AN ECOLOGICAL AND RIPARIAN / WETLAND IMPACT ASSESSMENT FOR THE PROPOSED POWERLINE CONNECTION BETWEEN BOLUBEDU SOLAR PARK AND BOLOBEDU SUBSTATION, GREATER LETABA LOCAL MUNICIPALITY, MOPANI DISTRICT, LIMPOPO PROVINCE

An EOH Company

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DECEMBER 2019

Conducted on behalf of:

AGES Limpopo

Compiled by:

Dr. BJ Henning (PhD plant Ecology; M.Sc Botany - Soil Science related Pr.Sci.Nat)

REPORT DISTRIBUTION LIST

Name	Institution
Ms. E. Grobler	AGES Limpopo

DOCUMENT HISTORY

Date	Version	Status
December 2019	1.0	Draft

Declaration

I, Barend Johannes Henning, declare that -

- I act as the independent specialist;
- I will perform the work relating to the project in an objective manner, even if this results in views and findings that are not favourable to the project proponent;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this project, including knowledge of the National Environmental Management Act, 1998 (Act No. 107 of 1998; the Act), regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I will take into account, to the extent possible, the matters listed in Regulation 8;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the project proponent and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the project; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority or project proponent;
- All the particulars furnished by me in this document are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of section 24F of the Act.

_____

SIGNATURE OF SPECIALIST

Company: Exigo Sustainability

Date: December 2019

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1 INTRODUCTION

Exigo Sustainability (Pty) Ltd was appointed by AGES Limpopo on Bolobedu Solar Farm PV (Pty) Ltd to conduct an ecological and riparian impact assessment for the proposed development and installation of a connection to a 132kV feeder bay in order to connect the Bolobedu Solar Park and the Bolobedu substation.

This report will include a detailed impact assessment of the proposed development on the biodiversity of the site, as well as assessments of drainages and wetlands. This assessment is essential as it will contribute to meeting the requirements of the National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) in accordance with the EIA Regulations of 2014, as amended, promulgated in terms of Section 24 (5) of NEMA as well as Chapter 4 of the National Water Act, 1998 (Act No. 36 of 1998) with specific reference to Section 21(c) and (i).

The assignment is interpreted as follows: Compile an ecological study on the flora (vegetation units), fauna and general ecology of the site and determine the potential impacts of the proposed development on the fauna and flora of the area as well as proposed mitigation measures. The study will be done according to guidelines and criteria set by the Limpopo Department of Economic Development, Environment and Tourism (LEDET) for biodiversity studies and the Department of Water and Sanitation (DWS) for wetland assessments. In order to compile this, the following had to be done:

1.1 INFORMATION SOURCES

The following information sources were obtained:

1. All relevant topographical maps, aerial photographs and information (previous studies and environmental databases) related to the ecological and wetland components in the study area;
2. Requirements regarding the fauna and flora survey as requested by the LEDET;
3. Requirements regarding the wetland assessment as stipulated in the following guidelines:
    a. A practical field procedure for identification and delineation of wetlands and riparian areas (DWAF, 2006);
    b. National Wetland Classification System for South Africa (SANBI, 2009);
4. Legislation pertaining to the biodiversity and wetlands of the study area as relevant;
5. Red data species list from the South African National Biodiversity Institute (SANBI).

1.2 REGULATIONS GOVERNING THIS REPORT

1.2.1 National Environmental Management Act, 1998 (Act No. 107 of 1998) (NEMA) - Regulation No. R982

This report was prepared in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) Gazette No. 38282 Government Notice R. 982 of 4 December 2014 (as amended). Appendix 6 – Specialist reports includes a list of requirements to be included in a specialist report. The report index is provided in Table 1.

Table 1 Requirements of Appendix 6 of GNR 982

Section of EIA Regulations, 2014	Description of EIA Regulations Requirements for Basic Assessment Reports	Section
Appendix 6: 1 (a)	Details of – The specialist who prepared the report; and The expertise of that specialist to compile a specialist report, including a curriculum vitae;	Appendix H
Appendix 6: 1 (b)	A declaration that the specialist is independent in a form as may be specified by the competent authority;	Declaration Page ii
Appendix 6: 1 (c)	An indication of the scope of, and purpose for which, the report was prepared;	Section 1.3
Appendix 6: 1 (d)	The date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 2.1
Appendix 6: 1 (e)	A description of the methodology adopted in preparing the report or carrying out the specialized process	Section 2
Appendix 6: 1 (f)	The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Sections 3.7 & 6
Appendix 6: 1 (g)	An identification of any areas to be avoided, including buffers	Section 6
Appendix 6: 1 (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 6
Appendix 6: 1 (i)	A description of any assumptions made and any uncertainties or gaps in knowledge	Section 1.3.3
Appendix 6: 1 (j)	A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4& 5
Appendix 6: 1 (k)	Any mitigation measures for inclusion in the EMPr	Section 5
Appendix 6: 1 (l)	Any conditions for inclusion in the environmental authorisation	Section 5
Appendix 6: 1 (m)	Any monitoring requirements for inclusion in the empr or environmental authorisation	Section 5
Appendix 6: 1 (n)	A reasoned opinion – As to whether the proposed activity or portions thereof should be authorised and if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the empr and where applicable, the closure plan	Section 7 & 8
Appendix 6: 1 (o)	A description of any consultation process that was undertaken during the course of preparing the specialist report	N/a
Appendix 6: 1 (p)	A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	N/a
Appendix 6: 1 (q)	Any other information requested by the competent authority	N/a

This Act also embraces all three fields of environmental concern namely: resource conservation and exploitation; pollution control and waste management; and land-use planning and development. The environmental management principles include the duty of care for wetlands and special attention is given to management and planning procedures.

1.2.2 Conservation of Agricultural Resources Act (Act No. 43 of 1983) (CARA)

This Act regulates the utilization and protection of wetlands, soil conservation and all matters relating thereto; control and prevention of veld fires, control of weeds and invader plants, the prevention of water pollution resulting from farming practices and losses in biodiversity.

1.2.3 National Environmental Management Biodiversity Act (Act 10 0f 2004) (NEMBA)

The following aspects of the NEMBA (2004) are important to consider in the compilation of an ecological report. It:

- Lists ecosystems that are threatened or in need of national protection;
- Links to Integrated Environmental Management processes;
- Must be taken into account in EMPs and IDPs;
- The Minister may make regulations to reduce the threats to listed ecosystems.

1.2.4 The National Forest Act (Act 84 of 1998) (NFA)

The National Forest Act:

- Promotes the sustainable management and development of forests for the benefit of all;
- Creates the conditions necessary to restructure forestry in State Forests;
- Provide special measures for the protection of certain forests and protected trees;
- Promotes the sustainable use of forests for environmental, economic, educational, recreational, cultural, health and spiritual purposes;
- Promotes community forestry.

1.2.5 The National Water Act (Act No. 36 of 1998)

Chapter 4 of the National Water Act, Act 36 of 1998 specifies that:

“In general a water use must be licensed unless it is listed in Schedule I, is an existing lawful use, is permissible under a general authorisation, or if a responsible authority waives the need for a licence. The Minister may limit the amount of water which a responsible authority may allocate. In making regulations the Minister may differentiate between different water resources, classes of water resources and geographical areas.”

In section 21 of the NWA water uses are listed as:

c. Impeding or diverting the flow of water in a watercourse;

i. Altering the bed, banks, course or characteristics of a watercourse;

1.2.6 Limpopo Environmental Management Act (2004)

The Limpopo Environmental Management Act (2004) deals with the conservation of wild animals, freshwater fish and the conservation and protection of flora in the Limpopo Province. Animals and plants are both listed in the schedules with different degrees of protection afforded to each.

1.3 TERMS OF REFERENCE

1.3.1 Objectives

1. The primary aim of this project is to investigate options for enhancing and / or maintaining biodiversity to mitigate the impact of the proposed development and related infrastructure with the overall objective of preventing further loss of biodiversity. The end product would be a tool for promoting and lobbying for the recognition of the importance of species habitat and habitat conservation. Options available to maintain the current level of floral diversity include:
    a. Protection of native vegetation restored elsewhere in return for unavoidable clearing;
    b. Minimisation of habitat fragmentation;
    c. Minimisation of any threats to the native flora and fauna and their habitats during the construction and operational phases of the development and;
    d. Rehabilitation to establish plant communities / landscaping that will provide future habitat values.
2. To produce a clear and agreed species and habitat priorities for conservation actions. This includes the following:
    i. Determine the potential ecological impacts and actions the development will have on the biodiversity on a species and habitat level;
    ii. Conduct a risk analyses of the impacts identified to determine the significance of the impacts on the fauna and flora of the study area;
    iii. Protection and enhancement of vegetation / habitats of high conservation value;
    iv. The retention of a substantial amount of native vegetation / habitat of adequate size and configuration to promote the conservation of the existing flora communities;
    v. Retention and / or creation of vegetation links, wildlife corridors and vegetation buffers where possible, subject to the appropriate bush fire risk management; and
    vi. The protection of water quality in the locality so as not to threaten native aquatic flora that rely on the watercourse for survival.
3. Provide recommendations on the ecological mitigation measures to be implemented by the developer and the way forward;

4. Delineate all wetlands and / or riparian areas associated with rivers / floodplains on site;
5. Determine the Present Ecological State (PES) and Ecological Importance and Sensitivity (EIS) of all wetlands and riparian areas along the proposed development site.

1.3.2 Scope

1. Detailed flora survey – in each vegetation type/plant community on site:
   a. After studying the aerial photographs identify specific areas to be surveyed and confirm location by making use of a Geographical Positioning System (GPS).
   b. Conduct a site visit and list the plant species present for plant community and ecosystem delimitation.
   c. Identify potential red data plant species, possible encroacher species, medicinal plants of value and exotic plant species.
   d. Indicate suitable plant species that can be used for the landscaping around the proposed development.
2. Plant community delimitation and description
   a. Process data to determine vegetation types on an ecological basis.
   b. Describe the habitat and vegetation.
3. Fauna scoping
   a. List the potential fauna present linked to the specific potential habitats that occur as identified in the vegetation survey.
   b. Analyse the data and identify potential red data fauna species, as well as other endemic or protected species of importance.
   c. Indicate species mitigation measures and management measures to be implemented to prevent any negative impacts on the fauna of the area.
4. Delineate and assess the wetland and / or riparian functionality on the proposed development site according to specific guidelines and methodology;
5. General
   a. Identify and describe ecologically sensitive areas. Create a sensitivity map to indicate specific sensitive areas based on various environmental parameters such as natural vegetation in a good condition, rockiness, slopes, flood lines etc.
   b. Identify problem areas in need of special treatment or management, e.g. bush encroachment, erosion, degraded areas, reclamation areas.
   c. Make recommendations, impact ratings and risk assessments for each impact.

1.3.3 Limitations and assumptions

- In order to obtain a comprehensive understanding of the dynamics of the flora and fauna of the study area, surveys should ideally be replicated over several seasons and over a number of years. However, due to project time constraints such long-term studies are not feasible and this biodiversity study was conducted over one season;
- The large study area did not allow for the finer level of assessment that can be obtained in smaller study areas. Therefore, data collection in this study relied heavily on data from representative, homogenous sections of vegetation units, as well as general observations, aerial photograph analysis, generic data and a desktop analysis;
- This report focuses only on the water courses and riparian areas at the proposed development site. Other wetland areas further away from the proposed development was not assessed.

Thus, even though it might be assumed that survey findings are representative of the ecosystem of the project area, it should be stated that the possibility exists that individual plants or animal species might have been missed due to the nature of the terrain. Therefore, maintaining due cognisance of the integrity and accuracy of the ecological survey, it should be stated that the ecological resources identified during the study do not necessarily represent all the ecological resources present on the property.

2 METHODS

2.1 VEGETATION SURVEY

Two basic methods were used during the vegetation survey:

- Line transects were walked along the proposed development to record the plant species present. Rare and threatened plant species and any botanically sensitive sites or habitats were searched for in the various vegetation units.
- The Braun-Blanquet survey technique to describe plant communities as ecological units was also used for this study. It allows for the mapping of vegetation and the comparison of the data with similar studies in the area.

The vegetation survey was conducted on site during December 2019. The vegetation was in a moderate to good condition and most species could be identified. No further surveys were necessary considering that the area received sufficient precipitation during the wet season to allow for the identification of most plants in the study area.

2.1.1 Data recorded:

Plant names used in this report are in accordance with Arnold & De Wet (1993), with the exception of a few newly revised species. A list of all plant species present, including trees, shrubs, grasses, forbs, geophytes and succulents were compiled. All identifiable plant species were listed. Notes were additionally made of any other features that might have an ecological influence as well as potential fauna habitat that might occur.

2.1.2 Red data species

A species list of the red data species previously recorded in the vicinity of the proposed development was obtained from the South African Biodiversity Institute (SANBI), South Africa as classified by the IUCN red data list categories.

2.1.3 Protected trees

A species list of the protected tree species was obtained from the Department of Forestry. These trees are listed by the NFA (Act 84 of 1998) as protected.

2.1.4 Data processing

A classification of vegetation data was done to identify, describe and map vegetation types. The descriptions of the vegetation units include the tree, shrub and herbaceous layers.

Conservation priority of each vegetation unit was assessed by evaluating the plant species composition in terms of the present knowledge of the vegetation of the Limpopo Province, as well as the represented vegetation types in the area.

The following four conservation priority categories were used for each vegetation unit:

- High: Ecologically sensitive and valuable land with high species richness that should be conserved and no development allowed.
- Medium: Land that should be conserved but on which low impact development could be considered with the provision of mitigation measures.
- Medium-low: Land that has some conservation value but on which development could be considered with limited impact on the vegetation / ecosystem. It is recommended that certain sections of the vegetation be maintained.
- Low: Land that has little conservation value and that could be considered for developed with little to no impact on the vegetation / ecosystem.

2.2 FAUNA SURVEY

The fauna survey was conducted as follows:

- A site survey was done to identify potential habitats after identifying the vegetation units. Fauna observed on site or any specific indication of species was noted as confirmed in the species lists.
- A scoping survey was then conducted by comparing the habitat types identified with the preferred habitats of species occurring in the area.

2.2.1 Data recorded:

A list of all species of fauna and their status as observed on the site or that could potentially occur on the site. Notes were made of any specific sensitive or specialized habitats that occur on the site.

2.2.2 Red data species lists

A species list of the red data species of the different faunal classes was obtained from the following references:

- Red Data Book of the Mammals of South Africa (Friedman & Daly, 2004)
- The Atlas of the Southern African Birds - digital data on quarter degree grid data (Avian Demography Unit, University of Cape Town)
- Atlas and red data book of the frogs of South Africa, Lesotho and Swaziland (Minter et al. 2004)
- South African Red Data Book – Reptiles and Amphibians. National Scientific Programmes Report no. 151;

2.2.3 Data processing

A comparison of the vegetation units occurring in the area was made to preferred habitats of faunal species. In addition to species observed on the site, lists of the potential mammal, bird, reptile, amphibian and insect species were compiled and mitigating measures recommended.

2.3 WETLAND DELINEATION AND CLASSIFICATION

The National Water Act, 1998 (Act 36 of 1998), defines wetlands as follows:

"Land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil."

Wetlands were delineated according to the delineation procedure given in "A Practical Field Procedure for the Identification and Delineation of Wetlands and Riparian Areas" (DWAF, 2003). Wetland indicators are divided into different unit indicators which need to be given consideration in the delineation of wetlands (Figure 1). The outer edge of the temporary zone requires the delineator to take the following specific indicators into account:

- The terrain unit indicator helps to identify those parts of the landscape where wetlands are more likely to occur.
- The Soil Form Indicator identifies the soil forms, as defined by Macvicar (1991), which are associated with prolonged and frequent saturation.
- The Soil Wetness Indicator identifies the morphological "signatures" developed in the soil profile as a result of prolonged and frequent saturation.
- Vegetation Indicator identifies hydrophilic vegetation associated with frequently saturated soils.

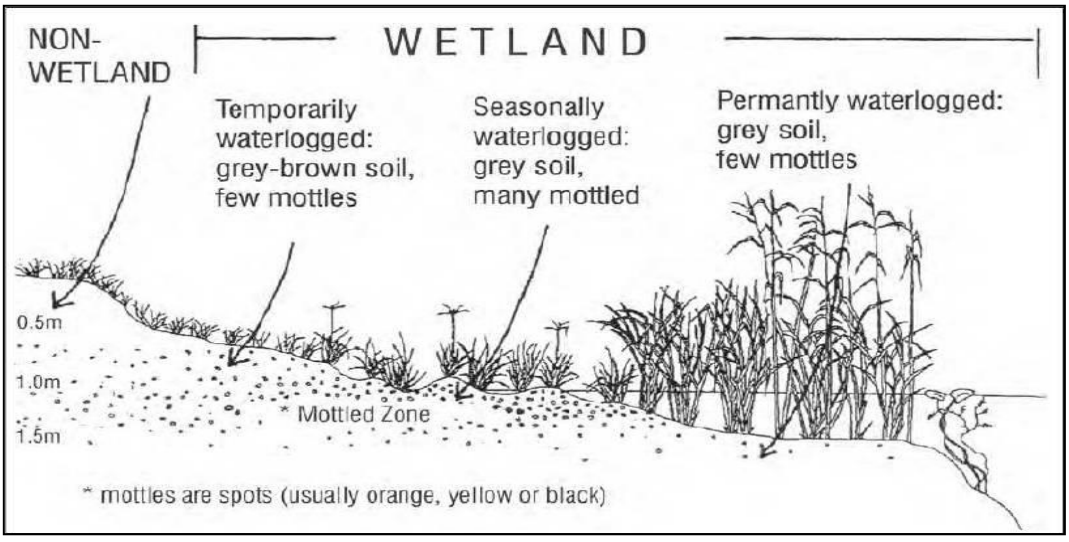


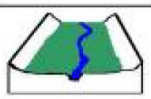
Figure 1. A cross section through a wetland showing how the soil form indicators and vegetation changes from the centre to the edge of the wetland (adapted from Kotze, 1996)

2.4 WETLAND CLASSIFICATION

The study area was sub-divided into transects and the soil profile was examined for signs of wetness within 50 cm of the surface using a hand auger along transects. The wetland boundaries were then determined by the positions of augered holes that showed signs of wetness as well as by the presence or absence of hydrophilic vegetation. The wetlands were subsequently classified according to their hydro-geomorphic setting based on the system proposed in the National Wetland Classification System (Table 2) (SANBI, 2009).

Furthermore, as a result of alluvial deposits being visible from the air, aerial photography was also used to assist in determining the extent of deposits, as well as the vegetation line indicating a difference in species composition or more vigorous growth. The aerial photographs were used to guide on-screen delineation of wetlands in ArcView GIS 3.3.

Table 2. Wetland Unit types based on hydrogeomorphic characteristics (Adapted from Kotze *et al.* 2005).

Hydro-geomorphic type	Code	Illustration	Description
Flood Plain	FP		Valley bottom areas with a well defined stream channel, gently sloped and characterized by floodplain features such as oxbow depressions and natural levees and the alluvial (by water) transport and deposition of sediment, usually leading to a net accumulation of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley Bottom with a Channel	VBC		Valley bottom areas with a well defined stream channel but lacking characteristic floodplain features. May be gently sloped and characterized by the net accumulation of alluvial deposits or may have steeper slopes and be characterized by the net loss of sediment. Water inputs from main channel (when channel banks overspill) and from adjacent slopes.
Valley Bottom Without a channel	VB		Valley bottom areas with no clearly defined stream channel, usually gently sloped and characterized by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.
Channelled Hillslope Seepage feeding a Water course	CHSW		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow and outflow is usually via a well defined stream channel connecting the area directly to a watercourse.
Hillslope Seepage feeding a Water course	HSW		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs are mainly from sub-surface flow connecting the area directly to a watercourse.
Hillslope Seepage not feeding a water course	HS		Slopes on hillsides, which are characterized by the colluvial (transported by gravity) movement of materials. Water inputs mainly from sub-surface flow and outflow either very limited or through diffuse sub-surface and/or surface flow but with no direct surface water connection to a watercourse.
Depression	D		A basin shaped area with a closed elevation contour that allows for the accumulation of surface water (i.e. it is inward draining). It may also receive sub-surface water. An outlet is usually absent.

2.5 RIPARIAN DELINEATION AND CLASSIFICATION

Riparian areas often associated with streams or drainage lines are also important to protect due to the followings ecological and hydrological functions that it performs (DWAF, 2003):

- Stabilize stream banks;
- Store water and aid in flood attenuation;
- Improve water quality by trapping nutrients and sediment;
- Maintain natural water temperature for aquatic species;
- Provide shelter and food for avifauna and other animals;
- Provide corridors for movement and migration of different species; and
- Act as a buffer between aquatic ecosystems and adjacent land uses.

The riparian areas have their own unique set of indicators. DWAF (2003) states that in order to classify an area as a riparian area it must have one or more of the following attributes:

- Are associated with a watercourse;
- Contain distinctively different plant species than adjacent areas; and contain species similar to adjacent areas but exhibiting more vigorous or robust growth forms; and
- May have alluvial soils.

The delineation process requires that the following be taken into account:

- Topography associated with the watercourse (figure 2);
- Vegetation (figure 3); and
- Alluvial soils and deposited material.

Many riparian areas display wetland indicators and should be classified as wetlands. However, other riparian areas are not saturated long enough or often enough to develop wetland characteristics, but also perform a number of important functions, which need to be safeguarded. In these areas alluvial deposits can predominate and/or the water table is too deep for most of the year to produce hydromorphic features in the top 50cm of the soil profile. These conditions do not support vegetation typically adapted to life in saturated soil and it is therefore important to delineate these riparian areas in addition to wetlands. Riparian areas commonly reflect the high-energy conditions associated with the water flowing in a water channel, whereas wetlands generally display more diffuse flow and are lower energy environments.

