1 | Erosion of drainage lines | Negative | Local | Long-term | Moderate | Likely | Moderate | Moderate | N/A | Low | N/A | N/A | Medium |

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# Geohydrological Assessment

## Scoping and Environmental Impact Assessment for the Proposed Development of the Phase 1 and Phase 2 Kuruman Wind Farm Facility, Kuruman, Northern Cape Province: SCOPING REPORT


*Report prepared for:*

CSIR – Environmental Management Services

P O Box 320

Stellenbosch

7600

*Report prepared by:*

Daniel Mulder, Julian Conrad and Neville Paxton

GEOSS – Geohydrological and Spatial Solutions International (Pty) Ltd

P.O. Box 12412

Die Boord, Stellenbosch, 7613

South Africa



19/04/2018

# SPECIALIST EXPERTISE

**CURRICULUM VITAE – Daniel Mulder**

**GENERAL**

| | |
|---|---|
| *Nationality:* | South African |
| *Profession:* | Geohydrologist |
| *Specialization:* | Groundwater exploration, regional development, monitoring and management, geohydrological impact assessment including GIS and Remote Sensing expertise. |
| *Position in firm:* | Geohydrologist at GEOSS - Geohydrological and Spatial Solutions International (Pty) Ltd |
| *Date commenced:* | 1$^{st}$ September 2018 |
| *Language skills:* | English (good – speaking, reading and writing)<br>Afrikaans (good - speaking, reading and writing). |

**KEY SKILLS**

- Groundwater exploration, development, monitoring and management.
- Arc GIS software (ESRI products)
- Proficient in working with regional groundwater development and management.

**RELEVANT EXPERIENCE**

- Numerous groundwater exploration, development, monitoring and management projects.
- Groundwater impact assessments

**EDUCATIONAL AND PROFESSIONAL STATUS**

**Qualifications**

| | |
|---|---|
| 2016 | BSc Hon –Hydrogeology; North West University, Potchefstroom Campus, South Africa |
| 2015 | BSc – Geology & Geography; North West University, Potchefstroom Campus, South Africa |

**Memberships**

- Ground Geological Society of South Africa (GSSA) / Groundwater Division of the Geological Society of South Africa

**EMPLOYMENT RECORD**

| | |
|---|---|
| September 2017 – present: | GEOSS (Geohydrological and Spatial Solutions International (Pty) Ltd |
| January 2017 – August 2017: | AGES (Africa Geo-Environmental Engineering and Science) (Pty) Ltd, Potchefstroom |

**CURRICULUM VITAE - Julian Edward Conrad**

**GENERAL**

| | |
|---|---|
| *Nationality:* | South African |
| *Profession:* | Geohydrologist |
| *Specialization:* | Groundwater exploration, development, management and monitoring and the application of spatial technologies for geohydrological assessment and management purposes |
| *Position in firm:* | Director & geohydrologist: GEOSS - Geohydrological and Spatial Solutions International (Pty) Ltd |
| *Language skills:* | English (mother tongue), Afrikaans (average). |

**Key skills**

- Project leadership and management for the delivery of contract projects on brief, budget and time.
- Groundwater Resource Directed Measures (RDM) projects, including Reserve determinations; Classification; and Resource Quality Objectives. Groundwater Catchment Management Strategies as well as groundwater Validation and Verification. Legal compliance of groundwater use.
- Groundwater management and monitoring – database design, development and analysis of groundwater level and quality data.
- Groundwater development - borehole drilling and test pumping supervision and analysis.
- Groundwater exploration - (aerial photo interpretation, resistivity, magnetic and EM34 geophysical surveys for borehole siting purposes)
- Specialization in Geographical Information Systems (GIS) for geohydrological application.

**Educational and professional status**
**Qualifications**
1995:M.Sc. (Hydrogeology and GIS), University of Rhode Island, United States of America
1985:B.Sc. (Hon) (Engineering geology), University of Natal, Durban, South Africa
1984: B.Sc. (Geology), University of Natal, Durban, South Africa.

**Courses**

| | |
|---|---|
| 2010 | Introduction to QGIS (GISSA) / Skills Presentation (Elsabé Daneel Productions cc) |
| 2006 | South African Groundwater Decision Tool (SAGDT) |
| 2004 | Fractured Rock Aquifer Assessment / 2001 Isotope Techniques in Catchment Management |
| 2000 | Groundwater Recharge |
| 1999 | Remote Sensing and Geohydrology / Applied 3D Groundwater Modelling (MODFLOW) |
| 1997 | Avenue Programming / 1995 ArcView (GIMS) |
| 1991 | Advanced training on Arc/Info (DWA&F) / 1990 Pump test analysis (IGS-UOFS). |

**Memberships**

- International Association of Hydrogeologists (IAH)
- Geological Society of South Africa (GSSA) / Groundwater Division of the Geological Society of South Africa
- Water Institute of South Africa (WISA)
- Geo-Information Society of South Africa (GISSA)
- South African Council for Natural Scientific Professions (SACNASP)

**EMPLOYMENT ECORD**

- 1 March 2001 – present: Founded GEOSS – a company specializing in geohydrology.

- 1 May 1990 – 28 Feb. 2001 Hydrogeologist with Environmentek, Groundwater Group, CSIR.
- Jan. 1986 – Dec. 1988 Geotechnical geologist with Rőssing Uranium Limited, Namibia.

**RELEVANT EXPERIENCE**

- 28 years' experience in geohydrology, including the development of the GRDM and Water Resources Classification methodologies. This includes work in Validation and Verification projects and the development of the groundwater component of Catchment Management Strategies.
- Numerous groundwater exploration; development; monitoring and management projects have been completed.
- Numerous Environmental Impact Assessment (EIA) projects have been completed, that have triggered groundwater studies, both at the Scoping and EIA phases.
- Project management of numerous groundwater projects and large projects that have included many sub-consultants and specialists, especially RDM studies.

PUBLICATIONS (DETAILS ON REQUEST).

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**CURRICULUM VITAE - Neville Paxton**

**GENERAL**

| | |
|---|---|
| *Nationality:* | South African |
| *Profession:* | Geohydrologist |
| *Specialization*: | Groundwater exploration, development, sampling and monitoring. |
| *Position in firm:* | Geohydrologist |
| *Year of birth & ID #:* | 1986 - 861228 5151 084 |
| *Language skills:* | Afrikaans (very good), English (mother tongue) |

**KEY SKILLS**

- Groundwater sampling, soil sampling, field measurements, borehole logging, data logging for groundwater monitoring, borehole depth and water level measurements, augering for piezometer installation, groundwater geophysics, yield test management and conducting hydrocensus studies.

**EDUCATIONAL AND PROFESSIONAL STATUS**

**Qualifications**

| | |
|---|---|
| 2014 | BSc (Hons) (Environmental & Engineering Geology- specialization: Hydrogeology) University of Pretoria |
| 2013 | BSc Bridging Course (Geology) University of Pretoria |
| 2009 | BSc (Geography) University of Pretoria |

**Memberships**

- Groundwater Division of the Geological Society of South Africa
- NICOLA - Network for Industrially Contaminated Land in Africa

**EMPLOYMENT RECORD**

- 5 January 2015 to present GEOSS, field assistance on Groundwater sampling and monitoring
- Mar 2014 – Dec 2014 Student geohydrologist at GCS (Groundwater Consulting Services)
- 2012 - 2014 University of Pretoria, GIS Assistant.

# SPECIALIST DECLARATION

I, **Julian E Conrad** as the appointed independent specialist, in terms of the 2014 EIA Regulations, hereby declare that I:

- I act as the independent specialist in this application;
- I 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;
- regard the information contained in this report as it relates to my specialist input/study to be true and correct, and do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the NEMA, the Environmental Impact Assessment Regulations, 2014 and any specific environmental management Act;
- 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 have no vested interest in the proposed activity proceeding;
- 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;
- I have ensured that information containing all relevant facts in respect of the specialist input/study was distributed or made available to interested and affected parties and the public and that participation by interested and affected parties was facilitated in such a manner that all interested and affected parties were provided with a reasonable opportunity to participate and to provide comments on the specialist input/study;
- I have ensured that the comments of all interested and affected parties on the specialist input/study were considered, recorded and submitted to the competent authority in respect of the application;
- all the particulars furnished by me in this specialist input/study are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

**Signature of the specialist**

**Name of company:** GEOSS - Geohydrological & Spatial Solutions International (Pty) Ltd.

**Professional Registration (including number):** SACNASP - 400159/05
**Date:** 06 March 2018

# LIST OF ABBREVIATIONS

| | |
|---|---|
| bh | Borehole |
| ch | collar height |
| EC | Electrical Conductivity |
| EIA | Environmental Impact Assessment |
| GEOSS | Geohydrological & Spatial Solutions International (Pty) Ltd. |
| GIS | Geographic Information System |
| ha | Hectare |
| L/s | liters per second |
| m | Meters |
| MAP | Mean Annual Precipitation |
| mbch | metres below collar height |
| mbgl | metres below ground level |
| mg/L | milligrams per litre |
| mm/a | millimetres per annum |
| mS/m | milliSiemens per meter |
| mV | milliVolts |
| NGA | National Groundwater Archive |
| ORP | Oxygen Reduction Potential |
| TDS | Total Dissolved Solids |
| temp | Temperature |
| WEF | Wind Energy Facility |
| WL | water level |
| WP | wind pump |
| WULA | Water Use License Application |

