MAY 2021

TSHEDZA 1 PRE PROJECT DEVELOPMENT (PTY) LTD PHOTOVOLTAIC SOLAR ENERGY FACILITY

AVIFAUNAL IMPACT ASSESSMENT REPORT

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DOCUMENT GUIDE

In terms of the NEMA 2014 EIA Regulations contained in GN R982 of 04 December 2014 (as amended in 2017) all specialist studies must comply with Appendix 6 of the NEMA 2014 EIA Regulations (GN R982 of 04 December 2014).

Legal Requirement		Relevant Section in Specialist study
(1)	A specialist report prepared in terms of these Regulations must contain-	
(a)	details of-	
	(i) the specialist who prepared the report; and	Professional Experience
	(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	Professional Experience and Appendix 4
(b)	a declaration that the specialist is independent in a form as may be specified by the competent authority;	Declaration of Independence
(c)	an indication of the scope of, and the purpose for which, the report was prepared;	Section 1 Section 3.1
(cA)	an indication of the quality and age of base data used for the specialist report;	Section 3.3
(cB)	a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	Section 4 Section 5 Section 9 Section 10
(d)	the duration, date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Section 3.2 Section 3.4
(e)	a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	Section 3.2 Section 5.1.6
(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;	Section 4 - 10
(g)	an identification of any areas to be avoided, including buffers;	Section 7
(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;	Section 7
(i)	a description of any assumptions made and any uncertainties or gaps in knowledge;	Section 3.4

(j)	a description of the findings and potential implications of such findings on the impact of the proposed activity or activities;	Section 12
(k)	any mitigation measures for inclusion in the EMPr;	Section 9 Section 11
(l)	any conditions for inclusion in the environmental authorisation;	Section 11 Section 12
(m)	any monitoring requirements for inclusion in the EMPr or environmental authorisation;	Section 11
(n)	a reasoned opinion	Section 12
	whether the proposed activity, activities or portions thereof should be authorised;	Section 12
	regarding the acceptability of the proposed activity or activities; and	Section 12
	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;	Section 12
(o)	a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not Applicable
(p)	a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Section 5.1.7
(q)	any other information requested by the competent authority.	Not Applicable

PROFESSIONAL EXPERIENCE

Ms. Megan Diamond Megan completed a Bachelor of Science degree in Environmental Management from the University of South Africa and has been involved in conservation for 20 years. She has 15 years' worth of experience in the field of bird interactions with electrical infrastructure and during this time has completed impact assessments for over 140 projects. During her tenure at the Endangered Wildlife Trust's Wildlife & Energy Programme and the Programme's primary project (i.e. the Eskom-EWT Strategic Partnership) from 2006 to 2013, Megan was responsible for assisting the energy industry and the national utility in minimising the negative impacts, associated with the construction and operation of electrical infrastructure, on wildlife through the provision of strategic guidance, risk and impact assessments, training and research. Megan (SACNASP Environmental Science Registration number 300022/14) currently owns and manages *Feathers Environmental Services* and is tasked with providing guidance to industry through the development of best practice procedures and avifaunal specialist studies for various developments including renewable energy facilities, power lines, power stations and substation infrastructure in addition to railway infrastructure and residential properties within South Africa and elsewhere within Africa. Megan has attended and presented at several conferences and facilitated workshops, as a subject expert, since 2007. Megan has authored and co-authored several academic papers, research reports and energy industry related guidelines, including the *BirdLife South Africa/ Endangered Wildlife Trust best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa* and the *Avian Wind Farm Sensitivity Map for South Africa* (2015), and played an instrumental role in facilitating the endorsement of these two products by the South African Wind Energy Association (SAWEA), IAIAsa (International Association for Impact Assessment South Africa) and Eskom. She chaired the Birds and Wind Energy Specialist Group in South Africa (2011/2012) and the IUCN/SSC Crane Specialist Group's Crane and Powerline Network (2013-2015), a working group comprised of subject matter experts from across the world, working in partnership to share lessons, develop capacity, pool resources, and accelerate collective learning towards finding innovative solutions to mitigate this impact on threatened crane populations. She is currently a member of the IUCN Stork, Ibis and Spoonbill Specialist Group and the Eskom-EWT Strategic Partnership Ludwig's Bustard Working Group.

DECLARATION OF INDEPENDENCE

I, Megan Diamond, in my capacity as a specialist consultant, hereby declare that I:

- Act as an independent specialist to Environmental Management Assistance (Pty) Ltd for this project.
- Do not have any personal or financial interest in the project except for financial compensation for specialist investigations completed in a professional capacity as specified by the Amendment to Environmental Impact Assessment Regulations, 2017.
- Will not be affected by the outcome of the environmental process, of which this report forms part of.
- Do not have any influence over the decisions made by the governing authorities.
- Do not object to or endorse the proposed developments, but aim to present facts and our best scientific and professional opinion with regard to the impacts of the development.
- Undertake to disclose to the relevant authorities any information that has or may have the potential to influence its decision or the objectivity of any report, plan, or document required in terms of the Amendment to Environmental Impact Assessment Regulations, 2017.

INDEMNITY

- This avifaunal impact assessment report is based on survey and assessment techniques which are limited by time and budgetary constraints relevant to the type and level of investigation undertaken.
- This report is based on a desktop investigation using the available information and data related to the site to be affected and a two-day summer site visit to the study area on 8 and 9 February 2021. No long-term investigation or monitoring has been conducted.
- The Precautionary Principle has been applied throughout this investigation.
- The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information at the time of study.
- Additional information may become known or available during a later stage of the process for which no allowance could have been made at the time of this report.
- The specialist investigator reserves the right to modify this report, recommendations and conclusions at any stage should additional information become available.
- Information, recommendations and conclusions in this report cannot be applied to any other area without proper investigation.
- This report, in its entirety or any portion thereof, may not be altered in any manner or form or for any purpose without the specific and written consent of the specialist investigator as specified above.
- Acceptance of this report, in any physical or digital form, serves to confirm acknowledgment of these terms and liabilities.

27 May 2021

EXECUTIVE SUMMARY

In order to demonstrate commitment to sustainable development and a pledge to move towards a cleaner energy future Tshedza 1 Pre Project Development (Pty) Ltd (hereinafter referred to as Tshedza) proposes to construct a Photovoltaic solar energy facility to supply power to the existing Ergo Mining (Pty) Ltd Brakpan Plant, a wholly owned subsidiary of DRD Gold Ltd. The identified site is situated on Ergo Mining owned land adjacent to the Withok Estates Agricultural Holdings and Witpoort Estates Agricultural Holdings areas of Brakpan within the City of Ekurhuleni Metropolitan Municipality, Gauteng Province.

The proposed study area is considered to have a MEDIUM Animal Species Theme Sensitivity and a HIGH Avian Theme Sensitivity, as a result of habitat that may support African Grass Owl *Tyto capensis* and the presence of wetland areas. A site sensitivity verification was conducted through the use of both a desktop analysis and an on-site inspection, conducted on 8 and 9 February 2021. The desktop analysis and on-site inspection revealed that the area demarcated as potential African Grass Owl habitat, occurs within a rehabilitated mine area and light industrial zone. The natural habitat in this area is highly fragmented and subject to significant disturbance and therefore unlikely to support African Grass Owl. The desktop analysis and on-site inspection of the proposed power line servitude proposes a LOW sensitivity rating for the proposed study area. Bird data analysis supports this premise, with no African Grass Owl observations in the study area or within the much broader area (comprised of nine pentad grid cells) during the SABAP2 survey period.

A total of 287 bird species have been recorded within the relevant pentads during the SABAP2 atlassing period to date. The presence of these species in the broader area provides an indication of the diversity of species that could potentially occur within the areas earmarked for the proposed Solar Energy Facility (SEF) and its associated overhead power line, particularly where pockets of natural vegetation/habitats persist. Of the 287 species, 14 of these are considered to be of regional conservation concern. An additional five species are endemic to South Africa, nine are near endemic species and a further 22 species that are endemic to southern Africa. The White Stork *Ciconia ciconia*, which is not listed, but is protected internationally under the *Bonn Convention on Migratory Species* has also been recorded in the study area.

It is important to note that Red List species have been recorded in low numbers, with less than 20 individual birds being recorded over the fourteen-year survey period. Lanner Falcon *Falco biarmicus* is the only Red List species recorded in the single pentad within which the proposed SEF development is located. The low report rates can be attributed to fairly high levels of disturbance and habitat loss associated with the surrounding mining and industrial practices which has undoubtedly displaced many of the naturally occurring species, that under optimum conditions, would inhabit these areas. Although this report focuses on Red List species, since the impacts associated with the construction and operation of the proposed SEF and its associated overhead power line are likely to be more biologically significant for these species, the impact on non-Red List species

is also assessed, albeit in less detail. Furthermore, Red List species can often be used as surrogate species for the others in terms of impacts and the necessary mitigation.

The site visit produced a combined list of 40 species, covering both the study and surrounding area. No Red List species were observed during the site visit. Most observations were of small passerine species that are common to this area. Each of these species has the potential to be displaced by the proposed SEF and its associated power line as a result of habitat transformation and disturbance. However, these species have persisted despite existing disturbance within the study area. This resilience, coupled with the fact that similar habitat is available throughout the broader area, means that the displacement impact will not be of regional or national significance. In addition, no raptor nests or other possible breeding sites were noted during the site survey.

The study area is located within the Grassland Biome and is comprised entirely of the Soweto Highveld Grassland vegetation type. The proposed study area has experienced a fairly substantial degree of transformation as a result of agricultural practices. While pockets of natural habitat persist, the fragmented nature of this habitat and the levels of existing disturbance, preclude an abundance of Red List species within the proposed development area. Investigation of the proposed study area and its immediate surrounds revealed the presence of rivers, wetlands, surface waterbodies, exotic tree stands and built-up areas.

In conclusion, the habitat within which the proposed study area is located is low to moderately sensitive from a potential bird impact perspective. In recent years, anthropogenic impacts, mostly in the form of mining and urbanisation have largely transformed the landscape resulting in a negative impact on avifaunal diversity and abundance with the study area. This is reflected in the low reporting rates for priority species, which may also indicate that levels of disturbance are high. The construction of the proposed PV SEF (up to 20MW) will result in impacts of LOW significance to birds occurring in the vicinity of the new infrastructure, which can be reduced to negligible levels through the application of mitigation measures. Given the presence of existing habitat degradation and disturbance, it is anticipated that the proposed PV SEF can be constructed within the Preferred Layout site and the 22kV overhead power line can be constructed along the Preferred Route Alignment with acceptable levels of impact on the resident avifauna subject to the following recommendations:

* Construction activities (i.e. all staff, vehicle and machinery) should be restricted to the immediate footprint of the infrastructure.
* Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of avifaunal species.
* Care should be taken not to introduce or propagate alien plant species/weeds during construction.
* Mitigation is complex at electrical structures since there are many factors that contribute to collisions with overhead power lines and electrocutions on the power line hardware. It is therefore recommended that

mitigation be applied reactively once the SEF and power line are operational, only if a significant problem is detected. Monitoring of this infrastructure for bird fatalities should be built into the operational environmental management programme for the proposed SEF.

* A carefully considered surface water/drainage management plan must be developed for the site including attention to the use of environmentally friendly cleaning chemicals.
* Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
* In addition to this, the normal suite of environmental good practices should be applied, such as ensuring strict control of staff, vehicles and machinery on site and limiting the creation of new roads as far as possible.

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1. INTRODUCTION

1.1 Background

The National Development Plan 2030 (NDP), implemented in 2013, identifies the need for various sectors to invest in a network of infrastructure that will support the country's medium- and long-term economic and social objectives (https://ipp-projects.co.za). Not surprisingly, energy infrastructure is a critical component of the NDP. Energy infrastructure plays an important role in fortifying economic activity and growth across the country and therefore the development of this infrastructure needs to be robust and extensive enough to meet industrial, commercial and household needs. South Africa's Renewable Energy potential is significant and together with a national commitment to transition to a low carbon economy, 26 030MW of the 2019 Integrated Resources Plan target of newly generated power are expected to be from renewable energy sources (https://ipp-projects.co.za). The Renewable Energy Independent Power Producer (REIPP) Procurement Programme was established to stimulate the renewable industry by contributing to the 26 030MW target and to ensure socio-economic and environmentally sustainable growth within South Africa.

In order to demonstrate commitment to sustainable development and a pledge to move towards a cleaner energy future Tshedza 1 Pre Project Development (Pty) Ltd (hereinafter referred to as Tshedza) proposes to construct a Photovoltaic (PV) solar energy facility (SEF) to supply power to the existing Ergo Mining (Pty) Ltd Brakpan Plant, a wholly owned subsidiary of DRD Gold Ltd. The identified site is situated on Ergo Mining owned land adjacent to the Withok Estates Agricultural Holdings and Witpoort Estates Agricultural Holdings areas of Brakpan within the City of Ekurhuleni Metropolitan Municipality, Gauteng Province (FIGURE 1). To date, renewable energy sources have been under-utilised within the Ekurhuleni Municipality and as a result, the Energy and Climate Change Strategy (ECCS) set a target of 10% of all energy used in Ekurhuleni to be supplied by clean energy resources by 2020. The two mining facilities i.e., Ergo Mining Brakpan Plant and the Brakpan/Withok Tailings Dam facility, are currently supplied with electricity by Eskom via the existing grid infrastructure. The proposed PV SEF will generate electricity with battery storage, to integrate with the existing Eskom grid to supply the Ergo Mining Brakpan Plant and the Brakpan/Withok Tailings Facility. The generated electricity will be utilised when there is an interruption to Eskom's supply in energy.

The National Environmental Management Act (NEMA) (Act 107 of 1998) requires that an impact assessment be conducted for any development which could have a significant effect on the environment, with the objective to identify, predict and evaluate the actual and potential impacts of these activities on ecological systems; identify alternatives; and provide recommendations for mitigation to minimize the negative impacts. In order to meet the Basic Assessment requirements as outlined in the 2014 National Environmental Management Act (No 107 of 1998) Regulations GNR 983 and GNR 985, as amended in 2017, Tshedza require detailed specialist studies that will document any potential fatal flaws, the impacts of the project and recommend measures to manage (maximise positive and minimise negative) and monitor those impacts. Tshedza has appointed

Environmental Management Assistance (Pty) Ltd as independent environmental assessment practitioners to manage the Basic Assessment process for the proposed developments. Feathers Environmental Services was subsequently appointed to compile a specialist avifaunal assessment report (based on a desktop review and a site visit conducted over a two-day period) which uses a set methodology and various data sets (discussed elsewhere) to determine which avian species regularly occur within the study area, the availability of bird micro habitats (i.e. avifaunal sensitive areas), the possible impacts of the proposed development and their significance and the provision of recommendations for the mitigation of the anticipated impacts. In general terms, the impacts that could be associated with a project of this nature include: displacement of birds as a result of habitat loss and disturbance associated with the construction and operation of the proposed PV SEF Project (up to 20MW); barrier effects; direct mortality as a result of collisions with the PV panels, electrocutions within the on-site substation; and nesting or other utilisation of the PV SEFs.

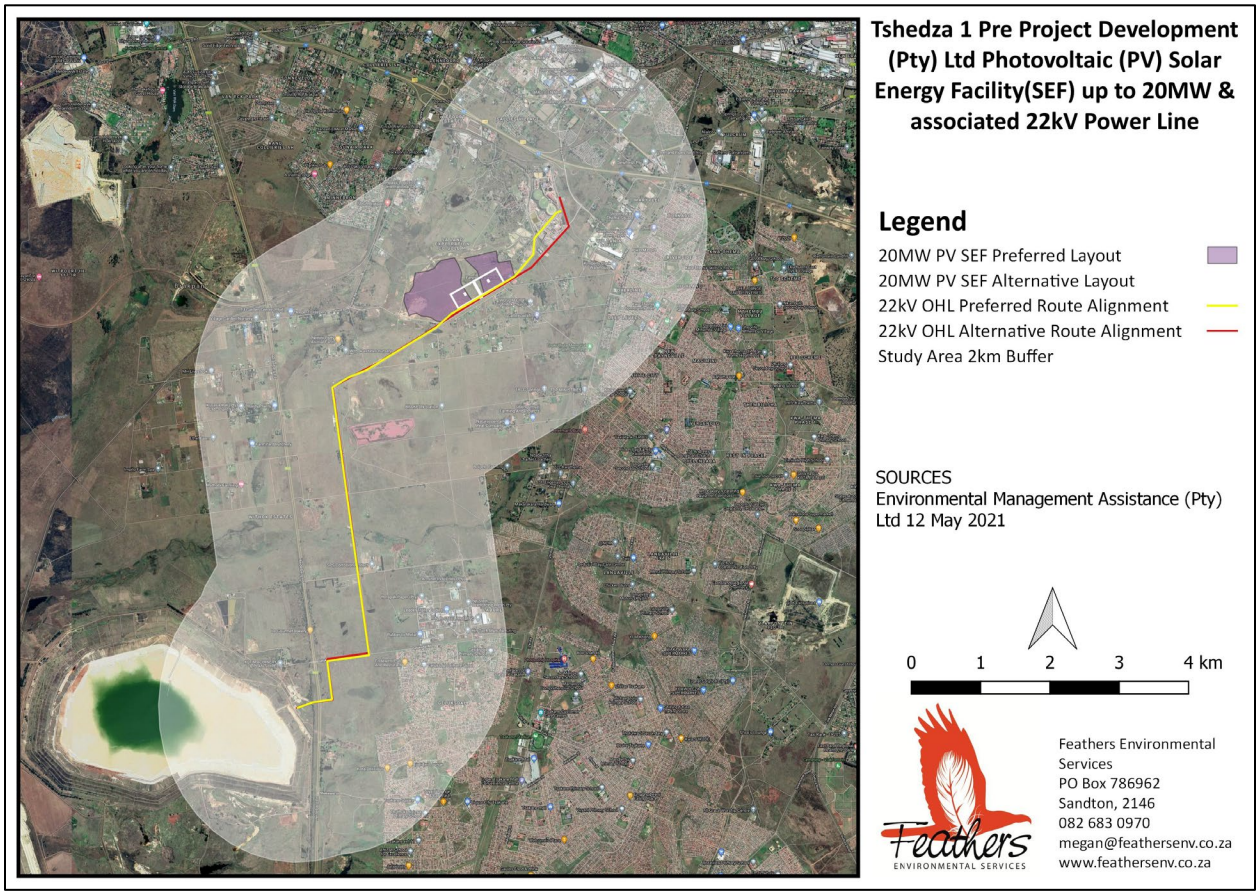

FIGURE 1: Regional map detailing the location of the proposed PV solar energy facility (up to 20MW) and its associated overhead power line development located within the Ekurhuleni Metropolitan Municipality, Gauteng Province.

1.2 Project Description

The proposed project site that has been earmarked for the proposed PV SEF is located in the Brakpan area, on the farm Witpoortjie 117IR portion 183, in the Ekurhuleni Metropolitan Municipality, Gauteng Province. The proposed PV SEF development envelope (Block 1 and Block 2) is approximately 17ha in extent.

The key infrastructure components associated with the proposed project will consist of the following:

* PV solar panels with an export capacity of up to 20MW;
* Mounting structures to support the PV panels. The PV panels will be mounted at an appropriate height so as to receive the maximum amount of solar radiation without the buffeting effects of the wind. The angle of the panel moves and tracks the sun so that the maximum amount of solar radiation can be collected through the day;
* Cabling between project components;
* An onsite 40m x 30m substation with central inverter/transformer stations to collect the energy generated from the PV panels and convert the electricity from direct to alternating current which can be evacuated into the electricity distribution grid;
* 100 MWh containerized battery storage 60m x 40m in size;
* An 22kV Overhead Power Line (OHL) approximately 11km in length which follows an existing slurry pipe servitude, to facilitate the connection of the SEF to two existing substations;
* Internal access roads (3m in width); and
* Associated buildings including a workshop area for maintenance, storage, and control facility with basic services such as water, sewage and electricity.

2. RELEVANT LEGISLATION AND GUIDELINES

The following pieces of legislation are applicable to this assessment:

2.1 The Convention on Biological Diversity

The Convention on Biological Diversity (CBD) is an international convention (to which South Africa is a signatory) and represents a commitment to sustainable development. The Convention has three main objectives: the conservation of biological diversity, the sustainable use of its components, and the fair and equitable sharing of the benefits from the use of genetic resources (http://www.cbd.int/convention/guide/). The convention makes provision (in a general policy guideline) for keeping and restoring biodiversity. In addition to this the CBD is an ardent supporter of thorough assessment procedures (Strategic Environmental Assessments (SEAs) and Environmental Impact Assessments (EIAs)) and requires that Parties apply these processes when planning activities that will have a biodiversity impact. An important principle encompassed

by the CBD is the precautionary principle which essentially states that where serious threats to the environment exist, lack of full scientific certainty should not be used as a reason for delaying management of these risks. The burden of proof that the impact will *not* occur lies with the proponent of the activity posing the threat. In addition, the Aichi Biodiversity Targets (CBD 2011) address several priority issues i.e. the loss of biodiversity and its causes; reducing direct pressure on biodiversity; safeguarding ecosystems, species and genetic diversity and participatory planning to enhance implementation of biodiversity conservation. Each of these is relevant in the case of energy infrastructure and bird conservation through all project phases from planning to the implementation of mitigation measures for existing developments.