The general approach for delineating riparian areas in the field is to identify the active channel or the lowest part of the river course. Most likely cues like water with associated emergent vegetation, sedges and reeds or alluvial soil and bedrock will be visible. From this point some topographic units like sandbars, active channel bank, flood benches and macro-channel bank with associated riparian vegetation will be identifiable. The next step would be to proceed upwards towards the macro-channel bank, taking note of alluvial soil, topographic units and vegetation indicators. The outer boundary will be the point on the edge of the macro channel bank where there is a difference between riparian and terrestrial vegetation.

Where riparian vegetation is unrecognisable, indicators like alluvial material and topographical units can be used to visualize the edge of a riparian area. Areas adjacent to a watercourse, need to be checked for riparian indicators. Riparian areas were identified using the following information:

- Topographical maps: Riparian areas normally occur within the flood area of a river or stream.
- Aerial photographs: As a result of alluvial deposits being visible from the air, aerial photography can assist in determining the extent of deposits, as well as the vegetation line indicating a difference in species composition or more vigorous growth.

A combination of the abovementioned indicators were used during the field survey to identify the indicator plant species, soil types and specific topography related to the wetland areas. The outer boundaries were then recorded using a Global Positioning System (GPS). Riparian areas were mapped by means of the computer programme Arcview 3.3.

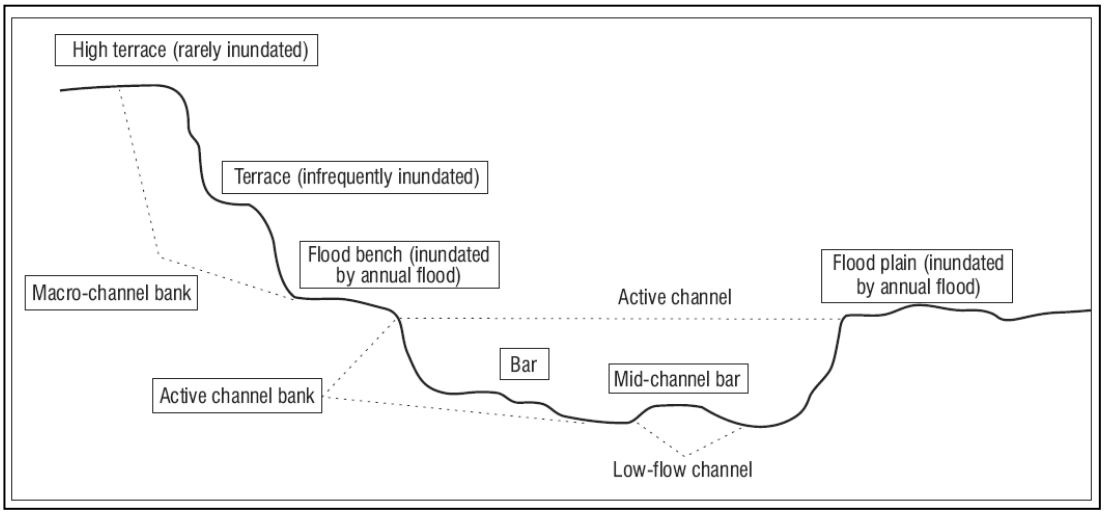


Figure 2. Cross section of topography associated with a channel and floodplains

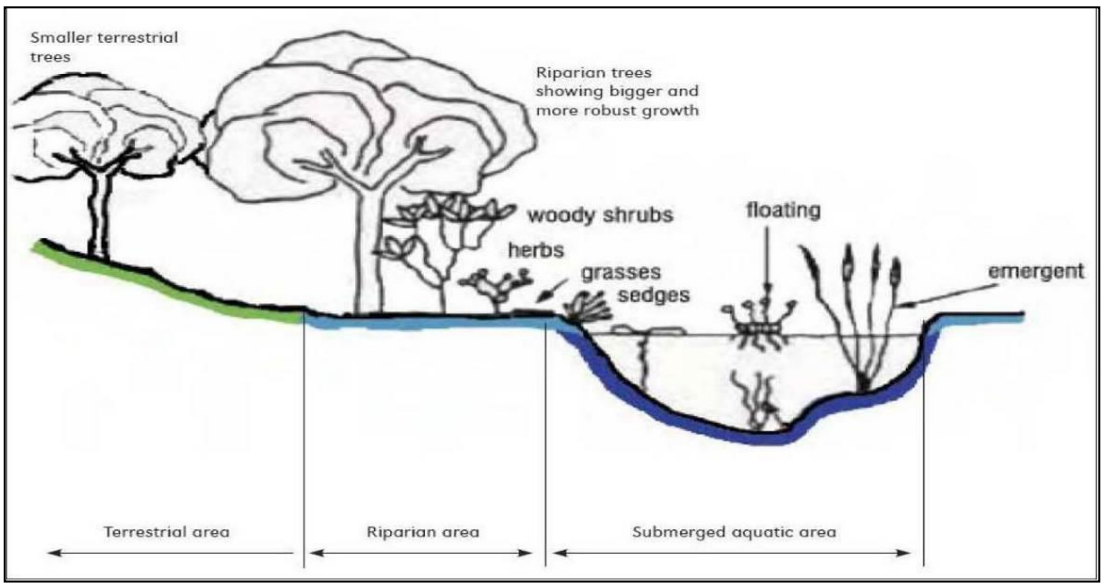


Figure 3. Typical cross section of a river channel displaying riparian habitat (DWA, 2003)

2.6 WETLAND INTEGRITY ASSESSMENTS

2.6.1 Present Ecological Status (PES) of wetlands

The Present Ecological State (PES) assessment of the wetlands within the study area was undertaken to determine the extent of departure of the wetlands from a natural state or reference condition. This method is based on the modified Habitat Integrity approach (Table 3) developed by Kleynhans (1999). Anthropogenic modification of the criteria and its attributes can have an impact on the ecological integrity of a wetland.

Table 3. Habitat integrity assessment criteria for wetlands (Adapted from DWAF, 2003)

Criteria and attributes	**Relevance**
Hydrologic	
Flow modification	Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration, frequency), volumes, velocity which affect inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.
Permanent Inundation	Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.
Water Quality	
Water Quality Modification	From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland
Sediment load modification	Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.
Hydraulic/Geomorphic	
Canalisation	Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. Channel diversions or drainage.
Topographic Alteration	Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railway lines and other substrate disruptive activities which reduce or changes wetland habitat directly or through changes in inundation patterns.
Biota	
Terrestrial Encroachment	Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.
Indigenous Vegetation Removal	Direct destruction of habitat through farming activities, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and increases potential for erosion.
Invasive plant encroachment	Affect habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).
Alien fauna	Presence of alien fauna affecting faunal community structure.
Over utilisation of biota	Overgrazing, Over-fishing, etc.

For the purpose of this study, the scoring system as described in the document “Resource Directed Measures for Protection of Water Resources, Volume 4. Wetland Ecosystems” (DWAF, 1999) was applied for the determination of the PES (Table 3). Two tools have recently been developed to facilitate the derivation of scores to reflect the present ecological sate, namely the Index of Habitat Integrity (IHI) DWA, 2007, and Wet-Health, developed by Macfarlane et al., 2008.

These tools have limitations in that they were developed primarily to assess conditions of floodplain and valley bottom wetlands and Hill slope seepage wetlands linked to drainage lines. The former tool was developed to provide a rapid assessment of the PES specifically for application in reserve studies, while the latter tool was developed to support the Working for Wetlands program. The objective of the latter tool was to provide a semi quantitative assessment of the state of wetland prior to rehabilitation, and one post rehabilitation to demonstrate "improvement". The intention in defining the health category (PES) of a wetland is to provide an indication of the current "condition" of a wetland in order to inform a management class. The latter provides the guidelines against that inform water quality and quantity required to maintain or improve the quality of the water resource.

The PES or health of wetlands has only been applied to the "natural" wetlands. Wetlands are rated on a scale of A to F, with A being a natural wetland and F being a completely modified and disturbed wetland (Table 4). The Wet-Health assesses the following factors that influence the "health" or condition of wetlands (floodplains and river channels associated with the site):

- Hydrology;
- Geomorphology
- Vegetation, and ideally
- Water quality.

The Present Ecological Status Class (PESC) of the wetlands was based on the available information for each of the criteria listed in Table 3 and the mean score determined for each wetland (Table 4). This approach is based on the assumption that extensive degradation of any of the wetland attributes may determine the PESC (DWAF, 2003).

Table 4. Present Ecological Status Class Descriptions

CLASS	CLASS BOUNDARY	CLASS DESCRIPTION
A	>4	**Unmodified, natural;** • The resource base reserve has not been decreased; • The resource capability has not been exploited
B	>3 and <=4	**Largely natural with few modification**; • The resource base reserve has been decreased to a small extent; • A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.
C	>2 and <=3	**Moderately modified**; • The resource base reserve has been decreased to a moderate extent. • A change of natural habitat and biota have occurred, but the basic ecosystem functions are still predominantly unchanged.
D	2	**Largely modified**; • The resource base reserve has been decreased to a large extent. • Large changes in natural habitat, biota and basic ecosystem functions have occurred.
E	>0 and <2	**Seriously modified**; • The resource base reserve has been seriously decreased and regularly exceeds the resource base; • The loss of natural habitat, biota and basic ecosystem functions is extensive.
F	0	**Critically modified**; • The resource base reserve has been critically decreased and permanently exceeds the resource base; • Modifications have reached a critical level and the resource has been modified completely with an almost total loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.

2.6.2 Ecological Importance and Sensitivity (EIS)

The Ecological Importance and Sensitivity (EIS) assessment was conducted according to the guidelines as discussed by DWAF (1999). Here DWAF defines "ecological importance" of a water resource as an expression of its importance to the maintenance of ecological diversity and function on local and wider scales. "Ecological sensitivity", according to DWAF (1999), is the system's ability to resist disturbance and its capability to recover from disturbance once it has occurred.

In the method outlined by DWAF a series of determinants for EIS are assessed for the wetlands on a scale of 0 to 4 (Table 5). The median of the determinants is used to determine the EIS of the wetland unit (Table 6).

Table 5. Criteria for assessing the Ecological Importance and Sensitivity of Wetlands

Determinant
PRIMARY DETERMINANTS
1. Rare & Endangered Species
2. Populations of Unique Species
3. Species/taxon Richness
4. Diversity of Habitat Types or Features
5. Migration route/breeding and feeding site for wetland species
6. Sensitivity to Changes in the Natural Hydrological Regime
7. Sensitivity to Water Quality Changes
8. Flood Storage, Energy Dissipation & Particulate/Element Removal
MODIFYING DETERMINANTS
9. Protected Status
10. Ecological Integrity

Score guideline Very high = 4; High = 3, Moderate = 2; Marginal/Low = 1; None = 0
Confidence rating Very high confidence = 4; High confidence = 3; Moderate confidence = 2; Marginal/low confidence = 1

Table 6. Ecological Importance and Sensitivity Classes

Ecological Importance and Sensitivity Category (EIS)	Range of Median
Very high Wetlands that are considered ecologically important and sensitive on a national or even international level. The biodiversity of these wetlands is usually very sensitive to flow and habitat modifications. They play a major role in moderating the quantity and quality of water of major rivers.	>3 and <=4
High Wetlands that are considered to be ecologically important and sensitive. The biodiversity of these wetlands may be sensitive to flow and habitat modifications. They play a role in moderating the quantity and quality of water of major rivers.	>2 and <=3
Moderate Wetlands that are considered to be ecologically important and sensitive on a provincial or local scale. The biodiversity of these Wetlands is not usually sensitive to flow and habitat modifications. They play a small role in moderating the quantity and quality of water of major rivers.	>1 and <=2
Low/marginal Wetlands that are not ecologically important and sensitive at any scale. The biodiversity of these Wetlands is ubiquitous and not sensitive to flow and habitat modifications. They play an insignificant role in moderating the quantity and quality of water of major rivers.	>0 and <=1

2.7 SENSITIVITY ASSESSMENT

The ecological sensitivity of any piece of land is based on its inherent ecosystem service and overall preservation of biodiversity.

2.7.1 Ecological function

The ecological function relates to the degree of ecological connectivity between systems within a landscape matrix. Therefore, systems with a high degree of landscape connectivity amongst one another are perceived to be more sensitive and will be those contributing to ecosystem service (*e.g*. wetlands) or overall preservation of biodiversity.

2.7.2 Conservation importance

Conservation importance relates to species diversity, endemism and the high occurrence of threatened and protected species or ecosystems protected by legislation.

2.7.3 Sensitivity scale

- High – sensitive ecosystem with either low inherent resistance or low resilience towards disturbance factors or highly dynamic systems considered being important for the maintenance of ecosystem integrity. Most of these systems represent ecosystems with high connectivity with other important ecological systems or with high species diversity and usually provide suitable habitat for a number of threatened or rare species. These areas should be protected;
- Medium – These are slightly modified systems which occur along gradients of disturbances of low-medium intensity with some degree of connectivity with other ecological systems or ecosystems with intermediate levels of species diversity but may include potential ephemeral habitat for threatened species;
- Low – Degraded and highly disturbed / transformed systems with little ecological function and which are generally very poor in species diversity.

2.8 IMPACT RATING ASSESSMENT MATRIX

An impact can be defined as any change in the physical-chemical, biological, cultural and/or socio-economic environmental system that can be attributed to human activities related to alternatives under study for meeting a project need.

The significance of the impacts will be determined through a synthesis of the criteria below (Plomp, 2004):

Probability. This describes the likelihood of the impact actually occurring:

- Improbable: The possibility of the impact occurring is very low, due to the circumstances, design or experience.
- Probable: There is a probability that the impact will occur to the extent that provision must be made therefore.

- Highly Probable: It is most likely that the impact will occur at some stage of the development.
- Definite: The impact will take place regardless of any prevention plans, and there can only be relied on mitigation actions or contingency plans to contain the effect.

Duration. The lifetime of the impact:

- Short term: The impact will either disappear with mitigation or will be mitigated through natural processes in a time span shorter than any of the phases.
- Medium term: The impact will last up to the end of the phases, where after it will be negated.
- Long term: The impact will last for the entire operational phase of the project but will be mitigated by direct human action or by natural processes thereafter.
- Permanent: Impact that will be non-transitory. Mitigation either by man or natural processes will not occur in such a way or in such a time span that the impact can be considered transient.

Scale. The physical and spatial size of the impact:

- Local: The impacted area extends only as far as the activity, e.g. footprint.
- Site: The impact could affect the whole, or a measurable portion of the study area.
- Regional: The impact could affect the area including the neighbouring areas.

Magnitude/ Severity. Does the impact destroy the environment, or alter its function:

- Low: The impact alters the affected environment in such a way that natural processes are not affected.
- Medium: The affected environment is altered, but functions and processes continue in a modified way.
- High: Function or process of the affected environment is disturbed to the extent where it temporarily or permanently ceases.

Significance. This is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required:

- Negligible: The impact is non-existent or unsubstantial and is of no or little importance to any stakeholder and can be ignored.
- Low: The impact is limited in extent, has low to medium intensity; whatever its probability of occurrence is, the impact will not have a material effect on the decision and is likely to require management intervention with increased costs.
- Moderate: The impact is of importance to one or more stakeholders, and its intensity will be medium or high; therefore, the impact may materially affect the decision, and management intervention will be required.
- High: The impact could render development options controversial or the project unacceptable if it cannot be reduced to acceptable levels; and/or the cost of management intervention will be a significant factor in mitigation.

The following weights will be assigned to each attribute:

Aspect	Description	Weight
Probability	Improbable	1
	Probable	2
	Highly Probable	4
	Definite	5
Duration	Short term	1
	Medium term	3
	Long term	4
	Permanent	5
Scale	Local	1
	Site	2
	Regional	3
Magnitude/Severity	Low	2
	Medium	6
	High	8
Significance	**Sum (Duration, Scale, Magnitude) x Probability**	
	Negligible	<20
	Low	<40
	Moderate	<60
	High	>60

The significance of each activity will be rated without mitigation measures and with mitigation measures for the development.

The mitigation effect of each impact will be indicated without and with mitigation measures as follows:

- Can be reversed
- Can be avoided, managed or mitigated
- May cause irreplaceable loss of resources

3 STUDY AREA

3.1 LOCATION AND DESCRIPTION OF ACTIVITY

The project is located on the farm Bolobedu 1024 LT which has been consolidated. The two farms that have been consolidated include the Remainder of the Farm Kromrivierfontein 360 LT, and the Remainder of the Farm Worcester 200 LT, Greater Letaba local Municipality, Mopani District Municipality, Limpopo Province. The proposed project is situated south of the R81 Mooketsi – Giyani road. The proposed project entails the establishment and installation of a connection of the Bolubedu Solar Park to the Eskom grid. The 75 mW PV Bolobedu PV power plant will be connected to the Eskom grid via a 132 kVa feeder bay. Access to the Bolubedu Solar Park and grid connection site, will be from the tar road between the villages of Lebaka and Ga-Femane to the south of the R81. The aerial image of the site is indicated in figure 5.

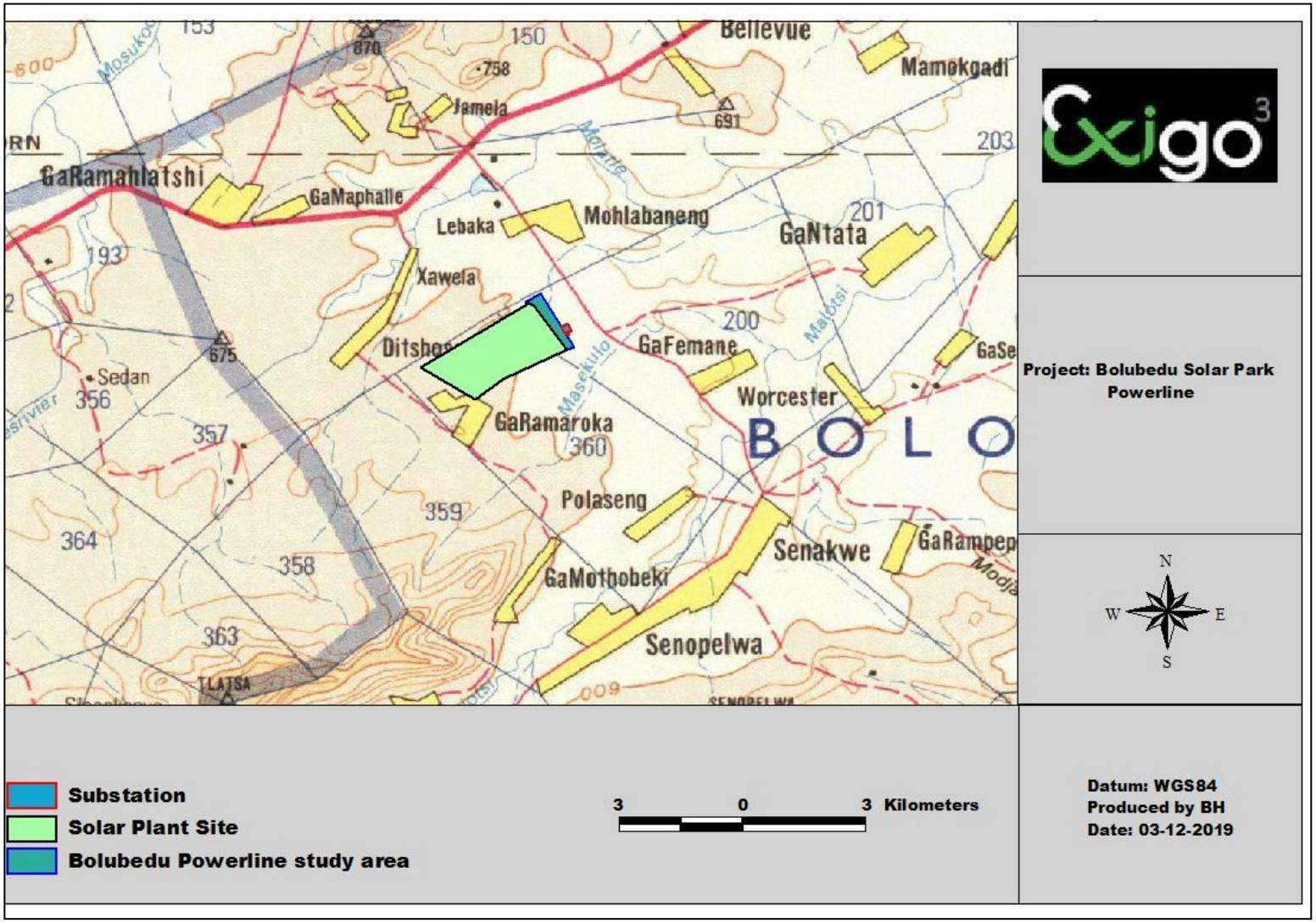


Figure 4. Regional Location Map

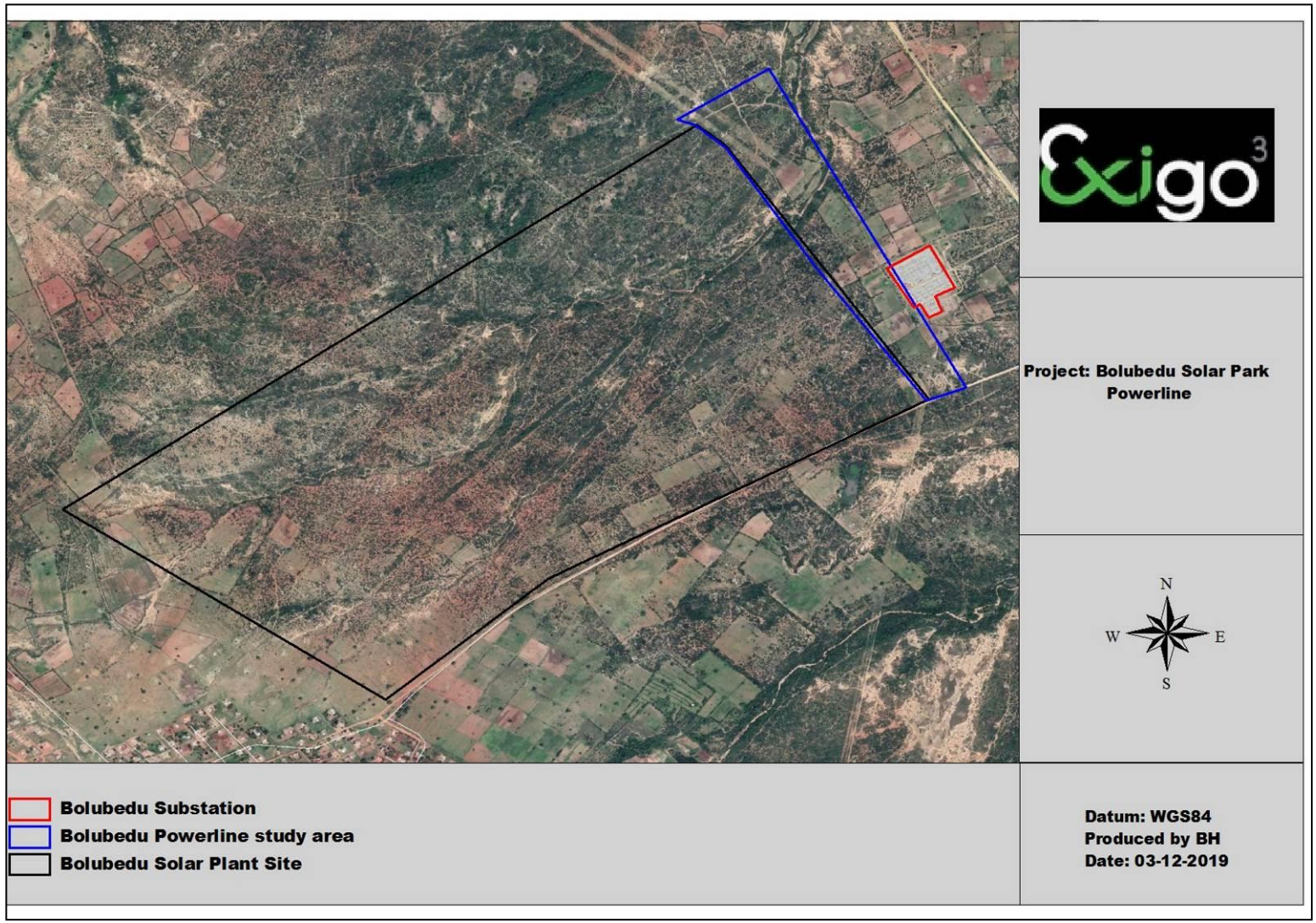


Figure 5. Location Map of the Powerline area in relation to the solar plant and substation