# GLOSSARY

| ***Definitions*** | |
|---|---|
| | |
| *Aquifer* | A geological formation that has structures or textures that hold water or permit appreciable water movement through them. |
| *Borehole* | includes a well, excavation, or any other artificially constructed or improved groundwater cavity which can be used for the purpose of intercepting, collecting or storing water from an aquifer; observing or collecting data and information on water in an aquifer; or recharging an aquifer [from National Water Act (Act No. 36 of 1998)]. |
| DRASTIC | An acronym for a groundwater vulnerability assessment methodology: D = depth to groundwater / R = recharge/ A = aquifer media type / S = soil type / T = topography / I = impact of the unsaturated zone / C = hydraulic conductivity. The methodology uses a rating and weighting approach and was developed by the Environmental Protection Agency (USA) |
| *Fractured aquifer* | Fissured and fractured bedrock resulting from decompression and/or tectonic action. Groundwater occurs predominantly within fissures and fractures. |
| *Groundwater* | Water found in the subsurface in the saturated zone below the water table or piezometric surface i.e. the water table marks the upper surface of groundwater systems. |
| *Intergranular aquifer* | Generally unconsolidated but occasionally semi-consolidated aquifers. Groundwater occurs within intergranular interstices in porous medium. Typically occur as alluvial deposits along river terraces. |
| *Intergranular and fractured aquifers* | Largely medium to coarse grained granite, weathered to varying thicknesses, with groundwater contained in intergranular interstices in the saturated zone, and in jointed and occasionally fractured bedrock. |
| *Karst aquifer* | Generally known as a bedrock having water bearing properties due to the formation of dissolution cavities. Usually highly soluble rock, in which the landforms are formed primarily by dissolution/precipitation of the rock. |
| *Vulnerability* | The tendency or likelihood for contaminants to reach a specified position in the ground-water system after introduction at some location above the uppermost aquifer (National Research Council, 1993). |

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# TABLES AND FIGURES

# Geohydrological Assessment

This chapter presents the findings of the Geohydrological Assessment that was prepared by Mr. Daniel Mulder, Mr. Julian Conrad and Mr. Neville Paxton (Geohydrological and Spatial Solutions International (PTY) Ltd (GEOSS)) as part of the Environmental Impact Assessment (EIA) for the proposed Kuruman Wind Energy Facility (WEF) project within the Northern Cape Province, South Africa.

## 1.1 INTRODUCTION AND METHODOLOGY

### 1.1.1 Scope and Objectives

The project Applicant intends to make use of boreholes to source groundwater (if available and if suitable) for the Construction and Operation phases of the project. During the construction phase (anticipated to be 18 months, with the highest use during the first 6 months) an average of 409,640 liters will be used per week (i.e. 0.7 L/s continuous use). The water is planned to be used for the construction of turbine bases, roads and for dust suppression. Groundwater will be stored in a suitable container or reservoir tanks (or similar) during the operational phase.

The overall scope of this Geohydrological Assessment is to determine the impact of the proposed project on the surrounding geohydrology and any geohydrological features, as well as to recommend mitigation measures to reduce the significance of potential negative impacts.

One of the objectives of this Geohydrological Assessment is to confirm whether the groundwater is in fact sufficient and suitable for use (i.e. in terms of quantity (i.e. borehole yields) and quality). This study is therefore aimed at providing a clear indication of groundwater availability and suitability from existing boreholes. The outcome of this study is also to recommend whether pipelines are required for the transfer of water from the boreholes to the site.

For this specialist study, a desktop study was conducted based on existing maps and reports of the geology and geohydrology of the study area. Groundwater data, including groundwater levels and groundwater quality data, was obtained from the National Groundwater Archive (NGA) for the area surrounding the proposed study site. This was followed by a detailed field work component for completion of the Geohydrological Assessment.

#### *1.1.2 Terms of Reference*

The Scope of Work is based on the following broad Terms of Reference, which have been specified for this specialist study on groundwater (i.e. this Geohydrological Assessment):

- Identify significant features or disturbances within the proposed project area and define any environmental risks in terms of geohydrology and the proposed project infrastructure;
- Conduct a desktop study and describe the existing environment in terms of geohydrology (including hydrogeological characterization of aquifers types, sensitivity and vulnerability), and groundwater (quality, quantity, use, potential for industrial or domestic use) in the area surrounding the proposed development;
- Conduct a on site assessment to determine the location of any boreholes and to collect groundwater samples (where possible) to ascertain the water quality;
- Develop a sensitivity map indicating the presence of sensitive areas, “no-go” areas, setbacks/buffers, as well as the identification of red flags or risks associated with geohydrological impacts;
- Highlight any gaps in baseline data and provide a description of confidence levels;
- Assess potential direct, indirect and cumulative impacts resulting from the construction, operational and decommissioning phases of the proposed project on the surrounding geohydrology;
- Identify any relevant legal and permit requirements that may be required in terms of groundwater/geohydrological impacts likely to be generated as a result of the proposed project;
- Provide mitigation, monitoring and management measures in order to minimize any negative geohydrological impacts and enhance the positive impacts;
- Assess the consequences and significance of potential groundwater contamination; and
- If necessary, recommend groundwater management and monitoring for the proposed site.

#### *1.1.3 Approach and Methodology*

The specialist study was completed as follows:

Task 1: A desktop study and relevant literature review pertaining to the site was completed. Borehole data was obtained from the NGA and a project GIS was established.

Task 2: A site visit was completed on 23, 24 and 25 January 2018. The field work included a hydrocensus, which extended to 1 km from the outline of the property boundaries. The objective of this task was three-fold:

- To locate the NGA boreholes and complete a borehole assessment.
- To locate boreholes not yet recorded on the NGA and complete assessments.
- To collect anecdotal information from the land owners in the area as well as from discussions with other experienced geohydrologists. It was essential to collect as much information as possible relating to groundwater quality, groundwater levels and borehole yields.

Task 3: All the data obtained from the desktop review and fieldwork was assessed and the impacts relating to the site evaluated.

Task 4: The findings of the investigation, potential risks, any potential mitigation measures, monitoring requirements as well as relevant recommendations have been included in a report. The impacts were assessed based on the methodology indicated in Chapter 4 of the EIA Report.

### 1.1.4 *Assumptions and Limitations*

The following assumptions and limitations apply:

- The geohydrological assessment is based on previous studies and available literature for the study area. Regional scale Geographic Information System (GIS) datasets based on 1: 500 000 and previous hydrogeological work completed has been assumed to be correct.
- The main limitation is that no drill records or yield test data exists for production or wind pump boreholes to clarify yields and geological logs.
- The acquisition of accurate groundwater levels proved to be difficult, therefore data was limited to information obtained from local parties. Nonetheless these limitations have not negatively impacted the conclusions of the project.

The information obtained was sufficient to provide comprehensive geohydrological characterization of the regional setting.

### 1.1.5 *Source of Information*

The geological information has been obtained from geological maps produced by the Council for Geoscience and Slabbert et al, (1999).

The groundwater related data and maps were obtained from the 1: 500 000 Hydrogeological map series of the Republic of South Africa (Department of Water Affairs and Forestry (DWAF), 2002).

The report compiled by GEOSS (2016) as part of a contamination risk assessment for a proposed tailings dam south-west of the study area within a similar geological setting was also reviewed and relevant information was used in this report, where applicable.

From the field visit (completed on the 23, 24 and 25 January 2018) the existing data sets were assessed and new data sourced. Data was collected on borehole/wind pump positions; depth to groundwater levels; and field chemistry (i.e. pH; temperature; electrical conductivity (EC); total dissolved solids (TDS); salinity and oxygen reduction potential (ORP)). The field data obtained from the site visit was useful as it enabled the assessment of the more regional existing data sets and provides valuable insights into the geohydrology of the area. Where possible groundwater was sampled and submitted for inorganic chemical analysis to a SANAS accredited laboratory (Bemlab) in the Western Cape. The chemistry analysis has been classified according to the SANS241-1: Standards for Drinking Water (2015).

## 1.2 APPLICABLE LEGISLATION AND PERMIT REQUIREMENTS

### *1.2.1 The National Water Act (NWA)*

The National Water Act (1998) is administered by the Department of Water and Sanitation (DWS) and is the main legislation for managing water resources in South Africa. The purpose of the NWA is to provide a framework for the equitable allocation and sustainable management of water resources. Both surface and groundwater sources are redefined by the Act as national resources which cannot be owned by any individual, and rights to which are not automatically coupled to land rights, but for which prospective users must apply for authorization and register as users. The National Water Act also provides for measures to prevent, control and remedy the pollution of surface and groundwater sources.