2.2 The Convention on the Conservation of Migratory Species of Wild Animals

The Convention on the Conservation of Migratory Species of Wild Animals (also known as CMS or the Bonn Convention) is an intergovernmental treaty and is the most appropriate instrument to deal with the conservation of terrestrial, aquatic and avian migratory species. The convention includes policy and guidelines with regards to the impacts associated with man-made infrastructure. CMS requires that Parties (South Africa is a signatory) take measures to avoid migratory species from becoming endangered (Art II, par. 1 and 2) and to make every effort to prevent the adverse effects of activities and obstacles that seriously impede or prevent the migration of migratory species (Art III, par. 4b and 4c). At CMS/CoP7 (2002) Res. 7.2 on Impact Assessment and Migratory Species was accepted, requesting Parties to apply appropriate SEA and EIA procedures for all proposed developments. An agreement developed in the framework of CMS, in force since November 1999, brings the 119 Range States of the Africa Eurasian Waterbird Agreement (AEWA) region together in a common policy to protect migratory waterbirds that use the flyway from the Arctic to southern Africa. The agreement contains a number of obligations that are relevant to migratory waterbirds and energy infrastructure. AEWA has also published a series of practical guidelines that enable Parties to effectively address conservation issues influencing the status of migratory waterbirds. The most relevant guideline for migratory birds and energy infrastructure is the *Guideline on how to avoid, minimise or mitigate impact of infrastructural developments and related disturbance affecting waterbirds* (Tucker & Treweek, 2008).

2.3 The Agreement on the Conservation of African-Eurasian Migratory Water Birds

The Agreement on the Conservation of African-Eurasian Migratory Water birds (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. The AEWA covers 255 species of birds ecologically dependent on wetlands for at least part of their annual cycle, including many species of divers, grebes, pelicans, cormorants, herons, storks, rails, ibises, spoonbills, flamingos, ducks, swans, geese, cranes, waders, gulls, terns, tropic birds, auks, frigate birds and even the South African penguin. The core activities carried out under AEWA are described in its Action Plan, which is legally binding for all countries that have joined the Agreement. The AEWA Action Plan details the various measures to be undertaken by Contracting

Parties (South Africa included) to guarantee the conservation of migratory waterbirds within their national boundaries. These include species and habitat protection, and the management of human activities, as well as legal and emergency measures.

2.4 The National Environmental Management Act 107 of 1998 (NEMA)

The National Environmental Management Act 107 of 1998 (NEMA) creates the legislative framework for environmental protection in South Africa and is aimed at giving effect to the environmental right in the Constitution. It sets out a number of guiding principles that apply to the actions of all organs of state that may significantly affect the environment. Sustainable development (socially, environmentally and economically) is one of the key principles, and internationally accepted principles of environmental management, such as the precautionary principle and the polluter pays principle, are also incorporated. NEMA also provides that a wide variety of listed developmental activities, which may significantly affect the environment, may be performed only after an environmental impact assessment has been done and authorization has been obtained from the relevant authority. Many of these listed activities can potentially have negative impacts on bird populations in a variety of ways. The clearance of natural vegetation, for instance, can lead to a loss of habitat and may depress prey populations, while erecting structures needed for generating and distributing energy, communication, and so forth can cause mortalities by collision or electrocution.

2.5 The National Environmental Management: Biodiversity Act 10 of 2004 (NEMBA) and the Threatened or Protected Species Regulations, February 2007 (TOPS Regulations)

The National Environmental Management: Biodiversity Act (No. 10 of 2004), (NEMBA) regulations on Threatened and Protected Species (TOPS) provides for the consolidation of biodiversity legislation through establishing national norms and standards for the management of biodiversity across all sectors and by different management authorities. The national Act provides for among other things, the management and conservation of South Africa's biodiversity; protection of species and ecosystems that necessitate national protection and the sustainable use of indigenous biological resources.

2.6 The National Environmental Management: Protected Areas Act 57 of 2003

The National Environmental Management: Protected Areas Act (No. 57 of 2003), as amended in 2014, provides for the protection and conservation of ecologically viable areas representative of South Africa's biological diversity and its natural landscapes and seascapes. The Act also provides for the establishment of a national register of all national, provincial and local protected areas that are managed in accordance with national norms and standards; and to endure intergovernmental co-operation and public consultation in matters concerning protected areas. Protected areas are declared in order to regulate the area as a buffer zone for protection of a special nature reserve, world heritage site or nature reserve; to enable owners of land to take

collective action to conserve biodiversity on their land and to seek legal recognition therefor; to protect the area if the area is sensitive to development due to its- (i) biological diversity; (ii) natural characteristics; (iii) scientific, cultural, historical, archeological or geological value; (iv) scenic and landscape value; or (v) provision of environmental goods and services; to protect a specific ecosystem outside of a special nature reserve, world heritage site or nature reserve; to ensure that the use of natural resources in the area is sustainable. This Act explicitly states that no development, construction or farming may be permitted in a nature reserve or world heritage site without the prior written approval of the management authority.

2.7 The National Environmental Management Act 107 of 1998 (NEMA) Protocol for the Specialist Assessment and Minimum Report Content Requirements for Environmental Impacts on Terrestrial Animal and or Avifaunal Species

This protocol provides the criteria for the specialist assessment and minimum report content requirements for impacts on terrestrial animal and/or avifaunal species for activities requiring environmental authorisation. This protocol replaces the requirements of Appendix 6 of the Environmental Impact Assessment Regulations. The assessment and reporting requirements of this protocol are associated with a level of environmental sensitivity identified by the national web based environmental screening tool (screening tool) for terrestrial animal species. The relevant terrestrial animal species data in the screening tool has been provided by the South African National Biodiversity Institute (SANBI).

2.8 Gauteng Biodiversity Conservation Plan, Version 3.3

Gauteng Nature Conservation, a component of the Gauteng Department of Agriculture and Rural Development (GDARD) produced the Gauteng Conservation Plan to 1) serve as the primary decision support tool for the biodiversity component of the Environmental Impact Assessment (EIA) process; 2) inform protected area expansion and biodiversity stewardship programmes in the province; and 3) serve as a basis for development of Bioregional Plans in municipalities within the province.

2.9 Gauteng Department of Agriculture and Rural Development (GDARD) Requirements for Biodiversity Assessments Version 3, March 2014

The Gauteng Department of Agriculture and Rural Development (GDARD) Requirements for Biodiversity Assessments is an important set of provincial conservation legislation that details the minimum requirements and accepted format for biodiversity assessments to be undertaken for proposed developments within the Gauteng province. The document provides specific avifaunal assessment requirements to ensure effective conservation of most bird species and their habitat. The appointed Specialist Ornithological Consultant must 1) determine whether the proposed development site falls within the known or expected distribution of any of the following Red List bird species prioritized by GDARD i.e. Cape Vulture *Gyps coprotheres*, Blue Crane *Anthropoides paradiseus*, Lesser Kestrel *Falco naumanni*, African Grass-Owl *Tyto capensis*, African Marsh-Harrier *Circus ranivorus*, White-backed Night-Heron *Calherodius leuconotus*, White-bellied Korhaan *Eupodotis senegalensis*, Martial Eagle *Polemaetus bellicosus*, African Finfoot *Podica senegalensis*, Lesser Flamingo

Phoenicopterus minor, Secretarybird *Sagittarius serpentarius*, Black Stork *Ciconia nigra*, Half-collared Kingfisher *Alcedo semitorquata* and Greater Flamingo *Phoenicopterus ruber*; 2) determine whether suitable habitat occurs on the proposed development site or neighbouring properties for those priority Red List species whose distribution overlaps with the proposed development site; 3) map suitable habitat according to the *Sensitivity Mapping rules for Biodiversity Assessments* (spatial rules for birds) and indicate the number of individuals/pairs that could potentially be supported in each habitat; and 4) where mitigation measures are appropriate, these must be detailed together with the relevant problem statement.

2.10 Best Practice Guidelines: Birds and Solar Energy

The most important guidance document from an avifaunal impact perspective that is currently applicable (but not legally binding) to solar energy development in South Africa is the *Birds and Solar Energy: Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern* (Jenkins et al, 2017). A gradient of survey and monitoring requirements for avian studies is recommended in the guidelines and is dependent on the proposed technology, size of footprint, the amount of available data, and the estimated sensitivity of the receiving environment. Based on these criteria, the proposed PV SEF has been assessed based on Regime 1, where structured and repeated baseline data collection is not required due to the lower-risk nature of the proposed development. Such projects require that the consulting specialist visit the site at least once, during peak period of avian abundance and activity. Sufficient time must be spent on site in order to obtain first-hand knowledge of the avian habitats present, and to predict the affected avifauna, the nature and scale of impacts and the best mitigation options available.

2.11 International Finance Corporation (IFC) Performance Standards on Environmental and Social Sustainability

The International Finance Corporation's (IFC) Sustainability Framework details the Corporation's strategic commitment to sustainable development, and is an integral part of IFC's approach to risk management. The Policy on Environmental and Social Sustainability describes IFC's commitments, roles, and responsibilities related to environmental and social sustainability. The Performance Standards are directed towards clients, providing guidance on how to identify risks and impacts, and are designed to help avoid, mitigate, and manage risks and impacts as a way of doing business in a sustainable way. Performance Standard 1 establishes the importance of (i) integrated assessment to identify the environmental and social impacts, risks, and opportunities of projects; (ii) effective community engagement through disclosure of project-related information and consultation with local communities on matters that directly affect them; and (iii) the client's management of environmental and social performance throughout the life of the project (http://www.ifc.org).

3. STUDY METHODOLOGY

3.1 Terms of Reference

The avifaunal specialist has conducted this impact assessment according to the following terms of reference:

- Conduct a site sensitivity verification through the use of 1) a desk top analysis, using satellite imagery; 2) a preliminary on-site inspection; and 3) any other available and relevant information.
- Assess various avifaunal datasets, including but not limited to Important Bird Areas (IBAs) and describe the avifaunal communities (particularly with reference to Red List species) most likely to impacted on by the proposed SEF development and its ancillary infrastructure;
- Identify and confirm avifaunal microhabitats within the proposed SEF study area and assess these for their suitability to support Red List and non-Red List priority species, in terms of breeding, roosting and foraging;
- Describe the avifaunal communities (both Red List and non-Red List priority species) most likely to be impacted, based on data collected as part of a systematic and quantified data collection process;
- Provide a detailed description of the impacts associated with the construction, operation and decommissioning of the proposed SEF development;
- Assess the significance (rated according to a pre-determined set of criteria, as supplied by Environmental Management Assistance (Pty) Ltd of the identified direct, indirect and cumulative impacts, during the construction, operation and decommissioning phases of the proposed SEF development based on data collected in-field;
- Consider layout plans and advise possible changes to the layout;
- Recommend practical mitigation measures for the management of the identified impacts, at each stage of the development process, for inclusion in the draft Environmental Management Programme (EMPr);
- Propose a monitoring programme for the sensitive areas, species or receptors (if necessary); and
- Describe the gaps in baseline data and provide an indication of the confidence levels. The best available data sources will be used to predict the impacts.

3.2 Methods

The following methodology was employed to compile this avifaunal scoping report:

- Collect and examine various avifaunal data sets (detailed in section 3.3) at a desktop level to determine the presence of sensitive Red List, as well as non-Red List priority species, that may be vulnerable to the impacts associated with the proposed SEF development;
- Suitable avifaunal habitats and potential sensitive areas within the immediate surrounds of the proposed SEF development, where impacts are likely to occur, were identified using various Geographic Information System (GIS) layers and Google Earth imagery and confirmed based on personal observations made during the site visit on 8-9 February 2021 (FIGURE 2);

* Primary bird data was collected by means of two survey methods during the site visit. These methods included point-count surveys at predetermined survey locations and incidental observations (section 4.1). These survey methods were employed to determine the bird community structure both at the project site and its immediate surrounds.
* The potential impacts, associated with the construction and operation of the proposed SEF and its ancillary infrastructure on the avifaunal community, and the significance were predicted and assessed according to quantitative criteria (APPENDIX 3); and
* Practical recommendations for the management and mitigation of potentially significant impacts, related to the construction and operation of the proposed SEF and its ancillary infrastructure, are provided in Section 6 for inclusion in the draft EMPr.

3.3 Data sources used

The following data sources and reports were used in varying levels of detail for this study:

* Screening Report for an Environmental Authorisation or for an Environmental Authorisation as required by the 2014 EIA Regulations - Proposed Site Environmental Sensitivity, Feathers Environmental Services, 5 February 2021
* 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 (20 February 2021) as a means to ascertain which species occur within the **broader area**, based on nine pentad grid cells surrounding the proposed SEF and its ancillary infrastructure. Each pentad is approximately 8 × 7.6 km. Between 2007 and 2021, a total of 1191 full protocol cards (i.e. 1191 bird surveys lasting a minimum of two hours each) have been completed across the nine pentads. The relevant pentads within the study area include: 2610_2815; 2610_2820; 2610_2825; 2615_2815; 2615_2820; 2615_2825; 2620_2815; 2620_2820 and 2620_2825 (FIGURE 3);
* The Important Bird Areas (IBAs) report (Marnewick et al. 2015) was consulted to determine the location of the nearest IBAs and their importance for this study. The study area is not located within an IBA, however the Blesbokspruit IBA (SA017) may have relevance to this study;
* Co-ordinated Waterbird Count Database (CWAC – Taylor et al. 1999) was consulted determine if large concentrations of water birds, associated with South African wetlands, may occur within the study area. The study area does not contain CWAC sites, however eight CWAC sites i.e., Cowles Dam, Grootvaly Wetland Reserve, Grootvaly on Blesbok, the Anglo Reserve, Marievale (Areas A & B), Leeupan and Apex Pan that are located within 20km of the study area and may have relevance to this study;
* Coordinated Avifaunal Roadcount project database (CAR – Young et al, 2003) - was consulted to obtain relevant data on large terrestrial bird report rates in the area. The study area does not contain a CAR route, however a single route (GD02) occurs within 20km of the study area and may have relevance to this study;

* The conservation status and endemism information of all bird species occurring in the aforementioned pentads was then determined with the use of the Eskom Red Data Book of Birds of South Africa, Lesotho and Swaziland (Taylor et al. 2015) and the IUCN Red List of Threatened Species (http://www.iucnredlist.org) and the most recent and comprehensive summary of southern African bird biology (Hockey et al. 2005);
* The latest vegetation classification described in the Vegetation Map of South Africa (South African National Biodiversity Institute, 2012 and Mucina & Rutherford, 2006) was consulted in order to determine which vegetation types occur within the proposed study area;
* High-resolution Google Earth ©2021 imagery was used to examine the microhabitats within the proposed study area;
* KMZ. shapefiles detailing the location of the proposed SEF and its associated overhead power line alignment, provided by Environmental Management Assistance (Pty) Ltd on 4 February 2021;
* A single season, two-day field visit to the study area was conducted on 8-9 February 2021 (summer survey) to form a first-hand impression of avifaunal species presence and micro-habitat occurring within the proposed development site the larger study area (FIGURE 2). This information, together with the SABAP2 data was used to compile a comprehensive list of species that could occur in the study area;
* Personal observations made during the aforementioned site visit to the study coupled with the author's experience gained from assessing various infrastructure development projects in the Gauteng region have been used to formulate a professional opinion of the species likely to occur in the study area and the likely impacts that the proposed development may have on the resident avifaunal community;
* The BirdLife South Africa position statement on solar energy and birds (BirdLife South Africa, 2012) and the *Birds and Solar Energy: Guidelines for assessing and monitoring the impact of solar power generating facilities on birds in southern* (Jenkins et al, 2017) was used for evaluating the potential impacts and to inform the site visit requirements for this assessment; and
* The power line - bird mortality incident database of the Eskom/Endangered Wildlife Trust Strategic Partnership (1996 to 2013) was consulted to determine which of the species occurring in the study area are typically impacted upon by power lines, and the extent of the impact.

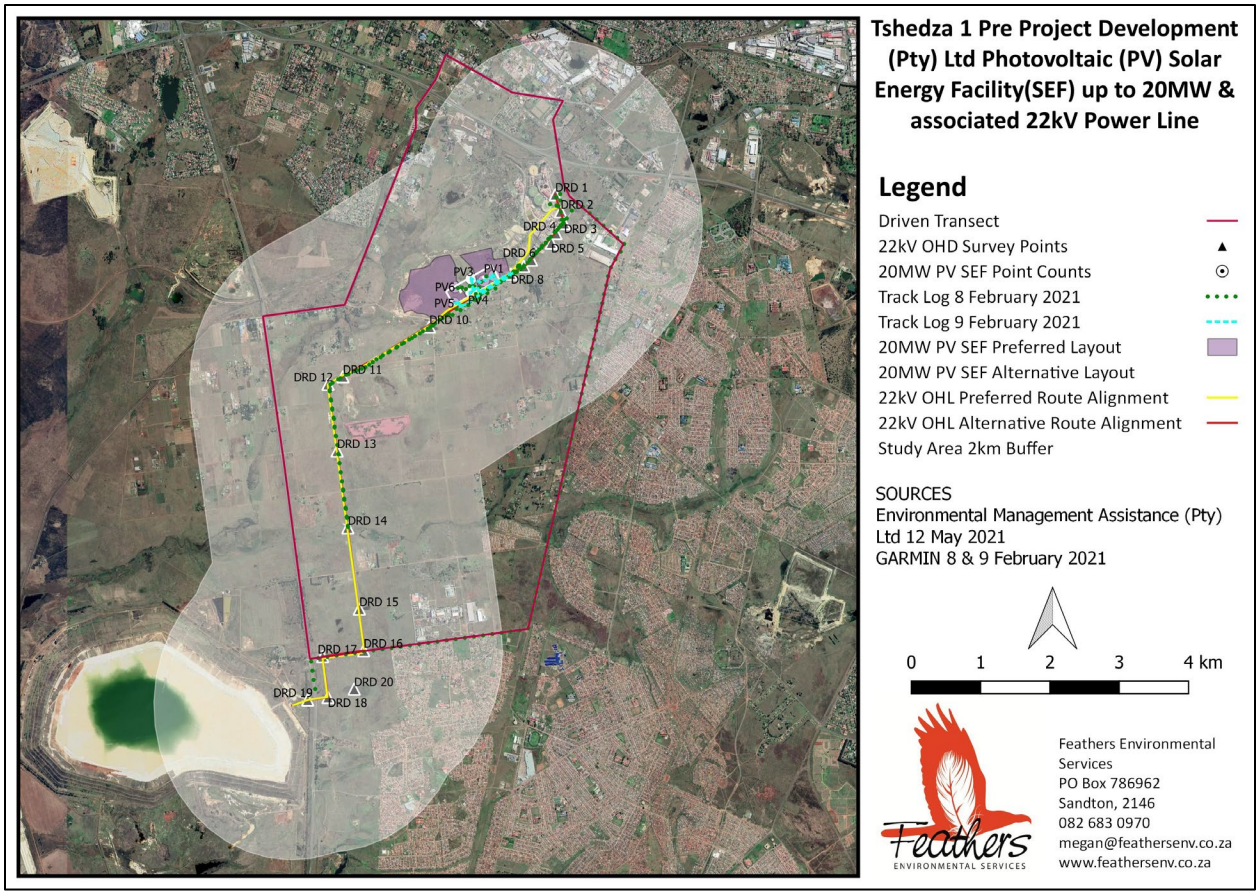

FIGURE 2: Regional map detailing the routes surveyed during the site visit to the study area conducted on 8-9 February 2021.

3.4 Limitations & assumptions

The author assumed that the sources of information used are reliable. However, it must be noted that there are limiting factors and these may potentially detract from the accuracy of the predicted results.

* The report is the result of a short-term study and is based on a two-day site visit to the proposed study area. No long-term, seasonal monitoring was conducted by the avifaunal specialist. This assessment relies upon secondary data sources with regards to bird occurrence and abundance such as the SABAP2 and IBA projects. These comprehensive datasets provide a valuable baseline against which any changes in species presence, abundance, and distribution can be monitored. However, primary information on bird habitat and avifaunal species occurrence collected during the site visit and together with professional judgement, based on extensive field experience since 2006, was used directly in determining which species of conservation importance are likely to occur within suitable avifaunal habitat types within the proposed study area. Based on these findings, the specialist was able to identify and assess the anticipated impacts and provide recommendations for mitigation.