3.2 CLIMATE

Climate in the broad sense is a major determinant of the geographical distribution of species and vegetation types. However, on a smaller scale, the microclimate, which is greatly influenced by local topography, is also important. Within areas, the local conditions of temperature, light, humidity and moisture vary greatly and it is these factors which play an important role in the production and survival of plants (Tainton, 1981). The climate for the region can be described as warm-temperate. In terrestrial environments, limitations related to water availability are always important to plants and plant communities. The spatial and temporal distribution of rainfall is very complex and has great effects on the productivity, distribution and life forms of the major terrestrial biomes (Barbour et al. 1987).

Giyani normally receives about 421mm of rain per year, with most rainfall occurring mainly during mid summer. Figure 6 shows the average rainfall values for Giyani per month. It receives the lowest rainfall (0mm) in June and the highest (93mm) in January. The monthly distribution of average daily maximum temperatures (Figure 7) shows that the average midday temperatures for Giyani range from 23.9°C in June to 31°C in January. The region is the coldest during July when the mercury drops to 8°C on average during the night.

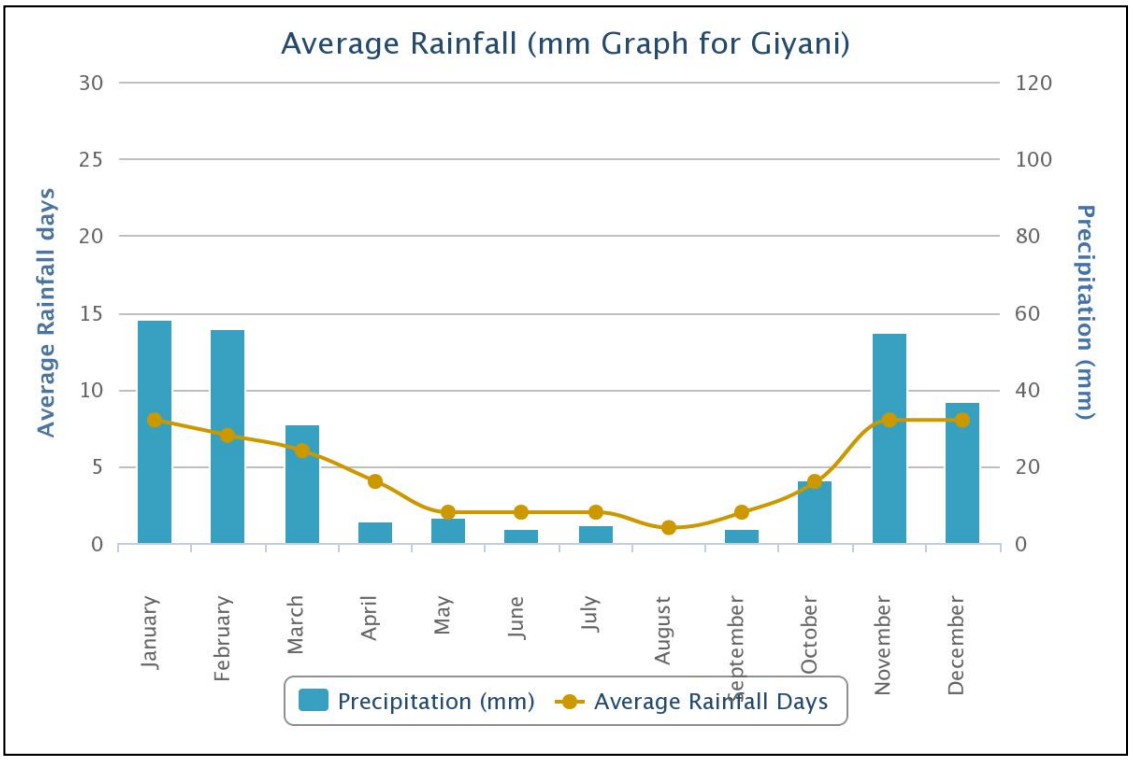


Figure 6. Average monthly rainfall for the Giyani area in the Limpopo Province

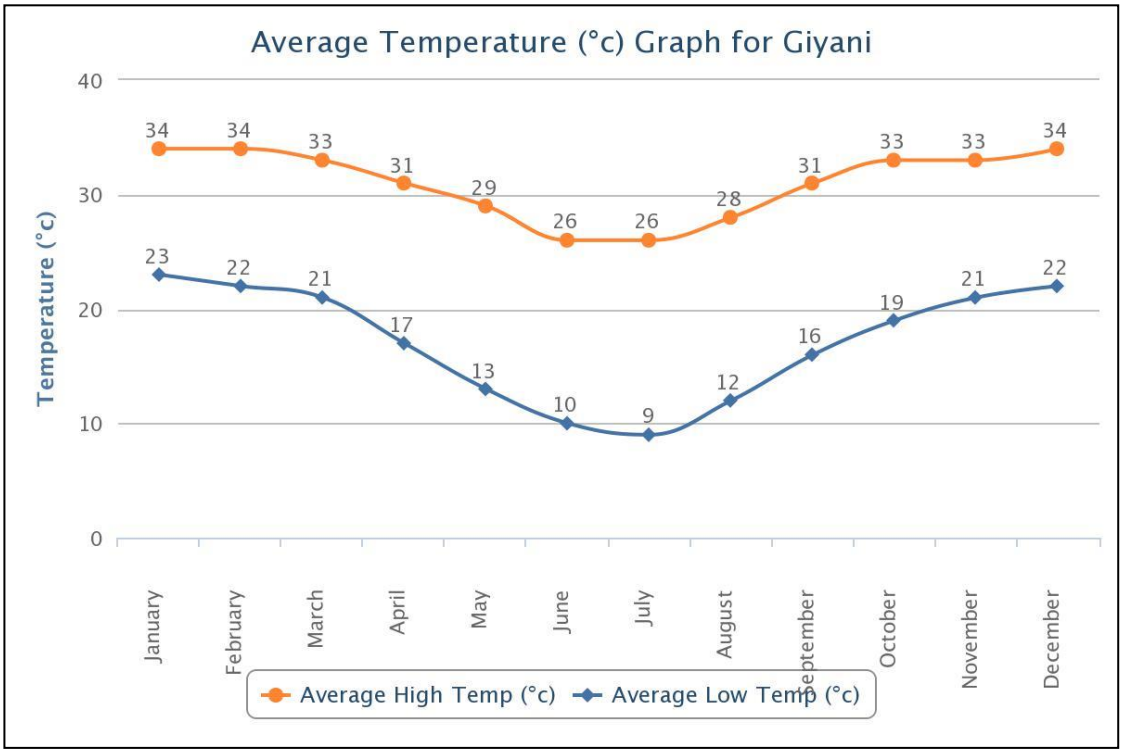


Figure 7. Average monthly temperatures for the Giyani area, Limpopo Province

3.3 VEGETATION TYPES

The development site lies within the Savanna biome which is the largest biome in Southern Africa. It is characterized by a grassy ground layer and a distinct upper layer of woody plants (trees and shrubs). The environmental factors delimiting the biome are complex and include altitude, rainfall, geology and soil types, with rainfall being the major delimiting factor. Fire and grazing also keep the grassy layer dominant. The most recent classification of the area by Mucina & Rutherford is the Granite Lowveld Bushveld vegetation type. Most of the proposed development sites have been completely modified and represent degraded bushveld or old fields.

The vegetation structure of the Granite Lowveld Vegetation Type is typical tall shrubland with few trees to medium dense low woodland on the deep sandy uplands, while dense thicket to open savanna dominate occurs in the bottomlands. At seeplines where convex topography changes to concave, a dense fringe of *Terminalia sericea* occurs, with *Eragrostis gummiflua* in the undergrowth. The conservation status of the vegetation type is vulnerable with some 17% conserved in Kruger National Park, and the same percentage conserved in smaller private reserves. More than 20% of this vegetation type has been transformed, mainly by cultivation and by settlement development.

3.4 GEOLOGY AND SOIL TYPES

Geology is directly related to soil types and plant communities that may occur in a specific area (Van Rooyen & Theron, 1996). A Land type unit is a unique combination of soil pattern, terrain and macroclimate, the classification of which is used to determine the potential agricultural value of soils in an area. The land type unit represented within the study area include the Ae326 land type (Land Type Survey Staff, 1987) (ENPAT, 2001). The land type, geology and associated soil type is presented in Table 1 below as classified by the Environmental Potential Atlas, South Africa (ENPAT, 2000).

Table 7. Land types, geology and dominant soil types of the proposed development site

Landtype	Soils	Geology
Ae326	Red-yellow apedal, freely drained soils; red, high base status, > 300 mm deep (no dunes)	Grey biotite gneiss and migmatite of the Goudplaats Gneiss in the north; leucocratic biotite granite of Vaalian age in the south and east; many diabase dykes.

Soils associated with the site are mostly deep red-yellow apedal sandy to sandyloam on the plains, while black, alluvial soils are associated with the drainage channels.

3.5 TOPOGRAPHY & DRAINAGE

The project area is characterised by slightly undulating to flat plains with two major drainage channels bisecting the area. The topography across the site is slightly undulating with the average elevation of 580 mamsl.

The site is located within the B81G quaternary catchment and is situated in the Letaba / Levuhu Water Management Area. Drainage occurs as sheet-wash towards the major rivers.

3.6 LAND USE AND EXISTING INFRASTRUCTURE

The current land-use on the project site is cattle grazing and small-scale subsistence farming. Neighbouring farms are being used for crop cultivation, livestock grazing and small-scale subsistence farming.

3.7 BACKGROUND ON CONSERVATION TOOLS AND SENSITIVITY ASSESSMENT

There are several assessments for South Africa as a whole, as well as on provincial levels that allow for detailed conservation planning as well as meeting biodiversity targets for the country's variety of ecosystems. These guides are essential to consult for development projects, and will form an important part of the sensitivity analysis.

Areas earmarked for conservation in the future, or that are essential to meet biodiversity and conservation targets should not be developed, and have a high sensitivity as they are necessary for overall functioning. In addition, sensitivity analysis in the field based in much finer scale data can be used to ground truth the larger scale assessments and put it into a more localised context.

3.8 CRITICAL BIODIVERSITY & ECOLOGICAL SUPPORT AREAS OF THE PROJECT AREA

The purpose of the Limpopo Conservation Plan version 2 (LCPv2) is to develop the spatial component of a bioregional plan (i.e. map of Critical Biodiversity Areas (CBA) and associated land-use guidelines). The Limpopo Conservation Plan categories for the impacted land are presented in Figure 8. The site is located in a NNA (Near natural Area) and ONA (Other Natural Area), although larger sections of the site are considered degraded. Development can be supported in these areas.

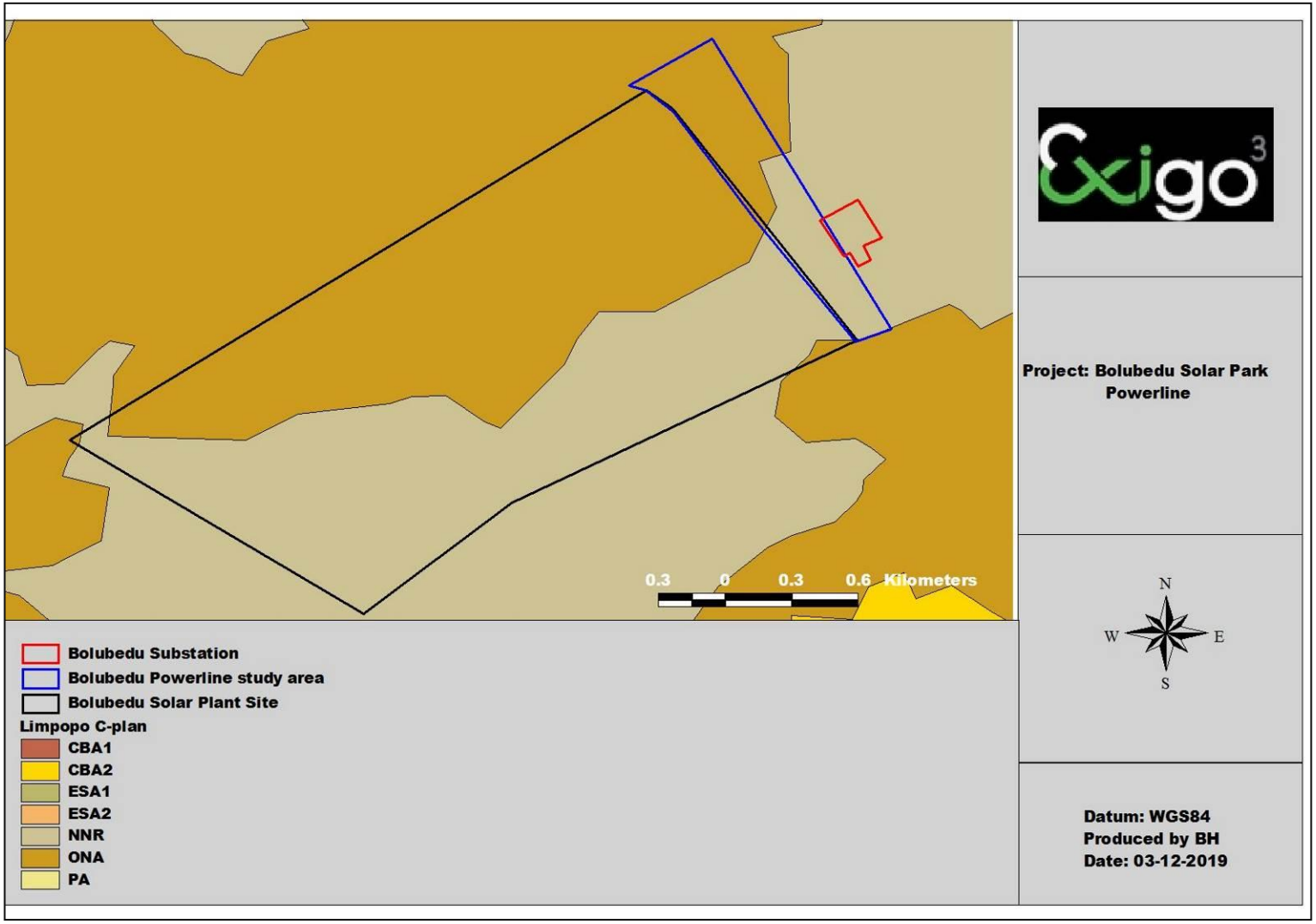


Figure 8. Terrestrial CBA areas of the study area (2014)

3.9 PROTECTED AREAS NETWORK AND NATIONAL PROTECTED AREAS EXPANSION STRATEGY (NPAES)

Officially protected areas, either provincially or nationally that occur close to a project site could have consequences as far as impacts on these areas are concerned. For the proposed development site and associated infrastructure however, the Manombe and Modjadji Nature Reserves is located further south of the project area (Figure 9).

The NPAES are areas designated for future incorporation into existing protected areas (both National and informal protected areas). These areas are large, mostly intact areas required to meet biodiversity targets, and suitable for protection. They may not necessarily be proclaimed as protected areas in the future and are a broad scale planning tool allowing for better development and conservation planning. The project area is not linked to any NPAES.

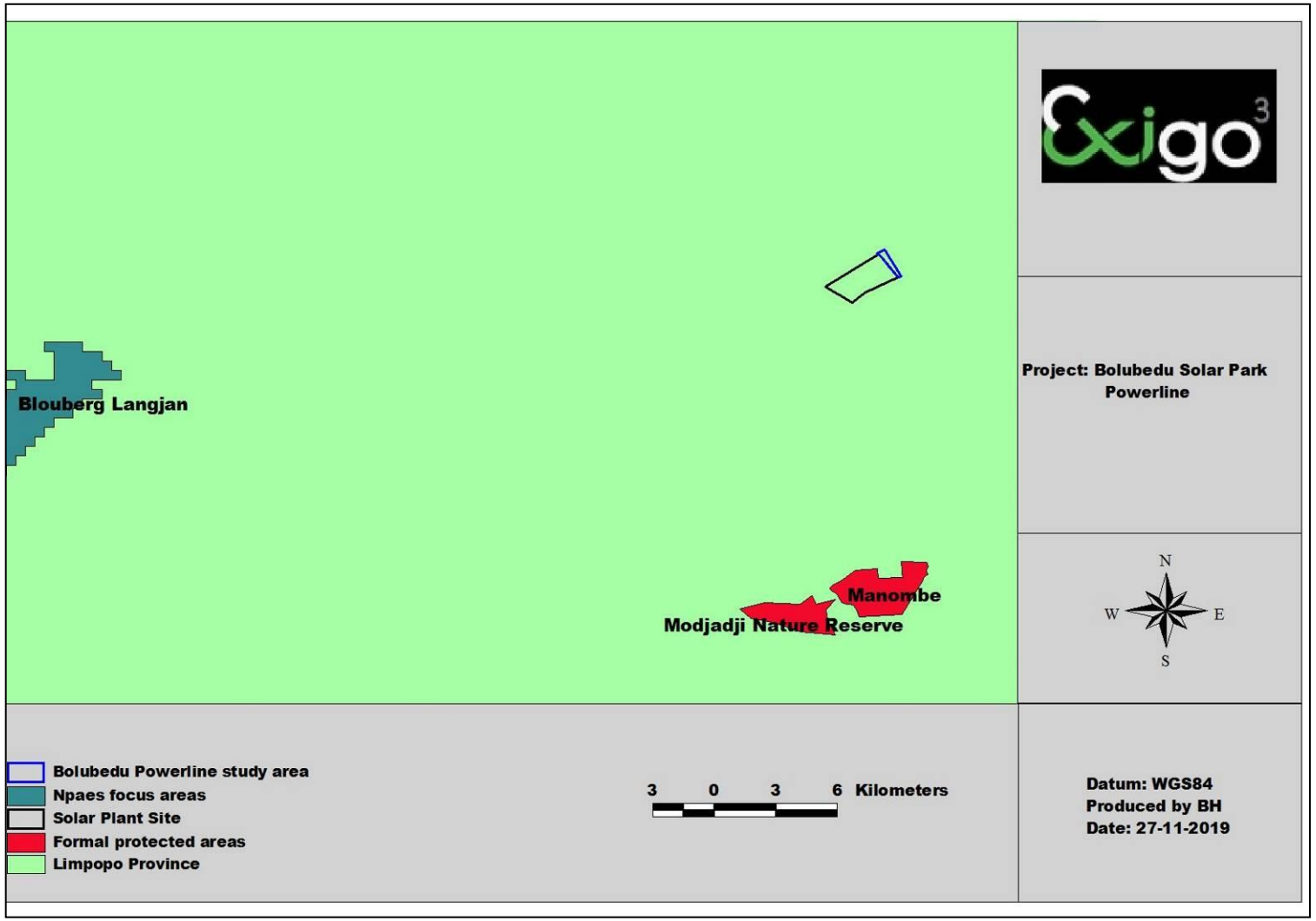


Figure 9. Protected areas in close proximity to the project area

3.10 IMPORTANT BIRD AREAS

An Important Bird Area (IBA) is an area recognized as being globally important habitat for the conservation of bird populations. Currently there are about 10,000 IBAs worldwide. At present, South Africa has 124 IBA's, covering over 14 million hectares of habitat for our threatened, endemic and congregatory birds. Yet only million hectares of the total land surface covered by our IBA's legally protected. The BirdLife SA IBA programme continues a programme of stewardship which will ultimately achieve formal protection (Birdlife, 2013). The project area is located outside any IBA with the closest IBA being Magoebaskloof to the south.