In terms of Section 21 of the National Water Act (NWA) the proposed development of the Kuruman WEF will entail the following water use activities:

- Section 21(a) - taking water from a water resource;
- Section 21(b) - storing water;
- Section 21(e) - engaging in a controlled activity identified as such in section 37(1) or declared under section 38(1);
- Section 21(g) - disposing of waste in a manner which may detrimentally impact on a water resource; and
- Section 21(j) - removing, discharging or disposing of water found underground if it is necessary for the efficient continuation of an activity or for the safety of people.

### *1.2.2 National Environment Management: Waste Management Act [NEM:WA] (No. 39 of 2004)*

The Act is the product of the National Waste Management Strategy as well as the White Paper on Integrated Pollution and Waste Management. It sets the framework for integrated waste management for the entire country. Future policies and legislation will need to follow its provisions and as such it will become a key law. The Act gives legal effect to the waste management hierarchy and the Minister has the right to set waste minimization norms and targets. Importantly the Act aims to ensure the minimizing of natural resources and hence promotes sustainable practices in the waste management arena. It therefore promotes and enforces improved prevention of pollution and ecological degradation.

## 1.3 DESCRIPTION OF THE AFFECTED ENVIRONMENT

### *1.3.1 Introduction*

The nearest town to the centroid of the study area is Kuruman, approximately 10 km to the north-east **Map 1 – APPENDIX A**. The Kuruman landscape is arid with red wind-transported sands occurring widely along plains with ironstone mountains stretching from north to south.

### *1.3.2 Rainfall and temperature*

Kuruman is located in a summer rainfall district. The town receives approximately 266 mm of rain per year. It typically receives the lowest rainfall (0 mm) in June (winter months) and the highest (52 mm) in February (summer months). During summer months the regional setting has high evaporation rates which decreases during the winter months. There is a clear correlation between the rainfall and the evaporation of the area **(Figure 1)**. This is true as precipitation occurs as late afternoon thunder showers (sometimes hail storms), due to evaporation during long hot summer days.

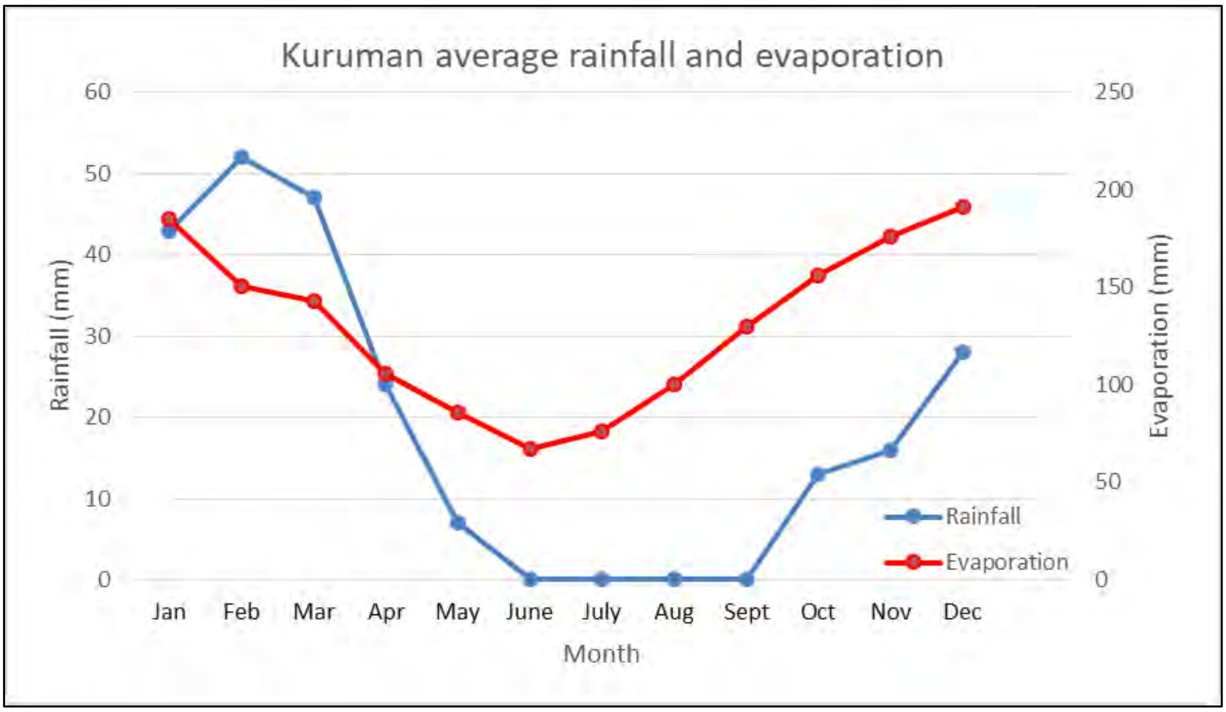


**Figure 1: Long Term Rainfall for Kuruman (1950 -2000). (Source: Cape Farm Mapper; https://gis.elsenburg.com/apps/cfm/)**

The monthly distribution of average monthly minimum and maximum temperatures (Figure 2) shows that the temperatures range from the lowest 1.3 °C in July to 31.1 °C in January. The region is the coldest during the July where previously temperatures reaching sub-zero have been recorded.

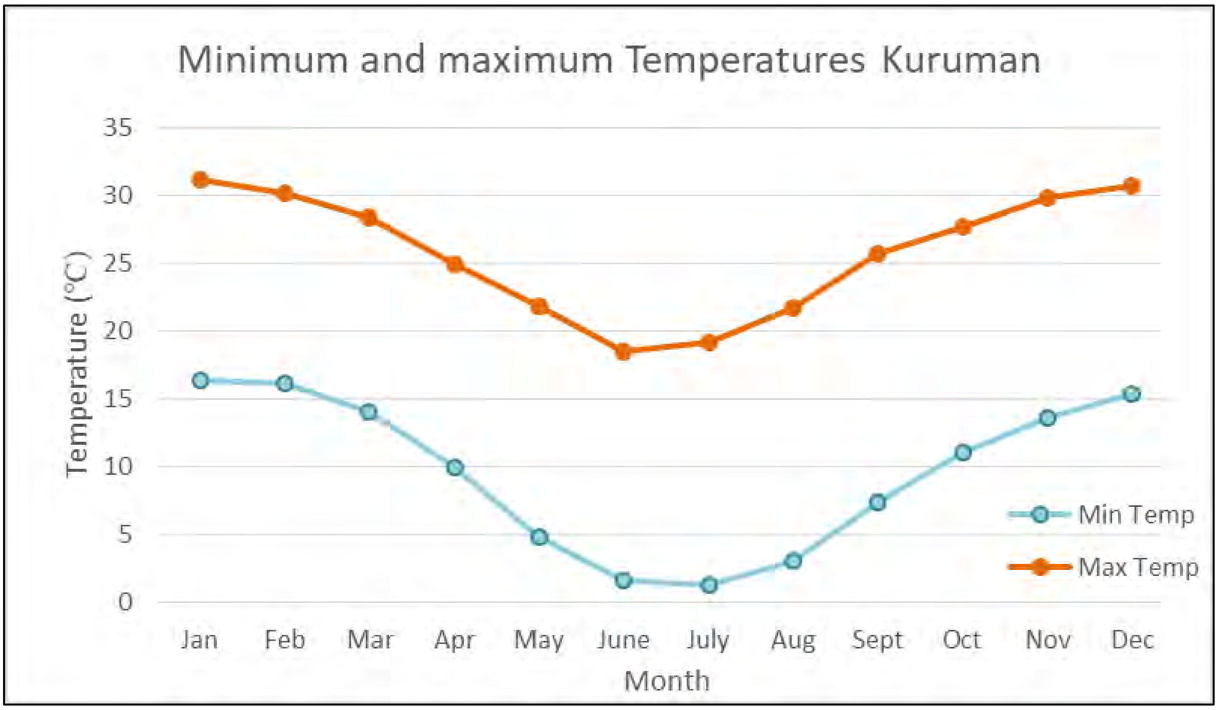


**Figure 2: Long term rainfall for Kuruman (1950 – 2000). (Source: Cape Farm Mapper; https://gis.elsenburg.com/apps/cfm/)**

### *1.3.3 Regional Geology*

The Geological Survey of South Africa (now the Council for Geoscience) has mapped the area at 1:250 000 scale (2722 - Kuruman). The geological setting is shown in **Map 2 (Appendix A)**. The main geology of the area is listed in **Table 1**.

