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A vegetation and fauna biodiversity assessment for the proposed Phase 1 Kloofsig photovoltaic power (PV) energy generation, on the Farm Kalk Poort RE/18, Hopetown, Northern Cape Province

September 2016

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Commissioned by:

SRK Consulting Engineers and Scientists

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EXECUTIVE SUMMARY

Vegetation

The site is Nama Karoo, consisting of the Northern Upper Karoo vegetation unit. As far as vegetation structure and floristic composition are concerned, the Northern Upper Karoo vegetation unit within the site is very homogeneous. Overall, the study site is dominated by small karroid shrubs, most below 50 cm, with signs that sparse grass cover fills the bare areas between after sufficient rain. Although four different karoo mapping units and an additional wetland / aquatic system were recognised, the differences in plant species composition are small. The plant species composition of the plant communities recognised is mostly quite similar, especially as far as dominant plant species are concerned. No red listed or protected plant species occur on the site.

Mammals

From a mammal habitat perspective three of the four major habitats are present, i.e. mainly terrestrial, with limited rupicolous, arboreal and wetland habitat present. The site is dry most of the year and does not support much wetland vegetation that is a prerequisite for discerning small mammals such as vlei rat and shrews. The terrestrial habitat is spatially predominant. The entire site consists of terrestrial karoo plains that support karoo dwarf shrub (bossiesveld).

Of the 43 mammal species expected to occur on the study site, no less than 27 were confirmed during the site visit.

Of the red data mammal species expected, the spectacled dormouse and the lesser red musk shrew have never been studied in their natural environments. No empirical data exist to gauge their conservation status, and as a consequence they are ranked as “Data Deficient (DD)” Red Data species. Hedgehogs fall prey to human sentiments and their pets. As a consequence the conservation status of these little insectivores declined to a “Near Threatened”. Brown hyenas, and to a lesser extent honey badgers, have an undeserved stigma as sheep killers and as a consequence they are prosecuted, and this resulted in their “Near Threatened” Red Data ranking.

Protected mammals in terms of the Biodiversity Act No 10 of 2004 that may be

present on the site include South African hedgehog, Black-footed cat, Brown hyena and Honey badger.

On a micro-scale, each of the panels of voltaic units can be expected to alter the floral composition by replacing plant species adapted to the sunny and arid exposed karoo conditions with extremes in ambient temperatures, to those amenable to shady conditions. On a local and especially regional scale no mammal species will come under threat, although the effect of the development is likely to be measureable at population levels.

Herpetofauna

In general the study site is a homogenous environment that contains one large herpetofauna habitat, namely terrestrial karoo.

Of the 39 herpetofauna species recorded and/or expected on the remainder of portion 18 of the farm Kalk Poort, 5 were confirmed to be present. No red data species occur within the study site.

From a herpetological perspective, all drainage lines and water bodies like the temporary pans and the artificial water points are regarded as sensitive.

The development is not considered a direct threat to any reptile or amphibian species, although the impact in space may be considered as small within on the widespread karoo plain habitat. The development is expected to have a small impact on herpetofauna and their environment, once the disruption of construction is over.

Wetlands and aquatic systems

In terms of the definitions given in the National Water Act, 1998 (Act No. 36 of 1998), two pans and a drainage line were identified on the Phase 1 Kloofsig site or within 500 m of the site boundary, or along the transect of the proposed power lines. The following wetland or aquatic systems were identified:

1. A **dry Natural pan** is present just outside the south-western corner of the site, (spanning both sides of the farm boundary fenceline). This pan is excluded from

the proposed development. The development will not impact on this pan as it is at least 50 m from the footprint of the proposed development.

2. Another pan also occurred previously on the site, but was **transformed** by a windpump, a water point for livestock and a sheep kraal. This area is proposed for development.
3. A **dry drainage line** is present north of and parallel to the eastern part of the proposed powerline south of the site, leading to the Eskom 132 kV Switch Staion. This powerline will have to cross the drainage line to reach the proposed substation 2. The pylons may possibly have a small insignificant impact on the drainage line, though moving the line slightly southwards, even along the road, will lessen the impact. Note that there is already a dysfunctional line (telephone line) along the proposed power line transect.