3.11 NATIONALLY THREATENED ECOSYSTEMS

The list of national Threatened Ecosystems has been gazetted (NEM:BA: National list of ecosystems that are threatened and in need of protection) and result in several implications in terms of development within these areas. Four basic principles were established for the identification of threatened ecosystems. These include:

- The approach must be explicit and repeatable;
- The approach must be target driven and systematic, especially for threatened ecosystems;
- The approach must follow the same logic as the IUCN approach to listing threatened species, whereby a number of criteria are developed and an ecosystem is listed based on its highest ranking criterion; and
- The identification of ecosystems to be listed must be based on scientifically credible, practical and simple criteria, which must translate into spatially explicit identification of ecosystems.

Areas were delineated based on as fine a scale as possible and are defined by one of several assessments: These areas are essential for conservation of the country's ecosystems as well as meeting conservation targets. The project area is not located within a Listed Threatened Ecosystem, with the Tzaneen Sour Bushveld classified as having a Vulnerable Ecosystem Status located directly west of the powerline corridor.

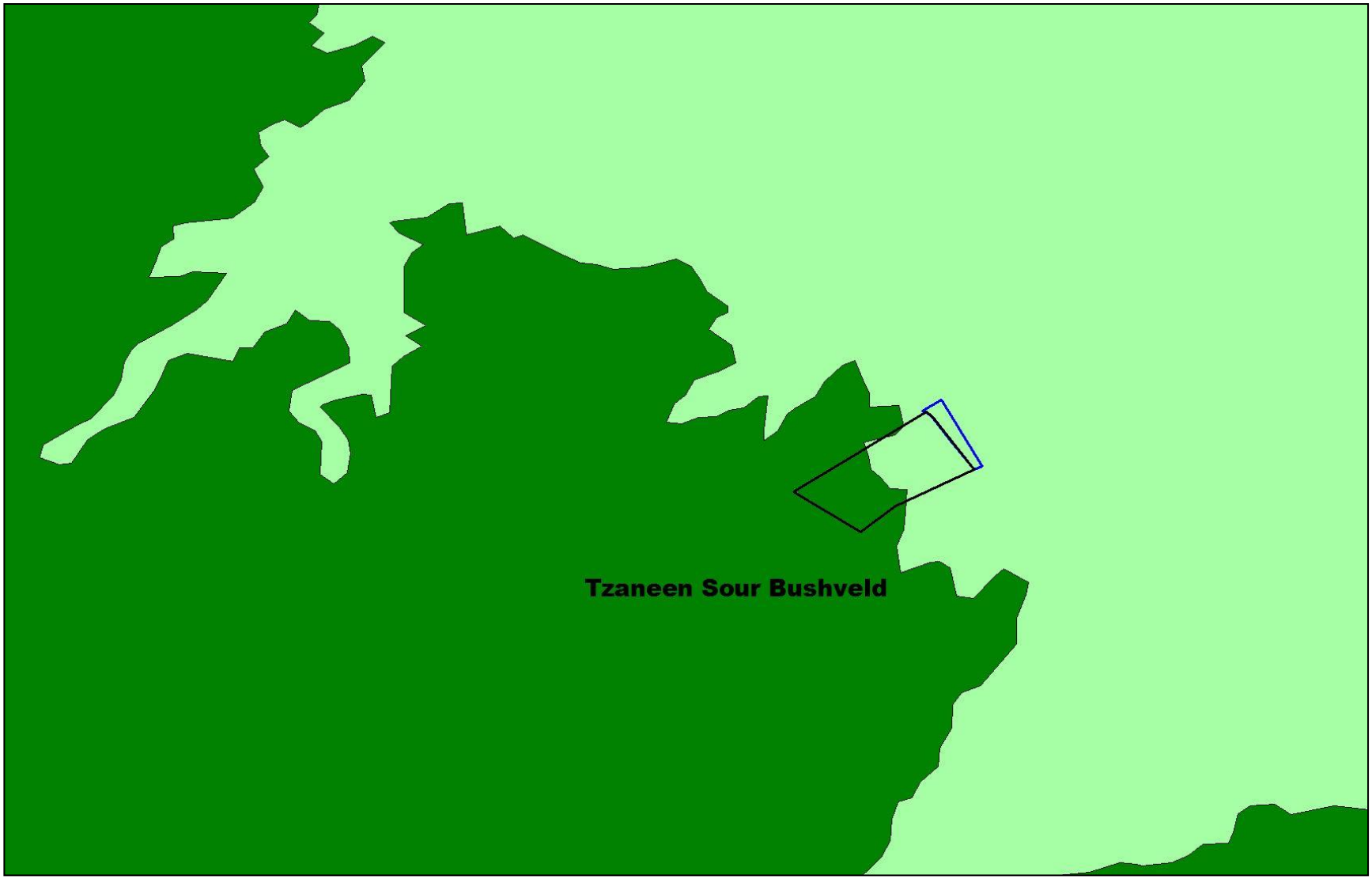


Figure 10. Threatened ecosystems map for the project area (SANBI)

4 RESULTS

4.1 VEGETATION UNITS

The proposed development is planned on a landscape that varies from slightly undulating to flat plains. The proposed development site currently represents communal land utilised for livestock grazing and small-scale subsistence farming. The vegetation units on the site vary according to soil characteristics, topography and land-use. Most of the site has become encroached by dense stands of sickle bush due to the overgrazing. Vegetation units were identified and can be divided into distinct vegetation units according to soil types and topography. The vegetation communities identified on the proposed development site are classified as physiographic physiognomic units, where physiognomic refers to the outer appearance of the vegetation, and physiographic refers to the position of the plant communities in the landscape.

The physiographic-physiognomic units will be referred to as vegetation units in the following sections. These vegetation units are divided in terms of the land-use, plant species composition, topographical and soil differences that had the most definitive influence on the vegetation units. Each unit is described in terms of its characteristics and detailed descriptions of vegetation units are included in the following section. A species list for the site is included in Appendix A, while a plant species list for the quarter degree grid square (QDS) is included in Appendix B. Photographs of each unit is included in the next section to illustrate the grass layer, woody structure and substrate (soil, geology etc.). The following vegetation units were identified during the survey.

1. Degraded *Dichrostachys cinerea* thickets on red-yellow apedal soils;
    - *Dichrostachys cinerea – Vachellia – Combretum* mixed thickets (Variation);
    - *Dichrostachys – Kirkia – Ficus* rocky dykes (Variation);
    - *Dichrostachys cinerea – Terminalia sericea* woodland on leached sandy soils (Variation);
    - *Dichrostachys cinerea – Colophospermum mopane – Senegalia niogrescens* thickets (Variation);
2. Old fields / cultivated land;
3. Drainage channels & riparian woodland.
4. Old quarries.

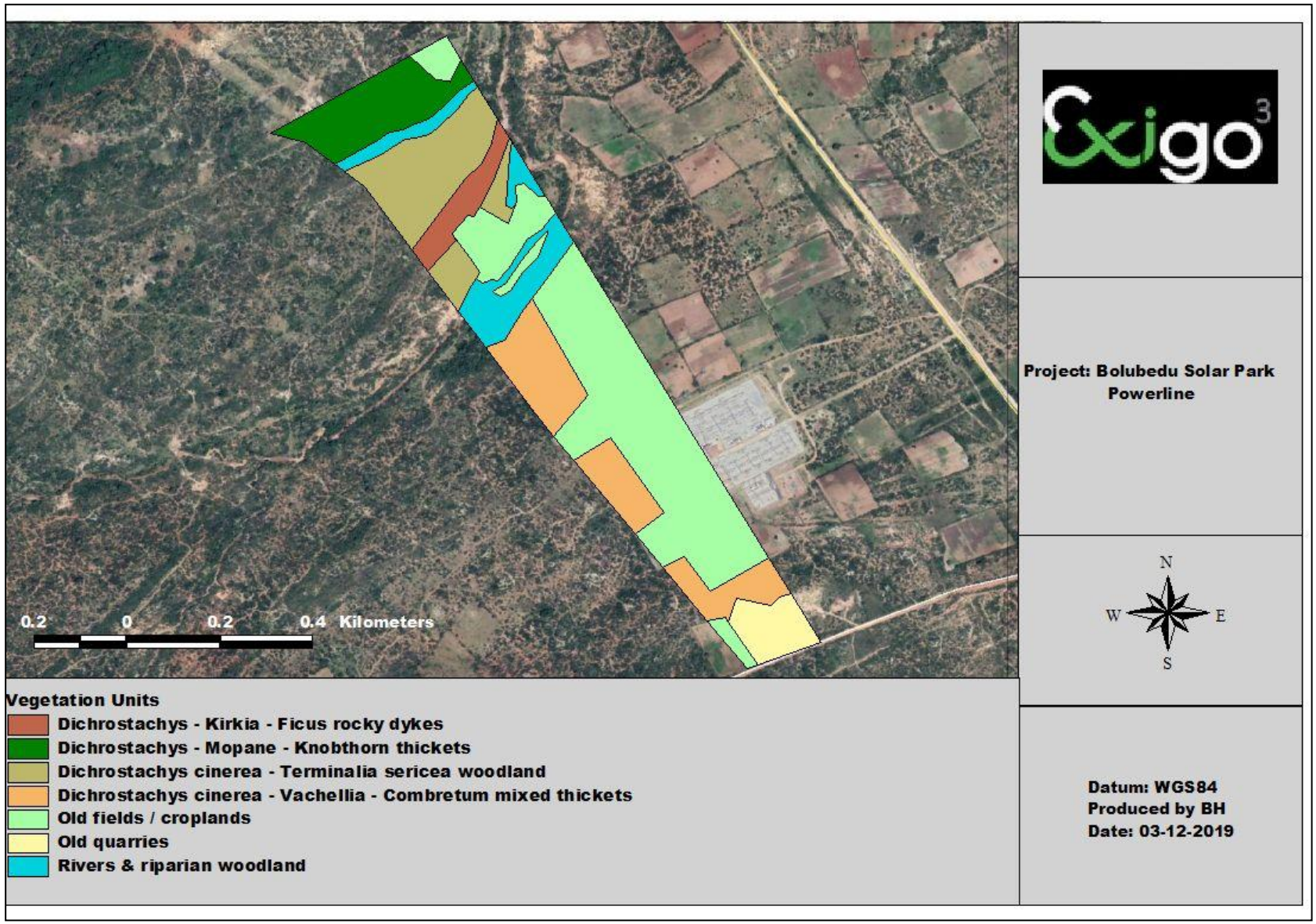


Figure 11. Vegetation Map

4.1.1 Degraded *Dichrostachys cinerea* thickets

This vegetation unit occurs throughout the proposed development site and represent degraded woodland and secondary old fields that became encroached as a result of serious overgrazing from the community livestock. The woody structure is dense thickets dominated by *Dichrostachys cinerea,* although most of the indigenous woodland elements are still present. The grass layer is in an overgrazed state. The protected tree species *Sclerocarya birrea, Balanites maughammi, Combretum imberbe* and *Philenoptera violaceae* occur scattered throughout the site.

Four variations of this vegetation unit occurs namely the mixed *Dichrostachys – Vachellia – Combretum* thickets (including the secondary old fields) (Photograph 1) associated with deeper red-yellow apedal soils (Clovelly, Hutton soil forms), thickets associated with dolerite dykes (Photograph 2) supporting woody species such as *Kirkia acuminata, Flueggia virosa, Ficus abutifolia* and *Combretum* species, while the northern section of the project area support the *Dichrostachys – Terminalia* woodland (Photograph 3) on shallow, gravelly to deeper, leached soils of the Glenrosa or Clovelly soil forms and the *Dichrostachys - Colophospermum mopane – Senegalia nigrescens* woodland (Photograph 4) on red apedal to greyish soils.

Secondary old fields are usually dominated by species such as *Dichrostachys cinerea, Vachellia tortilis*, *Colophospermum mopane* and *Ziziphus mucronata*. Where overgrazing occurs the encroacher *Dichrostachys cinerea* becomes dominant as is evident on certain areas of the site. The landscape and vegetation features of this unit include slightly undulating plains with Hutton soils. This vegetation unit is defined as a secondary old field variant/modified land which is evident from the higher tree cover/diversity as well as the higher shrub cover/diversity. Other degraded woodland areas represent a similar plant species composition and structure to the secondary old fields and is included in this vegetation unit based on these characteristics. No red data species were found as a result of the degraded state of the vegetation.

The degradation is evident due to the encroachment and invasion of the woody layer by indigenous shrubs such as *Dichrostachys cinerea* and young *Colophospermum mopane*. The present legislation under the Conservation of Agricultural Resources Act, 1983 (Act No 43 of 1983) (CARA), regulation 16, states that bush encroachers, which are indigenous plants, require sound management practices to prevent them from becoming problematic. Bush encroachment is a term used for "stands of plants such as sickle bush and various Acacia species where individual plants are closer to each other than three times the mean crown diameter". Ecological management need therefore be implemented in these areas to address the problem.

The characteristics of this vegetation unit are summarized in Table 8, while the state of the vegetation indicated in photographs 1,2, 3 and 4.

Table 8. Botanical analysis and characteristics of the Degraded *Dichrostachys cinerea* thickets

Degraded *Dichrostachys cinerea* thickets				
	Mixed thickets	**Rocky, dolerite dykes**	***Dichrostachys* – *Terminalia* woodland**	***Dichrostachys* – Mopane – Knobthorn thickets**
State of the vegetation:	Degraded woodland in an encroached state			
Need for rehabilitation	Medium - High			
Conservation priority	Medium			
Soils & Geology	Deep, red Hutton or Clovelly soils (loam to sandyloam) derived from granite	Rocky soils derived from dolerite	Shallow gravelly to deeper leached soils of the Glenrosa / Clovelly soil forms	Red apedal to slightly greyish soils derived from granite
Density of woody layer	Trees: 10-15% (avg. height: 3-6m) Shrubs: 30-40% (avg. height: 1-2m)			
Density of herbaceous layer	Grasses: 30-40% (avg. height: 0.8-1.2m) Forbs: <1% (avg. height: 0.8m)			
Sensitivity	Medium			
Red data species	None observed			
Protected species	*Sclerocarya birrea* (DAFF listed) *Combretum imberbe* (DAFF listed) *Phileneptera violaceae* (DAFF listed) *Balanites maughammi* (DAFF listed)			

The following specific recommendations for the area should be adhered to

- The vegetation unit is classified as having a medium sensitivity due to the widespread status in the Savanna Biome and the presence of protected trees and succulents in the degraded unit;
- The development can be supported provided that a licence is obtained from DAFF for the eradication of the protected trees.

Photograph 1. Degraded mixed sickle bush thickets on red apedal soils in the project area

Photograph 2. Dense, rocky dolerite dykes in the project area

Photograph 3. *Dichrostachys* – *Terminalia* woodland on shallow Clovelly soils in the northern section of the project area

Photograph 4. Dichrostachys – Mopane – Knobthorn thickets in the northern section of the site

4.1.2 Old fields / cultivated land

This vegetation unit represent primary old fields and small-scale subsistence farming. The degraded areas occur throughout large areas on deeper red-yellow to red apedal soils. The cultivated land (Photograph 5) occurs as pockets of small-scale subsistence farming on isolated areas. These areas do not represent a vegetation entity other than homogenous stands of crops and some exotic weeds and pioneer grasses. The old cultivated fields occur throughout the area and in this case only represent primary old fields (secondary old fields discussed under the mixed thickets).

Different stages of succession occur in the old fields, and the most common old fields in the Savanna Biome and surroundings are the young old fields of 1-5 years old (Smits et al., 1999) dominated by the pioneer grass species of disturbed areas, *Cynodon dactylon* (Van Oudtshoorn, 1999). Secondary grassland communities may develop from this old field variation, dominated by the secondary grassland species directly related to man-made disturbances, *Hyparrhenia hirta*. These fields are still in an early successional state, although somewhat older (older than 5 years) with several grass species like *Hyperthelia dissoluta, Aristida junciformis, Aristida congesta s. congesta* and *Eragrostis rigidior*. The landscape and vegetation features of the primary old fields (Photograph 6) on the proposed development site include slightly undulating plains with a low tree cover (< 1%) and dense (60-70%) grass layer. The dominant species include *Aristida* species, *Eragrostis lehmanniana* and *Cenchrus ciliaris*, indicating previous agricultural/utilising activities within these areas, while typical herbs/weeds include *Tagetes minuta* and *Bidens bipinnata*. The shrub layer (1 - 1,5m.) on the primary old fields covers 1 – 2%, while the forb layer covers 15-20% of the area. The soil in the area is red Hutton soils. The characteristics of the two variations are further described in Table 9.

Table 9. Botanical analysis and characteristics of the degraded woodland / grassland

	Primary old fields / cultivated land
Location:	Throughout the area on the plains and valleys where the impact of grazing, crop cultivation and anthropogenic influences are apparent.
State of the vegetation:	Completely modified to degraded
Characteristics:	Short, degraded grassland / cropfields
Density of woody layer:	Trees: <1% (avg. height: 3-6m) Shrubs: 1-2% (avg. height: 1-2m)
Density of herbaceous layer:	Grasses: 40-50% (avg. height: 1.2m) Forbs: 1-2% (avg. height: 0.5m)
Sensitivity:	Low sensitivity
Red data species:	None observed; no potential habitats
Protected tree species:	*Sclerocarya birrea, Philenoptera violaceae, Combretum imberbe*

Photograph 5. Small-scale subsistence farming on red apedal soils

Photograph 6. Primary old fields

The following general ecological observations and recommendations should be adhered to:

- A large percentage of the land in question on the plains does not appear to be of high conservation importance due to the impact from previously cultivated land, overgrazing and agricultural activities by the local communities. Most of the existing developed area consists of degraded grassland with occasional pockets of cultivated land. Much of the area is disturbed and used for grazing and cultivation purposes.
- The degraded areas have a low sensitivity due to the modified state of the vegetation.

4.1.3 Drainage channel & riparian woodland

This vegetation unit includes the drainage channels and riparian woodland in the project area. The non-perennial channels on site can be described as water courses or channels. (SANBI, 2009). The vegetation structure associated with the water courses vary from the actual channels being a sandy riverbed (Photograph 7) with alluvial sand and conglomerates to closed woodland along the riverbanks (Photograph 7). The narrow band of trees that occurs along the channel can be classified as riparian vegetation. The rivers flow from west to east. This channels and associated vegetation is very important for connectivity with adjacent vegetation as well as a migratory route for riparian animals.

4.1.3.1 Instream habitat / Channel Zone:

Section 1.1 (xi) of the National Water Act (1998) described “instream habitat" as the area which includes the physical structure of a watercourse and the associated vegetation in relation to the bed of the watercourse. The water courses on the site are non-perennial systems and the actual channels form a sandy riverbed. This is the result of deposition of sand in the riverbed as a result of sediment transport imbalances that occur upstream. Sediment transport imbalances have been caused by changes in the river catchments such as increased sediment yields and flood peak attenuation due to road crossings and small dam construction in the water courses upstream of the site. Historically floods used to flush river systems to maintain the long-term sediment balance in the river system, but with reduced flood peaks, sediment transport capacities in the rivers are reduced and flushing efficiency decreased. In the case of the water course on the site, the lack of flushing of the system has caused severe sedimentation in the system over the years.

4.1.3.2 Riparian zone

Riparian Habitat are described by the National Water Act (1998) Section 1.1 (xxi) as follows: "Riparian habitat" includes the physical structure and associated vegetation of the areas associated with a watercourse which are commonly characterised by alluvial soils, and which are inundated or flooded to an extent and with a frequency sufficient to support vegetation of species with a composition and physical structure distinct from those of

adjacent land areas". The most abundant and most conspicuous trees in the tall riparian woodland are *Diospyros mespiliformes, Combretum imberbe, Schotia brahypetala, Colophospermum mopane* and *Ficus sycomo*rus. Shrubs such as *Flueggia virosa, Gymnosporia senegalensis, Grewia flava* and *Dichrostachys cinerea* occur on the riverbanks or on the neighbouring low-lying areas. Typical grasses include *Panicum maximum, Eragrostis rotifer* and *Cenchrus ciliaris*. The layout should not impede on the water courses, although specific mitigation measures and a 30m buffer zone should be implemented to ensure the flow regime and functionality of water courses are kept intact. The characteristics of the drainage features on site are summarized in Table 5, while the state of the vegetation indicated in photograph 7.