**Table 1: Geological formation within the study area**

| Symbol | Lithology | Group | Formation |
|---|---|---|---|
| **Qs** | Red to flesh coloured windblown sand | N/A Quaternary deposits | |
| ▽△△ | Alluvium | N/A Quaternary deposits | |
| **Vo** | Amygloidal andesitic lava with interbeds of tuff, agglomerate, chert and red jasper | Olifantshoek | Ongeluk |
| **Vm** | Diamicite banded jasper, siltstone, mudstone, sandstone, grit and dolomite with chert | N/A | Gamagara |
| **Vad** | Yellow-brown banded or massive jaspilite with crocidolite; flat-pebble conglomerate | Griquatown | Danielskuil |
| **Vak** | Banded ironstone with subordinate amphibolite; crocidolite; ferruginised brecciated banded ironstone (blink-klip breccia. At base in places; brown jaspilite and chert. | | Kuruman |
| **Vgd** | Fine and coarse- grained dolomite, chert and dolomitic limestone with prominent inter-bedded chert, limestone and banded ironstone; chert breccia at top (siliceous breccia or manganese marker) | Campbell | Ghaapplato |

The stratigraphic sequence across the regional setting consists of sedimentary deposits and five distinct geological formations. The geological formations are overlain by Quaternary Age deposits which comprises of younger red to flesh coloured windblown sands and older rubble alluvial material. This is underlain by the volcanic rocks consisting of amygloidal andesitic lava from the Ongeluk Formation and the older Gamagara Formation, which consists of diamictite banded jasper that outcrops towards the west of the study area.
The Kuruman WEF is directly underlain by the Quaternary age alluvial material in the lower lying areas. This overlays the yellow brown ironstone (jaspilite) from the Danielskuil Formation and banded ironstone (subordinate amphibolite; crocidolite; ferruginised brecciated banded ironstone) of the Kuruman Formation. These geological units are part of the Griquatown group and form the distinctive north-south trending ironstone mountain ranges of the larger Kuruman area. This is underlain by fine and coarse - grained dolomite with interbedded chert of Ghaaplato Formation part of the Campbell Group.

The proposed Kuruman WEF (Phase 1 and Phase 2) is located in an area where there are two faults trending form north north west to south south west, where one splays towards the southeast. These faults are prominent in the Danielskuil and Kuruman Formations resulting in fracturing of the bedrock (Map 2, Appendix A). Historically the larger Kuruman area has been mined for iron ore and asbestos. The mining of iron ore, a still ongoing process occurs towards the south west of the study area (Kathu), where large quantities of iron ore is being mined from rocks of the Griquatown Group. The dewatering of these mines, significantly impact the local aquifer (close to mining activity) in terms of dropping groundwater levels. Previous mining of asbestos from rocks of the Griquatown Group in the proximity of the study area possessing a potential environmental contamination risk (air and water). Although all of these mines have been shut down, there might be an ongoing risk of contamination through exposure to remaining mine dumps. Regional Hydrogeology
According to the 1:500 000 scale groundwater map of Kuruman (2723) the northern portion of the study area hosts a karst aquifer with an average borehole yield of 0.1 – 0.5 L/s and ~5 L/s for the

most northern portion. The central portion of the study area hosts a fractured aquifer with an average borehole yield of 0.1 – 0.5 L/s. The most southern portion has average yields of 2 – 5 L/s **(Map 3 Appendix A).**

Groundwater quality is expected to be good with greatest recharge occurring in the mountainous areas. The regional 1:500 000 groundwater quality maps **(Map 4, Appendix A)** indicate that the study area's groundwater quality is classified as "good" with an associated electrical conductivity (EC) of 0 – 70 mS/m.

Both these classifications are based on regional datasets, and therefore only provide an indication of conditions to be expected.

#### *1.3.4 <u>Results of the Field Study</u>*

An initial desktop hydrocensus was completed using the NGA and a 1 km buffer search radius. The NGA database indicated no boreholes are present within the study area.

Despite the findings of the desktop hydrocensus using the NGA data, during the field hydrocensus (conducted on 23, 24 and 25 January 2018), the locations of fourteen boreholes were identified within the study area. Details of the hydrocensus boreholes are summarized in **Table 2** and shown on **Map 5 (Appendix. A**). The site visit was requested to only be conducted on the farms for the proposed development of the Kuruman WEF (Phase 1 and Phase 2). Although sites were visited on the surrounding farms, this was limited to three boreholes as access proved to be difficult. Despite this limitation, sufficient information regarding the regional geohydrological setting could be obtained from the site visit. Communication with the landowners of the respective farms proved to be valuable regarding groundwater information of the area and the past years. Groundwater conditions vary quite significantly over the extent of the study area, specifically with regard to water levels and yields. The groundwater quality seems to remain quite constant. Consultation with the land owners is always important for site specific data and anecdotal information. Mr Albutt (the occupier of farms reserved for Phase 1) was very helpful in this regard. As it has been stated there is limited seasonal variation (as explained in section 1.3.1) and thus limited variation in natural groundwater levels occurs. Groundwater quality is also reported to remain constant. Concerns were raised regarding possible asbestos contamination in groundwater. However it has been stated that prospecting has been done on large areas (farm portions for Phase A) and found there is no sufficient resource for mining purposes. The groundwater information can therefore be gathered irrespective of the season.

Seven of the fourteen boreholes were equipped with submersible pumps, running on either solar power or electricity and were in use for different pumping periods on a daily basis. Three were equipped with mono pumps and in use, mostly for livestock water provision. The three boreholes equipped with wind pumps are not in use. One borehole was found to be previously equipped with a wind pump but is now blocked. Groundwater levels and field chemistry were measured where possible. Most boreholes were equipped and in use, resulting in access difficulties preventing the measurement of water levels. Samples of the groundwater were collected and submitted for testing to characterize the groundwater of the area. The regional groundwater quality is classified as "good" with an associated Electrical Conductivity (EC) of 0 – 70 mS/m. All samples analysed had an EC < 70 mS/m. Borehole HBH10 had the highest EC (with a laboratory EC of 68 mS/m (the field EC measured was higher)).

Boreholes located in the fractured aquifer, which forms the greater portion of the study area have similar yields, where boreholes located in the Karst aquifer environment are highly variable yields.

**Table 2: Hydrocensus boreholes (24 – 26 January 2018)**

| BH_ID | Latitude (DD, WGS84) | Longitude (DD, WGS84) | WL (mbgl) | pH | EC (mS/m) | TDS (mg/L) | Temp (°C) | Yield (L/s) | Status | Comments |
|---|---|---|---|---|---|---|---|---|---|---|
| HBH1 | -27,53495° | 23,33459° | - | - | - | - | - | - | Not in Use | Wind pump. No access point for WL |
| HBH2 | -27,53500° | 23,33444° | - | - | - | - | - | - | Not in Use | Wind pump. No access point for WL |
| HBH3 | -27,53503° | 23,33483° | 87,1 | - | - | - | - | - | Not in Use | Wind pump. |
| HBH4 | -27,50562° | 23,40556° | - | 8,38 | 31,6 | 202 | 21 | - | In Use | Submersible pump equipped. |
| HBH5 | -27,50587° | 23,40571° | 14,37 | - | - | - | - | - | In Use | Submersible pump equipped. |
| HBH6 | -27,50251° | 23,40132° | 31 | 7,61 | 42,1 | 282 | 23,4 | - | In Use | Submersible pump equipped. |
| HBH7 | -27,49538° | 23,39873° | 31,2 | 8,03 | 21,9 | 140 | 25,6 | ~30 | In Use | Submersible pump equipped. |
| HBH8 | -27,52362° | 23,35946° | - | 7,42 | 16,9 | 112 | 23,8 | 4,5 | In Use | Submersible pump equipped, solar power. |
| HBH9 | -27,54420° | 23,37337° | - | 7,43 | 9 | 48,2 | 22,3 | 0,8 | In Use | Submersible pump equipped, solar power. |
| HBH10 | -27,57643° | 23,37623° | - | 7,92 | 90,6 | 50,1 | 23,7 | 0,2 | In Use | Submersible, pump equipped, solar power. BH depth ~ 240 m |
| HBH11 | -27,65011° | 23,40659° | - | 8,36 | 20,7 | 157 | 22,2 | - | In Use | Old Mono. BH depth ~120 m |
| HBH12 | -27,60462° | 23,39927° | - | 7,41 | 18,13 | 124 | 22,3 | - | In Use | Old Mono. BH depth ~180 m |
| HBH13 | -27,62941° | 23,43610° | - | - | - | - | - | - | Not in Use | Unequipped and blocked |
| HBH14 | -27,62883° | 23,44548° | - | 7,5 | 16,2 | 111,1 | 22,3 | - | In Use | Equipped, Old mono. |

HBH = hydrocensus borehole
WL = water level
m = metres
Temp = temperature
EC = electrical conductivity

TDS = total dissolved solids
mbgl = metres below ground level
mg/L = milligrams per litre
mS/m = milliSiemens per metre

#### *1.3.5 Geohydrological Characterisation (Aquifer Vulnerability)*

The new proposed site for the Kuruman Wind Energy Facility (Phase 1 and Phase 2) hosts both a fractured and karst aquifer that possess water bearing properties due to fracturing and dissolution cavities within the rocks respectively. Due to the secondary porosity of these aquifers contaminants may be transmitted at a higher rate, especially for the Karst environment. Several methods have been developed to classify an aquifer's vulnerability. The DRASTIC method has been applied to this study.

#### *1.3.6 Aquifer Vulnerability (DRASTIC)*

Groundwater vulnerability can be defined as the "tendency for contaminants to reach a specified position in the groundwater system after introduction at some location" (Vrba and Zaporozec, 1994). Key physical parameters which determine groundwater vulnerability include lithology, thickness, effective porosity, groundwater flow direction, age and residence time of water. Generally, the residence time of a contaminant in groundwater and the distance that it travels in the aquifer are considered important measures of vulnerability.