These wetlands and/or aquatic systems were very dry at the time of the surveys, had no surface water and did not show any obvious zonation. All these systems are seasonal, and temporal / intermittent.

Conclusion.

From a vegetation and fauna, as well as wetland point of view the area within the Kloofsig Phase 1 study site and proposed new powerline, the proposed development can be supported, though it is imperative that, should the development proceed, be carried out in a way to minimise not only species loss, but also the alteration and loss of habitats.

1. PROJECT BACKGROUND

In an initial initiative it was proposed to to build the Kloofsig Solar PV Energy Facility with a capacity to produce about 450 MW of electricity on the Remainder of Portion 18 of the farm Kalkpoort. This site lies just south of the Gariep (Orange) River, between the villages of Orania and Hopetown to the west and Van Der Kloof and Petrusville to the east, within the Pixley ka Seme District and Rhenosterberg Local Municipalities, Northern Cape Province (Figures 1 & 2). The site was selected for the extensive flat areas available on the farm, which is owned by the Havenga family and currently managed for livestock (mainly sheep, and cattle) and game (mainly springbok, and gemsbok). The site is already crossed by two Eskom high-voltage power lines of 765 kV and 400 kV, with two more 400 kV lines just to the east, which emanate from the hydroelectric power station at the wall of the Vanderkloof (previously P. K. le Roux) Dam. These power lines offer ideal on-site opportunities for connection to the national grid (Figure 3). Preliminary plans for the development were to construct six separate solar array units distributed over the farm (Figure 3).

In order to provide information to the applicant as well as the decision-making authorities EcoAgent CC was commissioned to complete a site screening assessment on the biodiversity and hence ecological sensitivity of the entire farm. The findings of this study are presented in an ecological sensitivity map provided as Figure 4.

During September 2016 SRK Consulting informed EcoAgent CC that:

- The project will continue only on the southern part of the farm
- The northern part of the farm will not be included in the development and will remain natural veld
- The project will be divided into three phases, each with a generation capacity of 75 MW, totalling 225 MW (Figure 5).

EcoAgent CC was then requested to provide the results of the biodiversity assessments, including the impact assessments, in three separate reports for Phases 1, 2 and 3, and that the three avifauna reports should be separate from the biodiversity reports. This report covers the biodiversity components for Phase 1.

The biodiversity impact assessments, including the flora, mammals, herpetofauna and wetland assessments (but excluding the avifauna assessment) for Phase 1 of the proposed decelopment are presented in this report.

In accordance with The Natural Scientific Professions Act (Act 27 of 2003) only persons registered with the South African Council for Natural Scientific Professions may practice in a consulting capacity. This report combines site visits on 17-19 April 2015 and on 6–8 October 2016 by the EcoAgent team (Prof GJ Bredenkamp, botanist, ecologist; Dr IL Rautenbach, mammalogist; and Mr JCP van Wyk, herpetologist) to assess the vegetation, wetlands and vertebrate fauna and possible impacts of the development and to suggest possible mitigation options.

This investigation is in accordance with the EIA Regulations No. R982-985, Department of Environmental Affairs and Tourism, 4 December 2014 emanating from Chapter 5 of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as well as the National Water Act 1998 (Act 36 of 1998).