Table 10. Botanical analysis and characteristics of the drainage features in the project area

State of the vegetation:	**Non-perennial drainage channels**
State of the vegetation:	Natural riparian woodland
Conservation priority	High
Characteristics	Non –perennial channel. The channels eventually feed the Molototsi River that occurs to the east of the site.
Dominant species	*Diospyros mespiliformes, Combretum imberbe, Schotia brahypetala, Colophospermum mopane and Ficus sycomorus*
Density of woody layer	Trees: 15-20% (avg. height: 3-6m) Shrubs: 5-10% (avg. height: 1-2m)
Density of herbaceous layer	Grasses: 40% (avg. height: 0.8-1.2m) Forbs: <1% (avg. height: 0.8m)
Sensitivity	High
Red data species	None observed
Protected species	*Combretum imberbe* *Philenoptera violaceae* *Sclerocarya birrea* *Spirostachys africana*

The following specific recommendations for the area should be adhered to for the drainage features on site:

- The vegetation associated with the water courses has a high sensitivity with a high conservation priority. No major alteration of these important drainage areas is recommended, especially considering it to form part of an important catchment. The potential to impact on the habitat is high and therefore a sufficient buffer zone of 30 meters is applicable for the solar plant, while strict mitigation should be implemented for the access road to allow natural flow underneath the road surface.
- All construction and maintenance activities should be conducted in such a way that minimal damage is caused to the drainage features on site.
- A detailed riparian delineation study should be conducted by a wetland specialist.

Photograph 7. Sandy riverbed associated with drainage channel in the northern section of the site

4.1.4 Old quarries

The old sand and gravel mining quarries occur in the southern section of the proposed powerline corridor and represent areas that have been used for mining of sand and gravel by the local communities. The cleared areas have recovered to a small extent and represent degraded grassland (similar to the old fields described under section 4.1.2), with small depressions forming where water collect. The surrounding areas formed dense sickle bush thickets that are often impenetrable (similar to the secondary shrubveld areas described in section 4.1.1). The Area is classified as having a Low Sensitivity due to the state of degradation and unlimited development of the corridor can be supported in the area.

4.2 FLORA: SPECIES LEVEL ASSESSMENT

South Africa has been recognized as having remarkable plant diversity with high levels of endemism. The major threats to plants in the study area are urban expansion, non-sustainable harvesting, collecting, overgrazing/browsing, mining and agriculture. The objective of this section was to compile a list of plant species for which there is conservation concern. This included threatened, rare, declining, protected and endemic species.

4.2.1 Red data Flora Species

A list of red data plant species previously recorded in the study area in which the proposed development is planned was obtained from the Plants of Southern Africa (POSA) database of SANBI. There are various categories for Red Data Book species, such as 'Endangered', 'Vulnerable', 'Rare' and 'Near threatened' as listed in the Red Data List of Southern African Plants (Hilton-Taylor 1996). No red listed species was documented for the proposed powerline corridor.

4.2.2 Protected tree species (NFA)

The National Forest Act (no.84 of 1998: National Forest Act, 1998) provides a list of tree species that are considered important in a South African perspective as a result of scarcity, high utilization, common value, etc. In terms of the National Forest Act of 1998, these tree species may not be cut, disturbed, damaged, destroyed and their products may not be possessed, collected, removed, transported, exported, donated, purchased or sold – except under license granted by DWAF (or a delegated authority). Obtaining relevant permits are therefore required prior to any impact on these individuals. The following protected tree species potentially occur in the area (Table 6). The development of the solar plant will need these to be cleared and therefore a permit application should be submitted to Department of Forestry to eradicate these species:

Table 11. List of protected tree species documented during the surveys

Tree species	Habitat
Balanites maughammi	Floodplains along drainage channels, although occur in isolated sandyloam areas on site
Combretum imberbe	Sandy to sandyloam soils, although more prominent along rivers
Philenoptera violaceae	Floodplains along drainage channels, although occur in isolated sandyloam areas on site
Sclerocarya birrea	Sandy soils on plateaus and undulating plains

4.2.3 Protected flora (LEMA)

Plant species are also protected according to the Limpopo Environmental Management Act. According to this Act, no person may pick, import, export, transport, possess, cultivate or trade in a specimen of a specially protected or protected plant species. The Appendices to the Act provide an extensive list of species that are protected, comprising a significant component of the flora expected to occur on site. Communication with Provincial authorities indicates that a permit is required for all these species, if they are expected to be affected by the proposed project.

After a detailed survey was conducted during December 2019, the following plant species was documented as protected under schedule 12 of the Limpopo Environmental Management (LEMA) Act (no. 7 of 2003) (Table 7).

Table 12. List of protected flora for the project area

Species	Impact of development on species
Spirostachys africana	None – habitat in riparian woodland
Scadoxis puniceus	None – habitat in riparian woodland

4.2.4 Invasive alien species

Invasive alien plants (IAPs) pose a direct threat not only to South Africa's biological diversity, but also to water security, the ecological functioning of natural systems and the productive use of land. They intensify the impact of fires and floods and increase soil erosion. Of the estimated 9000 plants introduced to this country, 198 are currently classified as being invasive. It is estimated that these plants cover about 10% of the country and the problem is growing at an exponential rate.

The Alien and Invasive Species Regulations (GNR 599 of 2014) are stipulated as part of the National Environmental Management: Biodiversity Act (10/2004). The regulation listed a total of 559 alien species as invasive and further 560 species are listed as prohibited and may not be introduced into South Africa.

The fight against invasive alien plants is spearheaded by the Working for Water (WfW) programme, launched in 1995 and administered through the DWS. This programme works in partnership with local communities, to whom it provides jobs, and also with Government departments including the Departments of Environmental Affairs and Tourism, Agriculture, and Trade and Industry, provincial departments of agriculture, conservation and environment, research foundations and private companies.

WfW currently runs over 300 projects in all nine of South Africa's provinces. Scientists and field workers use a range of methods to control invasive alien plants. These include:

- Mechanical methods - felling, removing or burning invading alien plants.
- Chemical methods - using environmentally safe herbicides.
- Biological control - using species-specific insects and diseases from the alien plant's country of origin. To date 76 bio-control agents have been released in South Africa against 40 weed species.
- Integrated control - combinations of the above three approaches. Often an integrated approach is required in order to prevent enormous impacts.

Vehicles often transport many seeds and some may be of invader species, which may become established along the drainage channel or roads through the area, especially where the area is disturbed. The construction phase of the development will almost certainly carry the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of

disturbance. The biggest risk is that invasive alien species such as the seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project. The following alien invasives and exotic plant species were recorded on site during the surveys (Table 8):

Table 13. List of exotic plant species occurring on the proposed development site

Species	Category
Agave sisalana	2
Argemone mexicana	1b
Opuntia ficus-indica	1b
Cereus jamacaru	1b

4.2.5 Encroacher species

The present legislation under the Conservation of Agricultural Resources Act, 1983 (Act No 43 of 1983) (CARA), regulation 16, states that bush encroachers, which are indigenous plants, require sound management practices to prevent them from becoming problematic. Bush encroachment is a term used for "stands of plants such as sickle bush and various Acacia species where individual plants are closer to each other than three times the mean crown diameter". Therefore CARA does not outlaw these plants, but instead prescribes management practices aimed at preventing bush encroachment, and at combating it where it already occurs. If communities of plants from the list of indicators occur in the natural vegetation of an area, the land users have to take the necessary precautions to prevent the deterioration of their land to such an extent that bush encroachment takes place. In cases where bush encroachment has already taken place, the land users have to remove the cause of deterioration and combat the encroachment of indicator species. Among the prescribed measures are the uprooting, felling or cutting of plants, the judicious application of registered herbicides, livestock reduction and the correct utilisation and protection of veld. Typical bush encroacher species that occur in the study area listed under CARA (Act No 43 of 1983) is included in Table 9:

Table 14. Listed encroacher species for the proposed development site

Species	Status	Habitat of species
Combretum apiculatum	Widespread	Gravelly, shallow soils associated with plains and outcrops / ridges
Dichrostachys cinerea	Widespread	Degraded woodland / natural woodland areas on sandy soils

Species	Status	Habitat of species
Grewia bicolor	Widespread	All habitats of area

4.2.6 Medicinal plants of the site

Medicinal plants are an important aspect of the daily lives of many people and an important part of the Southern African cultural heritage. The impact of the proposed development on populations of medicinal plants will be very little, although certain plants play an important role in the culture. The following medicinal plant species occur in the study area (Van Wyk & Gericke, 1997) as indicated in Table 10:

Table 15. Medicinal plant species and their habitats in the study area

Species	Indigenous / exotic	Status	Habitat of species
Combretum apiculatum	Indigenous	Widespread	Gravelly, shallow soils associated with plains and outcrops / ridges
Dichrostachys cinerea	Indigenous	Widespread	Degraded woodland / natural woodland areas on sandy soils
Flueggia virosa	Indigenous	Localized	Along floodplains of rivers / in seasonal zones of rivers
Grewia bicolor	Indigenous	Widespread	All habitats of area
Gomphocarpus fruticosa	Indigenous	Localized	Along floodplains of rivers / in seasonal zones of rivers
Gymnosporia senegalensis	Indigenous	Localized	Along floodplains of rivers / in seasonal zones of rivers
Schotia brachypetala	Indigenous	Localized	Riparian woodland / termitaria
Sclerocarya birrea	Indigenous	Widespread	Deep sandy soils on plains
Terminalia sericea	Indigenous	Widespread	Deep sandy soils on plains
Ziziphus mucronata	Indigenous	Widespread	Riparian woodland / floodplains / old fields on fertile soils

4.2.7 General

An important aspect relating to the proposed development should be to protect and manage the biodiversity (structure and species composition) of the vegetation types which are represented on the proposed development site. Vegetation removal should be limited to the footprint areas of the proposed development. The unnecessary impact on the surrounding woodland areas outside the mining footprint and plant development area should be avoided as far as possible.

4.3 FAUNAL ASSESSMENT

4.3.1 Overview

A healthy environment is inhabited by animals that vary from micro-organisms to the birds and mammals. The species composition and diversity are often parameters taken into consideration when determining the state of the environment. A comprehensive survey of all animals is a time consuming task that will take a long time and several specialists to conduct. The alternative approach to such a study is to do a desktop study from existing databases and conduct a site visit to verify the habitat requirements and condition of the habitat. If any rare or endangered species are discovered in the desktop study that will be negatively influenced by the proposed development, specialist surveys will be conducted.

A survey was conducted during December 2019 to identify specific fauna habitats, and to compare these habitats with habitat preferences of the different fauna groups (birds, mammals, reptiles, amphibians) occurring in the QDS. The area represents degraded grassland, cultivated fields, mixed woodland with some microphyllous and broadleaf elements in isolated areas, rocky outcrop and riparian woodland. Detailed fauna species list for the area is included in Appendix C (birds), D (mammals) and E (herpetofauna).

During the site visits mammals, birds, reptiles, and amphibians were identified by visual sightings through random transect walks. In addition, mammals were also recognized as present by means of spoor, droppings, burrows or roosting sites. The 500 meters of adjoining properties were scanned for important fauna habitats.

4.3.2 Mammal Habitat Assessment

Large mammals such as elephant, lion, buffalo and rhinoceros species that occurred historically at the site, are absent from the area, owing to anthropogenic impacts in recent centuries. This loss of large species means that the mammal diversity at the site is far from its original natural state not only in terms of species richness but also with regards to functional roles in the ecosystem.

Small antelope (e.g. grey duiker, steenbok) will still utilise the more natural areas of the site and a duiker and scrub hare were observed during the survey.

Feral cats and dogs from the township areas also move through this area on occasion.

The connectivity1 of the project site to the remainder of the larger area is Moderate to low due to other developments and roads. Of significance is the role of the river and riparian

1 C**onnectivity (habitat connectivity)** - Allowing for the conservation or maintenance of continuous or connected habitats, so as to preserve movements and exchanges associated with the habitat.

zone as zoogeographical dispersal corridor.

Most mammal species are highly mobile and will move away during construction. The impact will also be low if one compares the footprint of the development and the overall range of individual species. It is therefore considered highly unlikely that the species will be affected negatively by the development of the proposed power line, especially considering that the herbaceous layer will be preserved below the solar panel structures.

4.3.3 Avifaunal Habitat Assessment

Four major bird habitat systems were identified within the borders of the study site, including rocky habitats, riparian vegetation, woodland habitat and degraded grassland or cultivated land (old fields).

The riparian vegetation consists of two non-perennial river system with riparian vegetation. The river system is non-perennial though and therefore waterbirds will only periodically utilize this area for foraging. Due to the nature of the river, fish are not likely to occur in it and birds that feed on fish thus won't be attracted to the site. Frogs might occur during the summer months in the pools and small dams will attract bird species such as Hadeda, herons and hamerkops. The dominant vegetation within the riparian zone includes/consists of large Acacia and broadleaved trees, which grow taller due to the availability of water when compared to trees further away from the river. The largest surface area on site consists of woodland. Acacia trees generally attract many insects and in turn attract a good diversity of typical Acacia savanna bird species. The ground cover between the trees consists of mainly short grasses interspersed with shrubs. This riparian vegetation will favour bird species typically associated with a bushveld habitat.

Microphyllous woodland usually supports much higher bird numbers compared to the broadleaved woodlands. The area represents microphyllous woodland and supports many smaller bird species such as Ashy Tit, Pied Babbler, Kalahari Robin, Burntnecked Eremomela, Desert Barred Warbler, Marico Flycatcher, PriritBatis, Crimsonbreasted Shrike, Longtailed Shrike, Threestreaked Tchagra, Great Sparrow, Whitebrowed Sparrowweaver, Scalyfeathered Finch, Violeteared Waxbill and Blackcheeked Waxbill.

The broadleaved woodland occurring in the study area (footslopes) has quite a higher diversity of birds as a result of the crossover of habitats. Typical examples of broad-leaved-woodland birds are Pallid Flycatcher, Greencapped Eremomela, White-bellied Korhaan and Meyer's Parrot.

The rocky habitat on site is an important habitat for various fauna species of conservation concern of which the most important would be bats and smaller mammal species. Although larger mammal species may not be as common in this habitat type, smaller species such as the dassie and Jameson's red rock rabbit are important prey species to

predators in this habitat type. Dassies are the main prey of black eagles in the rocky areas (Walker, 1986). The scavenger, the brown hyena, also seems to prefer these rocky areas to hide during the daytime. Other typical nocturnal animals which may occur in this habitat type include large spotted genet, small spotted genet, and species with a wide habitat tolerance such as, African wild cat, porcupine, pangolin, honey badger and striped polecat.

Agricultural habitats (including old fields) sometimes cover extensive areas, and have become an artificial habitat that attracts a wide range of generalist species. Herons, storks, ibises, francolins, cranes, korhaans, plovers, pigeons and doves, larks, chats, pipits and starlings are attracted to the more open cultivated areas, while smaller species such as cuckoos, robins, sparrows, widows, finches, canaries and buntings are attracted to secondary growth around cultivation. Old fields represents a significant feeding area for many bird species in any landscape for the following reasons: through opening up the soil surface, land preparation makes many insects, seeds, bulbs and other food sources suddenly accessible to birds and other predators; the grasses are often eaten themselves by birds, or attract insects which are in turn eaten by birds.

4.3.4 Reptiles and Amphibians Assessment

Species such as the southern rock python, the black mamba, puff adder, boomslang, vine snake, spotted bush snake and several members of the green snakes (Philothamnus spp.) is expected to occur in the study area., although the presence of these snakes is dependant on the presence of their prey species (rodents, frogs etc.). The general habitat type for reptiles consists of open to dense bushveld, with limited available habitat for diurnally active and sit-and-wait predators, such as terrestrial skinks and other reptiles. Arboreal species are the more prominent components of the local herpetofauna. However, the following conservation actions should be considered as part of the development to ensure that the pythons are not impacted on:

- Protection of optimal habitats (riverine woodland; rocky habitats) in the surrounding area of the power line development;
- Conservation Education and Awareness Creation for local communities: All efforts must be made to promote conservation education and awareness creation on the need to reduce hunting/poaching at all levels whereby, decision makers, general public, schools and local communities must be carried along;
- Employment and Alternative Employment: The creation and provision of employment, alternative employment opportunities to the teeming populations of

unemployed youths, hunters and poachers will go a long way to discourage poachers, hunters, etc. from continuing in their trade which results directly in pet animals which end up in the international markets or intercepted once in a long while in transit.

The amphibians appear to be poorly represented on site. The most probable habitat to find frogs is in the seasonal pools associated with the drainage channels although this do not represent optimal habitats due to a lack of breeding habitat and water plants which will attract insect for foraging. The riparian zone of the drainage channels probably harbours a number of amphibian species but no particular hotspot for amphibian diversity is known from the site.

4.3.5 Invertebrates habitat assessment

Insects and spiders are very good indicators of the plant diversity and ecological sensitivity of an area. Butterflies can be used in the field as indicators of biodiversity. An insect and spider desktop survey was done in addition to the field observations.

All of the potential invertebrate habitats are well represented by a high family richness of insects and spiders. Spiders occur throughout all the habitats, and both web builders and active hunters find their ways in trapping and actively hunt around for potential food.

A number of invertebrate taxa are currently protected by Schedule B1 of the list of threatened and protected species issued in terms of Section 56(1) of the National Environmental Management: Biodiversity Act, 2004 and likely to occur on the study site.

4.3.6 Red data species

According to the existing databases and field survey the following number of fauna species included in the IUCN red data lists can potentially be found in the study area (Table 11):

Table 16. Red data list of potential fauna for the study area

English Name	Probability of occurrence	Conservation status
MAMMALS		
Rusty Pipistrelle	Low	Near Threatened
Brown Hyena	Low	Near Threatened (2015)
Vaal Rhebok	Very low	Near Threatened (2016)
Leopard	Very low	Vulnerable (2016)
HERPETOFAUNA		
Black File Snake	Low	Protected
Southern African Python	Medium	Vulnerable
BIRDS		

English Name	Probability of occurrence	Conservation status
Vulture, Lappet-faced	Medium – dependant on food source	Endangered
Bateleur	Medium	Endangered
Secretarybird	Medium	Vulnerable
Eagle, Martial	Medium	Endangered
Vulture, Hooded	Medium – dependant on food source	Endangered
Bustard, Black-bellied	Medium	Near Threatened
Vulture, White-backed	Medium – dependant on food source	Endangered
Falcon, Lanner	Medium	Vulnerable
Roller, European	High	Near Threatened
Bustard, Kori	Medium	Near Threatened
Eagle, Tawny	Medium	Endangered

The following general observations with regards to the study area can be made. Recommendations and mitigating measures need to be implemented to ensure the survival of these species other fauna habitats and feeding grounds:

- The impact of the proposed power line development on the red data and other mammal species will mostly have a medium probability as a result of the following:
    - The anthropogenic influences of crop cultivation occurring in the area will cause some fauna to migrate from the area to more natural areas with less disturbance;
    - The degraded and modified state of the old fields, cultivated land and encroached thickets vegetation is not suitable habitat for red data fauna species, and will only support general fauna such as birds, small antelopes and rodent species;
    - Habitat not being suitable or marginal.
    - If one considers the habitat descriptions of the red data species, some of them are limited in range or threatened as a direct result of habitat loss in the southern African sub-region, although other species with large home ranges (e.g. martial eagle) are not directly threatened by habitat loss. The impact of development on the red data species would therefore be less than predicted.
    - Larger mammal species no longer occur naturally in the area and are confined to nature reserves;
    - The vulture species (Whitebacked vulture, Lappetfaced vulture) will occur periodically in the area as a result of their feeding patterns (presence of

carcasses). The tall trees on the property provide potential breeding habitat for the Whitebacked vultures. The development of the power line will create habitat loss for species such as whitebacked vultures that will lose potential nesting sites in tall trees although a monitoring project on the populations in the Limpopo Province will give clearer indications what the actual impact of any development is on these rare birds;

- The development would not have a significant impact on the above mentioned red data fauna since the herbaceous layer will be preserved below the power line servitude and solar panels while adequate natural habitat/vegetation would be available on the peripheral habitats outside the study area as.
- Development also won't influence the natural feeding and movement patterns of the existing fauna in the area. Peripheral impacts on the larger area should however still be avoided.

- The protection of different habitat types in the area will be important to ensure the survival of the different animals due to each species' individual needs and requirements. Sufficient natural corridor sections should be protected around the proposed development footprints to allow fauna to move freely between the different vegetation units on the property. In this regard the surrounding woodland outside the footprint of the power line servitude and solar plant will be more than sufficient as corridors.

The following general mitigation and management actions taken on site, the impact on faunal populations should be low.

- Where holes pose a risk to animal safety when the poles are planted, they should be adequately cordoned off to prevent animals falling in and getting trapped and/or injured. This could be prevented by the constant excavating and backfilling of holes during power line construction.
- No animals may be poached, nor may any wild animal be fed. Many animals are protected by law and poaching or other interference could result in a fine or jail term. An environmental awareness programme should be implemented to educate construction workers of the relevance of the ecosystem components.
- Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for the raptors occurring in the area. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist.

- Roads in the area should be designed without vertical pavements to allow for the movement of small mammals. Small culverts underneath the road could provide easy migration of smaller fauna.
- Waste bins and foodstuffs should be made scavenger proof.
- Power line structures on the site can present electrocution hazards to birds when less than adequate separation exist between energized conductors or between energized conductors and grounded conductors. Avian-safe facilities can be provided by one or more of the following mitigation measures:
    - Increasing separation between conductors to achieve adequate separation for the species involved (larger birds, raptors);
    - Covering energized parts and / or covering grounded parts with materials appropriate for providing incidental contact protection to birds;
    - Applying perch managing techniques such as conspicuous objects and support roosting sites along the power line that would allow large raptors and bustards to safely roost;
    - A detailed avifauna study should address the impact of the power line on birds in more detail.
- Monitoring of the environmental aspects should be done over the longer term to ensure that impacts are limited to a minimum during the construction and operational phases. Monitoring of specific species is necessary to ensure that these species would be unaffected over the longer term by the development. Information on red data species should be provided to construction workers to make them more aware of these fauna and their behaviour.