There are two main groups of methods for assessing groundwater vulnerability, namely:

- Index or subjective rating methods,
- Statistical or process-based methods.

The "index or subjective rating method" is relatively easily addressed within a GIS framework. The cell-based layer approach facilitates the assignment of ratings and weights and rapid achievement of a final result of relative groundwater vulnerability. This approach also means that the algorithm can easily be repeated as new or more detailed data sets are obtained or if ratings and weightings need to be adjusted as a result of a sensitivity analysis for example. The most well-known "index or subjective rating method" is the "DRASTIC" method (Aller et al., 1987). The DRASTIC method of Aller et al. (1987) uses the typical overlay technique often applied in subjective rating methods. The DRASTIC approach is based on four major assumptions:

- The contaminant is introduced at ground surface
- The contaminant is flushed into the groundwater by precipitation
- The contaminant has the mobility of water
- The area evaluated using DRASTIC is 40.5 ha or larger.

The implication of these assumptions is that DRASTIC should not be used for contaminants that do not have the mobility of water or for point assessment (such as storage tanks). In addition, groundwater conditions in South Africa are dominated by secondary/fracture-controlled flow conditions. The DRASTIC method does not consider local preferential flow paths of fractured aquifer systems particularly well. The DRASTIC method takes into account the following factors:

| | | | |
|---|---|---|---|
| D | = | depth to groundwater | (5) |
| R | = | recharge | (4) |
| A | = | aquifer media | (3) |
| S | = | soil type | (2) |
| T | = | topography | (1) |
| I | = | impact of the vadose zone | (5) |
| C | = | conductivity (hydraulic) | (3) |

The number indicated in parenthesis at the end of each factor description is the weighting or relative importance at that factor.

Groundwater vulnerability maps developed using the DRASTIC method have been produced in many parts of the world. In spite of the widespread use of DRASTIC, the effectiveness of the method has been met with mixed success due to hydrogeological heterogeneity and the many assumptions that need to be made in determining groundwater vulnerability. In addition, the use of a generic vulnerability map only gives a broad indication of relative vulnerability and in many instances detailed scale, contaminant specific vulnerability assessments are required. From the assumptions outlined by Aller et al. (1987), DRASTIC can only be applied to non-point source pollution, as DRASTIC is inaccurate in point source assessments.

As part of the Groundwater Resources Assessment Project (DWAF, 2005), numerous data sets were produced and this enabled the mapping of groundwater vulnerability at the national scale on a 1 km by 1 km cell (pixel) size basis (Conrad and Munch, 2007). This national scale map indicates the relative vulnerability of groundwater resources throughout the country and provides project planners a clear idea of what level of groundwater protection is required.

A national scale map of groundwater vulnerability has been completed for South Africa (DWAF, 2005). The groundwater vulnerability for the study area is shown in **Map 6 - Appendix A**. The larger portion of the study area has a low groundwater vulnerability, where the vulnerability is classified as high towards the north-eastern portion of the study area to surface based contamination. Assuming the regional groundwater flow direction is towards the north east the vulnerability rating for the northern portion of the Kuruman WEF is high, where it expected to be low for the central and southern sections.

## 1.4 DESCRIPTION OF PROJECT ASPECTS RELEVANT TO THE GEOHYDROLOGICAL ASSESSMENT

As mentioned above, the Project Applicant intends to make use of existing boreholes to source groundwater (if available and if suitable) for the construction phase and operational phase. As a result, water pipelines may need to be constructed in order to transfer groundwater from existing boreholes to the proposed solar facility. In addition, groundwater will need to be stored on site in suitable containers or reservoir tanks during the construction and operational phases.

Generally, groundwater can be impacted negatively in two manners, namely:

- Over-abstraction (where groundwater abstraction exceeds recharge rates) which can result in the alteration of groundwater flow directions and gradients. Dropping water levels within a Karst aquifer may result in dolines or sinkholes.
- Quality deterioration (i.e. from anthropogenic activities negatively impacting groundwater quality).

For the proposed development of the Kuruman WEF; (Phase 1 and Phase 2), the use of groundwater is feasible. This recommendation is based on the current groundwater usage.

There is currently limited groundwater abstraction taking place in relation to the size of the study area and the average expected (based on regional datasets). Groundwater is mostly used for drinking purposes and for livestock. The low rainfall and high evapotranspiration rates within the study area are a limiting factor for the recharge of the aquifer underlying the study area.

The project Applicant intends to make use of boreholes to source groundwater (if available and if suitable) for the Construction and Operation phases of the project. During the Construction phase (anticipated 18 months, with the highest use during the first 6 months) an average of 409,640 liters per week will be abstracted; use includes the construction of turbine bases, roads and dust suppression, thereafter approximately 100 L/week during the Operational phase. Groundwater will be stored in suitable container or reservoir tanks (or similar) during the operational phase.

For the Construction phase of the proposed plant 400, 000 – 500, 000 litres is required per week (~70 000 L/day), thereafter decreasing to approximately 100 liters per week (14 L/day). This equates to 0.8 L/s – 1 L/s (pumped continuously) for the Construction phase per day, where < 0.1 L/s is required to meet the weekly water demand during the operational phase. This demand (Construction and Operational phase) can possibly be met by using the existing boreholes in agreement with current land owners. If the landowners have authorization/water use license for agricultural activities (e.g. irrigation); a legal agreement can be met, after consulting DWS and the land owner for the use of water for construction, operational and decommissioning phases of the development. If no such agreements can be formulated then additional boreholes can be drilled, yield tested, followed by a WULA. Groundwater abstracted will need to be stored in water tanks on site. In this regard, there will be generally about 5 to 10 x 10,000 litre tanks per site. Therefore, pipelines need to be constructed from the boreholes to the respective water storage sites.

The proposed project (Kuruman WEF; Phase 1 and Phase 2) and its associated activities can potentially impact the groundwater quality of the aquifer, although the probability of this occurring is low. The primary groundwater quality alteration concern is the high vulnerability area towards the north-eastern portion (Phase 1) despite the low potential. Possible contamination sources include contaminated storm water outflows, vehicle oil spillage and fuel leakage during the construction of temporary labour accommodation.

## 1.5 IDENTIFICATION OF IMPACTS

### 1.5.1 ***Key Issues Identified During the Scoping Phase***

The potential groundwater issues identified during the Scoping Phase of this EIA Process included:

- High groundwater vulnerability towards the north-east to surface based contaminants as a result of construction and operational activities (especially stormwater runoff) as part of Phase 1 of the Kuruman WEF.

### 1.5.2 ***Identification of Potential Impacts***

The following potential impacts (stated in no particular order) of the proposed project activities on groundwater and geohydrological resources are predicted:

- Impact on the groundwater as a result of potential spillages during the construction of storage facilities and temporary labour accommodation;
- Potential impact of increased storm water outflows during the construction and operational phase; and
- Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages during the construction, operational and decommissioning phases.

Any construction activities such as the excavation and installation of foundations and piling (narrow diameter holes for foundation purposes) will have minimal to no impact on the groundwater of the site or region, as the groundwater level is approximately 15 – 30 mbgl.
The potential impacts identified during the EIA Phase are:

### 1.5.3 ***Construction Phase***

- Potential impact on the groundwater as a result of the construction of storage yards and temporary labour accommodation;
- Potential impact of increased storm water outflows; and
- Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages.

### 1.5.4 ***Operational Phase***

- Potential impact of increased storm water outflows; and
- Potential impact on groundwater quality as a result of accidental oil spillages or fuel leakages.

### 1.5.5 ***Decommissioning Phase***

- Potential impact on groundwater quality as a result of accidental oil spillages and fuel leakages.

### 1.5.6 ***Cumulative impacts***

- Long term surface source pollution may lead to the formation of sinkholes in the Karst aquifer towards the north east of the study area, assuming the general groundwater flow direction is towards the north east.
-

# 1.6 ASSESSMENT OF IMPACTS AND IDENTIFICATION OF MANAGEMENT ACTIONS

### *1.6.1 Groundwater impact as a result of the construction storage yards and labour accommodation*

These impacts are only applicable during the construction phase and possibly the decommissioning phase; however, they are not applicable to the operational phase. The potential impact for the decommissioning phase will likely be negligible.

The status of this impact is rated as neutral with a site specific spatial extent and a short-term duration (i.e. the impact and risk will be experienced for less than 1 year). The consequence and probability of the impact is respectively rated as slight and extremely unlikely. The reversibility of the impact is rated as high and the irreplaceability is rated as low. The significance of the impact without the implementation of mitigation measures is rated as very low.

During the construction phase all reasonable measures must be taken to prevent soil and groundwater contamination. The main source of contamination will be from construction vehicles leaking oil or fuel, fuel storage and spillages may occur whilst filling vehicles and machinery. During the construction phase, vehicles must be regularly serviced and maintained to check and ensure there are no leakages.