* The site visit to the study area and the resultant observations were made in a single season (austral summer), during which time potential breeding activities for African Grass-Owl *Tyto capensis* could not be determined.
* By virtue of their mobility, the assessment of bird presence and abundance cannot be confined to the proposed SEF site, therefore the **study area was defined as a 2km zone** around the proposed development area. Avifaunal sensitivity has been defined for this study area i.e., the proposed SEF site in addition to the 2km zone surrounding the proposed development.
* Although the proposed SEF and its ancillary infrastructure are located largely within a single pentad grid cell (2615_2820), a larger area is necessary to obtain a dataset that is large enough (encompassing nine pentad grid cells) to ensure that reasonable conclusions about species diversity and densities, in a particular habitat type, can be drawn. Coverage by SABAP2 is extensive with a total of 1190 full protocol data cards being completed across the nine pentads (FIGURE 3). These surveys provide an accurate snapshot of the avifauna in the study area.
* The focus of this assessment is primarily on the potential impacts on regional Red List and priority species i.e., species that are vulnerable to the displacement and collision impacts associated with the construction and operation of the proposed SEF and its ancillary power line infrastructure. The impact on non-Red List species is also assessed, albeit in less detail. Furthermore, much of the mitigation recommended for Red List species will also protect non-Red List species in the study area.
* Predictions in this study are based on experience of these and similar species in different parts of South Africa, through the authors' experience working in the avifaunal specialist field since 2006. However, bird behaviour can't be reduced to formulas that will hold true under all circumstances. It must also be noted that, it is often not possible to entirely eliminate the risk of the disturbance and displacement impacts associated with the construction and operational activities. Our best possible efforts can probably not ensure zero impact on birds. Assessments such as this attempt to minimise the risk as far as possible, and although the impacts associated with the proposed developments will be unavoidable, they are likely to be temporary and of medium to low significance.

The above limitations need to be stated as part of this assessment so that the reader fully understands the complexities. **However, they do not detract from the confidence that this author has in the findings of this impact assessment report and subsequent recommendations for this project**.

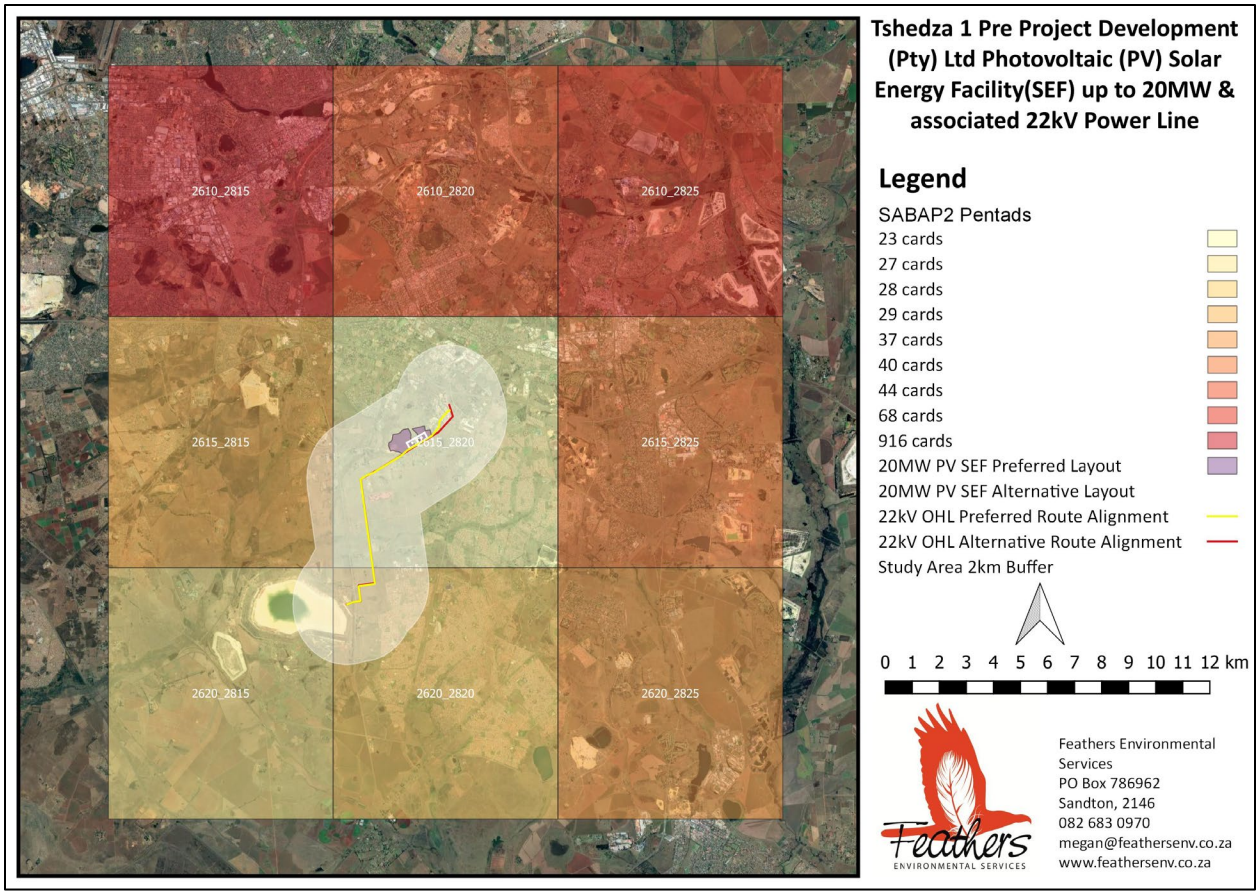

FIGURE 3: Location of the nine South African Bird Atlas Project 2 (SABAP2) pentad grid cells that were considered for the proposed SEF development.

4. SITE SENSITIVITY VERIFICATION

A screening report for the proposed study area was generated on 5 February 2021. The proposed study area occurs within the Gauteng Environmental Management Framework and within an Air Quality Priority Area. The proposed study area is considered to have a MEDIUM Animal Species Theme Sensitivity and a HIGH Avian Theme Sensitivity, as a result of habitat that may support African Grass Owl *Tyto capensis* and the presence of wetland areas. It is important to note that the delineation of wetlands actually pertains to the Bat Theme Sensitivity but may still have relevance to avifauna within the proposed study area. A site sensitivity verification was conducted through the use of both a desktop analysis and an on-site inspection, conducted on 8-9 February 2021 (FIGURE 2). The desktop analysis revealed that the area demarcated as potential African Grass Owl habitat, occurs within a rehabilitated mine area and light industrial zone. The natural habitat in this area is highly fragmented and subject to significant disturbance and therefore unlikely to support African Grass Owl. Similarly, the on-site inspection of the proposed PV SEF and its associated 22kV power line route alignment confirmed the fragmented nature and of the natural habitat within the broader area and the significant levels of existing disturbance. The desktop analysis and on-site inspection of the proposed power line servitude

proposes a LOW sensitivity rating for the proposed study area, with APPENDIX 2: FIGURES 1-7 providing photographic evidence thereof. Bird data analysis supports this premise, with no African Grass Owl observations in the study area or within the much broader area comprised of nine pentad grid cells.

5. DESCRIPTION OF THE AFFECTED ENVIRONMENT

5.1 Relevant Bird Populations

5.1.1. Important Bird Areas

Some sites are exceptionally important for maintaining the taxa dependent upon the habitats and ecosystems in which they occur. Vigorous protection of the most critical sites is one important approach to conservation. Many species may be effectively conserved by this means. Patterns of bird distribution are such that, in most cases, it is possible to select sites that support many species. These sites, carefully identified on the basis of the bird numbers and species complements they hold, are termed Important Bird Areas (IBAs). IBAs are selected such that, taken together, they form a network throughout the species' biogeographic distributions. IBAs are key sites for conservation – small enough to be conserved in their entirety and often already part of a protected-area network. They are responsible for one (or more) of three factors:

- Hold significant numbers of one or more globally threatened species;
- Are one of a set of sites that together hold a suite of restricted-range species or biome-restricted species;
- Have exceptionally large numbers of migratory or congregatory species.

The proposed SEF and its associated 22kV power line alignment are not located within the confines of an Important Bird Area (IBA). The closest IBA to the proposed study area is the Blesbokspruit IBA (SA021) with its most western boundary located approximately 10km to the east of the proposed solar site. The Blesbokspruit IBA is a large, highly modified wetland which extends along the Blesbokspruit, one of the Vaal River's larger tributaries, from the Grootvaly Wetland Reserve in the north to the Marievale Bird Sanctuary in the south. More than 220 species have been recorded for the IBA in SABAP2. The highly productive water which is artificially maintained by the inflow of mining, industrial and municipal effluents, provides food for Lesser Flamingo *Phoeniconaias minor* and Greater Flamingo *Phoenicopterus roseus*. The system also supports a diversity of waterbird species, including Goliath Heron *Ardea goliath*, Purple Heron *Ardea purpurea*, African Spoonbill *Platalea alba*, Glossy Ibis *Plegadis falcinellus*, Pied Avocet *Recurvirostra avosetta*, Red-knobbed Coot *Fulica cristata* and White-winged Tern *Chlidonias leucopterus* (Marnewick et al. 2015). African Marsh Harrier *Circus ranivorus and* African Grass-Owl *Tyto capensis* have been displaced from much of the surrounding area as a result of intense industrialisation, urbanisation and habitat modification.

Although this wetland is thought to hold 20,000 individual waterbirds, there is insufficient data to indicate that any species meet the IBA criteria (Marnewick et al. 2015). It is important to note that no distinct waterbird

flight paths were observed across the proposed solar site in relation to the network of wetland areas to the east of the study area during the site visits. Despite the close proximity (in bird terms) of the Blesbokspruit IBA to the study area, the construction and operation activities of the proposed SEF will not have a negative impact on the IBA and the species it supports. Of the species mentioned above only Red-knobbed Coot was recorded in the waterbody areas within the study area during the site visit.

5.1.2. Protected Areas

Four protected areas are located within a 20km radius of the proposed SEF and its associated 22kV power line alignment (FIGURE 4). These areas are protected by law and managed for biodiversity conservation, providing much needed habitat that can potentially support a diversity and abundance of avifaunal species. Similarly, to IBAs these areas may provide an indication of the avifaunal species that are likely to occur in similar habitats found within the study area.

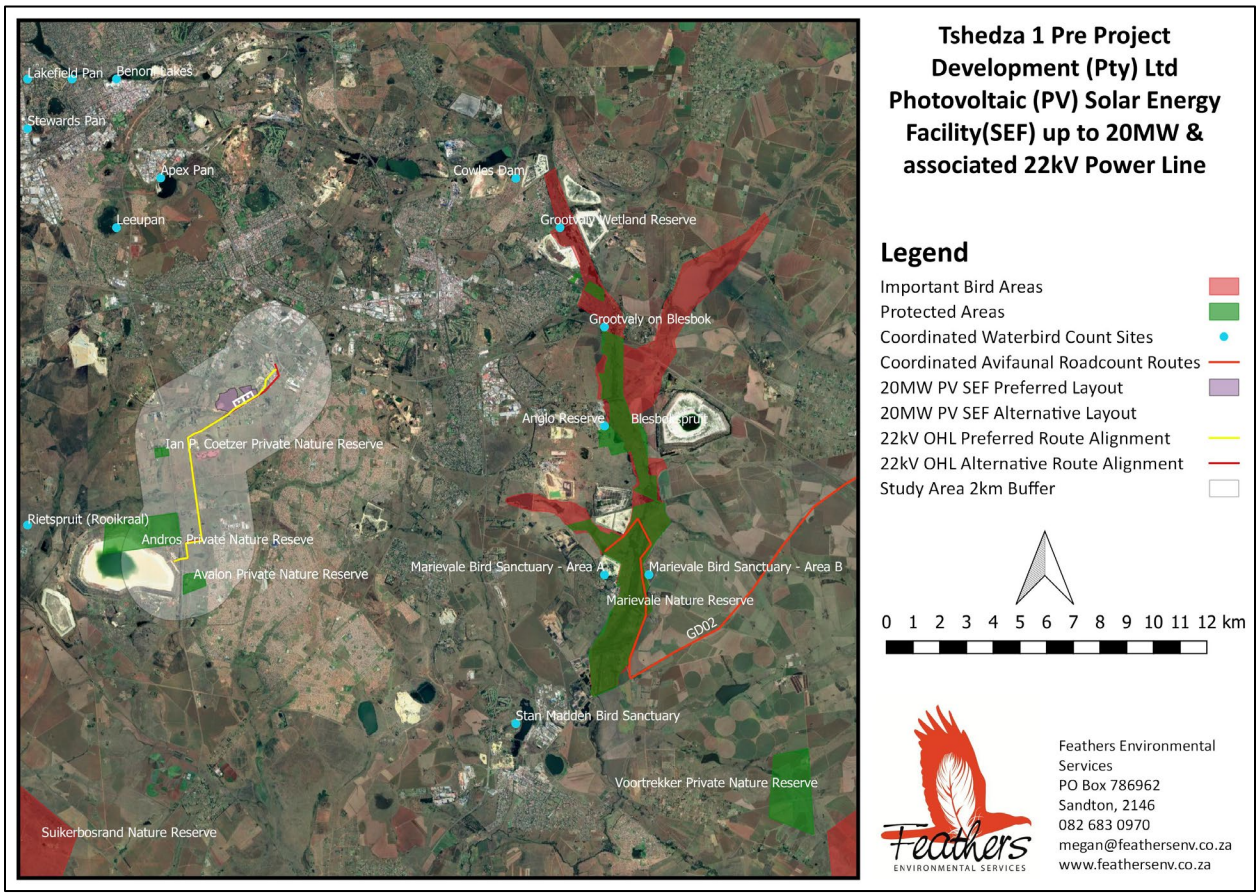

FIGURE 4: Regional map detailing the location of the proposed solar energy facility and its associated power line corridor alignment in relation to Important Bird Areas (IBAs), Protected Areas, Coordinated Waterbird Count Sites and Coordinated Avifaunal Roadcount Routes.

5.1.3. Coordinated Avifaunal Roadcount (CAR) Routes

Cranes, bustards, storks and other large birds that spend most of their time on the ground, need wide, open spaces and are certainly not restricted to protected areas. Agricultural habitats are used extensively for feeding, roosting and breeding, often because no natural, pristine habitats are available, and sometimes because the agricultural habitats are especially attractive to birds. Because of their size and conspicuous nature, these birds can be monitored using a relatively simple technique i.e. the road count. The Coordinated Avifaunal Roadcounts (CAR) project monitors the populations of 36 species of large terrestrial birds in agricultural habitats, in addition to gamebirds, raptors and corvids along 350 fixed routes covering over 19 000km (http://car.adu.org.za/). Although CAR road counts do not give an absolute count of all the individuals in a population, they do provide a measure of relative abundance in a particular area.

Given the built-up nature of the study area, there are no CAR routes within the close proximity to the proposed development. Route GD02 occurs within a 20km of the study area and is associated with the Blesbokspruit IBA. This route has recorded White Stork, Secretarybird *Sagittarius serpentarius*, Steppe Buzzard and Back-shouldered Kite *Elanus caeruleus*. Helmeted Guineafowl *Numida meleagris* and Black-shouldered Kite were the only species, monitored by the CAR project, that were recorded during the two site visits to the study area. Neither of these species are of conservation concern and are common inhabitants of urbanized environments.

5.1.4. Coordinated Waterbird Count (CWAC) Sites

A CWAC site is any body of water, other than the oceans, which supports a significant number (set at approximately 500 individual waterbirds, irrespective of the number of species) of birds which use the site for feeding, and/or breeding and roosting (Harrison et al, 2004). This definition includes natural pans, vleis, marshes, lakes, rivers, as well as a range of manmade impoundments (i.e. sewage works). The presence of a CWAC site within the study area is an indication of a large number of waterbird species occurring there and the overall sensitivity of the area.

Although there are no CWAC sites within the immediate study area, there are eight CWAC sites within 20km of the proposed solar site. These include Cowles Dam, Grootvaly Wetland Reserve, Grootvaly on Blesbok, the Anglo Reserve, Marievale (Areas A & B), Leeupan and Apex Pan (FIGURE 4). Seven of the eight sites are comprised of open water, reedbeds and marshes that support a wide variety of waterbirds including Greater Flamingo, Southern Pochard *Netta erythrophthalma*, Fulvous Duck *Dendrocygna bicolor*, Yellow-billed Duck *Anas undulata*, Red-billed Teal *Anas erythrorhyncha*, Cape Shoveller *Anas smithii*, Ruff *Philomachus pugnax*, Common Moorhen *Gallinula chloropus*, African Purple Swamphen *Porphyrio madagascariensis,* Dabchick, Squacco Heron *Ardeola ralloides*, Black-crowned Night Heron *Nycticorax nycticorax*, Egyptian Goose *Alopochen aegyptiacus*, Spur-winged Goose *Plectropterus gambensis*, Glossy Ibis, African Sacred Ibis *Threskiornis aethiopicus*, White- winged Tern, Grey-headed Gull *Larus cirrocephalus* and egret sp. Apex Pan is an open-water pan with a shoreline of grass/sedge, and an island of *Phragmites*. White-breasted Cormorant, African

Spoonbill and Black-headed Heron breed at the pan. Also an important site for Great Crested Grebe White-backed Duck, Greater and Lesser Flamingo, Red-knobbed Coot, Grey-headed Gull and Cape Wagtail. Sewage overflow and squatter encroachment has resulted in a dramatic decline in bird numbers at this site.

While these CWAC sites may provide an indication of the waterbird species that could be supported by natural and artificial impoundments within the study area, these sites will not have a significant impact on the sensitivity rating for the proposed SEF. Of the species mentioned above, Common Moorhen, Egyptian Goose, African Sacred Ibis and Cattle Egret *Bubulcus ibis* were recorded in various waterbody areas within the study area during the site visits. Similarly, none of these species are of conservation concern and are commonly found in *wetland* habitats.

5.1.5. South African Bird Atlas Project 2 Data (SABAP2)

A total of 287 bird species have been recorded within the relevant pentads during the SABAP2 atlassing period to date (APPENDIX 1). The presence of these species in the broader area provides an indication of the diversity of species that could potentially occur within the areas earmarked for the proposed SEF and its associated overhead power line, particularly where pockets of natural vegetation/habitats persist. Of the 287 species, 14 of these are considered to be of regional conservation concern i.e. regional Red List species (Taylor et al, 2015). An additional five species are endemic to South Africa (species that are native and restricted to South Africa), nine are near endemic species (species whose range extends only marginally outside South Africa) and a further 22 species that are endemic to southern Africa. The White Stork *Ciconia ciconia*, which is not listed, but is protected internationally under the *Bonn Convention on Migratory Species* has also been recorded in the study area.

It is important to note that with the exception of Maccoa Duck *Oxyura maccoa* (n=128), Lesser Flamingo (n=166) and Greater Flamingo (n=406) the remaining Red List species have been recorded in low numbers, with less than 20 individual birds being recorded over the fourteen-year survey period. The significant individual numbers of Maccoa Duck, Lesser and Greater Flamingo can be attributed to the number of observations/surveys conducted within three pentads to the north of the study area, which contain a series of wetlands and waterbodies - habitat that is capable of supporting these species in their abundance. Lanner Falcon *Falco biarmicus* is the only Red List species recorded in the single pentad within which the proposed SEF development is located. The low report rates can be attributed to fairly high levels of disturbance and habitat loss associated with the surrounding mining and industrial practices which has undoubtedly displaced many of the naturally occurring species, that under optimum conditions, would inhabit these areas. Although this report focuses on Red List species, since the impacts associated with the construction and operation of the proposed SEF and its associated overhead power line are likely to be more biologically significant for these species, the impact on non-Red List species is also assessed, albeit in less detail. Furthermore, Red List species can often be used as surrogate species for the others in terms of impacts and the necessary mitigation. The

non-Red List priority species that have been considered for this assessment include korhaan, buzzards, kestrels, falcons, herons, geese, ibis and various water dependent species. Each Red List species' potential for occurring in a specific habitat class is indicated in TABLE 1, in addition to the type of impact that could potentially affect each species, specific to the location of this development.

5.1.6. Primary Data Collection

A single summer survey was conducted on 8-9 February 2021. In order to describe the avifaunal community present, a concerted effort was made to sample the avifauna in all of the primary habitats that were available at the proposed solar site and within the larger study area by applying the following techniques:

a. Fixed Point Count Survey

A total of six fixed-point count survey points were established across the proposed SEF, sampling the dominant grassland habitat within the proposed study area (FIGURE 2). The survey completed on 8 February 2021 was conducted mid-morning to midday and the surveys completed on 9 February 2021 were conducted in the early to mid-morning hours avoiding the warmer period in the middle of the day when birds are less active and vocal, and hence less conspicuous (Bibby et al. 2000). At each survey point, the birds observed or heard (within 25m of the observer) over a period of five minutes (i.e. long enough to detect all the birds within the survey area, but short enough to avoid including birds that were not present in the area at the start and double counts) were recorded. A detailed description of the methods of conducting fixed-point counts is available in Jenkins et al. 2017. The data emanating from the fixed-point count surveys is presented in TABLE 2 and 3. Species diversity varied across the six point counts and appeared to be largely dependent on the microhabitats with the proposed SEF development envelope. Typically, the lapwing and swallow species were concentrated within the wetland areas at point counts 3 and 4. Cattle Egret featured prominently at point count 3 during the first survey on 8 February 2021 due to the presence of cattle drinking at the waterbody. Point counts 1 and 3 recorded the highest diversity of species each (n=7). The low density of species observed across the point counts was expected given the level of disturbance experienced at the proposed development site. Long-tailed Widowbird and Laughing Dove were observed regularly and in relative high densities within the proposed study area.