5 WATER COURSES OF THE PROJECT AREA

5.1.1 Water courses

The non-perennial channels on site can be described as water courses or channels. (SANBI, 2009). The vegetation structure associated with the water courses vary from the actual channels being a sandy riverbed with alluvial sand and conglomerates to closed woodland along the riverbanks. The narrow band of trees that occurs along the channel can be classified as riparian vegetation. The rivers flow from west to east. This channels and associated vegetation is very important for connectivity with adjacent vegetation as well as a migratory route for riparian animals.

5.2 WATER COURSE INTEGRITY ASSESSMENTS

For the purpose of this study only the riparian zones that bisect the proposed development site were assessed namely the northern water courses. In determining the integrity of these hydrogeomorphic units the condition of the site and the indirect and direct disturbances is taken into account. The roads, erosion, overgrazing, alien invasive vegetation species, etc. was taken into account in determining the PES and EIS of these wetland units (Table 17). Appendix A and B indicate the scores for the PES and EIS respectively.

Impacting activities which have altered the expected floristic composition include overgrazing, encroachment of woody layer, impoundment and road crossings.

Table 17. Present Ecological State, Ecological Importance & Sensitivity, Hydro-functional Importance and Direct Human Benefits of the wetland on the proposed development site

Wetland	PES	EIS
Main tributaries	Class B: Largely natural with few modifications	Moderate

The non-perennial water courses and riparian woodland in the northern section of the project area have a ‘Largely Natural’ PES, with the only impacts being from livestock overgrazing and some isolated eroded areas. These well-defined channels have a ‘Moderate’ EIS and support ecosystem functioning, especially in terms of the connectivity towards the larger area.

6 POTENTIAL IMPACTS OF THE PROPOSED DEVELOPMENT ON THE FAUNA AND FLORA

6.1 DIRECT HABITAT MODIFICATION

6.1.1 Description of impact:

The construction of the power line will result in loss of and damage to natural habitats. During the construction phase and maintenance of this infrastructure, some habitat modification and alteration inevitably takes place. However re-growth of grass under the power line will take place. The areas below the power line in grassland will have to be cleared (slashed) of excess vegetation at regular intervals in order to allow access to the area for maintenance, to prevent vegetation from intruding into the legally prescribed clearance gap between the ground and the power line conductors and to minimize the risk of fire which can result in electrical flashovers. These activities will have an impact on birds breeding, foraging and roosting in or in close proximity of the servitude through modification of habitat. Rehabilitation of some of these areas would be possible but there is likely to be long-term damage in large areas. Most habitat destruction will be caused during the construction of the solar plant and power line.

The impact of powerline and specific placement of the poles should be restricted to the proposed line and not over the larger area. Most of the natural vegetation has been modified to a large extent as a result of the overgrazing by livestock and the anthropogenic influences from the villages, although natural presentations of sensitive habitats still occur in the area.

6.1.1.1 Destruction or loss of floral diversity or vegetation communities

The following major impacts of the development will potentially impact on the flora of the site:

- Loss of threatened, “near-threatened” and endemic taxa: The anticipated loss of some of the habitats will result in the local displacement of these species. Any impact on the sensitive habitats such as wetlands where red data and protected species potentially occur could lead to extinction of these species from the area;
- The clearing of vegetation during construction and operation will result in an increase in edge habitat immediately adjacent to disturbed areas. Edge habitat is characterized by a predominance of generalist and alien species because these areas experience higher levels of stress and more frequent disturbance (in both time and space), for example higher light conditions, lower soil moisture conditions and higher exposure to wind. Edge habitat is characterized by highly competitive species which can invade areas of established vegetation, resulting

in a loss of sedentary species of mature habitats which are normally considered sensitive;

- The construction will lead to the loss of individual plants that will be cleared on the footprint areas;
- The construction activities can impact on surrounding vegetation by dust and altered surface run-off patterns;
- The disturbance of the area could lead to an increase in the growth of alien vegetation.

6.1.1.2 Loss of faunal diversity through migration and decline in animal numbers

The main impacts during construction involve the loss and fragmentation of habitats, with a consequent loss of biodiversity and possibly loss of species of special concern. This may result from direct land clearance, or occur indirectly via loss or changes in habitats due to consequent changes in drainage patterns, increased fire risk, or secondary impacts associated with socio-economic factors resulting from changes in surrounding land use.

The following major impacts of the development will potentially impact on the faunal habitats of the site:

- Habitat modification / destruction by construction activities could either directly cause fauna mortalities or will force animals out of the area and animal numbers will decrease. This impact could also take place because of hunting and snaring of animals in natural areas;
- Loss of threatened, “near-threatened” and conservation important taxa: The anticipated loss of the indigenous vegetation on site will result in the local displacement of some fauna species;
- Changes in the community structure: It is expected that the faunal species composition will shift, due to an anticipated loss in habitat surface area. In addition, it is predicted that more generalist species (and a loss of functional guilds) will dominate the study area. Attempts to rehabilitate will attract taxa with unspecialised and generalist life-histories. It is predicted that such taxa will persist for many years before conditions become suitable for succession to progress.

6.1.2 Mitigation measures:

- The removal of grassland, indigenous trees and shrubs should be kept to a minimum necessary. Trim, rather than fell of woody species along the power line route where possible. Brushwood should be left for the use of the landowner

or the local community, as agreed to by the landowner and with due regard to preventing fire hazards. The clearing and damage of plant growth in these areas should be restricted to the servitude and way leave area;

- Small sections of the power line might stretch through sensitive habitats such as riparian woodland. Where possible, the route should be amended to avoid such areas. Where the power line cannot be diverted around these sensitive habitats specific mitigation should be implemented to prevent negative impacts on the ecosystem. No clearance of vegetation should however occur in the sensitive areas (e.g. riparian) and power line poles should be placed outside these habitats.
- Peripheral impacts around the servitude area on the surrounding vegetation of the area should be avoided and a monitoring programme should be implemented to ensure the impacts are kept to a minimum, while the rehabilitation of the site should be prioritised after the power line has been completed.
- The vegetation of the remainder of the area has been completely modified through crop cultivation, wood harvesting or overgrazing by livestock. The clearing of vegetation in these areas will have a minimal impact on the natural environment although care should be taken along sloping areas not to cause serious soil erosion.
- During construction, sensitive habitats must be avoided by construction vehicles and equipment, wherever possible, in order to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place.
- All development activities should be restricted to specific recommended areas. The Environment Control Officer (ECO) should control these areas. Storage of equipment, fuel and other materials should be limited to demarcated areas. Layouts should be adapted to fit natural patterns rather than imposing rigid geometries. The entire development footprint should be clearly demarcated prior to initial site clearance and prevent construction personnel from leaving the demarcated area. This would only be applicable to the construction phase of the proposed development.
- The ECO should advise the construction team in all relevant matters to ensure minimum destruction and damage to the environment. The ECO should enforce any measures that he/she deem necessary. Regular environmental training should be provided to construction workers to ensure the protection of the habitat, fauna and flora and their sensitivity to conservation.

- Where holes for poles pose a risk to animal safety, they should be adequately cordoned off to prevent animals falling in and getting trapped and/or injured. This could be prevented by the constant excavating and backfilling during planting of the poles along the lines.
- Poisons for the control of problem animals should rather be avoided since the wrong use thereof can have disastrous consequences for the raptors occurring in the area. The use of poisons for the control of rats, mice or other vermin should only be used after approval from an ecologist.
- Limit pesticide use to non-persistent, immobile pesticides and apply in accordance with label and application permit directions and stipulations for terrestrial and aquatic applications.
- Monitoring should be implemented during the construction phase of the development to ensure that minimal impact is caused to the fauna and flora of the area.

6.2 HABITAT FRAGMENTATION

6.2.1 Description of impact:

The proposed power line development will inevitably result in natural movement patterns being disrupted during construction and, to a varying degree depending on how different species react to these barriers will result in the fragmentation of natural populations. The development will be a temporary impact in fragmenting the habitats of the area.

6.2.2 Mitigation measures:

- Use existing facilities (e.g., current roads) to the extent possible to minimize the amount of new disturbance;
- Ensure protection of important resources by establishing protective buffers to exclude unintentional disturbance. All possible efforts must be made to ensure as little disturbance as possible to the entire riparian zone during construction;
- During construction, sensitive habitats must be avoided by construction vehicles and equipment, wherever possible, in order to reduce potential impacts. Only necessary damage must be caused and, for example, unnecessary driving around in the veld or bulldozing natural habitat must not take place;
- Construction activities must remain within defined construction areas and the road servitudes. No construction / disturbance will occur outside these areas.

6.3 INCREASED SOIL EROSION AND SEDIMENTATION

6.3.1 Description of impact:

The construction activities associated with the development may result in widespread soil disturbance and is usually associated with accelerated soil erosion, particularly in areas receiving high rainfalls. Soil, sediments and associated contaminants are transported into streams, rivers and other water bodies, resulting in the loss or alteration of habitats for aquatic organisms, as well as changes in water quality. Soil erosion also promotes a variety of terrestrial ecological changes associated with disturbed areas, including the establishment of alien invasive plant species, altered plant community species composition and loss of habitat for indigenous fauna and flora.

6.3.2 Mitigation measures

- During and after construction, ensure storm water management around permanent infrastructure, rehabilitate disturbed areas, protect topsoil and protect sensitive soils. This will reduce the possibility of soil erosion;
- Minimize the amount of land disturbance and develop and implement stringent erosion and dust control practices. Control dust on construction sites and access roads using chemical dust suppressants;
- The control of soil erosion and siltation associated with construction and operation is important at all locations on site, and particularly adjacent to drainage lines, streams and wetland communities. Both temporary and permanent soil erosion control measures must be used during the construction and operation phases;
- Ensure the amount of bare soil exposed is minimized by staging earthworks in phases and leaving as much ground cover intact as possible during construction;
- Protect all areas susceptible to erosion and ensure that there is no undue soil erosion resultant from activities within and adjacent to the construction camp and Work Areas;
- Repair all erosion damage as soon as possible and in any case not later than six months before the termination of the construction period.

6.4 SOIL AND WATER POLLUTION

6.4.1 Description of impact:

Construction work will always carry a risk of soil and water pollution, with large construction vehicles contributing substantially due to oil and fuel spillages. If not promptly

dealt with, spillages or accumulation of waste matter can contaminate the soil and surface or ground water, leading to potential medium/long-term impacts on fauna and flora.

6.4.2 Mitigation measures:

- Water falling on areas polluted with oil/diesel or other hazardous substances must be contained. Any excess or waste material or chemicals should be removed from the site and discarded in an environmental friendly way;
- All construction vehicles should be inspected for oil and fuel leaks regularly, and any vehicle showing signs of leaking should be serviced immediately;
- Vehicle maintenance yards must not be situated in any close proximity to water courses and all used oil and other waste products should be disposed of in an accepted way – preferably it should be removed from the site and recycled;
- On-site Storm water control is vital to ensure that no ponding occurs;
- Storm water must be prevented from entering the site.

6.5 SPREAD AND ESTABLISHMENT OF ALIEN INVASIVE SPECIES

6.5.1 Description of impact:

The constructional activities almost certainly carry by far the greatest risk of alien invasive species being imported to the site, and the high levels of habitat disturbance also provide the greatest opportunities for such species to establish themselves, since most indigenous species are less tolerant of disturbance. The biggest risk is that seeds of noxious plants may be carried onto the site along with materials that have been stockpiled elsewhere at already invaded sites.

Continued movement of personnel and vehicles on and off the site, as well as occasional delivery of materials required for maintenance, will result in a risk of importation of alien species throughout the life of the project.

6.5.2 Mitigation measures:

- Institute strict control over materials brought onto site, which should be inspected for potential invasive invertebrate species and steps taken to eradicate these before transport to the site. Routinely fumigate or spray all materials with appropriate low-residual insecticides prior to transport to site. The contractor is responsible for the control of weeds and invader plants within the construction site for the duration of the construction phase. Alien invasive tree species should be eradicated;

- Control involves killing the plants present, killing the seedlings which emerge, and establishing and managing an alternative plant cover to limit re-growth and re-invasion. Weeds and invader plants will be controlled in the manner prescribed for that category by the Conservation of Agricultural Resources Act or in terms of Working for Water guidelines;
- Rehabilitate disturbed areas as quickly as possible to reduce the area where invasive species would be at a strong advantage and most easily able to establish;
- Institute a monitoring programme to detect alien invasive species early, before they become established and, in the case of weeds, before the release of seeds;
- Institute an eradication/control programme for early intervention if invasive species are detected, so that their spread to surrounding natural ecosystems can be prevented;
- A plan should be developed for control of noxious weeds and invasive plants that could occur as a result of new surface disturbance activities at the site. The plan should address monitoring, weed identification, the manner in which weeds spread, and methods for treating infestations. Require the use of certified weed-free mulching. Prohibit the use of fill materials from areas with known invasive vegetation problems. The spread of invasive nonnative plants should be avoided by keeping vehicles and equipment clean and reseeding disturbed areas with native plants.

6.6 NEGATIVE EFFECT OF HUMAN ACTIVITIES ON ECOSYSTEM

6.6.1 Description of impact:

An increase in human activity on the site and surrounding areas is anticipated. The risk of snaring, killing and hunting of certain faunal species will increase. Increased access for labour during construction could result in the increased collection of medicinal plants, firewood, building wood, and other plant material. This could impact negatively on biodiversity through the removal or damage of red data species, as well as result in the general degradation of habitat quality.

If staff compounds are erected for construction workers, the risk of pollution because of litter and inadequate sanitation and the introduction of invasive fauna and flora are increased.

6.6.2 Mitigation measures:

- Maintain proper firebreaks around entire development footprint;
- Construction activities must remain within defined construction areas. No construction / disturbance will occur outside these areas;
- Construction activities must be restricted to working hours Monday to Friday, unless otherwise approved by the appropriate competent person in consultation with the affected residents;
- Educate workers regarding the occurrence of important resources in the area and the importance of protection;
- Instruct employees, contractors, and site visitors to avoid harassment and disturbance of wildlife, especially during reproductive (e.g. courtship, nesting) seasons. In addition, control pets to avoid harassment and disturbance of wildlife;
- Camp fires at construction sites must be strictly controlled to ensure that no veld fires are caused.

6.7 ROAD MORTALITY

6.7.1 Description of impact:

Large numbers of fauna are killed daily on roads. They are either being crushed under the tyres of vehicles in the case of crawling species, or by colliding with the vehicle itself in the case of avifauna or flying invertebrates. The impact is intensified at night, especially for flying insects, as result of their attraction to the lights of vehicles. The proposed development will most definitely cause fauna mortalities on the roads during the construction and operational phases.

6.7.2 Mitigation measures:

- More fauna are normally killed the faster vehicles travel. A speed limit should be enforced (40km/h for dirt roads; 50km/h for access roads and 80km/h for national roads). It can be considered to install speed bumps in sections where the speed limit tends to be disobeyed. (Speed limits will also lessen the probability of road accidents and their negative consequences);
- Travelling at night by construction vehicles should be avoided or limited as much as possible.

6.8 AIR POLLUTION

6.8.1.1 Description of impact:

The construction processes for the development will release dust and gasses, into the broader environment through vehicle emissions, dust from soil stockpiles and gravel roads. The environmental impacts of wind-borne dust, gases and topsoil stockpiles are primarily related to human health and ecosystem damage. The proposed development will typically comprise the following sources and associated air quality pollutants:

- Land clearing operations and scraping;
- Stockpiling (particulate matter);
- Materials handling operations (truck loading & unloading, tipping, stockpiling);
- Vehicle entrainment on paved and unpaved roads;
- Windblown dust-fugitive emissions (stockpiles).

6.8.1.2 Mitigation measures:

- Dust suppression must be undertaken. Implement standard dust control measures, including chemical dust suppression and / or strategic surfacing of some roads in the project area (frequency will depend on many factors including weather conditions, soil composition and traffic intensity and must thus be adapted on an ongoing basis) of construction areas and access roads, and ensure that these are continuously monitored to ensure effective implementation;
- Soil dumps may be covered if necessary;
- A speed limit (preferably 40 km/hour) should be enforced on dirt roads;

6.9 IMPACT ASSESSMENT MATRIX FOR THE CONSTRUCTION PHASE OF THE DEVELOPMENT

Table 18 indicates the impacts described above and specific ratings of significance the impact will potentially have on the flora and fauna of the area. The most significant impacts are habitat destruction and dust, although impacts such as alien species invasion and spillages are limited or can be successfully mitigated.

Table 18. Impact Assessment Matrix for the proposed development

No	Activity	Impact	P	D	S	M	Significance without Mitigation		Mitigation Measures	P	D	S	M	Significance with Mitigation	
Construction Phase									**Construction Phase**						
1	Clearing of vegetation for infrastructure, access roads etc.	Habitat modification	5	3	1	6	50	Moderate	See section 7.1.2	4	3	1	2	24	Low
2	Clearing of vegetation for infrastructure, access roads etc.	Habitat fragmentation	4	4	1	6	44	Moderate	See section 7.2.2	2	4	1	2	14	Negligible
3	Exposure of soils to rainfall and wind during construction	Soil erosion	4	4	2	6	48	Moderate	See section 7.3.2	2	4	2	2	16	Negligible
4	Movement of vehicles on site during construction	Spillages of harmful substances leading to soil and water pollution	5	3	1	6	50	Moderate	See section 7.4.2	4	3	1	2	24	Low
5	Continued movement of personnel and vehicles on and off the site during the construction phase	Spread of alien invasive species	4	3	2	6	44	Moderate	See section 7.5.2	2	3	2	2	14	Negligible
6	Construction of infrastructure, access roads etc.	Negative effect of human activities on flora	4	3	2	6	44	Moderate	See section 7.6.2	2	3	2	2	14	Negligible
8	Continued movement of vehicles on and off the site during the construction phase	Fauna mortality on roads	4	3	3	6	48	Moderate	See section 7.7.2	2	3	2	2	14	Negligible
9	Continued movement of vehicles on and off the site during the construction phase	Air / Dust pollution	5	3	2	6	55	Moderate	See section 7.8.2	4	3	2	2	28	Low
Operational Phase									**Operational Phase**						
1	Movement of vehicles on site during construction	Spillages of harmful substances leading to soil and water pollution	2	4	3	6	26	Low	See section 7.4.2	2	3	2	2	14	Negligible

No	Activity	Impact	P	D	S	M	Significance without Mitigation			Mitigation Measures	P	D	S	M	Significance with Mitigation	
2	Continued movement of personnel and vehicles on and off the site during the occasional delivery of materials required for maintenance during the operational phase	Spread of alien invasive species	2	4	3	6	26	Low		See section 7.5.2	2	3	2	2	14	Negligible
3	Continued movement of vehicles on and off the site during the occasional delivery of materials required for maintenance during the operational phase	Fauna mortality on roads	2	4	1	6	22	Low		See section 7.7.2	2	3	2	2	14	Negligible

7 SENSITIVITY ASSESSMENT

Following the ecological surveys, the classification of the study area into different sensitivity classes and development zones was based on information collected at various levels on different environmental characteristics. Factors which determined sensitivity classes were as follows:

- Presence, density and potential impact of development on rare, endemic and protected plant species
- Conservation status of vegetation units
- Soil types, soil depth and soil clay content
- Previous land-use
- State of the vegetation in general as indicated by indicator species

Below included is the sensitivity map for the proposed development (Figure 12). Only criteria applicable to the specific vegetation units were used to determine the sensitivity of the specific unit.