With effective implementation of these prevention / mitigation actions, the impact of the proposed project on groundwater is predicted to be of very low significance (even without the implementation of mitigation measures).

### *1.6.2 Groundwater impact as a result of increased Storm Water Outflows (Construction and Operational Phase)*

The groundwater within the study area is wide spread in occurrence. The large recharge area and low rainfall percentage for the regional setting should be less susceptible to pollution from storm water outflows. This is due to spontaneous rainfall events that would likely flow as surface runoff and follow the natural surface flow regime. Thus, it is expected that storm water requires no filtration or treatment as outflows pose no significant risk to groundwater contamination.

The status of this impact is rated as neutral with a site specific spatial extent and short-term duration (i.e. the impact and risk will be experienced for less than 1 year). The consequence and probability of the impact is respectively rated as slight and extremely unlikely. The reversibility of the impact is rated as high and the irreplaceability is rated as low. The significance of the impact without the implementation of mitigation measures is rated as very low.

The impact of the proposed project on groundwater as a consequence of the presence of the storm water is predicted to be very low significance (with or without the implementation of mitigation measures).

### *1.6.3 Potential Impact on Groundwater Quality as a result of Accidental Oil Spillages or Fuel Leakages (Construction, Operational and Decommissioning Phases)*

If there is an accidental oil spill or fuel leakage during the construction, operational or decommissioning phases, then the low permeability of the unsaturated zone will provide significant attenuation capacity. The status of this impact (for the construction, operation and decommissioning phases) is rated as neutral with a site specific spatial extent and short-term duration (i.e. the impact and risk will be experienced for less than 1 year). The consequence and probability of the impact are respectively rated as slight and extremely unlikely. The reversibility of the impact is rated as high and the irreplaceability is rated as low. The significance of the impact without the implementation of mitigation measures is rated as very low.

A precautionary approach must be implemented and reasonable measures should be undertaken to prevent oil spillages and fuel leakages from occurring. During the construction phase, vehicles must be regularly serviced and maintained to check and ensure there are no leakages. Any engines that stand in one place for an excessive length of time must have drip trays. Diesel fuel storage tanks should be above ground on an impermeable surface in a bunded area. Construction vehicles and equipment should also be refueled on an impermeable surface. A designated area should be established at the construction site camp for this purpose, if off-site refueling is not possible. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes.

With effective implementation of these prevention / mitigation actions, the impact of the project on groundwater as a consequence of the presence of accidental oil spillages and fuel leakages is predicted to be of very low significance.

#### *1.6.4 Cumulative Impacts*

The utilization of groundwater as a source of water supply for the proposed project is feasible, as the geological setting has potential for further groundwater development, yielding good quality water. The fractured bedrock and the Karst aquifer in the lower lying areas towards the north-east should receive sufficient recharge from the north-south trending mountains.

Therefore, it is a necessity that potential impacts during the construction and operational phases are taken in account for, as well as precautionary actions and proper implementation of the mitigation measures. It is recommended that the water quality of boreholes downgradient (located in the Karst environment) on the Kuruman WEF is monitored on a regular basis (e.g. quarterly).

## 1.7 IMPACT ASSESSMENT SUMMARY

The following tables provide a summary of the impact the proposed wind farm will play on groundwater within the study area.

**Table 3: Impact assessment summary table for the Construction Phase**

| Construction Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct and Indirect Impacts | | | | | | | | | | | | | |
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation/ Management (Residual Impact/ Risk) | | |
| Construction of storage and labour accommodation yards | Groundwater contamination | Neutral | Site | Short-term | Slight | Unlikely | High | Low | All reasonable measures must be taken to prevent soil and groundwater contamination.<br><br>Vehicles to be correctly serviced | Low | Very low | 5 | High |
| Stormwater outflows | Groundwater contamination | Neutral | Site | Short-term | Slight | Unlikely | High | Low | All reasonable measures must be taken to prevent soil, storm water outflows, and groundwater contamination | Very low | Very low | 5 | High |

| Construction Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct and indirect Impacts | | | | | | | | | | | | | |
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation / Management (Residual Impact/ Risk) | | |
| Accidental oil spillage / fuel leakage | Groundwater contamination | Neutral | Site | Short - term | Slight | Extremely unlikely | High | Low | Vehicles must be regularly serviced and maintained to check and ensure there are no leakages. Any engines that stand in one place for an excessive length of time must have drip trays. Diesel fuel storage tanks should be above ground on an impermeable surface in a bunded area. Construction vehicles and equipment should also be refuelled on an impermeable surface. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes | Low | Very low | 5 | High |

**Table 4: Impact assessment summary table for the Operational Phase**

| Operational Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct and Indirect Impacts | | | | | | | | | | | | | |
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation/ Management (Residual Impact/ Risk) | | |
| Storm water outflow impact on groundwater | Groundwater contamination | Neutral | Site | Medium-term | Slight | Very Unlikely | High | Low | All reasonable measures must be taken to prevent soil, storm water outflows and groundwater contamination | Low | Very low | 5 | High |

| Operational Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct and Indirect Impacts | | | | | | | | | | | | | |
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation/ Management (Residual Impact/ Risk) | | |
| Accidental oil spillage / fuel leakage | Groundwater contamination | Neutral | Site | Short- term | Slight | Extremely unlikely | High | Low | Vehicles must be regularly serviced and maintained to check and ensure there are no leakages. Any engines that stand in one place for an excessive length of time must have drip trays. Diesel fuel storage tanks should be above ground on an impermeable surface in a bunded area. Vehicles and equipment should also be refuelled on an impermeable surface. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes | Low | Very low | 5 | High |

**Table 5: Impact assessment summary table for the Decommissioning Phase**

| Decommissioning Phase | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Direct Impacts | | | | | | | | | | | | | |
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation/ Management (Residual Impact/ Risk) | | |
| Accidental oil spillage / fuel leakage | Groundwater contamination | Neutral | Site | Short- term | Slight | Extremely unlikely | High | Low | Vehicles must be regularly serviced and maintained to check and ensure there are no leakages. Any engines that stand in one place for an excessive length of time must have drip trays. Diesel fuel storage tanks should be above ground on an impermeable surface in a bunded area. Vehicles and equipment should also be refuelled on an impermeable surface. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes | Low | Very low | 5 | High |

**Table 6: Cumulative impact assessment summary table**

| Cumulative Impacts | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Aspect/ Impact Pathway | Nature of Potential Impact/ Risk | Status | Spatial Extent | Duration | Consequence | Probability | Reversibility of Impact | Irreplaceability | Potential Mitigation Measures | Significance of Impact and Risk | | Ranking of Residual Impact/ Risk | Confidence Level |
| | | | | | | | | | | Without Mitigation/ Management | With Mitigation/ Management (Residual Impact/ Risk) | | |
| Accidental oil spillage / fuel leakage | Groundwater contamination | Neutral | Site | Short- term | Slight | Extremely unlikely | High | Low | Vehicles must be regularly serviced and maintained to check and ensure there are no leakages. Any engines that stand in one place for an excessive length of time must have drip trays. Diesel fuel storage tanks should be above ground on an impermeable surface in a bunded area. Vehicles and equipment should also be refuelled on an impermeable surface. If spillages occur, they should be contained and removed as rapidly as possible, with correct disposal procedures of the spilled material. Proof of disposal (waste disposal slips or waybills) should be obtained and retained on file for auditing purposes | Low | Very low | 5 | High |
| Storm water outflow impact on groundwater | Groundwater contamination | Neutral | Site | Medium-term | Slight | Very Unlikely | High | Low | All reasonable measures must be taken to prevent soil, storm water outflows and groundwater contamination | Low | Very low | 5 | High |

## 1.8 INPUT TO THE ENVIRONMENTAL MANAGEMENT PROGRAM

Certain measures need to be put in place to ensure that the local and regional aquifers' groundwater does not get contaminated. The following aspects are considered to be applicable to the Kuruman WEF:

- All vehicles and other equipment (generators etc.) must be regularly serviced to ensure they do not spill oil. Vehicles should be refueled on paved (impervious) areas, optimally off-site. If liquid product is being transported it must be ensured this does not spill during transit.
- Emergency measures and plans must be put in place and rehearsed in order to prepare for accidental spillage.
- Diesel fuel storage tanks must be above ground in a bunded area.
- Engines that stand in one place for an excessive length of time must have drip trays.
- Vehicle and washing areas must also be on paved surfaces and the by-products removed to an evaporative storage area or a hazardous waste disposal site (if the material is hazardous).

## 1.9 CONCLUSION AND RECOMMENDATIONS

Groundwater on site and in the local setting is suitable for human consumption and general use in terms of quality. Groundwater use is currently minimal within the study area with primary use being small scale stock watering and domestic use. The study area is located in a geological setting that has potential for groundwater development due to fracturing for a large portion of the proposed Phase 1 and the whole of Phase 2 of the Kuruman WEF. A small portion of Phase 1 consists of a Karst aquifer environment that has its water bearing properties due to dissolution cavities. The fractured and Karst aquifers may be impacted as the transmissivity is expected to be high in both environments. This will only occur once contamination of the aquifers takes place, which is highly unlikely.