TABLE 1: Annotated list of regional Red List, Endemic & Near Endemic species that have been recorded in the relevant pentads surrounding the proposed SEF and its ancillary infrastructure development.

COMMON NAME	CONS. STATUS	AV. REPORT RATE (NO. OF BIRDS)	GRASSLAND	WETLANDS RIVERS & DAMS	EXOTIC TREE STANDS	HABITAT LOSS	DISTURBANCE	COLLISION PV PANELS	COLLISION POWER LINE	ELECTROCUTION
Buzzard, Jackal *Buteo rufofuscus*	Near Endemic	0.2 (2)	foraging	-	x	-	-	-	x	x
Cisticola, Cloud *Cisticola textrix*	Near Endemic	6.5 (77)	x	-	-	x	x	x	-	-
Cliff-swallow, South African *Hirundo spilodera*	Endemic	1.6 (19)	x	-	-	x	x	x	-	-
Cormorant, Cape *Phalacrocorax capensis*	EN	0.1 (1)	-	x (vagrant)	-	-	-	-	-	-
Duck, Maccoa *Oxyura maccoa*	NT	10.8 (128)	-	x	-	-	x	x	x	-
Eagle, Martial *Polemaetus bellicosus*	EN	0.1 (1)	foraging	-	x	-	-	-	x	x
Falcon, Lanner *Falco biarmicus*	VU	0.4 (5)	x	-	x	x	x	x	x	x
Flamingo, Greater *Phoenicopterus ruber*	EN	34.1 (406)	-	x	-	-	-	-	x	-
Flamingo, Lesser *Phoenicopterus minor*	VU	13.9 (166)	-	x	-	-	-	-	x	-
Flycatcher, Fairy *Stenostira scita*	Near Endemic	0.1 (1)	gardens	-	-	x	x	x	-	-
Flycatcher, Fiscal *Sigelus silens*	Near Endemic	11.1 (132)	x	-	-	x	x	x	-	-
Grassbird, Cape *Sphenoeacus afer*	Near Endemic	0.3 (3)	x	-	-	-	x	x	-	-
Kestrel, Lesser *Falco naumanni*	GDARD	0.2 (2)	x	-	-	-	x	x	x	x
Kingfisher, Half-collared *Alcedo semitorquata*	NT	0.1 (1)	-	x	-	-	-	-	-	-
Lark, Eastern Long-billed Certhilauda semitorquata	Endemic	0.1 (1)	x	-	-	x	x	x	-	-

COMMON NAME	CONS. STATUS	AV. REPORT RATE (NO. OF BIRDS)	GRASSLAND	WETLANDS RIVERS & DAMS	EXOTIC TREE STANDS	HABITAT LOSS	DISTURBANCE	COLLISION PV PANELS	COLLISION POWER LINE	ELECTROCUTION
Marsh-harrier, African *Circus ranivorus*	EN	1.6 (19)	x	x	-	x	x	-	x	x
Painted-snipe, Greater *Rostratula benghalensis*	NT	0.2 (2)	-	x	-	-	-	-	-	-
Pelican, Great White *Pelecanus onocrotalus*	VU	0.1 (1)	-	x	-	-	-	-	x	-
Pratincole, Black-winged *Glareola nordmanni*	NT	0.5 (6)	x	-	-	x	x	-	-	-
Rock Thrush, Cape *Monticola rupestris*	Endemic	0.1 (1)	-	-	-	-	-	-	-	-
Rock-thrush, Sentinel *Monticola explorator*	Endemic	0.1 (1)	x	-	-	x	x	x	-	-
Starling, Pied *Spreo bicolor*	Endemic	11.8 (141)	x	-	-	x	x	x	-	-
Stork, Abdim's *Ciconia abdimii*	NT	0.3 (3)	x	-	-	x	x	-	x	x
Stork, Yellow-billed *Mycteria ibis*	EN	1.0 (12)	-	x	-	-	x	-	x	x
Stork, White *Ciconia ciconia*	BONN	1.3 (15)	x	x	-	-	x	-	x	x
Tern, Caspian *Sterna caspia*	VU	0.1 (1)	-	x	-	-	-	-	-	-
Thrush, Karoo *Turdus smithi*	Near Endemic	76.5 (910)	gardens	-	-	x	x	x	-	-
Weaver, Cape *Ploceus capensis*	Near Endemic	0.3 (4)	x	-	-	x	x	x	-	-
White-eye, Cape *Zosterops virens*	Near Endemic	55.5 (660)	gardens	-	-	x	x	x	-	-
EN = Endangered; VU = Vulnerable; NT = Near-threatened										

TABLE 2: Fixed Point Count - Species diversity across survey points

SPECIES	TAXONOMIC NAME	SURVEY POINT 1	SURVEY POINT 2	SURVEY POINT 3	SURVEY POINT 4	SURVEY POINT 5	SURVEY POINT 6
Barbet, Black-collared	*Lybius torquatus*	x					
Canary, Black-throated	***Crithagra atrogularis***	x					
Cisticola, Zitting	***Cisticola juncidis***		x	x		x	x
Crow, Pied	*Corvus albus*	x					
Dove, Laughing	***Streptopelia senegalensis***	x			x	x	
Dove, Red-eyed	*Streptopelia semitorquata*	x				x	
Egret, Cattle	*Bubulcus ibis*			x			
Goose, Egyptian	*Alopochen aegyptiaca*			x			
Lapwing, Blacksmith	***Vanellus armatus***			x	x	x	
Lapwing, Crowned	*Vanellus coronatus*			x			
Lark, Rufous-naped	***Mirafra africana***						x
Stonechat, African	***Saxicola torquatus***		x				x
Swallow, Barn	*Hirundo rustica*	x		x	x		
Swallow, Greater Striped	*Cecropis cucullata*			x	x		
Widowbird, Long-tailed	*Euplectes progne*	x				x	x

TABLE 3: Fixed Point Count Summary Data

SPECIES	TAXONOMIC NAME	# BIRDS	# RECORDS
Barbet, Black-collared	*Lybius torquatus*	1	1
Canary, Black-throated	***Crithagra atrogularis***	4	3
Cisticola, Zitting	***Cisticola juncidis***	6	6
Crow, Pied	*Corvus albus*	1	1
Dove, Laughing	***Streptopelia senegalensis***	8	5
Dove, Red-eyed	*Streptopelia semitorquata*	3	3
Egret, Cattle	*Bubulcus ibis*	3	2
Goose, Egyptian	*Alopochen aegyptiaca*	3	2
Lapwing, Blacksmith	***Vanellus armatus***	6	4
Lapwing, Crowned	*Vanellus coronatus*	5	2
Lark, Rufous-naped	***Mirafra africana***	1	1
Stonechat, African	***Saxicola torquatus***	4	3
Swallow, Barn	*Hirundo rustica*	8	5
Swallow, Greater Striped	*Cecropis cucullata*	5	4
Widowbird, Long-tailed	*Euplectes progne*	11	5

b. Vehicle Transect Survey

This data collection aims to establish the presence of large terrestrial species and raptors. However, during the site visit it became apparent that large terrestrial species and raptors were unlikely to feature prominently, as a result of the absence of suitable habitat and the significant existing disturbance within the study area. Despite the lack of large terrestrial species presence, a single Vehicle Transect (VT) count was established on suitable roads surrounding the solar site, totalling approximately 23 kilometres (11.2km conducted on 8 and 9 February 2021) and all species encountered along this route were recorded and presented in TABLE 4 Eighteen species were recorded along the transect.

TABLE 4: Vehicle Transect Summary Data

SPECIES	SCIENTIFIC NAME	#BIRDS	#RECORDS
Bishop, Southern Red	*Euplectes orix*	33	7
Bulbul, Dark-capped	*Pycnonotus tricolor*	7	5
Fiscal, Common	*Lanius collaris*	3	3
Go-Away-Bird, Grey	*Corythaixoides concolor*	5	3
Guineafowl, Helmeted	*Numida meleagris*	7	1
Ibis, Hadeda	*Bostrychia hagedash*	7	3
Kite, Black-shouldered	*Elanus caeruleus*	4	4
Lapwing, Blacksmith	*Vanellus armatus*	8	5
Lapwing, Crowned	*Vanellus coronatus*	6	3
Masked Weaver, Southern	*Ploceus velatus*	11	9
Mousebird, Speckled	*Colius striatus*	9	2
Myna, Common	*Acridotheres tristis*	8	7
Pigeon, Speckled	*Columba guinea*	1	1
Sparrow, Cape	*Passer melanurus*	19	5
Starling, Cape Glossy	*Lamprotornis nitens*	2	2
Thrush, Karoo	*Turdus smithi*	1	1
Turtle-dove, Cape	*Streptopelia capicola*	6	7
Widowbird, Long-tailed	*Euplectes progne*	23	5

c. Focal Site Surveys

Focal sites are any identifiable features within the landscape that support avifauna (e.g. a roost or nesting site) or have the potential to support breeding pairs or large densities of avifauna (e.g. dams, wetlands, river systems). A single focal site DRD10 (FIGURE 2 and APPENDIX 2 - FIGURE 4) was established within the study area and is a representative of the waterbodies that occur within the broader study area and habitat that is likely to support various collision prone species. Ten water dependent species were recorded at this Focal Site, none of which are species of conservation concern. Each of these species are common to urban environments and are unlikely to be displaced permanently from the study area.

The site visit produced a combined list of 40 species (APPENDIX 1 - highlighted in grey), covering both the study area and to a limited extent, the surrounding area. No Red List species were observed during the site visit. Most observations were of small passerine species that are common to this area. Each of these species has the potential to be displaced by the proposed SEF and its associated power line as a result of habitat transformation and disturbance. However, these species have persisted despite existing disturbance within the study area. This resilience, coupled with the fact that similar habitat is available throughout the broader area, means that the displacement impact will not be of regional or national significance. In addition, no raptor nests or other possible breeding sites were noted during the site survey.

5.1.7. Interested and Affected Party Comments and Local Knowledge

Comments were received from Ms. Jeanne-Michele White and Mrs. Santjie White on 17 and 25 March 2021 respectively, regarding the presence and breeding activities of African Grass Owl, Marsh Owl *Asio Capensis and* African Marsh Harrier, in addition to the occasional presence of Blue Crane *Anthropoides paradeus*, Verreaux's Eagle *Aquilla verreauxii and* Secretarybird according to observations carried out in the area over a 15-year period.

The following response was submitted to Ms. Jeanne-Michele White and Mrs. Santjie White on 30 March 2021:

* In accordance with the most current legislation, a screening report was generated for the SEF development on 5 February 2021, using the DEA Online Screening Tool. The screening report concluded that the proposed study area (the SEF development site, including a 2km buffer) is considered to have a MEDIUM Animal Species Theme Sensitivity, based on the POSSIBLE occurrence of African Grass Owl *Tyto capensis* and a HIGH Avian Theme Sensitivity based on the presence of wetland areas within the study area. It is important to note that the 17ha SEF development site is actually deemed to be of LOW sensitivity and the delineation of wetlands within the broader study area, actually pertains to the Bat Theme Sensitivity. However, the sensitivity of this habitat type was still considered as it may have relevance to priority avifauna occurring within the proposed study area. A site sensitivity verification was conducted through the use of both a desktop analysis and an on-site inspection, conducted on 8-9 February 2021. The desktop analysis and on-site inspection, revealed that the study area demarcated as potential African Grass Owl habitat, occurs within a rehabilitated mine area and is bordered by a light industrial zone and residential area. The natural habitat in this area is highly fragmented and subject to significant disturbance (i.e. pastoral activities, industrial activities as well as vehicle and pedestrian traffic) and therefore unlikely to support African Grass Owl. An analysis of the South Africa Bird Atlas Project 2 and CAR datasets supports this premise, with no African Grass Owl observations in the study area or within the much broader area of 68,000ha.

* The *BirdLife South Africa Best Practice Guidelines: Birds and Solar Energy* require that a Regime 1 assessment (comprised of 1-5 days) occur at proposed SEF development sites that are less than 30ha in size and are of medium sensitivity. A two-day site visit was conducted on 8-9 February 2021. The survey completed on 8 February 2021 was conducted mid-morning to midday and the surveys completed on 9 February 2021 were conducted in the early to mid-morning hours and again in the late afternoon hours, to accommodate possible temporal variances and avoid the warmer period in the middle of the day when birds are less active and vocal, and hence less conspicuous.
* A total of six fixed-point count survey points were established across the proposed SEF development site, sampling the dominant grassland habitat within the proposed study area. The entire power line route alignment was assessed using a walked transect. The survey also included a vehicle (driven) transect to collect bird occurrence data for the broader study area and as well observation made at a focal site (a large waterbody) within the study area.
* The South African Bird Atlas Project 2 (SABAP2), Important Bird Areas, Coordinated Waterbird Count and Coordinated Avifaunal Roadcount datasets were consulted to **support** the findings of the primary in-field surveys. These datasets **do not replace or supersede** in-field observations, professional judgement and extensive experience of the avifaunal specialist. These comprehensive datasets do however provide a valuable baseline against which any changes in species presence, abundance, and distribution can be monitored.
* The site visit to the study area and the resultant observations were made in a during the peak season (austral summer), in accordance with the *BirdLife South Africa Best Practice Guidelines: Birds and Solar Energy*.
* By virtue of avian mobility, the assessment of bird occurrence cannot be confined to the proposed SEF site alone, therefore the **study area was defined as a 2km zone** around the proposed development area. Avifaunal sensitivity was defined for this study area.
* Although the proposed SEF and its ancillary power line infrastructure are located largely within a single SABAP 2 pentad grid cell (2615_2820), a larger area is necessary to obtain a dataset that is large enough (encompassing nine pentad grid cells – approx. 68,000ha) to ensure that reasonable conclusions about species diversity and densities can be drawn. Coverage by SABAP2 is **extensive** with a total of 1190 bird surveys, lasting a minimum of two hours each being completed across the nine pentads. These surveys provide an accurate snapshot of the avifauna in the study area, but again **do not replace or supersede** in-field observations.
* Recognising that these databases might not have a record of **every** species occurrence within an area (despite the number of surveys conducted over a minimum of 14 years), avifaunal specialists welcome comments and encourage collaboration with I&APs who may have details of key species occurring within their respective areas. Having compiled and curated species lists for over 15 years, Ms. White has access to avifaunal data that should be shared with citizen science project like SABAP 2 or BirdLasser to ensure that the most accurate and up-to date avifaunal data is available to decision makers.

5.2 Bird Habitat Classes (Microhabitats)

Vegetation is one of the primary factors determining bird species distribution and abundance in an area. It is widely accepted within ornithological circles that vegetation structure is more important in determining which bird species will occur there. The classification of vegetation types is from Mucina & Rutherford (2006 and 2012), while from an avifaunal perspective, the Atlas of southern African Birds (SABAP1) recognises six primary vegetation divisions or biomes within South Africa, namely (1) Fynbos (2) Succulent Karoo (3) Nama Karoo (4) Grassland (5) Savanna and (6) Forest (Harrison et al. 1997). Whilst much of the distribution and abundance of bird species can be attributed to the broad vegetation types present in an area, it is the smaller spatial scale habitats (micro habitats) that support the requirements of a particular bird species that need to be examined in greater detail. Micro habitats are shaped by factors other than vegetation, such as topography, land use, food availability, and various anthropogenic factors all of which will either attract or deter birds and are critically important in mapping the site in terms of avifaunal sensitivity and ultimately informing mitigation requirements. Investigation of the proposed SEF development site and its associated 22kV power line alignment revealed at least four broadly described avifaunal micro habitats i.e. grassland, rivers, waterbodies and exotic/alien tree stands with APPENDIX 2 providing a photographic record of the bird habitats.

5.2.1. Grassland

The proposed SEF site and surrounding study area are located within a single primary vegetation division namely the Grassland Biome, specifically Tsakane Clay Grassland and Soweto Highveld Grassland (South African National Biodiversity Institute, 2012 and Mucina & Rutherford, 2006).

Tsakane Clay Grassland occurs within the Gauteng and Mpumalanga Provinces, extending in a narrow band from Soweto to Springs, broadening southwards to Nigel and from there towards Vereeniging, as well as north of the Vaal Dam and between Balfour and Standerton. This vegetation type occurs predominantly on flat to slightly undulating plains and low hills and is short and dense in structure. Tsakane Clay Grassland is dominated by a mixture of common Highveld grasses such as *Themeda triandra*, *Heteropogon contortus* and *Elionurus muticus* (Mucina & Rutherford, 2012). More than 60% of the vegetation type is transformed by cultivation, urbanisation, mining, dam-building and roads. Increasing urbanisation and infrastructure development bring further pressure on the remaining vegetation (Mucina & Rutherford 2006). Soweto Highveld Grassland occurs on gently to moderately undulating landscape on the Highveld plateau, supporting short to medium-high, dense, tufted grassland dominated almost entirely by *Themeda triandra*. In areas where the grassland is intact, only scattered small wetlands, narrow stream alluvia, pans and occasional ridges or rocky outcrops interrupt the continuous grassland cover. Similarly, almost half of this vegetation type is already transformed by cultivation, urban sprawl, mining and building of road infrastructure (Mucina & Rutherford 2006).

Of South Africa's 841 bird species, 350 occur in the Grassland Biome. This includes 29 species of conservation concern (i.e. those species declining in numbers), ten endemics, and as many as 40 specialist species that are

exclusively dependent on grassland habitat. Grasslands represent a significant feeding area for many bird species in densely populated areas and will typically attract Lanner Falcon, African Marsh-harrier, Black-winged Pratincole, Abdim's Stork and White Stork observed during the SABAP2 survey period. Grassland patches are also a favourite foraging area for game birds such as francolins, spurfowl and Helmeted Guineafowl. This in turn could attract large raptors i.e. Martial Eagle because of both the presence and accessibility of prey.

It is important to note that the area that has been earmarked for the proposed SEF development has experienced significant transformation in the form of mining and urbanisation which dominate the landscape. Although the proposed study area has been largely rehabilitated and the grassland habitat has recovered (APPENDIX 2: FIGURE 1), fairly significant levels of disturbance persist within the study area in the form of vehicle and pedestrian traffic, pastoral activities and mining operations in the immediate surrounds. SABAP2 reporting rates for the Red List avifauna potentially occurring in grassland habitat in the study area are very low (see TABLE 4-1) and the absence of these Red List grassland dependent species at the proposed SEF site is an indication of the significant levels of human activity and disturbance. Therefore, the potential displacement impacts as a result of habitat loss and disturbance associated with the construction and operation of the proposed SEF and its associated 22kV power line infrastructure are likely to be low for the aforementioned grassland dependent species.

5.2.2. Rivers, Wetlands & Surface Waterbodies

Most rivers in southern Africa are in the east and extreme south, in the higher rainfall areas. These freshwater resources provide important corridors of microhabitat for waterbirds (13 of which are mostly restricted to riverine habitat in southern Africa) that will regularly utilise rivers not only as a source of drinking water and food, but also for bathing and cover for skulking species. In addition, the thick riverine woodland with large shady riparian trees, offers important breeding substrate for a variety of birds (e.g. Half-collared Kingfisher), including raptors (Hockey et al 2005).

The Rietpsruit and Withokspruit river system feature within the study area (FIGURE 5 and APPENDIX 2 - FIGURE 2). Relevant to this study, the proposed 22kV power line alignment traverses the Withokspruit. Given the current level of disturbance and utilisation Withokspruit, it is unlikely that the Red List species that have been recorded in the study area will frequent the watercourse. Therefore, potential collision and displacement impacts as a result of habitat loss, disturbance and collision associated with the construction and operation of the proposed 22kV power line are likely to be low.

Wetlands are characterized by slow flowing seasonal water (or permanently wet) and tall emergent vegetation (rooted or floating) and provide habitat for many water birds. The conservation status of many of the bird species that are dependent on wetlands reflects the critical status of wetlands worldwide, with many having already been destroyed. There are examples of localized wetlands within the study area (FIGURE 5 and

APPENDIX 2: FIGURE 3), which may represent attractive foraging habitat for sensitive species such as Greater Painted-snipe, Bar-tailed Godwit, Curlew Sandpiper and White Stork (Young 2003). It is also the preferred roosting and foraging habitat for the African Marsh Harrier (Hockey et al 2005). Various common species i.e. ibis, herons and geese will also utilise wetlands for their foraging needs.