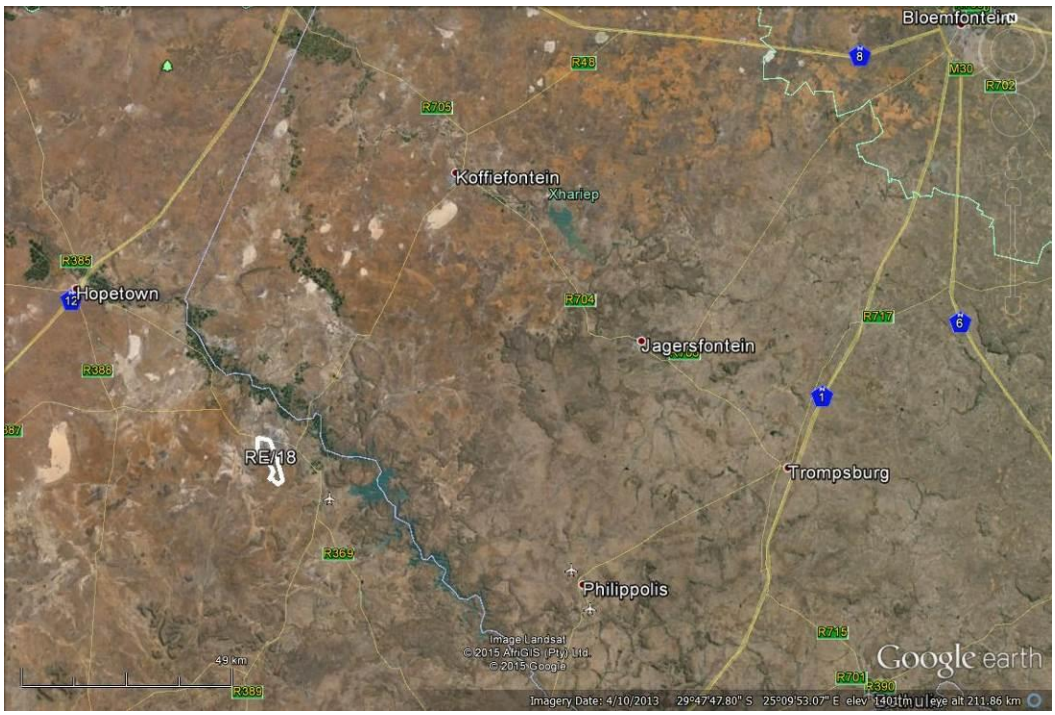

Figure 1: Satellite image to show the location of the Kalkpoort RE/18 (white polygon) in relation to the main surrounding towns, borders, roads and features.

Figure 2: Satellite image of Kalkpoort RE/18 (white polygon) in relation to the Gariep River, Vanderkloof Dam, nearby villages and local access routes. Note especially the R369 forming the northern border of the site and the small secondary road from Petrusville that passes just south of the site.