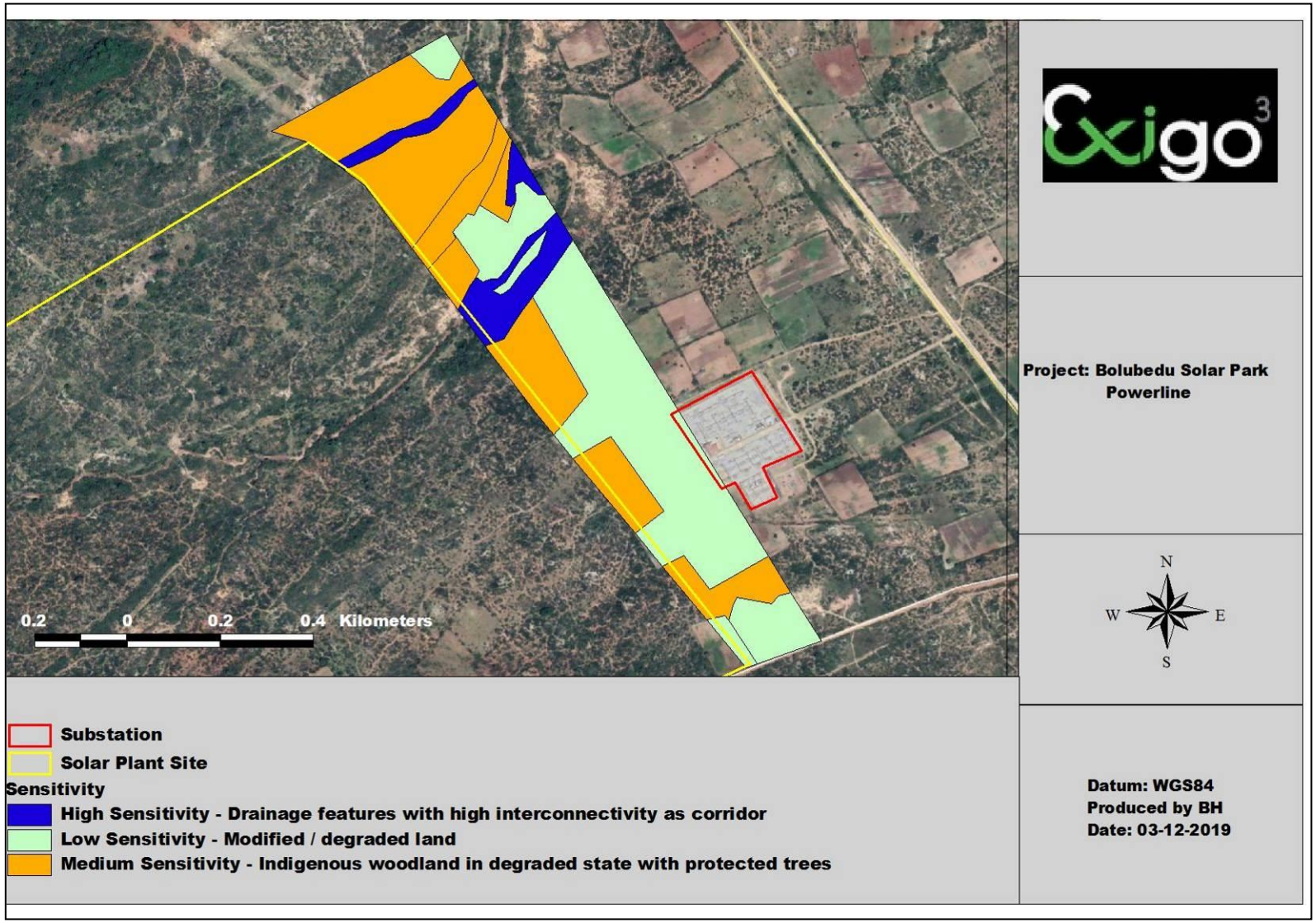


Figure 12. Sensitivity Map for the proposed development

8 DISCUSSION

Following the investigation and potential ecological impact of the proposed power line development from the Bolubedu Solar Park to the Bolubedu Substation on the fauna and flora of the area, some conclusions can be made:

All aspects of the environment, especially living organisms, are vulnerable to disturbance of their habitat. The proposed power line development will potentially impact and modify the vegetation and faunal habitats of the route servitude to a certain extent varying according to the state of the environment (vegetation and fauna habitats) alongside the route.

Most sensitive sections: It is evident from the distribution of biodiversity, presence of threatened species and sites of scientific interest, that the proposed power line construction has the potential for negative impact on the flora and faunal of the study area. This is particularly true of the natural vegetation units.

Most sensitive habitats: Many threatened species are woodland or riparian specialists, linked to these habitats either for breeding, feeding or shelter. Major impacts on riverine areas should be avoided wherever possible during power line construction. Existing hydrodynamics must be protected to ensure that water regimes are maintained. The power line servitude must be maintained to serve as buffer zones to prevent the immediate impact of chemical pollution or increased fire risk.

Monitoring of threatened species: A large number of endemic and protected species have been recorded in region. The EMP for the power line construction phase should highlight the conservation status of these species and note that steps must be undertaken in conjunction with conservation authorities to protect or translocate any populations encountered during project actions. Ecological monitoring is recommended for the construction phase of the development considering the presence of protected trees and potential red data fauna on areas surrounding the site.

The importance of rehabilitation and implementation of mitigation processes to prevent negative impacts on the environment during and after the constructional phase of the power line should be considered a high priority. The proposed site for the power line servitude varies from being in a degraded state to pristine.

A number of potential impacts were identified and assessed. A few of these were assessed as having potentially medium or high significance, including the following:

- Destruction or disturbance to sensitive ecosystems leading to reduction in the overall extent of a particular habitat;

- Increased soil erosion;
- Impairment of the movement and/or migration of animal species resulting in genetic and/or ecological impacts;
- Destruction/permanent loss of individuals of rare, endangered, endemic and/or protected species;
- Soil and water pollution through spillages;
- Establishment and spread of declared weeds and alien invader plants;
- Impacts of human activities on fauna and flora of the area during construction;
- Impacts of power line on avifauna (electrocutions and collissions).
- Air pollution through dusts and fumes from construction vehicles (construction phase)

Mitigation measures are provided that would reduce these impacts from a higher to a lower significance. Furthermore, the proposed layout plan of the development should be consistent with the sensitivity map and recommendations stipulated in this report, and the impact on the sensitive habitats on site should be kept to a minimum. **The most suitable route should be chosen according to the sensitivity analyses.**

9 CONCLUSION

All aspects of the environment, especially living organisms, are vulnerable to disturbance of their habitat. If we can bring about a more integrated approach to living within our ecosystems, we are much more likely to save the fundamental structure of biodiversity. Positive contributions can be made even on a small scale such as within the proposed power line development. All stakeholders need to be involved to avoid a loss of biodiversity in the area.

The proposed power line servitude route should avoid sensitive areas such as riverine areas. The preferred route should be chosen to minimize impacts on sensitive vegetation types that may impact on species of conservation importance. Where sensitive areas of natural vegetation cannot be avoided, a number of mitigation measures have been recommended to minimise and/or offset impacts (licence application for eradication of protected species etc.). Negative impacts can be minimised by strict enforcement and compliance with an Environmental Management Plan which takes into account the recommendations for managing impacts detailed above.

Provided that the proposed power line development is consistent with the sensitivity map and take all the mitigation measures into consideration stipulated in this report, the planned development can be supported.

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11 APPENDIX A. PLANT SPECIES LISTS FOR SITE

Woody species	Grass species	Forbs, geophytes & succulents
Acacia gerrardi	*Aristida species*	*Agave sessilana*
Acacia nigrescens	*Botriochloa radicans*	*Aloe lutescens*
Acacia permixta	*Cynodon dactylon*	*Aloe davyana*
Acacia rehmanniana	*Eragrostis lehmanniana*	*Argemone mexicana*
Acacia senegalensis v. leiorhachis	*Eragrostis rigidior*	*Asparagus africanus*
Balanites maughammi	*Eragrostis rotifer*	*Bulbostylis burchelli*
Capparis tomentosa	*Eragrostis trichophora*	*Ceratotheca triloba*
Cassia abbreviata	*Heteropogon contortus*	*Crinum species*
Cassia petersiana	*Panicum maximum*	*Cyanotis speciose*
Combretum apiculatum	*Setaria sphacelata*	*Cyperus sexangularis*
Combretum collinum	*Sporobolus africanus*	*Drimiopsis spp.*
Combretum hereroense	*Sporobolus pyramidalis*	*Gomphocarpus fruticosus*
Combretum imberbe	*Tricholaena monachne*	*Hypoxis rigidula*
Combretum zeyheri	*Urochloa mosambicensis*	*Ocimum americanum*
Commiphora africana	*Urochloa panicoides*	*Scadoxis puniceus*
Dichrostachys cinerea		*Schoenoplectus spp.*
Diospyros lycioides		*Vernonia colorata*
Diospyros mespiliformes		*Vigna vexillata*
Euclea divinorum		*Waltheria indica*
Euphorbia tirucalli		*Xerohyta retinervis*
Ficus ingens		*Zanzevieria hyacinthoides*
Ficus sycomorus		*Aloe chabaudi*
Flueggia virosa		*Kalanchoe paniculata*

Gossypium herbaceum		*Boophane distycha*
Grewia bicolor		*Selaginella dregei*
Gymnosporia buxifolia		*Achyranthes aspera*
Gymnosporia senegalensis		*Neurautanenia angustifolia*
Kirkia acuminata		
Kraussia floribunda		
Lannea schweinfurtii		
Ormocarpum trichocarpum		
Peltophorum africanum		
Philenoptera violaceae		
Schotia brachypetala		
Sclerocarya birrea		
Spirostachys africana		
Sterculia rogersii		
Terminalia prunoides		
Terminalia sericea		
Ziziphus mucronata		
Colophospermum mopane		

12 APPENDIX B. PLANT SPECIES LIST FOR QDS

Family	Genus	Sp1	IUCN
Fabaceae	*Pterocarpus*	*rotundifolius*	LC
Ricciaceae	*Riccia*	*albolimbata*	
Poaceae	*Echinochloa*	*colona*	LC
Combretaceae	*Combretum*	*apiculatum*	LC
Poaceae	*Sporobolus*	*ioclados*	LC
Poaceae	*Eragrostis*	*viscosa*	LC
Capparaceae	*Maerua*	*parvifolia*	LC
Fabaceae	*Pterocarpus*	*angolensis*	LC
Loganiaceae	*Strychnos*	*madagascariensis*	LC
Fabaceae	*Albizia*	*harveyi*	LC
Poaceae	*Eriochloa*	*meyeriana*	LC
Poaceae	*Themeda*	*triandra*	LC
Convolvulaceae	*Evolvulus*	*alsinoides*	LC
Poaceae	*Tragus*	*koelerioides*	LC
Poaceae	*Sporobolus*	*pyramidalis*	LC
Poaceae	*Panicum*	*maximum*	LC
Cactaceae	*Opuntia*	*ficus-indica*	NE
Lentibulariaceae	*Utricularia*	*stellaris*	LC
Poaceae	*Eragrostis*	*superba*	LC
Ebenaceae	*Diospyros*	*mespiliformis*	LC
Poaceae	*Cenchrus*	*ciliaris*	LC
Rubiaceae	*Empogona*	*kirkii*	
Pteridaceae	*Cheilanthes*	*involuta*	LC
Fabaceae	*Bauhinia*	*galpinii*	LC
Celastraceae	*Gymnosporia*	*senegalensis*	LC
Phyllanthaceae	*Phyllanthus*	*incurvus*	LC
Poaceae	*Leptochloa*	*eleusine*	LC
Euphorbiaceae	*Jatropha*	*zeyheri*	LC
Fabaceae	*Ptycholobium*	*contortum*	LC
Lamiaceae	*Endostemon*	*tereticaulis*	LC
Fabaceae	*Ormocarpum*	*trichocarpum*	LC
Moraceae	*Ficus*	*thonningii*	
Malvaceae	*Adansonia*	*digitata*	LC
Moraceae	*Ficus*	*abutilifolia*	LC
Vitaceae	*Rhoicissus*	*revoilii*	LC
Kewaceae	*Kewa*	*bowkeriana*	LC
Poaceae	*Perotis*	*patens*	LC
Amaranthaceae	*Hermbstaedtia*	*fleckii*	LC
Poaceae	*Hyparrhenia*	*dichroa*	LC
Asteraceae	*Conyza*	*attenuata*	

Family	Genus	Sp1	IUCN
Hypericaceae	*Hypericum*	*lalandii*	LC
Moraceae	*Ficus*	*ingens*	LC
Solanaceae	*Solanum*	*lichtensteinii*	LC
Rhamnaceae	*Helinus*	*integrifolius*	LC
Poaceae	*Setaria*	*incrassata*	LC
Fabaceae	*Piliostigma*	*thonningii*	LC
Thymelaeaceae	*Lasiosiphon*	*sericocephalus*	LC
Archidiaceae	*Archidium*	*ohioense*	
Apocynaceae	*Calotropis*	*procera*	
Lamiaceae	*Salvia*	*coccinea*	
Portulacaceae	*Portulaca*	*kermesina*	LC
Euphorbiaceae	*Croton*	*megalobotrys*	LC
Ricciaceae	*Riccia*	*atropurpurea*	
Phyllanthaceae	*Phyllanthus*	*maderaspatensis*	LC
Malvaceae	*Corchorus*	*confusus*	LC
Cyperaceae	*Cyperus*	*austro-africanus*	LC
Malvaceae	*Hibiscus*	*micranthus*	
Poaceae	*Eragrostis*	*arenicola*	LC
Poaceae	*Eragrostis*	*trichophora*	LC
Potamogetonaceae	*Potamogeton*	*octandrus*	LC
Euphorbiaceae	*Euphorbia*	*cupularis*	LC
Molluginaceae	*Glinus*	*lotoides*	LC
Poaceae	*Chloris*	*gayana*	LC
Combretaceae	*Combretum*	*hereroense*	
Asphodelaceae	*Aloe*	*arborescens*	LC
Malvaceae	*Dombeya*	*rotundifolia*	LC
Pedaliaceae	*Ceratotheca*	*triloba*	LC
Malvaceae	*Hibiscus*	*vitifolius*	LC
Acanthaceae	*Ruellia*	*cordata*	LC
Asteraceae	*Laggera*	*decurrens*	LC
Poaceae	*Paspalum*	*urvillei*	NE
Convolvulaceae	*Ipomoea*	*obscura*	LC
Boraginaceae	*Cordia*	*monoica*	LC
Hyacinthaceae	*Merwilla*	*plumbea*	NT
Boraginaceae	*Ehretia*	*amoena*	LC
Malvaceae	*Hibiscus*	*schinzii*	LC
Poaceae	*Fingerhuthia*	*africana*	LC
Cyperaceae	*Pycreus*	*pelophilus*	LC
Onagraceae	*Ludwigia*	*octovalvis*	LC
Vitaceae	*Rhoicissus*	*tridentata*	NE
Boraginaceae	*Heliotropium*	*ovalifolium*	LC

Family	Genus	Sp1	IUCN
Fabaceae	*Indigofera*	*lupatana*	LC
Fabaceae	*Indigastrum*	*costatum*	LC
Bignoniaceae	*Kigelia*	*africana*	LC
Apocynaceae	*Cryptolepis*	*capensis*	LC
Phyllanthaceae	*Bridelia*	*mollis*	LC
Ebenaceae	*Diospyros*	*lycioides*	LC
Asteraceae	*Eclipta*	*prostrata*	
Salicaceae	*Oncoba*	*spinosa*	LC
Combretaceae	*Combretum*	*collinum*	LC
Meliaceae	*Turraea*	*obtusifolia*	LC
Meliaceae	*Trichilia*	*emetica*	LC
Moraceae	*Ficus*	*glumosa*	LC
Poaceae	*Enneapogon*	*scoparius*	LC
Poaceae	*Ischaemum*	*afrum*	LC
Poaceae	*Sporobolus*	*nitens*	LC
Acanthaceae	*Justicia*	*divaricata*	
Fabaceae	*Erythrina*	*humeana*	LC
Orchidaceae	*Eulophia*	*hereroensis*	LC
Capparaceae	*Maerua*	*angolensis*	LC
Cyperaceae	*Schoenoplectus*	*muricinux*	LC
Cyperaceae	*Cyperus*	*rupestris*	LC
Poaceae	*Eriochloa*	*stapfiana*	LC
Poaceae	*Aristida*	*congesta*	LC
Cyperaceae	*Kyllinga*	*alba*	LC
Potamogetonaceae	*Potamogeton*	*crispus*	LC
Apocynaceae	*Asclepias*	*multicaulis*	LC
Cyperaceae	*Cyperus*	*distans*	LC
Potamogetonaceae	*Potamogeton*	*schweinfurthii*	LC
Malvaceae	*Grewia*	*olukondae*	LC
Poaceae	*Hyparrhenia*	*rufa*	LC
Poaceae	*Setaria*	*sphacelata*	LC
Hydrocharitaceae	*Najas*	*horrida*	
Ruscaceae	*Sansevieria*	*hyacinthoides*	LC
Cucurbitaceae	*Momordica*	*balsamina*	LC
Apiaceae	*Choritaenia*	*capensis*	LC
Kirkiaceae	*Kirkia*	*acuminata*	LC
Fabaceae	*Senegalia*	*schweinfurthii*	LC
Caryophyllaceae	*Sagina*	*maritima*	
Fabaceae	*Mundulea*	*sericea*	
Asteraceae	*Dicoma*	*tomentosa*	LC
Rubiaceae	*Catunaregam*	*taylorii*	LC

Family	Genus	Sp1	IUCN
Pedaliaceae	*Dicerocaryum*	*senecioides*	LC
Poaceae	*Pogonarthria*	*squarrosa*	LC
Fabaceae	*Albizia*	*versicolor*	LC
Rhamnaceae	*Berchemia*	*discolor*	LC
Urticaceae	*Obetia*	*tenax*	LC
Fabaceae	*Tephrosia*	*villosa*	NE
Poaceae	*Urochloa*	*mosambicensis*	LC
Solanaceae	*Datura*	*stramonium*	
Poaceae	*Eragrostis*	*rotifer*	LC
Urticaceae	*Pouzolzia*	*mixta*	LC
Agavaceae	*Chlorophytum*	*galpinii*	LC
Polygalaceae	*Polygala*	*sphenoptera*	LC
Combretaceae	*Combretum*	*erythrophyllum*	LC
Ricciaceae	*Riccia*	*runssorensis*	
Malvaceae	*Gossypium*	*herbaceum*	LC
Malvaceae	*Hibiscus*	*calyphyllus*	LC
Poaceae	*Aristida*	*bipartita*	LC
Convolvulaceae	*Ipomoea*	*cairica*	LC
Poaceae	*Hyparrhenia*	*tamba*	LC
Asteraceae	*Aspilia*	*mossambicensis*	LC
Apocynaceae	*Gomphocarpus*	*tomentosus*	LC
Convolvulaceae	*Merremia*	*palmata*	LC
Poaceae	*Eleusine*	*coracana*	LC
Olacaceae	*Ximenia*	*caffra*	LC
Acanthaceae	*Dyschoriste*	*rogersii*	LC
Poaceae	*Schmidtia*	*pappophoroides*	LC
Rhamnaceae	*Ziziphus*	*zeyheriana*	LC
Menispermaceae	*Cocculus*	*hirsutus*	
Plantaginaceae	*Plantago*	*major*	
Lobeliaceae	*Lobelia*	*pinifolia*	LC
Loranthaceae	*Erianthemum*	*ngamicum*	LC
Poaceae	*Chloris*	*pycnothrix*	LC
Fabaceae	*Tephrosia*	*villosa*	NE
Fabaceae	*Senna*	*septemtrionalis*	NE
Boraginaceae	*Trichodesma*	*zeylanicum*	LC
Lamiaceae	*Volkameria*	*glabra*	LC
Ricciaceae	*Riccia*	*congoana*	
Poaceae	*Digitaria*	*eriantha*	LC
Passifloraceae	*Adenia*	*digitata*	LC
Nymphaeaceae	*Nymphaea*	*lotus*	LC
Asteraceae	*Linzia*	*glabra*	LC

Family	Genus	Sp1	IUCN
Ebenaceae	*Euclea*	*divinorum*	LC
Fabaceae	*Senegalia*	*senegal*	LC
Fabaceae	*Senna*	*petersiana*	LC
Phyllanthaceae	*Bridelia*	*cathartica*	LC
Convolvulaceae	*Ipomoea*	*crassipes*	LC
Anacardiaceae	*Searsia*	*leptodictya*	NE
Asteraceae	*Xanthium*	*strumarium*	
Lamiaceae	*Leonotis*	*nepetifolia*	LC
Apocynaceae	*Schizoglossum*	*garcianum*	LC
Fabaceae	*Vachellia*	*nilotica*	LC
Asteraceae	*Parapolydora*	*fastigiata*	
Convolvulaceae	*Ipomoea*	*magnusiana*	LC
Fabaceae	*Crotalaria*	*monteiroi*	LC
Fabaceae	*Erythrina*	*lysistemon*	LC
Amaranthaceae	*Gomphrena*	*celosioides*	
Poaceae	*Heteropogon*	*contortus*	LC
Orobanchaceae	*Alectra*	*orobanchoides*	LC
Poaceae	*Andropogon*	*gayanus*	LC
Apocynaceae	*Carissa*	*spinarum*	
Polygonaceae	*Persicaria*	*madagascariensis*	
Fabaceae	*Senna*	*italica*	LC
Apocynaceae	*Catharanthus*	*roseus*	NE
Poaceae	*Sorghum*	*versicolor*	LC
Fabaceae	*Neorautanenia*	*mitis*	LC
Burseraceae	*Commiphora*	*mollis*	LC
Asteraceae	*Tagetes*	*minuta*	
Euphorbiaceae	*Croton*	*sylvaticus*	LC
Solanaceae	*Solanum*	*campylacanthum*	
Amaranthaceae	*Amaranthus*	*thunbergii*	LC
Asteraceae	*Senecio*	*pentactinus*	LC
Poaceae	*Aristida*	*congesta*	LC
Poaceae	*Aristida*	*adscensionis*	LC
Moraceae	*Ficus*	*sycomorus*	LC
Cyperaceae	*Lipocarpha*	*micrantha*	LC
Asparagaceae	*Asparagus*	*setaceus*	LC
Fabaceae	*Mundulea*	*sericea*	LC
Acanthaceae	*Barleria*	*elegans*	LC
Fabaceae	*Colophospermum*	*mopane*	LC
Poaceae	*Trichoneura*	*grandiglumis*	LC
Convolvulaceae	*Ipomoea*	*papilio*	LC