Many thousands of earthen and other dams exist in the southern African landscape. Whilst dams have altered flow patterns of streams and rivers, and affected many bird species detrimentally, a number of species have benefited from their construction. The construction of these dams has probably resulted in a range expansion for many water bird species that were formerly restricted to areas of higher rainfall. Man-made impoundments, although artificial in nature, can be very important for a variety of birds, particularly water birds. Apart from the water quality, the structure of the dam, and specifically the margins and the associated shoreline and vegetation, plays a big role in determining the species that will be attracted to the dam. The broader study area contains several dams and the species of conservation concern recorded in the study area by SABAP2 that are likely to be attracted to these dams (FIGURE 5 and APPENDIX 2: FIGURE 4) include Greater Flamingo, Lesser Flamingo, Maccoa Duck, Yellow-billed Stork and White Stork. Common species in the study area that could use dams and dam edges include African Darter *Anhinga rufa*, Red-knobbed Coot *Fulica cristata,* Reed Cormorant *Phalacrocorax africanus,* White-breasted Cormorant *Phalacrocorax carbo*, various heron and duck species, Common Moorhen, Black-winged Stilt, African Sacred Ibis *Threskiornis aethiopicus*, Egyptian Goose *Alopochen aegyptiacus and* Blacksmith Lapwing *Vanellus armatus*.

Given the location of the wetlands and dams outside of the proposed solar site boundary and the fact that the area is already subject to considerable existing disturbance, coupled with the low reporting rates for the majority of the Red List species supported by these habitats, construction and operational activities associated with the proposed SEF are unlikely to have a permanent negative impact on the wetlands and the bird communities that these may support. Similarly, for the more common species that are fairly resilient to disturbance, the potential displacement impacts are unlikely to be permanent and of regional or national significance.

5.2.3. Exotic Tree Stands

Although stands of *Eucalyptus* are strictly speaking invader species, they have become important refuges for certain species of raptors, particularly Amur Falcon *Falco amurensis*, a Palearctic migrant, which will commonly roost in small stands of *Eucalyptus* in suburbs of small towns. Black Sparrowhawk *Accipiter melanoleucus* and Ovambo Sparrowhawk *Accipiter ovampensis* are another two species that use these trees for roosting and breeding purposes. Although *Eucalyptus* stands do not feature within the SEF development envelop, they do occur alongside the proposed 22kV power line alignment (APPENDIX 2: FIGURE 5). However given the availability of stands of *Eucalyptus* in the broader area, the displacement impacts are likely to be of low significance.

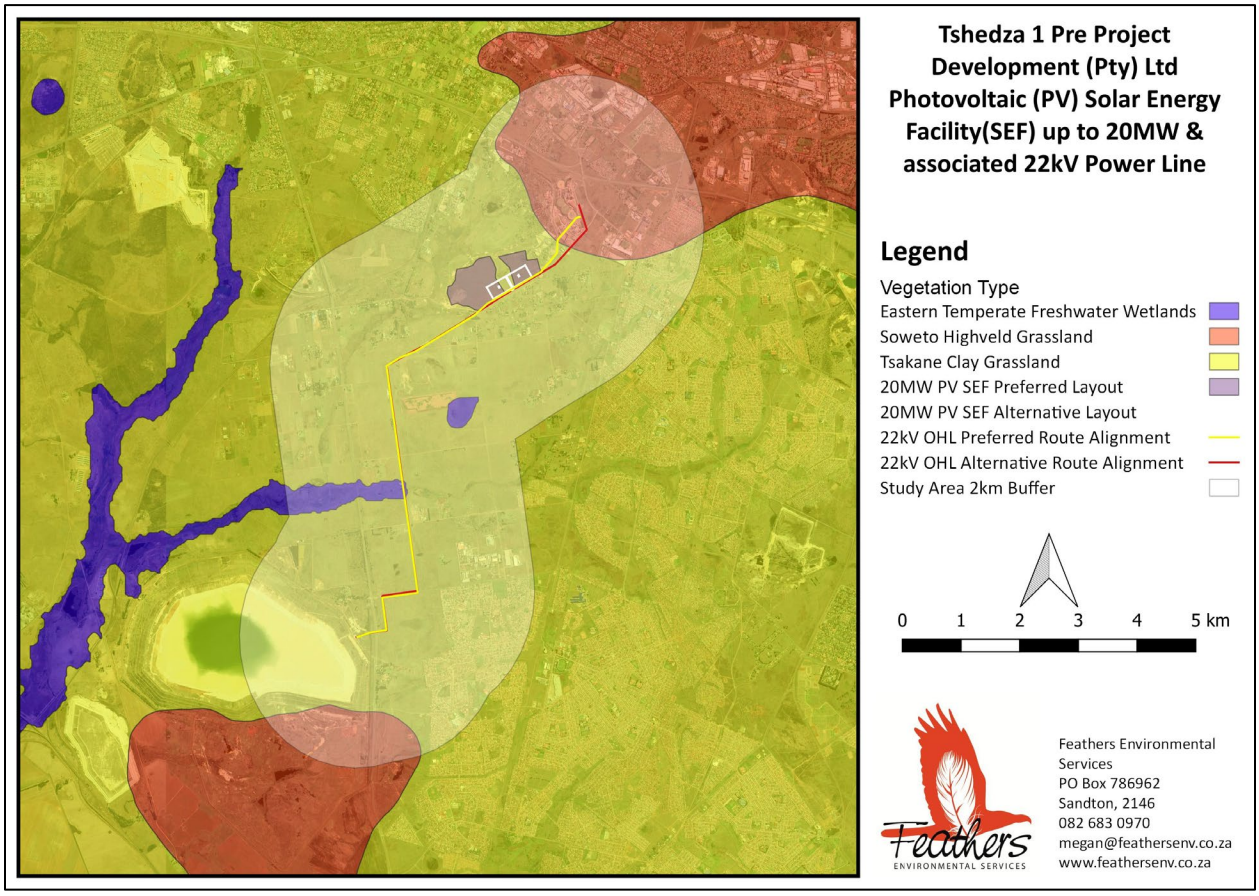

FIGURE 5: Regional map detailing the various vegetation types occurring at the proposed development site and within the broader study area

5.2.4. Built-up Industrial and Residential Areas

These areas include surface infrastructure such as roads and buildings (APPENDIX 2: FIGURE 6 and 7). Built-up areas generally are of little value to sensitive Red List bird species due to their degraded nature and the associated disturbance factor. They do however play an important role in providing safe refuge and foraging opportunities for small passerine species that have become common in urban environments.

TABLE 1 details the micro habitats that each of the Red List bird species (recorded by SABAP2) will typically frequent in the study area. It must be stressed that birds can and will, by virtue of their mobility, utilise almost any areas in a landscape from time to time. However, the analysis in TABLE 1 represents each species' most preferred or normal habitats. These locations are where most of the birds of that species will spend most of their time which in turn provides an indication of where impacts on those species will be most significant.

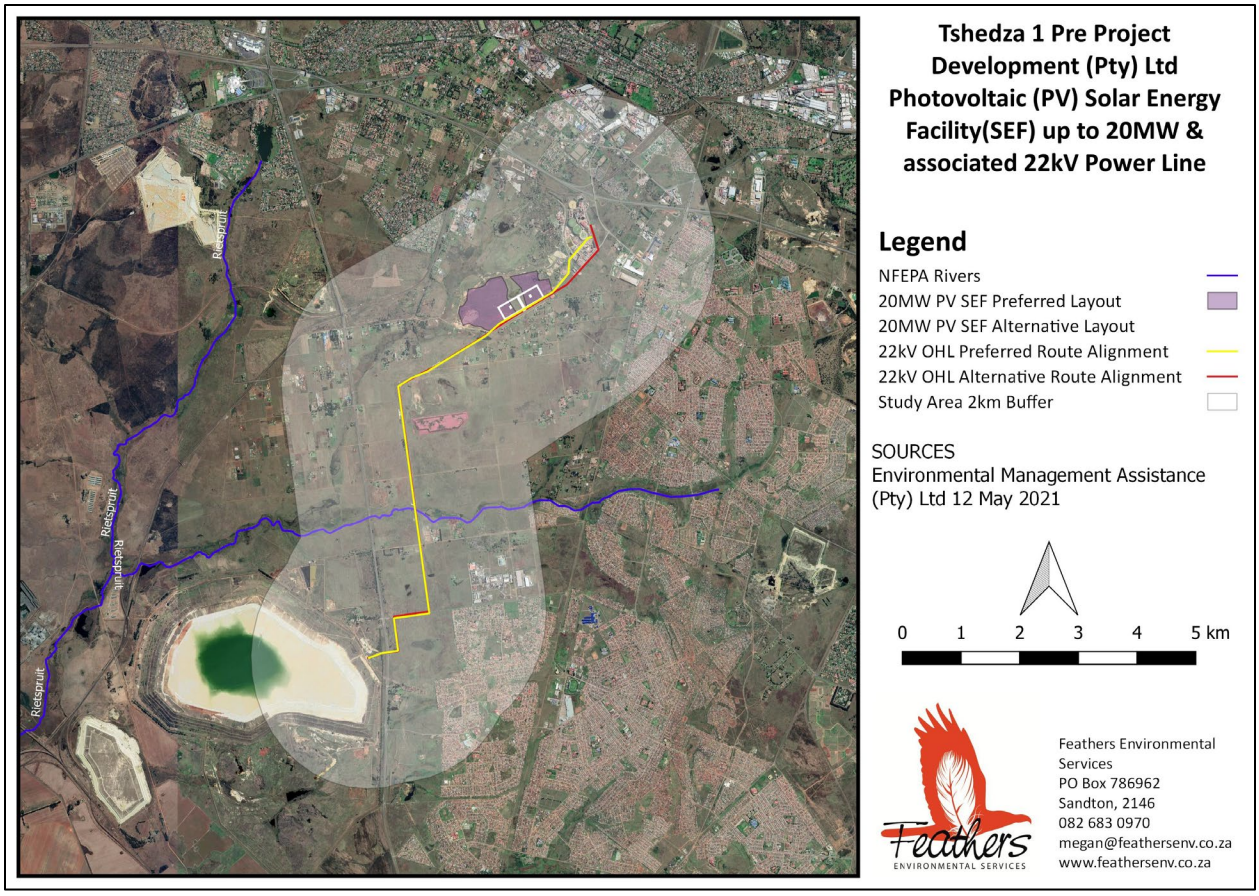

FIGURE 6: Regional map detailing the perennial, non-perennial rivers and wetlands occurring at the proposed development site and within the broader study area.

6. GENERAL DESCRIPTION OF BIRD INTERACTIONS WITH ELECTRICITY GENERATION & POWER LINE INFRASTRUCTURE

The effects of any development 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 diversity of species present. The principal areas of concern for Red List and non-Red List priority species related to the proposed SEF development are listed below and presented in TABLE 1:

* Displacement due to habitat loss in the physical infrastructure (SEF and its associated infrastructure, and the 22kV power line footprint;
* Displacement due to disturbance associated with construction and operation/maintenance of the proposed SEF development and the 22kV power line;
* Mortality due to collision with the PV panels;
* Mortality due to collision with the earthwires and/or conductors of the 22kV power line;

* Mortality due to electrocution on the 22kV power line infrastructure; and
* Displacement due to habitat loss as a result of altered run-off and the use of chemical pollutants

6.1 Displacement as a result of habitat loss or transformation

This impact is dependent on various factors i.e., the location and the scale of the facility, the amount of habitat affected; the uniqueness of the habitat; and the sensitivity and conservation status of the bird species utilizing that habitat. Areas of habitat may be cleared to accommodate the considerable amount of infrastructure required, reducing the amount of habitat available to birds for foraging, roosting and breeding (Smallie, 2013). Typically, PV panels occupy a surface area of approximately 2-5ha per MW according to Ong *et al*, 2013 and Hernandez *et al,* 2014 or approximately 1.4 to 6.2ha per MW according to US Department of Energy 2012 and together with the associated roads, substations, offices and its ancillary grid connection, SEFs occupy a relatively large amount of land and represent a significant anthropogenic land use in any environment (Walston *et al*, 2015). This impact is likely to have dire consequences for the smaller bird species with small home ranges as entire territories could be removed during construction activities.

In a study comparing the avifaunal habitat use within PV arrays versus the adjoining managed grassland at airports in the USA, DeVault et al. (2014) found that species diversity within the PV arrays was reduced (37) compared to the grasslands (46), supporting the view that solar development is generally detrimental to wildlife on a local scale. A local case study aimed at identifying the functional and structural changes in bird communities in and around the development footprint of the 180ha Jasper PV solar facility in the Northern Cape (Visser, 2016), revealed that bird density and diversity per unit area was higher in the boundary and untransformed landscape. However, the extent was not considered to be statistically significant and therefore suggests that the PV facility matrix is pervious to most species. A key finding of this study was that the distribution of birds in the landscape changed, in response to changes in the distribution and abundance of habitat resources such as food, water and nesting sites. These changes in resource availability were detrimental to shrubland specialists, but in contrast, open country, grassland and generalist species, were favoured by the changes brought about by the development (Visser 2016).

The grassland vegetation present at the proposed SEF site is subject to significant existing disturbance. It is therefore unlikely to support the more sensitive grassland species listed in TABLE 4-1, including African Grass-Owl identified by the national web based environmental screening tool and any habitat loss impacts that may occur are likely to only affect local bird populations. Unfortunately, due to the nature of this impact, it would be extremely difficult to mitigate and therefore the significance of the impact cannot be reduced to negligible levels. The displacement impact on the local avifauna as a result of habitat loss is rated to be of **LOW** significance as far as Red List species are concerned.

6.2 Displacement as a result of disturbance

Construction of energy generation facilities requires a significant amount of machinery and labour to be present on site for a period of time. For most bird species, construction activities are likely to be a cause of temporary disturbance and will impact on foraging, breeding and roosting behaviors. However, for shy, sensitive species or ground nesting birds, construction activities in close proximity to breeding locations, could be a source of disturbance resulting in temporary breeding failure or even permanent abandonment of nests and displacement from the site entirely. In addition, species commuting around the area may become disorientated, avoid the site and fly longer distances than usual as a result, and for some species this may have critical energy implications (Smallie, 2013). Similarly, but to a lesser extent, ongoing maintenance activities at the operational facility, are likely to cause some degree of disturbance to birds in the general vicinity.

The broader study area is already subjected to a fairly significant degree of disturbance associated with mining and urbanisation in the immediate vicinity of the proposed development. In addition, no nests or species exhibiting breeding behavior (specifically African Grass-Owl and other raptors) were observed during the site visits. While development in this area will undoubtedly displace some species, based on the proposed development footprint, the bird species likely to occupy this area, and the fact that similar habitat is available within the broader study area, displacement as a result of habitat transformation is unlikely to be permanent and of national significance. Impacts of LOW significance are probable.

6.3 Mortality due to collisions with the PV panels (impact trauma)

This impact refers to collision-related fatality i.e. fatality resulting from the direct contact of the bird with a project structure(s). This type of fatality has been occasionally documented at solar projects of all technology types (McCrary *et al*. 1986; Hernandez *et al*. 2014; Kagan *et al*. 2014). In some instances, the bird is not killed outright by the collision impact, but succumbs to predation later, as it cannot avoid predators due to its injuries.

Sheet glass used in commercial and residential buildings has been well established as a hazard for birds. When the sky is reflected in the sheet glass, birds fail to see the building as an obstacle and attempt to fly through the glass, mistaking it for empty space. Although very few cases have been reported it is possible that the reflective surfaces of solar panels could constitute a similar risk to avifauna. An extremely rare but potentially related problem is the so-called "lake effect" where reflections from solar facilities' infrastructure, particularly large sheets of dark blue PV panels, may attract birds in flight, who mistake the broad reflective surfaces for water (Kagan et al. 2014).

The results of mortality searches at various solar facilities in the USA (all technology types), suggest that impact trauma ranks as the highest identifiable cause of avian mortality (Harvey & Associates 2014a and 2014b, Kagan et al. 2014 and Walston *et al*. 2015). The unusually high percentage of waterbird mortalities at the Desert Sunlight PV facility (44%) may support the "lake effect" hypothesis (West 2014). Although in the case of Desert

Sunlight, the proximity of evaporation ponds may act as an additional risk increasing factor, in that birds are both attracted to the water feature and habituated to the presence of an accessible aquatic environment in the area. This may translate into the misinterpretation of diffusely reflected sky or horizontal polarised light source as a body of water. However, due to limited data it would be premature to make any general conclusions about the influence of the lake effect or other factors that contribute to fatality of water-dependent birds. The activity and abundance of water-dependent species near solar facilities may depend on other site-specific or regional factors, such as the surrounding landscape (Walston *et al*. 2015). However, until such time as enough scientific evidence has been collected to discount the "lake effect" hypothesis, it must be considered as a potential source of impact.

The only scientific investigation of potential avifaunal impacts that has been performed at a South African PV facility was conducted at the Jasper PV solar facility in the Northern Cape Province (Visser 2016). The Jasper PV facility contains 325 360 solar panels over a footprint of 180ha. Mortality surveys were conducted over a three-month period, with a total of seven mortalities recorded among the solar panels which gives an average rate of 0.003 birds per hectare surveyed per month. All fatalities were inferred from feather spots. The study concluded inter alia that the short study period, and lack of comparable results from other sources made it difficult to provide a meaningful assessment of avian mortality at PV facilities. It further stated that despite these limitations, the few bird fatalities that were recorded might suggest that there is no significant collision-related mortality at the study site (Visser 2016).

It is important to understand that bird abundance and flight activity levels differ according to habitat availability, and other natural features. Therefore the impact on birds through direct fatality is very site specific. The priority species that may occur in the study area which could potentially be exposed to collision risk are listed in TABLE 1. In addition, the so-called "lake effect" could act as a potential attraction to numerous waterbird species recorded in the broader study area. It is also important to note, that in order to increase solar panel efficiency and power output, most solar panels are treated with an anti-reflective coating which may mitigate this impact. It is not possible to determine whether this impact will occur until operational monitoring reveals actual mortalities at the proposed SEF. Impacts of **LOW** significance are probable.

6.4 Mortality due to electrocution on the 22kV power line infrastructure

Electrocution refers to the scenario where a bird is perched or attempts to perch on the electrical structure and causes an electrical short circuit by physically bridging the air gap between live components and/or live and earthed components (van Rooyen 2004). Electrocution risk is strongly influenced by the power line voltage of the and design of the tower structure and mainly affects larger, perching species that are capable of spanning the spaces between energized components. This is particularly likely when more than one bird attempts to sit on the same pole, a behaviour that is typical of gregarious species when perching or roosting. Relevant to this

project, ibis and herons may be susceptible to this impact The risk of electrocution on the proposed power line poles is evaluated to be of LOW significance.

6.5 Mortality due to collision with the overhead 22kV power line conductors

Collisions are the biggest single threat posed by power lines to birds in southern Africa (van Rooyen 2004). Most heavily impacted upon are bustards, storks, cranes and various species of waterbirds. These species are mostly heavy-bodied birds with limited maneuverability, which makes it difficult for them to take the necessary evasive action to avoid colliding with power lines (van Rooyen 2004, Anderson 2001). Unfortunately, many of the collision sensitive species are considered threatened in southern Africa. A potential impact of the proposed 22kV power lines is collisions with the overhead conductors. Quantifying this impact in terms of the likely number of birds that will be impacted, is very difficult because a number of variables play a role in determining the risk, for example weather, rainfall, wind, age, flocking behaviour, power line height, light conditions, topography, population density and so forth. However, from incidental record keeping by the Endangered Wildlife Trust: Wildlife & Energy Programme it is possible to give a measure of what species are likely to be impacted upon (see FIGURE 8 below - Jenkins et al. 2010). This only gives a measure of the general susceptibility of the species to power line collisions, and not an absolute measurement for any specific line.

Relevant to this development, collisions are likely to be linked to specific habitat types and/or specific sets of circumstances potentially involving Red List species, but more likely ibises, egrets and herons that are likely to utilise the study area, particularly along sections of the proposed alignment that traverse the open grassland patches and near waterbodies. This impact is rated to be of LOW significance.