The geohydrological assessment is based on incremental impacts with in the local project area. Considering the regional geohydrological setting the potential for groundwater vulnerability is low. The rating is however high for a small portion towards the north-east of Phase 1 proposed area. Despite the low rating for the larger portion of the study area, proper mitigation practice should be implemented to prevent/minimize negative impacts on the local aquifers (quality and quantity). Special attention should be given to point source pollution potential as the general groundwater flow regime is towards the north-east.

With regards to infrastructure development the proposed Kuruman WEF (Phase 1 and Phase 2) should have little impact, should proper mitigation practices be implemented. No specific conditions are required for inclusion in the environmental authorisation.

Groundwater is considered to be a viable source of water for the construction phase and operational phases of the development of both the proposed Phase 1 and Phase 2 of the Kuruman WEF. This is based on information obtained during the site assessment which includes; groundwater quality data and current groundwater usage in the study area.

The Project Applicant aims to use groundwater as a source, therefore, it is recommended that the existing boreholes (and possibly newly drilled holes) are yield tested according to the SANS 10299_4-2003 guideline for borehole testing to assess their sustainable yield. In addition, a Water Use License will be required for the use of the groundwater. Considering the water requirements for the proposed Kuruman WEF, it is expected that groundwater will have to be used in the construction, operational and decommissioning phases. All boreholes being used during the above mentioned phases should be equipped with monitoring infrastructure, including an observation pipe (closed at the bottom); for manual or automated water level monitoring. Installation of a timer set to pump according to recommendations made from yield tests, installation of sampling tap and flow volume meter.

In terms of geohydrological characterisation the proposed activity can be authorised. No specific measures are applicable other than all measures to prevent soil and groundwater contamination, especially by hydrocarbons, must implemented. It is recommended that groundwater quality is monitored and compared to the baseline samples submitted to the laboratory, initially on a quarterly basis (especially for the construction phase), thereafter it can be re-evaluated annually (especially for the construction phase) and adjusted accordingly. Considering the risk of historical asbestos mining within the regional setting it is recommended that a baseline sample is taken from boreholes to be used during all the phases of the Kuruman WEF, thereafter monitored and compared annually.

## 1.10 REFERENCES


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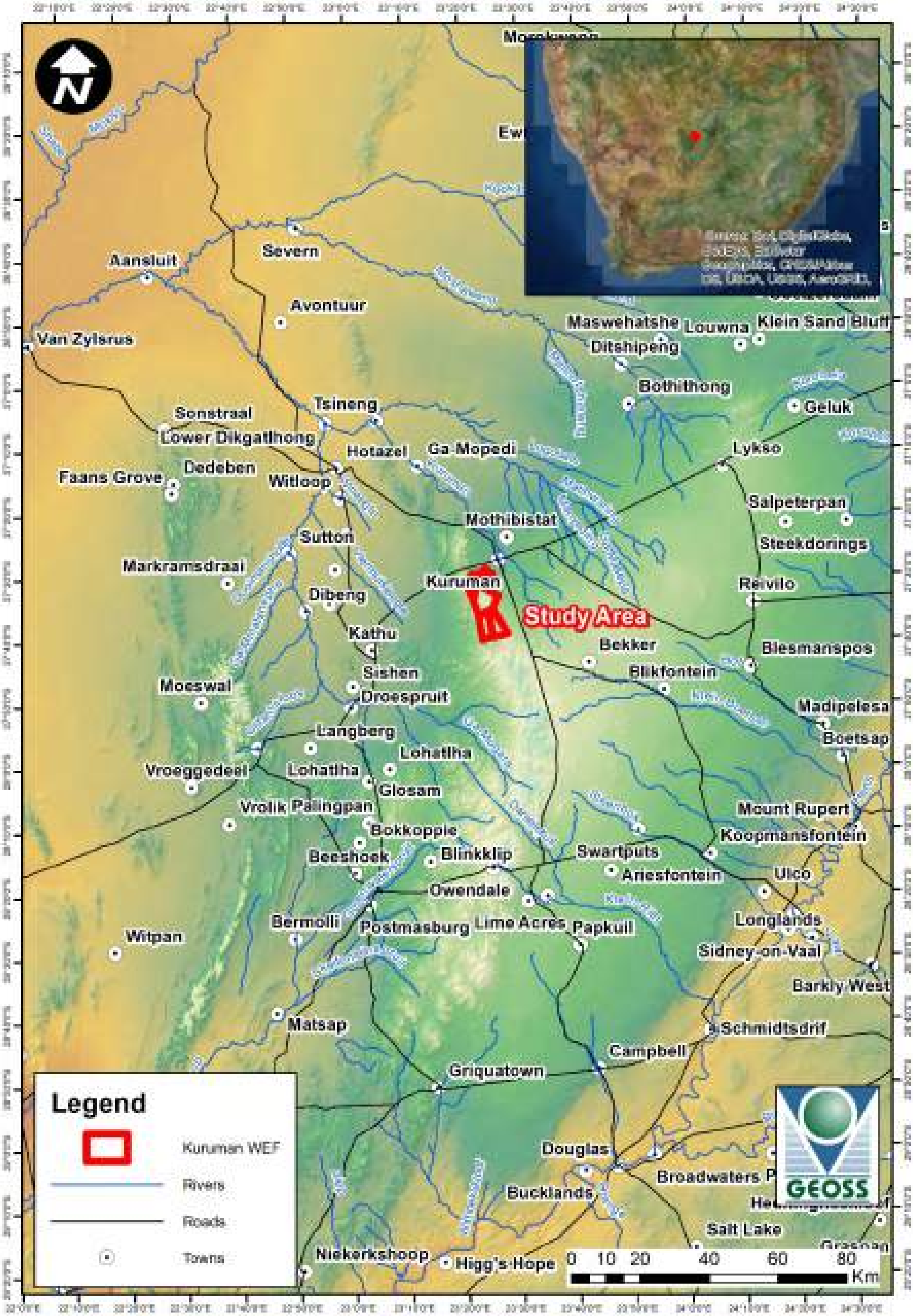
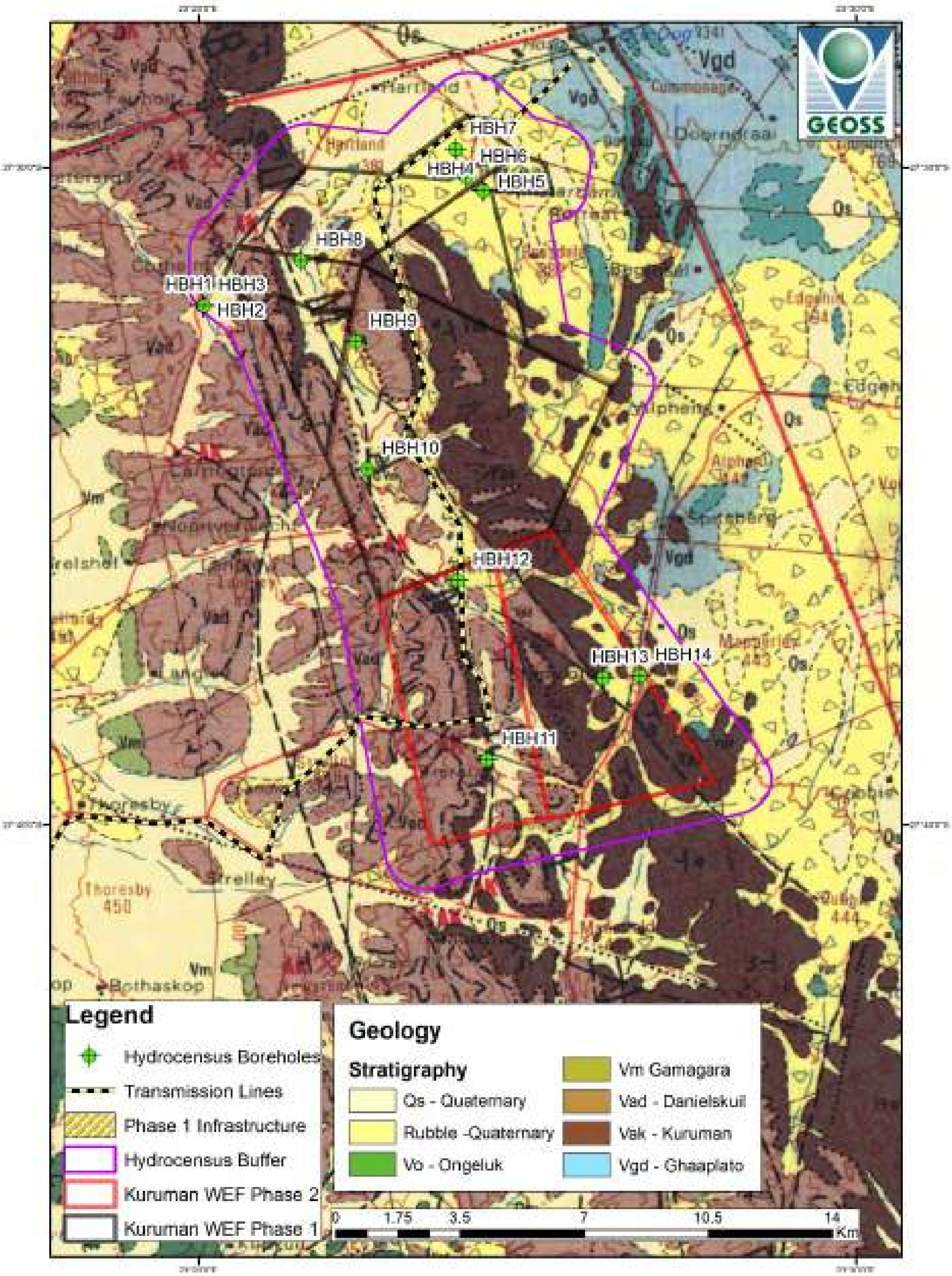
## 1.11 APPENDICES