13 APPENDIX C. BIRD SPECIES LIST FOR QDS

Common_group	Common_species	Genus	Species
Barbet	Acacia Pied	*Tricholaema*	*leucomelas*
Batis	Chinspot	*Batis*	*molitor*
Bee-eater	European	*Merops*	*apiaster*
Bee-eater	Little	*Merops*	*pusillus*
Bishop	Southern Red	*Euplectes*	*orix*
Bishop	Yellow	*Euplectes*	*capensis*
Boubou	Southern	*Laniarius*	*ferrugineus*
Brubru	Brubru	*Nilaus*	*afer*
Bulbul	Dark-capped	*Pycnonotus*	*tricolor*
Bunting	Cinnamon-breasted	*Emberiza*	*tahapisi*
Bunting	Golden-breasted	*Emberiza*	*flaviventris*
Bush-shrike	Grey-headed	*Malaconotus*	*blanchoti*
Bush-shrike	Orange-breasted	*Telophorus*	*sulfureopectus*
Buzzard	Lizard	*Kaupifalco*	*monogrammicus*
Buzzard	Steppe	*Buteo*	*vulpinus*
Canary	Yellow-fronted	*Crithagra*	*mozambicus*
Cisticola	Rattling	*Cisticola*	*chiniana*
Cisticola	Red-faced	*Cisticola*	*erythrops*
Cormorant	Reed	*Phalacrocorax*	*africanus*
Coucal	Burchell's	*Centropus*	*burchellii*
Crombec	Long-billed	*Sylvietta*	*rufescens*
Crow	Pied	*Corvus*	*albus*
Cuckoo	Diderick	*Chrysococcyx*	*caprius*
Cuckoo	Klaas's	*Chrysococcyx*	*klaas*
Dove	Laughing	*Streptopelia*	*senegalensis*
Dove	Namaqua	*Oena*	*capensis*
Dove	Rock	*Columba*	*livia*
Drongo	Fork-tailed	*Dicrurus*	*adsimilis*
Eagle	Wahlberg's	*Aquila*	*wahlbergi*
Egret	Cattle	*Bubulcus*	*ibis*
Egret	Little	*Egretta*	*garzetta*
Falcon	Amur	*Falco*	*amurensis*
Finch	Cut-throat	*Amadina*	*fasciata*
Flycatcher	Pale	*Bradornis*	*pallidus*
Flycatcher	Spotted	*Muscicapa*	*striata*
Go-away-bird	Grey	*Corythaixoides*	*concolor*
Grebe	Little	*Tachybaptus*	*ruficollis*
Greenbul	Sombre	*Andropadus*	*importunus*
Greenbul	Yellow-bellied	*Chlorocichla*	*flaviventris*
Hamerkop	Hamerkop	*Scopus*	*umbretta*

Common_group	Common_species	Genus	Species
Heron	Black-headed	*Ardea*	*melanocephala*
Heron	Grey	*Ardea*	*cinerea*
Hornbill	Southern Yellow-billed	*Tockus*	*leucomelas*
Indigobird	Purple	*Vidua*	*purpurascens*
Jacana	African	*Actophilornis*	*africanus*
Kingfisher	Brown-hooded	*Halcyon*	*albiventris*
Kite	Yellow-billed	*Milvus*	*aegyptius*
Lark	Rufous-naped	*Mirafra*	*africana*
Mannikin	Bronze	*Spermestes*	*cucullatus*
Masked-weaver	Lesser	*Ploceus*	*intermedius*
Masked-weaver	Southern	*Ploceus*	*velatus*
Mousebird	Red-faced	*Urocolius*	*indicus*
Mousebird	Speckled	*Colius*	*striatus*
Myna	Common	*Acridotheres*	*tristis*
Oxpecker	Red-billed	*Buphagus*	*erythrorhynchus*
Paradise-flycatcher	African	*Terpsiphone*	*viridis*
Paradise-whydah	Long-tailed	*Vidua*	*paradisaea*
Pipit	Buffy	*Anthus*	*vaalensis*
Plover	Three-banded	*Charadrius*	*tricollaris*
Prinia	Tawny-flanked	*Prinia*	*subflava*
Puffback	Black-backed	*Dryoscopus*	*cubla*
Quail	Common	*Coturnix*	*coturnix*
Quelea	Red-billed	*Quelea*	*quelea*
Scimitarbill	Common	*Rhinopomastus*	*cyanomelas*
Scrub-robin	White-browed	*Cercotrichas*	*leucophrys*
Shrike	Lesser Grey	*Lanius*	*minor*
Shrike	Red-backed	*Lanius*	*collurio*
Sparrow	Cape	*Passer*	*melanurus*
Sparrow	House	*Passer*	*domesticus*
Sparrow-weaver	White-browed	*Plocepasser*	*mahali*
Spoonbill	African	*Platalea*	*alba*
Spurfowl	Swainson's	*Pternistis*	*swainsonii*
Starling	Cape Glossy	*Lamprotornis*	*nitens*
Starling	Red-winged	*Onychognathus*	*morio*
Starling	Violet-backed	*Cinnyricinclus*	*leucogaster*
Sunbird	Collared	*Hedydipna*	*collaris*
Sunbird	Marico	*Cinnyris*	*mariquensis*
Sunbird	Scarlet-chested	*Chalcomitra*	*senegalensis*
Sunbird	White-bellied	*Cinnyris*	*talatala*
Swallow	Barn	*Hirundo*	*rustica*
Swallow	Greater Striped	*Hirundo*	*cucullata*

Common_group	Common_species	Genus	Species
Swallow	Lesser Striped	*Hirundo*	*abyssinica*
Swallow	Wire-tailed	*Hirundo*	*smithii*
Swift	African Black	*Apus*	*barbatus*
Swift	Little	*Apus*	*affinis*
Swift	White-rumped	*Apus*	*caffer*
Tchagra	Black-crowned	*Tchagra*	*senegalus*
Tchagra	Brown-crowned	*Tchagra*	*australis*
Tinkerbird	Yellow-fronted	*Pogoniulus*	*chrysoconus*
Turtle-dove	Cape	*Streptopelia*	*capicola*
Warbler	Olive-tree	*Hippolais*	*olivetorum*
Warbler	Willow	*Phylloscopus*	*trochilus*
Waxbill	Blue	*Uraeginthus*	*angolensis*
Weaver	Spectacled	*Ploceus*	*ocularis*
Weaver	Village	*Ploceus*	*cucullatus*
Whydah	Pin-tailed	*Vidua*	*macroura*
Widowbird	White-winged	*Euplectes*	*albonotatus*
Wood-dove	Emerald-spotted	*Turtur*	*chalcospilos*
Wren-warbler	Stierling's	*Calamonastes*	*stierlingi*

14 APPENDIX D MAMMAL SPECIES LIST

Family	Scientific name	Common name	Red list
Bovidae	*Aepyceros melampus*	Impala	Least Concern
Bovidae	*Connochaetes taurinus taurinus*	Blue wildebeest	Least Concern (2016)
Bovidae	*Kobus ellipsiprymnus ellipsiprymnus*	Waterbuck	Least Concern (2016)
Bovidae	*Pelea capreolus*	Vaal Rhebok	Near Threatened (2016)
Bovidae	*Raphicerus campestris*	Steenbok	Least Concern (2016)
Bovidae	*Sylvicapra grimmia*	Bush Duiker	Least Concern (2016)
Bovidae	*Taurotragus oryx*	Common Eland	Least Concern (2016)
Bovidae	*Tragelaphus angasii*	Nyala	Least Concern (2016)
Bovidae	*Tragelaphus scriptus*	Bushbuck	Least Concern
Bovidae	*Tragelaphus strepsiceros*	Greater Kudu	Least Concern (2016)
Canidae	*Canis adustus*	Side-striped Jackal	Least Concern (2016)
Canidae	*Canis mesomelas*	Black-backed Jackal	Least Concern (2016)
Cercopithecidae	*Cercopithecus albogularis*	Samango Monkey	Least Concern (2008)
Cercopithecidae	*Chlorocebus pygerythrus*	Vervet Monkey	Least Concern (2016)
Cercopithecidae	*Papio ursinus*	Chacma Baboon	Least Concern (2016)
Emballonuridae	*Taphozous (Taphozous) mauritianus*	Mauritian Tomb Bat	Least Concern
Equidae	*Equus quagga*	Plains Zebra	Least Concern (2016)
Felidae	*Caracal caracal*	Caracal	Least Concern (2016)
Felidae	*Felis catus*	Domestic Cat	Introduced
Felidae	*Panthera leo*	Lion	Least Concern (2016)
Felidae	*Panthera pardus*	Leopard	Vulnerable (2016)
Giraffidae	*Giraffa giraffa giraffa*	South African Giraffe	Least Concern (2016)
Herpestidae	*Atilax paludinosus*	Marsh Mongoose	Least Concern (2016)
Herpestidae	*Helogale parvula*	Common Dwarf Mongoose	Least Concern (2016)
Herpestidae	*Herpestes sanguineus*	Slender Mongoose	Least Concern (2016)
Herpestidae	*Ichneumia albicauda*	White-tailed Mongoose	Least Concern (2016)
Hippopotamidae	*Hippopotamus amphibius*	Common Hippopotamus	Least Concern (2016)
Hyaenidae	*Hyena brunnea*	Brown Hyena	Near Threatened (2015)
Hystricidae	*Hystrix africaeaustralis*	Cape Porcupine	Least Concern
Macroscelididae	*Elephantulus brachyrhynchus*	Short-snouted Elephant Shrew	Least Concern (2016)
Molossidae	*Chaerephon pumilus*	Little Free-tailed Bat	Least Concern (2016)
Muridae	*Acomys (Acomys) spinosissimus*	Southern African Spiny Mouse	Least Concern
Muridae	*Aethomys ineptus*	Tete Veld Aethomys	Least Concern (2016)
Muridae	*Gerbilliscus leucogaster*	Bushveld Gerbil	Least Concern (2016)
Muridae	*Lemniscomys rosalia*	Single-Striped Lemniscomys	Least Concern (2016)
Muridae	*Mus (Nannomys) minutoides*	Southern African Pygmy Mouse	Least Concern
Mustelidae	*Mellivora capensis*	Honey Badger	Least Concern (2016)
Nesomyidae	*Cricetomys ansorgei*	Southern Giant Pouched Rat	Least Concern (2016)
Nesomyidae	*Saccostomus campestris*	Southern African Pouched Mouse	Least Concern (2016)
Sciuridae	*Paraxerus cepapi*	Smith's Bush Squirrel	Least Concern (2016)

Family	Scientific name	Common name	Red list
Soricidae	*Suncus lixus*	Greater Dwarf Shrew	Least Concern (2016)
Suidae	*Phacochoerus africanus*	Common Warthog	Least Concern (2016)
Suidae	*Potamochoerus larvatus*	Bush-pig	Least Concern (2016)
Vespertilionidae	*Neoromicia capensis*	Cape Serotine	Least Concern (2016)
Vespertilionidae	*Neoromicia nana*	Banana Pipistrelle	Least Concern
Vespertilionidae	*Nycticeinops schlieffeni*	Schlieffen's Twilight Bat	Least Concern (2016)
Vespertilionidae	*Pipistrellus (Pipistrellus) rusticus*	Rusty Pipistrelle	Near Threatened
Viveridae	*Genetta maculata*	Common Large-spotted Genet	Least Concern
Viverridae	*Civettictis civetta*	African Civet	Least Concern (2016)
Viverridae	*Genetta genetta*	Common Genet	Least Concern (2016)

15 APPENDIX E HERPETOFAUNA LIST

Scientific name	Common name	Status
FROGS & TOADS		
Breviceps adspersus	Bushveld Rain Frog	Not threatened
Bufo garmani	Olive Toad	Not threatened
Bufo gutturalis	Guttural Toad	Not threatened
Cacosternum boettgeri	Boettger's Caco	Not threatened
Chiromantis xerampelina	Southern foam nest frog	Not threatened
Kassina senegalensis	Bubbling Kassina	Not threatened
Leptopelis mossambicus	Brown-backed tree frog	Not threatened
Phrynobatrachus mababiensis	Dwarf puddle frog	Not threatened
Phrynobatrachus natalensis	Snoring puddle frog	Not threatened
Phrynomantis bifasciatus	Banded rubber frog	Not threatened
Ptychadena anchietae	Plain grass frog	Not threatened
Ptychadena mossambica	Broad-banded grass frog	Not threatened
Pyxicephalus edulis	Lesser bullfrog	Not threatened
Tomopterna natalensis	Natal Sand Frog	Not threatened
REPTILES		
Acanthocercus atricollis	Southern tree agama	Not threatened
Agama aculeata	Ground agama	Not threatened
Amblyodipsas polylepis	Common purple glossed snake	Not threatened
Aparallactus capensis	Cape centipede eater	Not threatened
Aspidelaps scutatus	Shield nose snake	Not threatened
Atractaspis bibronii	Southern Burrowing Asp	Not threatened
Bitis arietans	Puffadder	Not threatened
Causus rhombeatus	Common night adder	Not threatened
Chamaeleo dilepis	Flap-neck chameleon	Not threatened
Crotaphopeltis hotamboeia	Red-lipped snake	Not threatened
Dasypeltis scabra	Common egg eater	Not threatened
Dendroaspis polylepis	Black mamba	Not threatened
Dispholidus typus	Boomslang	Not threatened
Duberria lutrix	Common slug eater	Not threatened
Elapsoidea sunderwallii	Sundevall's garter snake	Not threatened
Geochelone pardalis	Leopard tortoise	Not threatened
Gerrhosaurus flavigularis	Yellow-throated plated lizard	Not threatened
Gerrhosaurus nigrolineatus	Black lined plated lizard	Not threatened
Gerrhosaurus validus	Giant plated lizard	Not threatened
Hemidactylus mabouia	Moreau's tropical house gecko	Not threatened
Homopjolis wahlbergii	Wahlberg's velvet gecko	Not threatened
Homoroselaps lacteus	Spotted Harlequin snake	Not threatened
Ichnotropis squamulosa	Common rough scaled lizard	Not threatened
Lamprophis fuliginosus	Brown house snake	Not threatened
Lamprophis guttatus	Spotted house snake	Not threatened
Leptotyphlops scutifrons	Peter's thread snake	Not threatened

Scientific name	Common name	Status
Leptotyplops longicaudus	Long-tailed thread snake	Not threatened
Lycophidion capense	Cape wolf snake	Not threatened
Lycophidion variegatum	Variegated wolf snake	Not threatened
Lygodactylus nigropunctatus	Black-spotted dwarf gecko	Not threatened
Mabuya quinquetaeniata	Rainbow skink	Not threatened
Mabuya striata	Striped skink	Not threatened
Mabuya varia	Variable skink	Not threatened
Mehelya capensis	Cape file snake	Protected species
Mehelya nyassae	Black file snake	Protected species
Monopeltis infuscata	Dusky spade-snouted worm lizard	Not threatened
Naja annulifera	Snouted cobra	Not threatened
Naja mossambica	Mosambique spitting cobra	Not threatened
Nucras ornata	Ornate sandveld lizard	Not threatened
Pachydactylus vansoni	Van Son's Thick toed gecko	Not threatened
Panaspis spp.	Spotted-necked snake eyed skink	Not threatened
Panaspis wahlbergii	Wahlberg's snake eyed skink	Not threatened
Pedioplanis lineocellata	Spotted sand lizard	Not threatened
Philothamnus semivariegatus	Spotted bush snake	Not threatened
Platysaurus intermedius	Common flat lizard	Not threatened
Psammophis mossambicus	Olive grass snake	Not threatened
Psammophis subtaeniatus	Stripe-bellied sand snake	Not threatened
Psammophylax rhombeatus	Spotted skaapsteker	Not threatened
Psammophylax tritaeniatus	Striped skaapsteker	Not threatened
Python natalensis	South African Python	Vulnerable
Rhinotyphlops lalandei	Delalande’s beaked blind snake	Not threatened
Rhinotyphlops schlegelii	Schlegel's beaked blind snake	Not threatened
Teloscopus semiannulatus	Eastern tiger snake	Not threatened
Thelotornis capensis	Vine snake	Not threatened
Varanus albigularis	Rock Monitor	Not threatened

APPENDIX F PES SCORES OF THE WETLANDS ON SITE

Criteria and Attributes	Relevance	Rivers & riparian woodland
Flow Modification	Consequence of abstraction, regulation by impoundments or increased runoff from human settlements or agricultural land. Changes in flow regime (timing, duration, frequency), volumes, velocity which affect inundation of wetland habitats resulting in floristic changes or incorrect cues to biota. Abstraction of groundwater flows to the wetland.	3
Permanent Inundation	Consequence of impoundment resulting in destruction of natural wetland habitat and cues for wetland biota.	3
Water Quality Modification	From point or diffuse sources. Measure directly by laboratory analysis or assessed indirectly from upstream agricultural activities, human settlements and industrial activities. Aggravated by volumetric decrease in flow delivered to the wetland.	4
Sediment Load Modification	Consequence of reduction due to entrapment by impoundments or increase due to land use practices such as overgrazing. Cause of unnatural rates of erosion, accretion or infilling of wetlands and change in habitats.	4
Canalisation	Results in desiccation or changes to inundation patterns of wetland and thus changes in habitats. River diversions or drainage.	4
Topographic Alteration	Consequence of infilling, ploughing, dykes, trampling, bridges, roads, railway lines and other substrate disruptive activities which reduce or changes wetland habitat directly in inundation patterns.	3
Terrestrial Encroachment	Consequence of desiccation of wetland and encroachment of terrestrial plant species due to changes in hydrology or geomorphology. Change from wetland to terrestrial habitat and loss of wetland functions.	3
Indigenous Vegetation Removal	Transformation of habitat for farming, grazing or firewood collection affecting wildlife habitat and flow attenuation functions, organic matter inputs and in increases potential for erosion.	3
Invasive Plant Encroachment	Affects habitat characteristics through changes in community structure and water quality changes (oxygen reduction and shading).	4
Alien Fauna	Presence of alien fauna affecting faunal community structure	3
Over utilisation of Biota	Overgrazing, overfishing, etc.	2
Total		36
Mean		3.3
Category		Largely Natural with few modifications
Ecological Management Class		B

APPENDIX G EIS SCORES OF THE WATER COURSES ON SITE

Determinant	Rivers & riparian woodland
PRIMARY DETERMINANTS	
1. Rare & Endangered Species	2
2. Populations of Unique Species	1
3. Species/taxon Richness	2
4. Diversity of Habitat Types or Features	3
5. Migration route/breeding and feeding site for wetland species	1
6. Sensitivity to Changes in the Natural Hydrological Regime	2
7. Sensitivity to Water Quality Changes	2
8. Flood Storage, Energy Dissipation & Particulate/Element Removal	3

MODIFYING DETERMINANTS	
9. Protected Status	0
10. Ecological Integrity	2
TOTAL*	18
MEDIAN	1.8
OVERALL ECOLOGICAL SENSITIVITY AND IMPORTANCE	**MODERATE**

APPENDIX H. CURRICULUM VITAE OF SPECIALIST

CURRICULUM VITAE

B J Henning

PhD Plant Ecology

PERSONAL DETAILS

Name:	BAREND JOHANNES HENNING
Date of Birth:	1976-09-06
Profession/Specialization:	Senior Ecologist / Associate
Years with Firm:	12 years (Ages & Exigo)
Nationality:	South African
Years experience:	15 years

QUALIFICATIONS

University attended:	University of Pretoria, Pretoria (1995- 2002) PhD Plant Ecology, MSc (Botany), BSc (Hons.), BSc

KEY QUALIFICATIONS AND EXPERIENCE

- Senior Ecologist for Exigo (previously AGES Gauteng) since November 2012. Involved in the following aspects:
    - Vegetation surveys, sensitivity and zoning analysis of development sites, including eco-estates, mines, residential developments, shopping centres, roads, water supply and other related infrastructure etc (Reference: Mr Herman Gildenhuys, Exigo; 0127512160; Mr Johan Botha, AGES Limpopo; 0152911577)
    - Faunal analysis and scoping reports (Reference: Mr Herman Gildenhuys, Exigo; 0127512160; Mr Johan Botha, AGES Limpopo; 0152911577)
    - Agricultural potential and land capability studies of soils on farms. (Reference: Mr Herman Gildenhuys, Exigo; 0127512160; Mr Johan Botha, AGES Limpopo; 0152911577)
    - Avifauna studies related to solar plant and power line connection developments;
    - Wetland delineations and functional capacity assessments (completed advanced wetland course of the Continued Education Department, University of Pretoria 2010 as well as Wetland rehabilitation course of the University of the Free State);

- Wildlife Management Plans and habitat assessment for rare and endangered game species;
- Spatial Development Frameworks;
- Strategic Development Area Frameworks for local municipalities
- GIS related functions;

- Previously employed as Senior Environmental Scientist for AGES Limpopo since September 2006 involved in all of the abovementioned aspects;
- Environmental Consultant for Envirodel Wildlife & Ecological Services cc and Dubel Integrated Environmental Services, Polokwane 2004 - 2006. Involved in the following aspects:
  - Wildlife management plans for game farms /reserves throughout the Limpopo Province
  - Environmental impact assessments (vegetation surveys and faunal scoping reports), habitat suitability analysis and report compilation.
  - Coordinating and performing grass monitoring surveys for the Limpopo Tourism and Parks Board
  - Soil potential studies.
- Environmental Consultant for Ficus – pro Environmental Services cc., Modimolle 2004 / 5. Involved mostly in fieldwork, report compilation or impact studies. Reference: Mr. R. Venter (0147173378)
- Subconsultant for AGES (Africa Geo-Environmental Services 2005-2006. Vegetation surveys and sensitivity zoning and analyses. Mr Johan Botha (0836449957)
- Eco-Agent environmental services cc, Pretoria 2002 - 2004. Involved in environmental impact studies. Prof G. J. Bredenkamp (0825767046), University of Pretoria.
- Enviroguard environmental services cc, Heidelberg 2002 - 2004. Involved in environmental impact studies. Prof L. R Brown (0825767046).
- GIS related aspects for all the abovementioned aspects on projects

POSITION AND DUTIES

Employed as Senior Ecological Specialist. Main duties and responsibilities include:

- Compilation of project proposals;
- Conducting specialist assessments
  - Ecological assessments
  - Soils and Land use potential studies;
  - Wetland assessments;

  - Agricultural assessments;
  - Avifauna assessments;
  - Wildlife Management Plans and assessments.
- Liaison with clients;
- GIS and map compilation;
- Project admin and management;
- Integration and interaction with the environmental consultants;
- Travelling;

Any ad hoc duties that may be given by immediate manager.