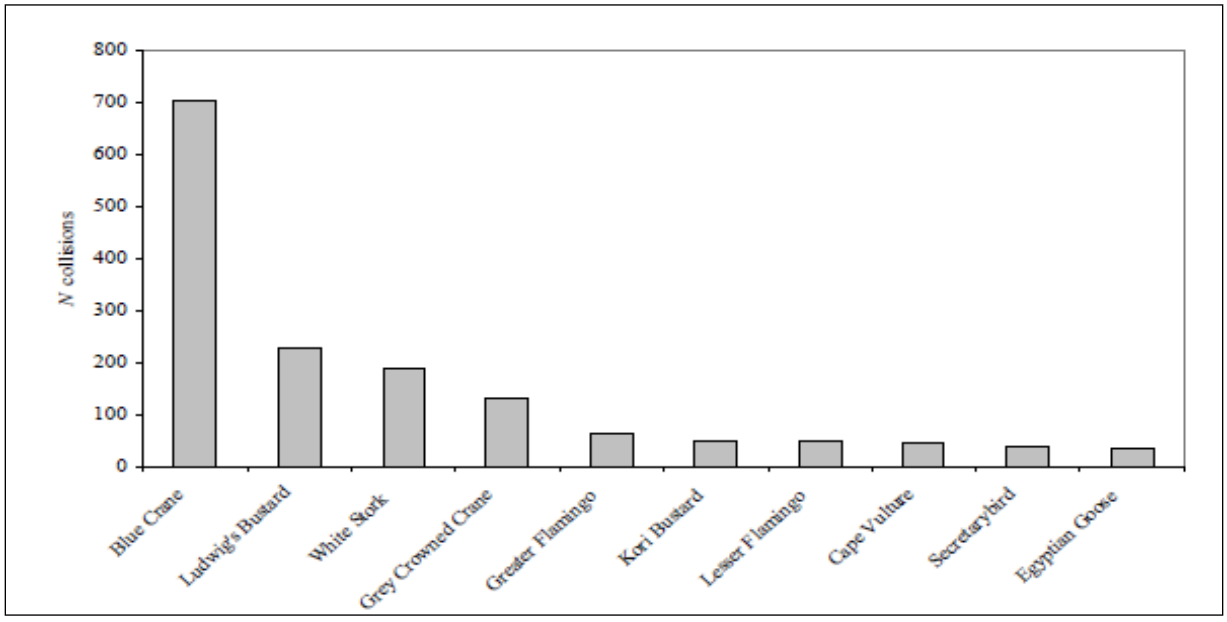

FIGURE 7: The top ten collision prone bird species in South Africa, in terms of reported incidents contained in the Eskom/EWT Strategic Partnership central incident register 1996 - 2007 (Jenkins et al. 2010)

6.6 Altered Runoff & Chemical Pollution

The transformation of the site surface from natural vegetation to infrastructure alters the manner in which water moves on the site after rainfall and cleaning of infrastructure. If this is not carefully managed this could cause soil erosion reducing the remaining bird habitat further by affecting off site areas. Increased runoff could also create moister conditions on or near the site thereby attracting more birds to the area and increasing the likelihood of other interactions with the facility.

Jenkins *et al,* 2017 suggests that pollution could occur if hazardous chemicals are used to clean PV panels once operational. This could have secondary effects on vegetation, invertebrate populations and in turn food availability and habitat for birds.

These impacts are rated to be of LOW significance.

6.7 Nesting

Various bird species are quick to seize a new opportunity for perching, roosting or nesting, including on man-made structures (van Rooyen & Ledger 1999, de Goede 2011 and de Goede & Jenkins 2001). Relevant to the proposed SEF, passerine and corvid species are likely to use certain parts of the proposed facility once commissioned. Whilst nesting could be viewed as a positive impact for birds, it can result in operational problems for the facility. An increase in the number of birds roosting, nesting and feeding at the facility could lead to increased defecation on the solar infrastructure causing panel obstruction requiring management actions such as nest management in order to ensure that the nests don't interfere with operations or increase fire risk. Nest relocation or removal should be done under permit from the provincial authority. It is also likely that some small species will use the PV panels for shade and this will create a new microhabitat on the site. This should not adversely affect the operation of the equipment however and should also not lead to direct mortalities by these small species.

7. SENSITIVITY MAPPING

At both a landscape and site-specific level, the avifaunal sensitivity of the proposed PV SEF site is considered to be LOW. Sensitive features present within the proposed study area include the river systems, waterbodies and wetland areas to the north of the proposed SEF site boundary. The river and wetlands have been buffered by a conservative 80m and assigned a medium sensitivity rating. Ordinarily, rivers and wetland systems would be assigned a higher sensitivity rating given their importance in terms of avifauna. However, owing to the fact that these habitats are subject to existing disturbances, but still have some degree of connectivity with other ecosystems, a medium sensitivity has been allocated. The remainder of the study area (particularly the area earmarked for the proposed development) is comprised of rehabilitated grassland habitat in some parts and

heavily transformed habitat in other parts and is therefore considered to be of low sensitivity. A map delineating these areas is provided below (FIGURE 8).

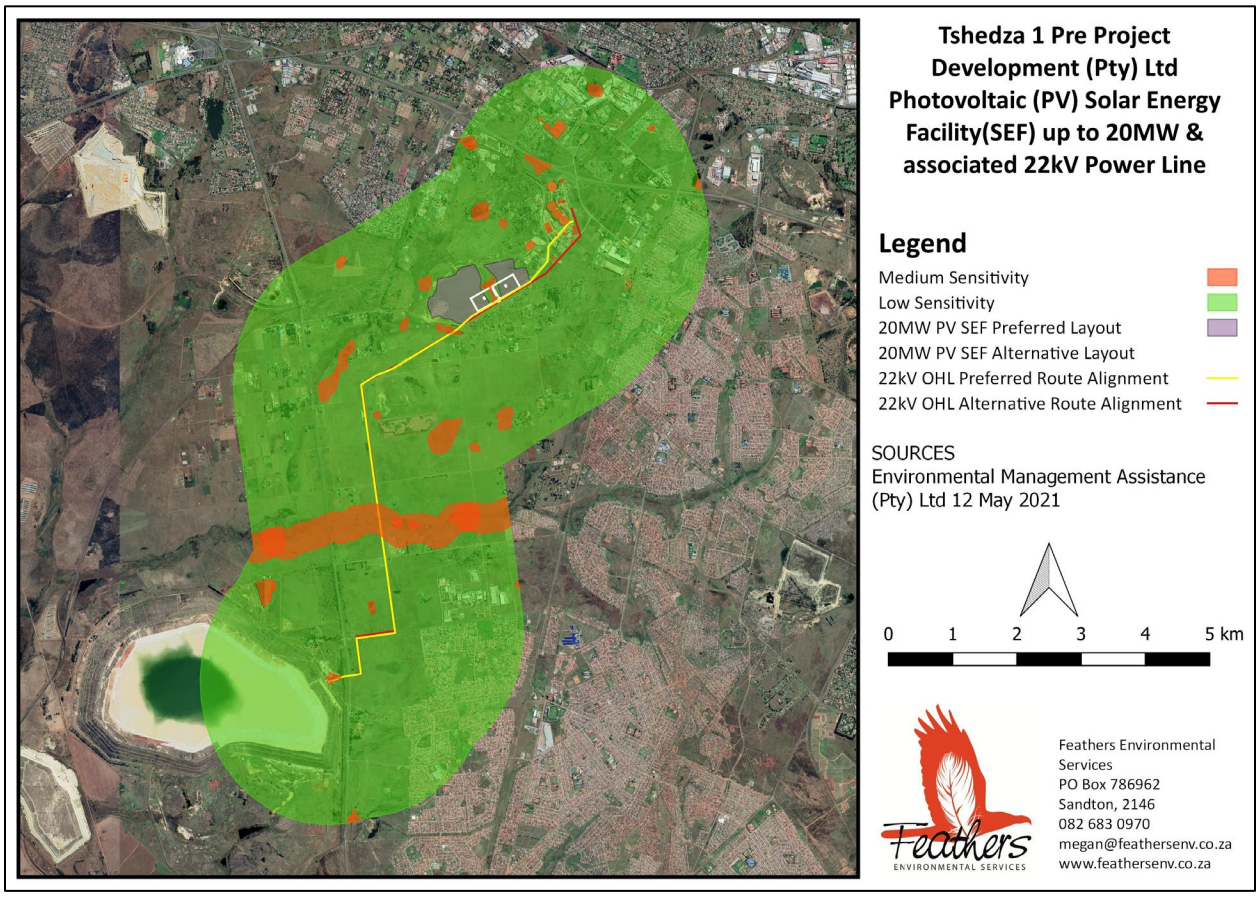

FIGURE 8: Avifaunal sensitivity map. Medium sensitivity areas are denoted in orange and low sensitivity areas are represented in green.

8. IDENTIFICATION OF A PREFERRED ALTERNATIVE

One of the objectives of this study is to determine the Solar PV site and 22kV overhead power line alternative that poses the least impact to the avifaunal community, particularly the sensitive Red List avifauna present within the study area.

The two alternatives that have been proposed for the SEF and the 22kV power line i.e. Preferred Layout/Route Alignment and Alternative Layout/Route Alignment occur within the same pentad. They are comprised of identical vegetation units and are subjected to similar land use practices and therefore likely to be identical in terms of species diversity and density too. With this in mind, the selection of a preferred Site Layout and Route Alignment has been determined using observations of available micro habitat (specifically waterbody and

wetland areas and drainage lines), species composition and the location of the Site Layouts and Route Alternatives in relation to existing infrastructure.

With regards to the PV SEF site location, the Preferred Layout avoids the drainage line and the small dam that are confined within and located adjacent to the northern boundary of the Alternative Layout respectively. The Preferred Layout also contains areas that are heavily transformed and subject to significant levels of existing habitat degradation and disturbance. It is on this basis that the **Preferred Layout is considered to pose the least impact** to the resident avifaunal community.

In terms of the 22kV OHL, the Preferred Route Alignment and the Alternative Route Alignment are largely identical except for the portion to the north east of the PV facility. The Preferred Route Alignment traverses across the Ergo Mining (Pty) Ltd Brakpan Plant, supplying the generated power directly into the Ergo Mining (Pty) Ltd Brakpan Plant Substation and not the Eskom Substation to the north of the plant. Although both route alignments are located in areas that are subject to existing levels of habitat transformation and disturbance, that are likely to preclude the presence of Red-List collision prone species, the **Preferred Route Alignment is likely to pose less of a collision risk** given the shorter length of line and its orientation within the Ergo Mining (Pty) Ltd Brakpan Plant.

9. ASSESSMENT OF EXPECTED IMPACTS

A quantitative methodology was used to describe, evaluate and rate the significance of the aforementioned impacts associated with the construction, operation and decommissioning of the proposed SEF and its ancillary infrastructure. This assessment is presented in tabular format below for both pre- and post-mitigation according to set criteria described in APPENDIX 3. The potential impacts of the proposed SEF and its ancillary infrastructure on the avifaunal community have been assessed separately given the characteristics of each development.

In general, the site has been determined to have a **LOW** sensitivity in terms of avifauna, based on the anticipated presence of priority species in the study area, the various micro-habitats available to avifauna in the broader study area, and the current levels of disturbance.

TABLE 5 Assessment of the habitat loss and/or transformation caused by the construction of the SEF and its associated 22kV power line

Activity:		Construction of the SEF and 22kV Power Line				
Impact:		Displacement of Red List species as a result of habitat loss & transformation				
Significance rating:		Duration	Extent	Magnitude	Probability	Significance
Preferred Layout & Route Alignment	Pre-Mitigation	4	1	4	3	27
	Post-Mitigation	4	1	2	2	14
Alternative Layout & Route Alignment	Pre-Mitigation	4	1	4	4	36
	Post-Mitigation	4	1	2	3	21
Is the Impact Reversible?		• Low reversibility - The construction of the infrastructure will require the complete eradication of the vegetation within the project footprint				
Mitigation Measures:		• Given the disturbed nature of the habitat and the absence of unique habitat features at the proposed development site, there is no specific mitigation required. • Construction activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species • All construction activities should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment. • All temporary disturbed areas should be rehabilitated according to the site's rehabilitation plan, following construction.				
Cumulative impacts:		• The surrounding area is already heavily transformed as a result of industrial and urban activities. Although relatively small in size, the proposed development site does contain grassland and wetland habitats that are important to a variety of waterbird and passerine species and therefore the cumulative impact is deemed to be of moderate significance.				
Residual impacts:		• Smaller passerine species may return once the construction activity is completed and the site rehabilitated, but it is unlikely that the numbers will recover to those recorded prior to the development due to the significant habitat transformation that will take place.				
Climate Change:		• N/A				

TABLE 6 Assessment of the disturbance impact caused by the construction of the SEF and its associated 22kV power line

Activity:		Construction of the SEF and 22kV Power Line				
Impact:		Displacement of Red List species as a result of disturbance				
Significance rating:		Duration	Extent	Magnitude	Probability	Significance
Preferred Layout & Route Alignment	Pre-Mitigation	1	2	4	3	21
	Post-Mitigation	1	2	2	2	10
Alternative Layout & Route Alignment	Pre-Mitigation	1	2	6	4	36
	Post-Mitigation	1	2	4	3	21
Is the Impact Reversible?		• High reversibility - After the construction activities, have ceased, the source of displacement will disappear.				
Mitigation Measures:		• All construction activities should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment. • Construction activity should be restricted to the immediate footprint of the infrastructure. • Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of Red Data species. • Measures to control noise should be applied according to current best practice in the industry.				
Cumulative impacts:		• In addition to the proposed PV SEF arrays, there are several activities (i.e. mining, light industrial and urbanisation) that feature prominently both within the development zone and the broader study area - a significant source of existing disturbance. These activities, coupled with the limited habitat diversity and degradation within the proposed development site, are a likely cause of the absence of Red List species within the development zone. Those species that have persisted have undoubtedly developed a tolerance for the current levels of disturbance and are likely to persist within the broader area despite the development of the SEF.				
Residual impacts:		• The majority of species observed in the study area may return once the construction activity is completed				
Climate Change:		• N/A				

TABLE 7 Assessment of mortality due to collision with the PV panels

Activity:	Operation of the SEF				
Impact:	Mortality at PV facility (impact trauma on PV panels)				
Significance rating:	Duration	Extent	Magnitude	Probability	Significance
Pre-Mitigation	4	2	4	2	20
Post-Mitigation	4	2	2	2	16
Is the Impact Reversible?	• High reversibility - If the PV SEF is de-commissioned the collision risk will disappear				
Mitigation Measures:	• The PV panels should spend as little time as possible in a vertical position as this presents a greater collision hazard. It is not clear at this stage whether the panels will be at a fixed tilt or utilise single axis tracking. • An operational monitoring programme, that includes carcass searches to provide an indication of fatality rates as a result of collisions, and if there are any spatial, temporal or conditional patterns to the frequency of collisions. • Most importantly, operational monitoring should highlight if mitigation (i.e. modifications to the panel design to reduce the illusionary characteristics of the panels) is required to reduce impacts to acceptable levels.				
Cumulative impacts:	• An extensive power line network features prominently within the immediate vicinity of the proposed study area. The addition of reflective PV panels will potentially increase the collision risk. Collisions with the proposed PV panels will have a medium cumulative impact.				
Residual impacts:	• It is envisaged that mitigation, if required, will reduce but not eliminate collision mortality.				
Climate Change:	• N/A				

TABLE 8 Assessment of mortality due to collision with the earthwires and/or conductors of the 22kV power line

Activity:	Operation of the 22kV power line				
Impact:	Mortality due to collision with the 22kV power line				
Significance rating:	Duration	Extent	Magnitude	Probability	Significance
Pre-Mitigation	4	2	4	2	20
Post-Mitigation	4	2	2	1	8
Is the Impact Reversible?	• High reversibility - If the 22kV power line is mitigated and/or de-commissioned the collision risk will disappear				
Mitigation Measures:	• Mitigation is complex at electrical structures since there are many factors that contribute to collisions with overhead power. It is therefore recommended that mitigation be applied reactively once the 22kV power line is operational, only if a significant problem is detected. Monitoring of this infrastructure for bird fatalities should be built into the operational environmental management plan for the SEF and its associated ancillary infrastructure.				
Cumulative impacts:	• An extensive power line network features prominently within the immediate vicinity of the proposed study area. Any additional power lines will potentially increase the collision risk to power line sensitive species (i.e. large terrestrial species and various waterfowl species) that may be present the broader study area and therefore collisions with the proposed grid connection will have a medium cumulative impact.				
Residual impacts:	• Mitigation will reduce but not entirely eliminate collision mortality				
Climate Change:	• N/A				

TABLE 9 Assessment of mortality due to electrocution on the 22kV power line infrastructure

Activity:	Operation of the 22kV power line				
Impact:	Mortality due to electrocution on the 22kV power line infrastructure				
Significance rating:	Duration	Extent	Magnitude	Probability	Significance
Pre-Mitigation	4	2	4	2	20
Post-Mitigation	4	2	2	1	8
Is the Impact Reversible?	• High reversibility - If the 22kV power line is mitigated and/or de-commissioned the electrocution risk will disappear				
Mitigation Measures:	• The 22kV power line must be constructed using a bird friendly structure (i.e. Inverted Delta-T Structure) • Additional mitigation in the form of insulating sleeves on *jumpers* present on strain poles, terminal poles and box transformers should also be considered. • Post construction monitoring to include power line surveys to evaluate electrocution mortality and assess the efficacy of mitigation measures.				
Cumulative impacts:	• An extensive power line network features prominently within the immediate vicinity of the proposed study area. Any additional power lines will potentially increase the electrocution risk to power line sensitive species (i.e. storks, ibis and herons) that may be present the broader study area and therefore electrocutions on the pole tops of the proposed grid connection will have a medium cumulative impact.				
Residual impacts:	• Mitigation will reduce electrocution mortality to negligible levels.				
Climate Change:	• N/A				

TABLE 10 Assessment of habitat impacts associated with altered run-off and chemical pollution

Activity:	Operation of the SEF and 22kV power line - particularly cleaning of the solar panels				
Impact:	Habitat loss associated with altered run-off and chemical pollution				
Significance rating:	Duration	Extent	Magnitude	Probability	Significance
Pre-Mitigation	4	2	4	2	20
Post-Mitigation	4	2	2	1	8
Is the Impact Reversible?	• High reversibility - a robust water management plan will eliminate habitat loss				
Mitigation Measures:	• This will need to be managed through the development of a carefully considered surface water/drainage management plan for the site. • The surface water management plan should stipulate the use of environmentally friendly and acceptable cleaning products.				
Cumulative impacts:	• The surrounding area is already heavily transformed as a result of industrial and urban activities. Although relatively small in size, any additional loss of habitat as a result of altered runoff and the use of chemical pollutants is deemed to have a medium cumulative impact.				
Residual impacts:	• Smaller passerine species may return once the construction activity is completed and the site rehabilitated.				
Climate Change:	• N/A				

10. CUMULATIVE IMPACT

Cumulative effects are commonly understood to be impacts from different projects that combine to result in significant change, which could be larger than the sum of all the individual impacts. The cumulative impacts have been assessed below, according to the guidance offered by the DEA (DEAT (2004) Cumulative Effects Assessment, Integrated Environmental Management, Information Series 7, Department of Environmental Affairs and Tourism (DEAT), Pretoria) and IFC guidelines (Good Practice Handbook - Cumulative Impact Assessment and Management: Guidance for the Private Sector in Emerging Markets"(International Finance Corporation)) on this matter.

Specifically, the steps undertaken in the cumulative impact assessment section of the study were as follows:

* Define and assess the impacts of the PV SEF project. *See Section 6.1 to 6.7.*
* Identify and obtain details for all operational and authorised overhead power lines and SEFs (within a 30km radius of PV SEF activities). *Two solar projects are approved within a 30km radius of the PV SEF (DEA online screening tool).*
* Identify impacts of the proposed PV SEF project which are also likely or already exist at the other projects. *All of the impacts described in Section 6.1 to 6.7 will occur on the other solar PV facilities. However the most important one of these impacts and the one which we know will definitely occur (i.e. some of the others are slightly speculative) is that of habitat destruction. The area of habitat which is altered or destroyed is also a good indicator of some of the other impacts. We have therefore used habitat destruction as the focus impact for the cumulative impact assessment. Habitat destruction is likely to be most significant for a suite of small passerine species.*
* Where possible obtain reports and data for other projects. *In most cases specialist avifaunal studies were not done. Ecological reports considered avifauna but not comprehensively.*
* As far as possible quantify the effect of all projects on key bird species local populations (defined and estimated). *Where the amount of habitat to be altered or destroyed has been specified in other project reports this has been used. See Table 11 for these figures.*
* Express the likely impacts associated with the PV SEF project as a proportion of the overall impacts on key species. *This analysis is presented in Table 11. PV SEF will represent 68% of the total habitat destruction across all solar projects. We have to assume that the importance of the habitat for the relevant bird species is uniform across all this habitat. In which case the PV SEF will contribute approximately 68% of the total impact of habitat destruction on birds. It is however important to note that our estimate is that all three projects will only take up 0.0087% of the total area within the 30km radius of the PV SEF site. Of this 0.0087% the PV SEF contributes 0.006%. In our view this is a small proportion of the broader landscape.*
* A reasoned overall opinion will be expressed on the suitability of the proposed development against the above background. This will include a cumulative impact assessment statement. *This has been presented below Table 11.*
* The decision making process with respect to the above will be clearly documented in the report. *This section.*
* Identified cumulative impacts must be clearly defined and where possible the size of the identified impact quantified and indicated. *See above and Table 11*
* Detailed process flow and proof must be provided to indicate how the specialists' recommendations, mitigation measures and conclusions from the various similar developments in the area were taken into consideration in the assessment of cumulative impacts and when the conclusion and mitigation measures were drafted for this project. *This section.*
* The cumulative impacts significance rating must also inform the need and desirability of the proposed development. *This has been addressed with the Cumulative Impacts Statement.*

* A cumulative impact environmental statement on whether the proposed development must proceed. *See below Table 11.*

TABLE 11. Summary information for the proposed solar facilities within 30km of the PV SEF.