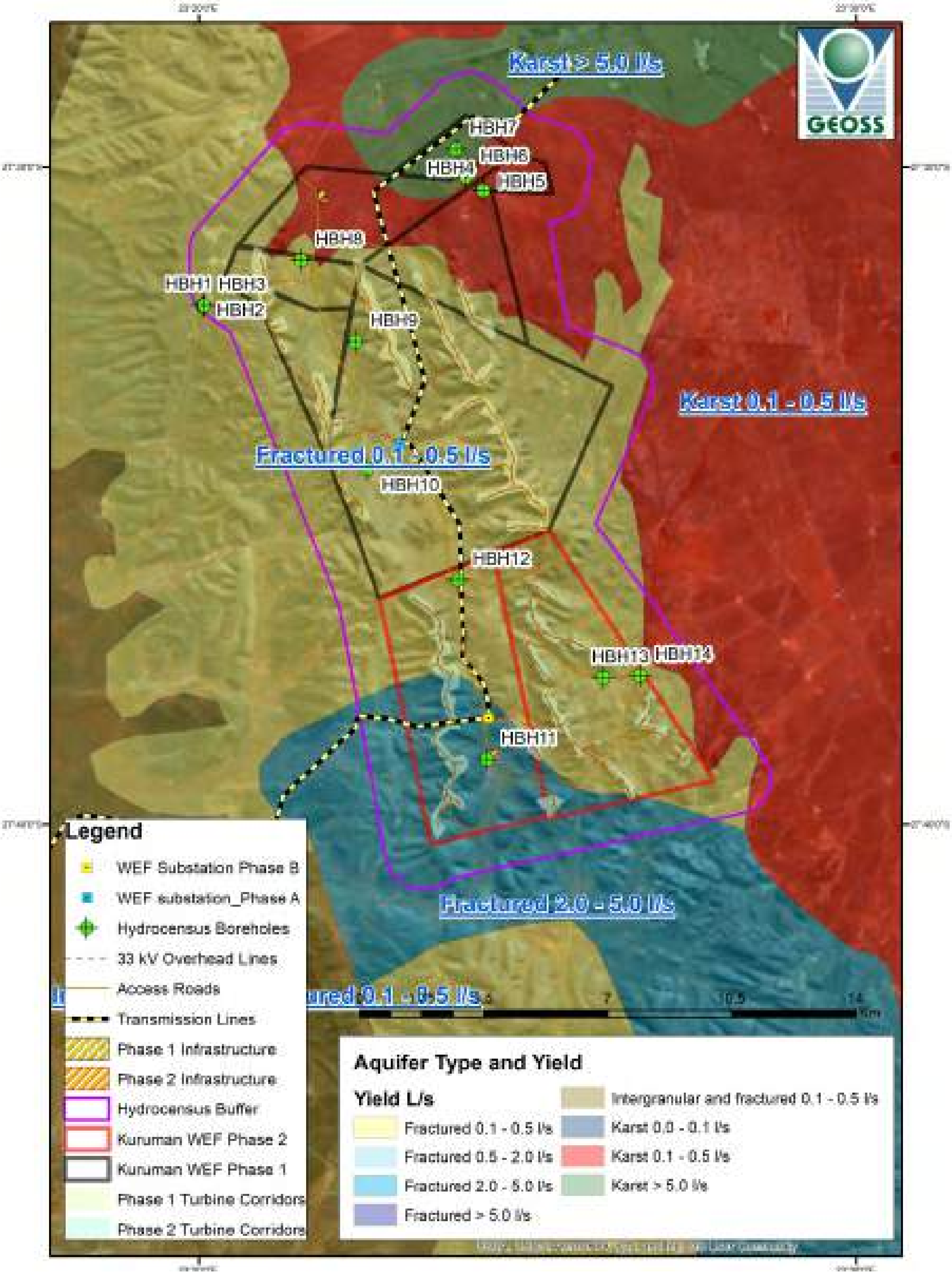
#### *1.11.1 APPENDIX A: Maps*



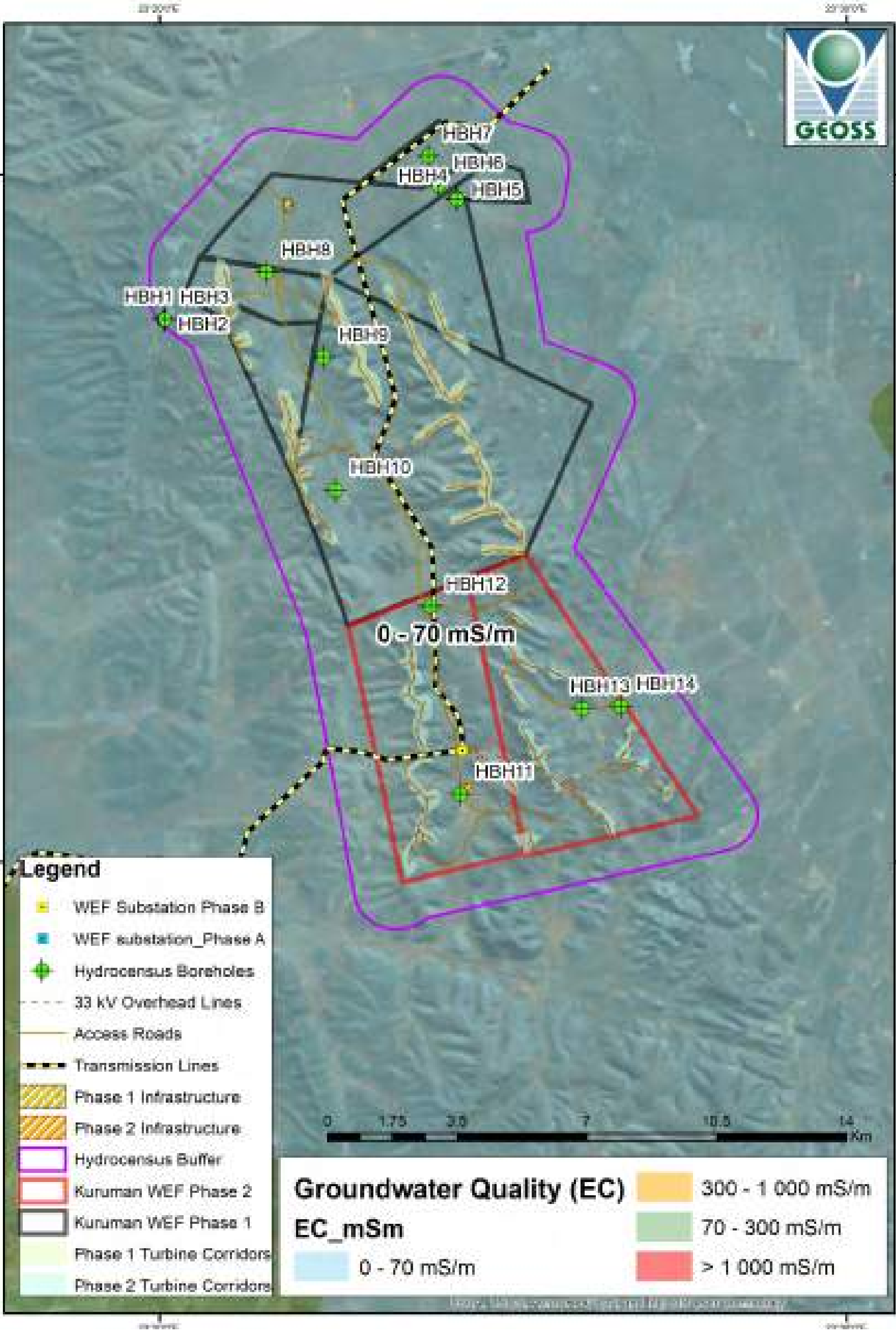

**Map 1: Locality map of the study area within a regional setting**




**Map 2: Geological setting of the study area (CGS map: 1:250 000 scale 2922– Prieska).**




**Map 3: Hydrogeological setting of the study area: Aquifer type and yield (DWAF, 2722 Prieska).**




**Map 4: Regional groundwater quality (Department of Water Affairs groundwater map: 1:500 000 scale 2722 - Kuruman)**