Project	Capacity (MW)	Footprint (ha)	Proportion of total footprint of all projects	Proportion of 30km radius circle (282 743 hectares)
14/12/16/3/3/1/569	3MW	2	2.2%	0.0007%
14/12/16/3/3/2/706	unknown	6	6.8%	0.002%
20MW PV SEF (Preferred Layout)	up to 20MW	79.4	91%	0.028%
Total	**-**	**87.4ha**	**100%**	**0.0307%**

10.1 Cumulative Impact Statement

The proposed SEF will result in the removal of vegetation, albeit transformed rendering the area almost totally unavailable as habitat for birds. It stands to reason that the more land is transformed in this way the greater the impact on birds. The cumulative impact of multiple SEFs on birds is therefore negative. Given that we have assessed the impact of this proposed PV SEF to be of LOW significance for avifauna, the construction of multiple additional facilities will result in the overall cumulative impact being MODERATE.

11. MEASURES FOR INCLUSION IN THE ENVIRONMENTAL MANAGEMENT PROGRAMME

Based on the anticipated impacts described above the following recommendations are provided regarding practical mitigation measures for potentially significant impacts to be included in the draft Environmental Management Programme (EMPr).

OBJECTIVE: Assessment and mitigation of displacement and direct mortality impacts caused by the PV Solar Energy Facility (up to 20MW) and its associated 22kV power line infrastructure.

Project component/s	PV SEF including PV panels, cabling between project components, 22kV power line, access roads, various operations buildings.
Potential Impact	Permanent displacement and mortality of local populations of Red List and non-Red List species caused by habitat loss, disturbance, collisions with the PV panels and with the conductors of the 22kV overhead power line in addition to electrocution on the 22kV power line infrastructure.

Activity/risk source	• Construction of the PV SEF (up to 20MW) and its associated infrastructure within sensitive avifaunal habitat. • Unmitigated construction and operational activities.		
Mitigation: Target/Objective	No avifaunal mortality and displacement as far as practically possible for the duration of the operational life span of the PV SEF and its associated 22kV power line infrastructure.		
Mitigation: Action/control		Responsibility	Timeframe
Displacement (Habitat Loss or Transformation & Disturbance): * Construction activity should be restricted to the immediate footprint of the infrastructure. * Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of priority species. * All construction activities should be strictly managed according to generally accepted environmental best practice standards, so as to avoid any unnecessary impact on the receiving environment. * All temporary disturbed areas should be rehabilitated according to the site's rehabilitation plan, following construction. * Measures to control noise should be applied according to current best practice in the industry.		Solar PV Developer, Construction Manager, Environmental Control Officer and Avifaunal Specialist.	From the commencement of construction (inclusive of all project components to the completion of construction.
Collision Mortality (PV arrays): * The PV panels should spend as little time as possible time in a vertical position as this presents a greater collision hazard. It is not clear at this stage whether the panels will be at a fixed tilt or utilise single axis tracking. * An operational monitoring programme, that includes carcass searches to provide an indication of fatality rates as a result of collisions, and if there are any spatial, temporal or conditional patterns to the frequency of collisions. * Immediate mitigatory action to be taken upon record of first Red List species collision mortality. * If repeated (<5) collision impacts of non-Red List species are recorded once the SEF is operational, it is recommended that an		PV Solar Facility Developer, PV Solar Facility Environmental Manager, Environmental Control Officer and Avifaunal Specialist	Post construction monitoring should be conducted for a minimum three years of operation. Additional monitoring requirements will be determined following an assessment of the data collected over the three-year period.

avifaunal specialist investigate the mortalities and provide recommendations for site-specific mitigation to be applied reactively. * Most importantly, operational monitoring should highlight if mitigation (i.e. modifications to the panel design to reduce the illusionary characteristics of the panels) is required to reduce impacts to acceptable levels.		
Collision Mortality (22kV Power Line): * Immediate mitigatory action to be taken upon record of first Red List species collision mortality. * If repeated (<5) collision impacts of non-Red List species are recorded once the 22kV power line is operational, it is recommended that an avifaunal specialist investigate the mortalities and provide recommendations for site-specific mitigation to be applied reactively. * Monitoring of this infrastructure for bird fatalities should be built into the operational environmental management plan for the SEF and its associated ancillary infrastructure.	PV Solar Facility Developer, PV Solar Facility Environmental Manager, Environmental Control Officer and Avifaunal Specialist	Post construction monitoring should be conducted for a minimum three years of operation. Additional monitoring requirements will be determined following an assessment of the data collected over the three-year period.
Mortality as a result of electrocutions on the 22kV power line infrastructure * The 22kV power line must be constructed using a bird friendly structure (i.e. Inverted Delta-T Structure) * Additional mitigation in the form of insulating sleeves on *jumpers* present on strain poles, terminal poles and box transformers must be installed. * Immediate mitigatory action to be taken upon record of first Red List species electrocution mortality. * If repeated (<5) electrocution impacts of non-Red List species are recorded once the 22kV power line is operational, it is recommended that an avifaunal specialist investigate the mortalities and provide recommendations for site-specific mitigation to be applied reactively. * Post construction monitoring to include power line surveys to evaluate	PV Solar Facility Environmental Manager, Environmental Control Officer and Avifaunal Specialist	Post construction monitoring should be conducted for a minimum three years of operation. Additional monitoring requirements will be determined following an assessment of the data collected over the three-year period..

electrocution mortality and assess the efficacy of mitigation measures. If repeated impacts are recorded once the on-site substations are operational, it is recommended that an avifaunal specialist investigate the mortalities and provide recommendations for site-specific mitigation.		
Habitat loss associated with altered run-off and chemical pollution * A carefully considered surface water/drainage management plan for the site must be developed. * The surface water management plan must stipulate the use of environmentally friendly and acceptable cleaning products.	PV Solar Facility Environmental Manager, Environmental Control Officer and Avifaunal Specialist	Water management strategies to be developed prior to commissioning and implemented during the operational life span of the SEF and its associated 22kV power line infrastructure.
Nest building on PV and 22kV power line infrastructure: * If repeated quality of supply impacts are recorded once the SEF and 22kV power line are operational, it is recommended that these impacts be assessed by a suitably qualified avifaunal specialist and site-specific mitigation be applied reactively.	PV Solar Facility Environmental Manager, Environmental Control Officer and Avifaunal Specialist	Nest management strategies to be identified and implemented reactively, if required.
Performance Indicator	* Habitat loss is confined to the SEF footprint and rehabilitation results in the size and extent of habitat present at the start of construction remains intact at end of construction phase. * Sustainable levels of mortalities are reported on a monthly basis and the necessary mitigation measures are implemented.	
Monitoring	* Environmental Control Officer to ensure that construction activities are confined to the site footprint to avoid any additional impacts on bird species residing in the broader area. * Environmental manager and/or maintenance staff to conduct regular (preferably weekly) inspections of the PV arrays and the associated 22kV power line to record the number of mortalities, nesting activity and faecal matter fouling on solar PV panels and 22kV power line and determine the effectiveness of the mitigation actions taken.	

12. CONCLUSION AND IMPACT STATEMENT

In conclusion, the habitat within which the proposed study area is located is low to moderately sensitive from a potential bird impact perspective. In recent years, anthropogenic impacts, mostly in the form of mining and urbanisation have largely transformed the landscape resulting in a negative impact on avifaunal diversity and abundance with the study area. This is reflected in the low reporting rates for priority species, which may also indicate that levels of disturbance are high. The construction of the proposed PV SEF (up to 20MW) will result in impacts of LOW significance to birds occurring in the vicinity of the new infrastructure, which can be reduced to negligible levels through the application of mitigation measures. Given the presence of existing habitat degradation and disturbance, it is anticipated that the proposed PV SEF can be constructed within the **Preferred Layout** site and the 22kV overhead power line can be constructed along the **Preferred Route Alignment** with acceptable levels of impact on the resident avifauna subject to the following recommendations:

* Construction activities (i.e. all staff, vehicle and machinery) should be restricted to the immediate footprint of the infrastructure.
* Access to the remainder of the site should be strictly controlled to prevent unnecessary disturbance of avifaunal species.
* Care should be taken not to introduce or propagate alien plant species/weeds during construction.
* Mitigation is complex at electrical structures since there are many factors that contribute to collisions with overhead power lines and electrocutions on the power line hardware. It is therefore recommended that mitigation be applied reactively once the SEF and power line are operational, only if a significant problem is detected. Monitoring of this infrastructure for bird fatalities should be built into the operational environmental management programme for the facility.
* A carefully considered surface water/drainage management plan must be developed for the site including attention to the use of environmentally friendly cleaning chemicals.
* Maximum use should be made of existing access roads and the construction of new roads should be kept to a minimum.
* In addition to this, the normal suite of environmental good practices should be applied, such as ensuring strict control of staff, vehicles and machinery on site and limiting the creation of new roads as far as possible.

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APPENDIX 1: SOUTH AFRICAN BIRD ATLAS PROJECT DATA (SABAP2) FOR THE PROPOSED PROJECT

Family Name	Scientific Name	Red Data Global	Red Data Regional	Endemicity South Africa	Endemicity Southern Africa	Average Report Rate	No. of Records
Apalis, Bar-throated	Apalis thoracica					0.1	1
Avocet, Pied	Recurvirostra avosetta					8.7	103
Babbler, Arrow-marked	Turdoides jardineii					0.5	6
Barbet, Acacia Pied	Tricholaema leucomelas				Near-endemic	0.3	4
Barbet, Black-collared	Lybius torquatus					42.4	504
Barbet, Crested	Trachyphonus vaillantii					74.3	884
Batis, Chinspot	Batis molitor					0.2	2
Bee-eater, White-fronted	Merops bullockoides					0.3	4
Bee-eater, European	Merops apiaster					1.3	15
Bishop, Yellow	Euplectes capensis					0.2	2
Bishop, Yellow-crowned	Euplectes afer					13.6	162
Bishop, Southern Red	Euplectes orix					81.2	966
Bittern, Little	Ixobrychus minutus					3.7	44
Bokmakierie	Telophorus zeylonus				Near-endemic	1.1	13
Boubou, Southern	Laniarius ferrugineus				Endemic	7.4	88
Brubru	Nilaus afer					0.1	1
Bulbul, African Red-eyed	Pycnonotus nigricans				Near-endemic	1.0	12
Bulbul, Dark-capped	Pycnonotus tricolor					82.4	981
Bunting, Cape	Emberiza capensis				Near-endemic	0.1	1
Bunting, Cinnamon-breasted	Emberiza tahapisi					0.2	2
Buttonquail, Kurrichane	Turnix sylvaticus					0.2	2
Buzzard, Jackal	Buteo rufofuscus			Near endemic	Endemic	0.2	2
Buzzard, Steppe	Buteo buteo					0.7	8
Canary, Cape	Serinus canicollis				Endemic	0.1	1
Canary, Yellow-fronted	Crithagra mozambica					1.1	13
Canary, Yellow	Crithagra flaviventris				Near-endemic	11.5	137
Canary, Black-throated	Crithagra atrogularis					31.6	376

Family Name	Scientific Name	Red Data Global	Red Data Regional	Endemicity South Africa	Endemicity Southern Africa	Average Report Rate	No. of Records
Chat, Familiar	Cercomela familiaris					0.3	4
Chat, Anteating	Myrmecocichla formicivora				Endemic	1.7	20
Cisticola, Lazy	Cisticola aberrans					0.1	1
Cisticola, Rattling	Cisticola chiniana					0.2	2
Cisticola, Desert	Cisticola aridulus					1.5	18
Cisticola, Wing-snapping	Cisticola ayresii					2.4	29
Cisticola, Zitting	Cisticola juncidis					21.8	259
Cisticola, Levaillant's	Cisticola tinniens					48.4	576
Cisticola, Cloud	Cisticola textrix			Near endemic	Near-endemic	6.5	77
Cliff-swallow, South African	Petrochelidon spilodera			Breeding-endemic	Breeding-endemic	1.6	19
Coot, Red-knobbed	Fulica cristata					86.0	1,023
Cormorant, Cape	Phalacrocorax capensis	EN	EN		Breeding-endemic	0.1	1
Cormorant, White-breasted	Phalacrocorax lucidus					53.7	639
Cormorant, Reed	Phalacrocorax africanus					66.7	794
Coucal, Burchell's	Centropus burchellii				Near-endemic	6.5	77
Crake, African	Crecopsis egregia					0.1	1
Crake, Corn	Crex crex					0.1	1
Crake, Black	Amaurornis flavirostra					9.1	108
Crow, Cape	Corvus capensis					0.1	1
Crow, Pied	Corvus albus					34.6	412
Cuckoo, Jacobin	Clamator jacobinus					0.1	1
Cuckoo, Klaas's	Chrysococcyx klaas					0.1	1
Cuckoo, Diderick	Chrysococcyx caprius					15.8	188
Cuckoo, Red-chested	Cuculus solitarius					6.6	79
Darter, African	Anhinga rufa					54.3	646
Dove, Namaqua	Oena capensis					0.5	6
Dove, Rock	Columba livia					71.5	851
Dove, Red-eyed	Streptopelia semitorquata					90.2	1,073

Family Name	Scientific Name	Red Data Global	Red Data Regional	Endemicity South Africa	Endemicity Southern Africa	Average Report Rate	No. of Records
Dove, Laughing	Streptopelia senegalensis					95.0	1,13
Drongo, Fork-tailed	Dicrurus adsimilis					0.3	4
Duck, Unidentified	N/A N/A					0.1	1
Duck, Comb	Sarkidiornis melanotos					0.4	5
Duck, Mandarin	Aix galericulata					0.7	8
Duck, Hybrid Mallard	Anas hybrid					0.8	9
Duck, Maccoa	Oxyura maccoa	NT	NT			10.8	128
Duck, Domestic	Anas platyrhynchos					2.9	35
Duck, White-backed	Thalassornis leuconotus					3.3	39
Duck, African Black	Anas sparsa					4.0	48
Duck, White-faced	Dendrocygna viduata					45.9	546
Duck, Fulvous	Dendrocygna bicolor					5.5	65
Duck, Mallard	Anas platyrhynchos					5.6	67
Duck, Yellow-billed	Anas undulata					55.6	662
Eagle, Martial	Polemaetus bellicosus	VU	EN			0.1	1
Eagle, Long-crested	Lophaetus occipitalis					0.3	3
Eagle-owl, Spotted	Bubo africanus					1.3	15
Egret, Little	Egretta garzetta					11.8	140
Egret, Great	Egretta alba					2.0	24
Egret, Yellow-billed	Egretta intermedia					4.4	52
Egret, Cattle	Bubulcus ibis					46.4	552
Falcon, Peregrine	Falco peregrinus					0.1	1
Falcon, Lanner	Falco biarmicus	LC	VU			0.4	5
Falcon, Amur	Falco amurensis					6.4	76
Finch, Red-headed	Amadina erythrocephala				Near-endemic	39.8	474
Firefinch, Red-billed	Lagonosticta senegala					0.1	1
Fiscal, Common	Lanius collaris					78.7	936
Fish-eagle, African	Haliaeetus vocifer					0.6	7

Family Name	Scientific Name	Red Data Global	Red Data Regional	Endemicity South Africa	Endemicity Southern Africa	Average Report Rate	No. of Records
Flamingo, Lesser	Phoeniconaias minor	NT	NT			13.9	166
Flamingo, Greater	Phoenicopterus roseus	LC	NT			34.1	406
Flufftail, Red-chested	Sarothrura rufa					0.5	6
Flycatcher, Fairy	Stenostira scita			Near endemic	Endemic	0.1	1
Flycatcher, Spotted	Muscicapa striata					0.8	9
Flycatcher, Fiscal	Sigelus silens			Near endemic	Endemic	11.1	132
Francolin, Orange River	Scleroptila gutturalis					0.5	6
Go-away-bird, Grey	Corythaixoides concolor					68.7	817
Godwit, Bar-tailed	Limosa lapponica	NT	LC			2.9	34
Goose, Domestic	Anser anser					13.4	159
Goose, Spur-winged	Plectropterus gambensis					41.1	489
Goose, Egyptian	Alopochen aegyptiaca					89.9	1,07
Goshawk, Gabar	Melierax gabar					0.3	3
Grassbird, Cape	Sphenoeacus afer			Near endemic	Endemic	0.3	3
Grebe, Black-necked	Podiceps nigricollis					1.1	13
Grebe, Great Crested	Podiceps cristatus					24.9	296
Grebe, Little	Tachybaptus ruficollis					53.4	635
Green-pigeon, African	Treron calvus					0.7	8
Greenshank, Common	Tringa nebularia					2.3	27
Guineafowl, Helmeted	Numida meleagris					69.8	831
Gull, Hartlaub's	Chroicocephalus hartlaubii				Endemic	0.1	1
Gull, Kelp	Larus dominicanus					0.2	2
Gull, Lesser Black-backed	Larus fuscus					1.0	12
Gull, Grey-headed	Chroicocephalus cirrocephalus					86.3	1,027
Hamerkop	Scopus umbretta					1.0	12
Harrier-Hawk, African	Polyboroides typus					2.4	28
Heron, Green-backed	Butorides striata					0.9	11
Heron, Squacco	Ardeola ralloides					15.8	188

Family Name	Scientific Name	Red Data Global	Red Data Regional	Endemicity South Africa	Endemicity Southern Africa	Average Report Rate	No. of Records
Heron, Goliath	Ardea goliath					35.8	426
Heron, Grey	Ardea cinerea					37.2	443
Heron, Black-headed	Ardea melanocephala					57.1	679
Heron, Purple	Ardea purpurea					7.1	85
Heron, Black	Egretta ardesiaca					9.4	112
Honey-buzzard, European	Pernis apivorus					0.1	1
Honeyguide, Lesser	Indicator minor					0.8	10
Honeyguide, Greater	Indicator indicator					4.1	49
Hoopoe, African	Upupa africana					31.0	369
Hornbill, African Grey	Tockus nasutus					0.2	2
House-martin, Common	Delichon urbicum					0.7	8
Ibis, Glossy	Plegadis falcinellus					62.8	747
Ibis, African Sacred	Threskiornis aethiopicus					87.8	1,045
Ibis, Hadeda	Bostrychia hagedash					94.1	1,12
Jacana, African	Actophilornis africanus					3.0	36
Kestrel, Greater	Falco rupicoloides					0.1	1
Kestrel, Lesser	Falco naumanni					0.2	2
Kestrel, Rock	Falco rupicolus					0.2	2
Kingfisher, Half-collared	Alcedo semitorquata	LC	NT			0.1	1
Kingfisher, Brown-hooded	Halcyon albiventris					0.3	3
Kingfisher, Woodland	Halcyon senegalensis					0.6	7
Kingfisher, Giant	Megaceryle maxima					1.7	20
Kingfisher, Malachite	Alcedo cristata					2.6	31
Kingfisher, Pied	Ceryle rudis					8.0	95
Kite, Yellow-billed	Milvus aegyptius					0.3	4
Kite, Black-shouldered	Elanus caeruleus					41.8	498
Korhaan, Northern Black	Afrotis afraoides				Endemic	0.5	6
Lapwing, African Wattled	Vanellus senegallus					57.8	688

Family Name	Scientific Name	Red Data Global	Red Data Regional	Endemicity South Africa	Endemicity Southern Africa	Average Report Rate	No. of Records
Lapwing, Crowned	Vanellus coronatus					64.3	765
Lapwing, Blacksmith	Vanellus armatus					91.9	1,094
Lark, Eastern Long-billed	Certhilauda semitorquata			Endemic	Endemic	0.1	1
Lark, Melodious	Mirafra cheniana	NT	LC	Near endemic	Endemic	0.1	1
Lark, Spike-heeled	Chersomanes albofasciata				Near-endemic	2.4	29
Lark, Rufous-naped	Mirafra africana					3.5	42
Lark, Red-capped	Calandrella cinerea					5.8	69
Longclaw, Cape	Macronyx capensis				Endemic	18.1	215
Mannikin, Bronze	Lonchura cucullata					0.8	9
Marsh-harrier, Western	Circus aeruginosus					0.1	1
Marsh-harrier, African	Circus ranivorus	LC	EN			1.6	19
Martin, Banded	Riparia cincta					0.8	10
Martin, Sand	Riparia riparia					1.2	14
Martin, Brown-throated	Riparia paludicola					22.4	266
Martin, Rock	Hirundo fuligula					7.6	90
Masked-weaver, Southern	Ploceus velatus					95.3	1,134
Moorhen, Common	Gallinula chloropus					74.1	882
Mousebird, White-backed	Colius colius				Endemic	0.1	1
Mousebird, Red-faced	Urocolius indicus					68.3	813
Mousebird, Speckled	Colius striatus					69.7	829
Myna, Common	Acridotheres tristis					94.1	1,12
Neddicky, Neddicky	Cisticola fulvicapilla					3.8	45
Night-Heron, Black-crowned	Nycticorax nycticorax					11.8	141
Nightjar, Freckled	Caprimulgus tristigma					0.2	2
Olive-pigeon, African	Columba arquatrix					49.2	585
Oriole, Black-headed	Oriolus larvatus					0.5	6
Ostrich, Common	Struthio camelus					0.7	8
Owl, Barn	Tyto alba					0.5	6

Family Name	Scientific Name	Red Data Global	Red Data Regional	Endemicity South Africa	Endemicity Southern Africa	Average Report Rate	No. of Records
Owl, Marsh	Asio capensis					1.6	19
Painted-snipe, Greater	Rostratula benghalensis	LC	NT			0.2	2
Palm-swift, African	Cypsiurus parvus					48.5	577
Paradise-flycatcher, African	Terpsiphone viridis					1.9	23
Parakeet, Rose-ringed	Psittacula krameri					2.4	28
Parrot, Meyer's	Poicephalus meyeri					0.4	5
Peacock, Common	Pavo cristatus					0.8	10
Pelican, Great White	Pelecanus onocrotalus	LC	VU			0.1	1
Pigeon, Speckled	Columba guinea					69.2	823
Pipit, Buffy	Anthus vaalensis					0.2	2
Pipit, Plain-backed	Anthus leucophrys					0.5	6
Pipit, African	Anthus cinnamomeus					15.4	183
Plover, Common Ringed	Charadrius hiaticula					0.2	2
Plover, Kittlitz's	Charadrius pecuarius					1.8	22
Plover, Three-banded	Charadrius tricollaris					30.5	363
Pochard, Southern	Netta erythrophthalma					28.1	334
Pratincole, Black-winged	Glareola nordmanni	NT	NT			0.5	6
Prinia, Black-chested	Prinia flavicans				Near-endemic	10.8	128
Prinia, Tawny-flanked	Prinia subflava					44.5	530
Puffback, Black-backed	Dryoscopus cubla					0.3	4
Quail, Common	Coturnix coturnix					0.4	5
Quailfinch, African	Ortygospiza fuscocrissa					2.7	32
Quelea, Red-billed	Quelea quelea					8.2	97
Rail, African	Rallus caerulescens					2.6	31
Reed-warbler, Great	Acrocephalus arundinaceus					1.6	19
Reed-warbler, African	Acrocephalus baeticatus					19.3	230
Robin-chat, Cape	Cossypha caffra					67.5	803
Rock-thrush, Cape	Monticola rupestris			Endemic	Endemic	0.1	1

Family Name	Scientific Name	Red Data Global	Red Data Regional	Endemicity South Africa	Endemicity Southern Africa	Average Report Rate	No. of Records
Rock-thrush, Sentinel	Monticola explorator			Endemic	Endemic	0.1	1
Roller, Lilac-breasted	Coracias caudatus					0.1	1
Ruff	Philomachus pugnax					9.1	108
Rush-warbler, Little	Bradypterus baboecala					39.1	465
Sanderling, Sanderling	Calidris alba					0.1	1
Sandpiper, Common	Actitis hypoleucos					1.3	16
Sandpiper, Curlew	Calidris ferruginea	NT	LC			1.4	17
Sandpiper, Marsh	Tringa stagnatilis					2.3	27
Sandpiper, Wood	Tringa glareola					4.7	56
Scimitarbill, Common	Rhinopomastus cyanomelas					0.1	1
Seedeater, Streaky-headed	Crithagra gularis					12.9	154
Shelduck, South African	Tadorna cana				Endemic	3.1	37
Shikra	Accipiter badius					0.1	1
Shoveler, Cape	Anas smithii				Near-endemic	55.6	662
Shrike, Crimson-breasted	Laniarius atrococcineus				Near-endemic	0.1	1
Shrike, Lesser Grey	Lanius minor					0.4	5
Shrike, Red-backed	Lanius collurio					0.5	6
Snake-eagle, Black-chested	Circaetus pectoralis					0.3	4
Snipe, African	Gallinago nigripennis					7.3	87
Sparrow, Southern Grey-headed	Passer diffusus					10.8	128
Sparrow, House	Passer domesticus					72.8	866
Sparrow, Cape	Passer melanurus				Near-endemic	94.0	1,119
Sparrowhawk, Black	Accipiter melanoleucus					0.3	4
Sparrowhawk, Little	Accipiter minullus					0.4	5
Sparrowhawk, Ovambo	Accipiter ovampensis					1.3	15
Sparrow-weaver, White-browed	Plocepasser mahali					3.8	45
Spoonbill, African	Platalea alba					16.8	200
Spurfowl, Natal	Pternistis natalensis				Near-endemic	0.1	1

Family Name	Scientific Name	Red Data Global	Red Data Regional	Endemicity South Africa	Endemicity Southern Africa	Average Report Rate	No. of Records
Spurfowl, Swainson's	Pternistis swainsonii					15.4	183
Starling, Common	Sturnus vulgaris					0.2	2
Starling, Red-winged	Onychognathus morio					1.9	23
Starling, Pied	Lamprotornis bicolor			Endemic	Endemic	11.8	141
Starling, Wattled	Creatophora cinerea					30.3	360
Starling, Cape Glossy	Lamprotornis nitens					74.1	882
Stilt, Black-winged	Himantopus himantopus					13.3	158
Stint, Little	Calidris minuta					6.7	80
Stonechat, African	Saxicola torquatus					38.7	460
Stork, Abdim's	Ciconia abdimii	LC	NT			0.3	3
Stork, Yellow-billed	Mycteria ibis	LC	EN			1.0	12
Stork, White	Ciconia ciconia					1.3	15
Sunbird, Malachite	Nectarinia famosa					0.1	1
Sunbird, Amethyst	Chalcomitra amethystina					11.6	138
Sunbird, White-bellied	Cinnyris talatala					29.7	353
Swallow, Pearl-breasted	Hirundo dimidiata					0.2	2
Swallow, Lesser Striped	Cecropis abyssinica					1.0	12
Swallow, Barn	Hirundo rustica					28.7	342
Swallow, White-throated	Hirundo albigularis					32.7	389
Swallow, Greater Striped	Cecropis cucullata					43.6	519
Swamphen, African Purple	Porphyrio madagascariensis					38.4	457
Swamp-warbler, Lesser	Acrocephalus gracilirostris					39.7	472
Swan, Black	Cygnus atratus					14.6	174
Swift, African Black	Apus barbatus					0.3	3
Swift, Common	Apus apus					0.4	5
Swift, Horus	Apus horus					0.7	8
Swift, Little	Apus affinis					19.6	233
Swift, White-rumped	Apus caffer					35.0	416

Family Name	Scientific Name	Red Data Global	Red Data Regional	Endemicity South Africa	Endemicity Southern Africa	Average Report Rate	No. of Records
Tchagra, Black-crowned	Tchagra senegalus					0.1	1
Teal, Red-billed	Anas erythrorhyncha					22.6	269
Teal, Hottentot	Anas hottentota					23.7	282
Teal, Cape	Anas capensis					5.3	63
Tern, Caspian	Sterna caspia	LC	VU			0.1	1
Tern, Whiskered	Chlidonias hybrida					13.9	165
Tern, White-winged	Chlidonias leucopterus					5.4	64
Thick-knee, Spotted	Burhinus capensis					53.9	642
Thrush, Groundscraper	Turdus litsitsirupa					0.1	1
Thrush, Karoo	Turdus smithi			Near endemic	Endemic	76.5	910
Tinkerbird, Yellow-fronted	Pogoniulus chrysoconus					0.1	1
Tit-babbler, Chestnut-vented	Sylvia subcaerulea				Near-endemic	0.1	1
Turtle-dove, Cape	Streptopelia capicola					95.4	1,135
Wagtail, Yellow	Motacilla flava					0.2	2
Wagtail, African Pied	Motacilla aguimp					0.3	3
Wagtail, Cape	Motacilla capensis					81.8	974
Warbler, Marsh	Acrocephalus palustris					0.8	9
Warbler, Sedge	Acrocephalus schoenobaenus					1.4	17
Warbler, Willow	Phylloscopus trochilus					3.8	45
Waxbill, Blue	Uraeginthus angolensis					0.2	2
Waxbill, Common	Estrilda astrild					13.9	166
Waxbill, Orange-breasted	Amandava subflava					5.2	62
Weaver, Cape	Ploceus capensis			Near endemic	Endemic	0.3	4
Weaver, Village	Ploceus cucullatus					0.3	4
Weaver, Thick-billed	Amblyospiza albifrons					49.4	588
Wheatear, Mountain	Oenanthe monticola				Near-endemic	22.9	272
Wheatear, Capped	Oenanthe pileata					9.7	116
White-eye, Cape	Zosterops virens			Near endemic	Endemic	55.5	660

Family Name	Scientific Name	Red Data Global	Red Data Regional	Endemicity South Africa	Endemicity Southern Africa	Average Report Rate	No. of Records
Whydah, Pin-tailed	Vidua macroura					26.4	314
Widowbird, White-winged	Euplectes albonotatus					1.7	20
Widowbird, Red-collared	Euplectes ardens					1.8	22
Widowbird, Long-tailed	Euplectes progne					20.2	240
Widowbird, Fan-tailed	Euplectes axillaris					5.5	65
Wood-hoopoe, Green	Phoeniculus purpureus					50.2	597
Woodpecker, Cardinal	Dendropicos fuscescens					2.0	24
Wryneck, Red-throated	Jynx ruficollis					10.8	129

APPENDIX 2: AVIFAUNAL HABITAT OBSERVED WITHIN THE STUDY AREA

FIGURE 1: Grassland habitat dominates the proposed PV SEF site

FIGURE 2: The Withokspruit is a feature along the proposed 22kV power line route alignment

FIGURE 3: An example of wetland vegetation within the study area. Exotic tree stands feature in the background

FIGURE 4: A waterbody associated with a small river system within the study area. Focal Point surveys (DRD10) were conducted at this waterbody

FIGURE 5: Another example of wetland habitat and exotic *Eucalyptus* tree strands

FIGURE 6: The proposed study area is located adjacent to an operational mine - a source of significant habitat degradation and disturbance

FIGURE 7: Residential areas also feature within the study area

APPENDIX 3: METHOD OF ASSESSING THE SIGNIFICANCE OF POTENTIAL ENVIRONMENTAL IMPACTS

Characteristic	Definition	Terms	Scoring
Duration	The time period over which a resource / receptor is affected.	**Temporary** - (period of less than 1 year - negligible/ pre-construction/ construction) **Short term** - period of less than 5 years ie commissioning/operational period **Medium term** - period of less than 15 years ie operational period **Long term** - period of less than 20 years ie life of project **Permanent** - a period that exceeds the life of project– ie irreversible.	Temporary – 1 Short term – 2 Medium term – 3 Long term – 4 Permanent – 5
Extent	The reach of the impact (ie physical distance an impact will extend to)	**On-site** - impacts that are limited to the Project site. **Local** - impacts that are limited to the Project site and adjacent properties. **Regional** - impacts that are experienced at a regional scale, ie Gauteng. **National** - impacts that are experienced at a national scale. **Trans-boundary/International** - impacts that are experienced outside of South Africa.	On-site – 1 Local – 2 Regional – 3 National – 4 International – 5
Probability	Measure of the probability with which the impact is expected to occur	**Unlikely -** probably will not happen **Improbable -** some possibility, but low likelihood **Probable -** distinct possibility) **Highly probable -** most likely **Definite -** impact will occur regardless of any prevention measures	Unlikely – 1 Improbable – 2 Probable – 3 Highly probable – 4 Definite – 5
Magnitude	A measure of the damage that the impact will cause if it does occur	**No effect** - will have no effect on the environment **Minor** – minor and will not result in an impact on processes **Low** – low and will cause a slight impact on processes **Moderate** – moderate and will result in processes continuing but in a modified way **High** - processes are altered to the extent that they temporarily cease **Very high** - results in complete destruction of patterns and permanent cessation of processes	No effect – 0 Minor – 2 Low – 4 Moderate – 6 High – 8 Very high – 10

The significance (quantification) of potential environmental impacts identified during the Basic Assessment have been determined using a ranking scale, based on the following (terminology has been taken from the Guideline Documentation on EIA Regulations, of the Department of Environmental Affairs and Tourism, April 1998):

Occurrence

- Probability of occurrence (how likely is it that the impact may occur?)
- Duration of occurrence (how long may it last?)

Severity

- Magnitude (severity) of impact (will the impact be of high, moderate or low severity?)
- Scale/extent of impact (will the impact affect the national, regional or local environment, or only that of the site?)

The environmental significance of each potential impact is assessed using the following formula:

Significance Points (SP) = (Magnitude + Duration + Extent) x Probability

The maximum value is 100 Significance Points (SP). Potential environmental impacts were rated as high, moderate or low significance on the following basis:

- < 30 significance points = LOW environmental significance.
- 30- 60 significance points = MODERATE environmental significance
- >60 significance points = HIGH environmental significance

APPENDIX 4: CURRICULUM VITAE

MEGAN DIAMOND

PERSONAL DETAILS

Date of Birth | *7 December 1978*

Driver's License | *Code A and B*

Home Language | *English*

Other Languages | *Afrikaans*

EDUCATION

BSc Environmental Management | *University of South Africa (UNISA)* 2002 – 2009

ACCREDITATION

South African Council for Natural Scientific Professions | *Environmental Science*

Registration Number: 300022/14

EXPERIENCE

Owner & Avifaunal Specialist | *Feathers Environmental Services*

July 2013 – Present

- Perform specialist avifaunal assessment studies to minimise the impact of industrial infrastructure on birds and their habitats;
- Provide strategic guidance to industry through the development of best practice procedures and guidelines;
- Review and comment on methodologies, specialist studies and EIA reports for Renewable Energy projects;
- Provide input into renewable energy and power line developments elsewhere in Africa and across the globe;
- Manage the collection and collation of relevant and complete desktop and/or field datasets;
- Manage pre- and post-construction avifaunal monitoring data collected at wind and solar energy facilities;
- Site assessments, either as part of the project team or independently;
- Preparation of reports according to project deadlines, including the use of Geographic Information Systems (GIS) to portray data;
- Attendance of specialist integration meetings; and
- Liaison with stakeholders where necessary.

Wildlife & Energy Programme Manager | *Endangered Wildlife Trust*

October 2006 – June 2013

Programme management

- Annually review the programme's conservation and research strategic objectives and update in accordance with the EWT's and programme's vision and mission including work plans for staff etc.;
- Ensure timeous, professional delivery on all aspects of Wildlife & Energy Programme activities;
- Formulate, prioritise and approve relevant research and conservation projects;
- Ensure acceptable quality of all research projects and their outputs;
- Participate in international network liaison as and when required;
- Produce regular popular articles & media releases on the Wildlife & Energy Programme projects and outputs & contribute to the EWT publications;
- Establish & maintain a network with relevant national & international stakeholders;
- Deliver presentations at relevant meetings, functions, workshops & conferences on behalf of the programme;
- Assist with compilation of newsletters, updating of webpage, compilation of press articles, any advocacy issues;
- Identify & establish partnerships to achieve Wildlife & Energy Programme conservation goals.

Eskom –EWT Strategic Partnership

- Ensure that this partnership is managed effectively and sustainably against its goals. Manage staff in this division;
- Develop and maintain relationships with Eskom;
- Negotiate the terms of reference for the annual service level agreements between EWT and Eskom, to ensure the sustainability of the relationship;
- Compile annual report to Eskom Corporate Environment and Sustainability;
- Produce monthly reports to Eskom's regional grids on the status of incident follow-up;
- Attend applicable forums to interact with Eskom stakeholders;
- Participate in international network liaison as and when required;
- Maintain a network with all relevant local and regional level stakeholders (meetings, forums, workshops, etc.);
- Identify research needs relating to the management of wildlife interaction with power lines;
- Conduct research projects on wildlife and power line interaction and present the results at national and international conferences and workshops;
- Development and implementation of training for Eskom field services staff (at various levels) in the management of wildlife interactions; and
- Conduct special investigations on power lines relating to wildlife induced faulting.

Environmental Impact Assessment Division

- Ensure that this division operates effectively and efficiently at all times and manage staff in this division; and

- Conduct specialist avifaunal studies for new power lines developments including: tendering/quoting for the projects, conducting field work, preparing reports, presenting results & negotiating the acceptance of recommendations, final "walk through" as part of Environmental Management Plans; general project management, all liaison with clients, Eskom, authorities, Interested and Affected Parties etc.

Management and administration

- Ensure all programme staff have relevant terms of reference;
- Ensure that all programme staff are performance appraised against their terms of reference;
- Compile and manage programme budgets, monthly reports, work plans and strategy;
- Monitor expenditure and take corrective action if necessary; and
- Ensure timely delivery on all projects to all stakeholders.

CONFERENCE ATTENDANCE

- *Society for Conservation Biology 21st Annual Meeting (1-5 July 2007)*
- *The 6th TAWIRI Scientific Conference (3 – 6 December 2007) Presented a paper titled "*Co-operative management of wildlife and power line conflicts: an African solution"
- Pan-African Ornithological Congress (7-12 September 2008)
- International Conference on Overhead Lines, Design, Construction, Inspection & Maintenance, Fort Collins Colorado USA. (29 March – 1 April 2010) Presented a paper titled "Bird's eye view: how birds see is key to avoiding power line collision"
- Windaba 2011 – Implementing South African Wind Energy (27-29 September 2011)
- Pan African Vulture Summit (16-20 April 2012) Presented a paper titled "Electrification in Africa – Are our vultures being strung along"
- 4th Wind Power Africa Conference & Renewable Energy Exhibition (28-30 May 2012) Presented a paper titled "Wind Energy in Africa – what does this really mean for our continent's birds"
- 13th Pan-African Ornithological Congress (14-21 October 2012) Presented a paper titled "Stringing South Africa's Terrestrial Birds Along - Monitoring of Bird Interactions with Power Line and Experimental Testing of Bird Collision Mitigation at the Karoo Long Term Monitoring Site"
- AEWA Single Species Action-Planning Workshop for the Conservation of the Grey Crowned Crane (10-13 September 2013) Presented and participated in the workshop as a subject expert (energy and bird interactions)

AUTHORED & CO-AUTHORED PAPERS

Jenkins, A.R., Smallie, J. & Diamond, M. 2009. Balls, flashers, flappers and coils: South African perspectives on a global search for ways to prevent avian collisions with overhead lines. In: Harebottle, D.M., Craig, A.J.F.K., Anderson, M.D., Rakatomonana, H. & Muchai, M. (eds). Proceedings of the 12th Pan-African Ornithological Congress, 2008. Cape Town, Animal Demography Unit.

Smallie, J., Diamond, M. & Jenkins, A. 2009. Lighting up the African continent – what does it mean for our birds? pp. 38–43. In: Harebottle, D.M., Craig, A.J.F.K., Anderson, M.D., Rakotomanana, H. & Muchai. (eds). *Proceedings of the 12th Pan-African Ornithological Congress, 2008*. Cape Town, Animal Demography Unit.

Jenkins, A. R., Smallie, J.J and Diamond, M. 2010 Avian collisions with power lines: a global review of causes and mitigation with a South African perspective. Bird Conservation International, page1 of16.

Retief, E.F., Diamond, M., Anderson, M.D., Smit, H.A., Jenkins, A.R., Brooks, M. 2011. Avian Wind Farm Sensitivity Map for South Africa.

Jenkins, A.R., Van Rooyen, C.S., Smallie, J.J., Harrison, J.A., Diamond, M. And Smit, H.A. 2012. BirdLife South Africa / Endangered Wildlife Trust best practice guidelines for avian monitoring and impact mitigation at proposed wind energy development sites in southern Africa.

Jenkins, A.R., De Goede, K.H., Sebele, L. and Diamond, M. 2013. Brokering a settlement between eagles and industry: sustainable management of large raptors nesting on power infrastructure. Bird Conservation International (2013) 23:232 – 246.

Diamond, M., Harris, J., Mirande, C. and Austin, J. 2014. People of a feather flock together: A global initiative to address crane and power line interactions. 13th North American Crane Workshop Summary. Lafayette, Louisiana.

Page-Nicholson, S., Tate, G., Hoogstad, C., Murison, M., Diamond, M., Blofield, A., Pretorius, M., Michael, M.D. 2018. Mitigating the Impact of Large Mammals on Wooden Electrical Distribution Poles in the Kruger National Park, South Africa. African Journal of Wildlife Research.

Diamond, M. and Hoogstad, C. (in press) Collisions and habitat loss associated with utility lines and wind turbines. IUCN SSC Crane Specialist Group – Crane Conservation Strategy.