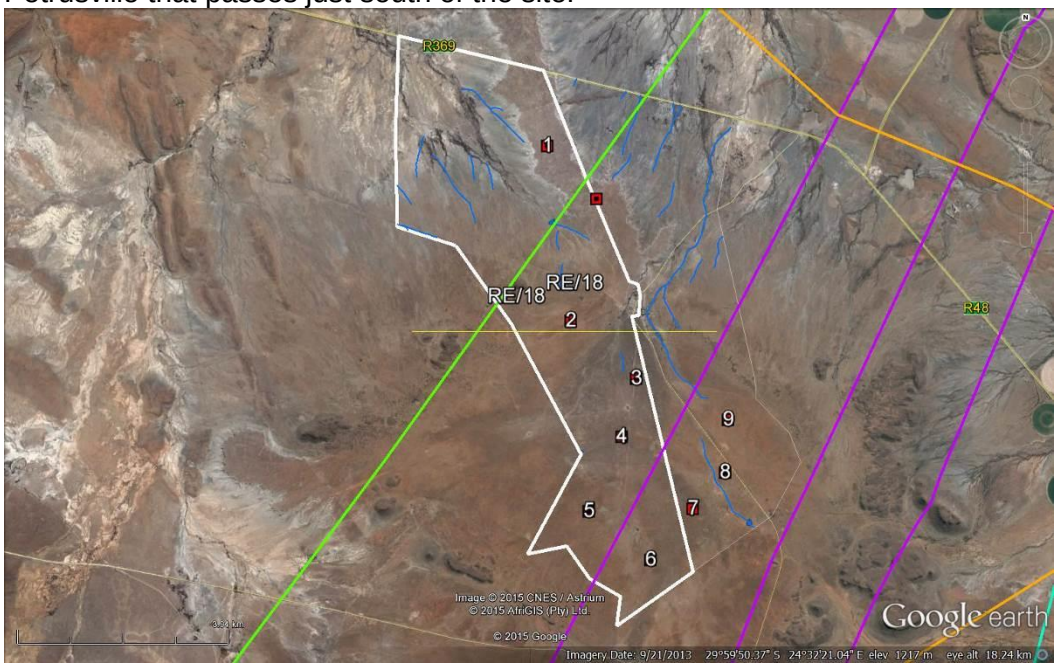

Figure 3: Close-up satellite image of Kalkpoort 18 (white polygon), showing locations 1-6 within the site that were provisionally selected as positions for the arrays during a recent aerial survey, the roads passing at either end, and the existing Eskom high-voltage transmission lines crossing the area (765 kV green, 400 kV purple). (Positions 7-9 were not relevant for this study)

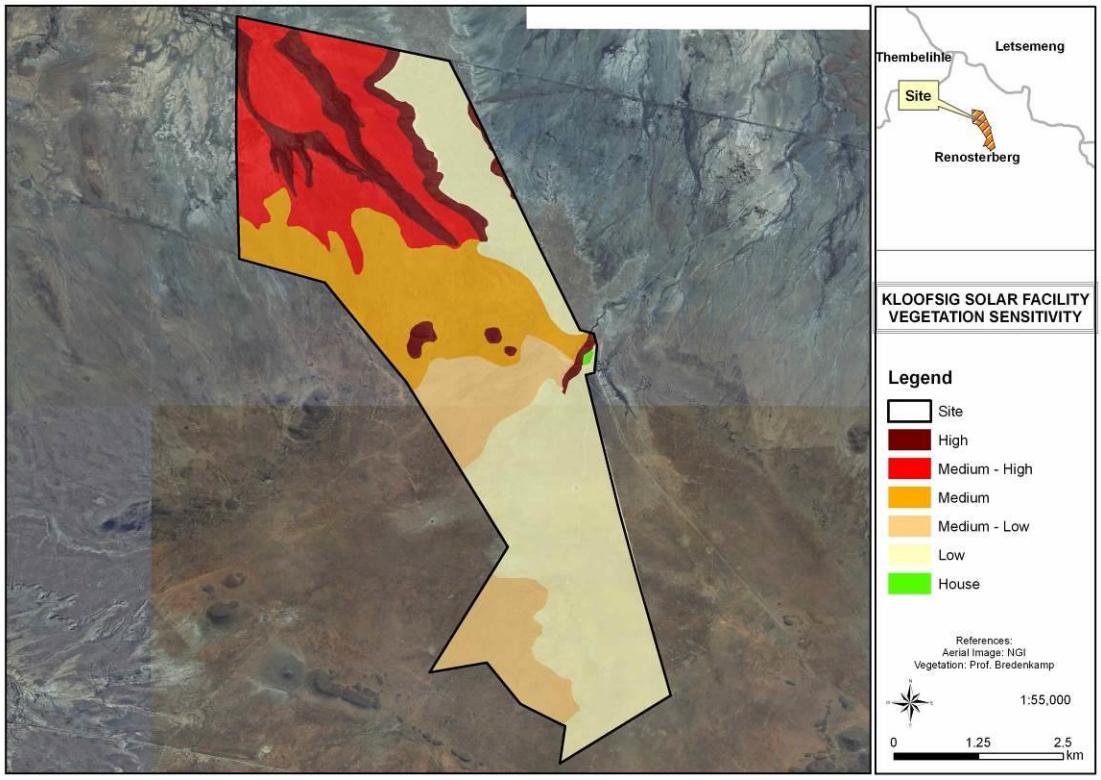

Figure 4: Ecological sensitivity map of the entire Kalkpoort RE/18 (EcoAgent 2015).

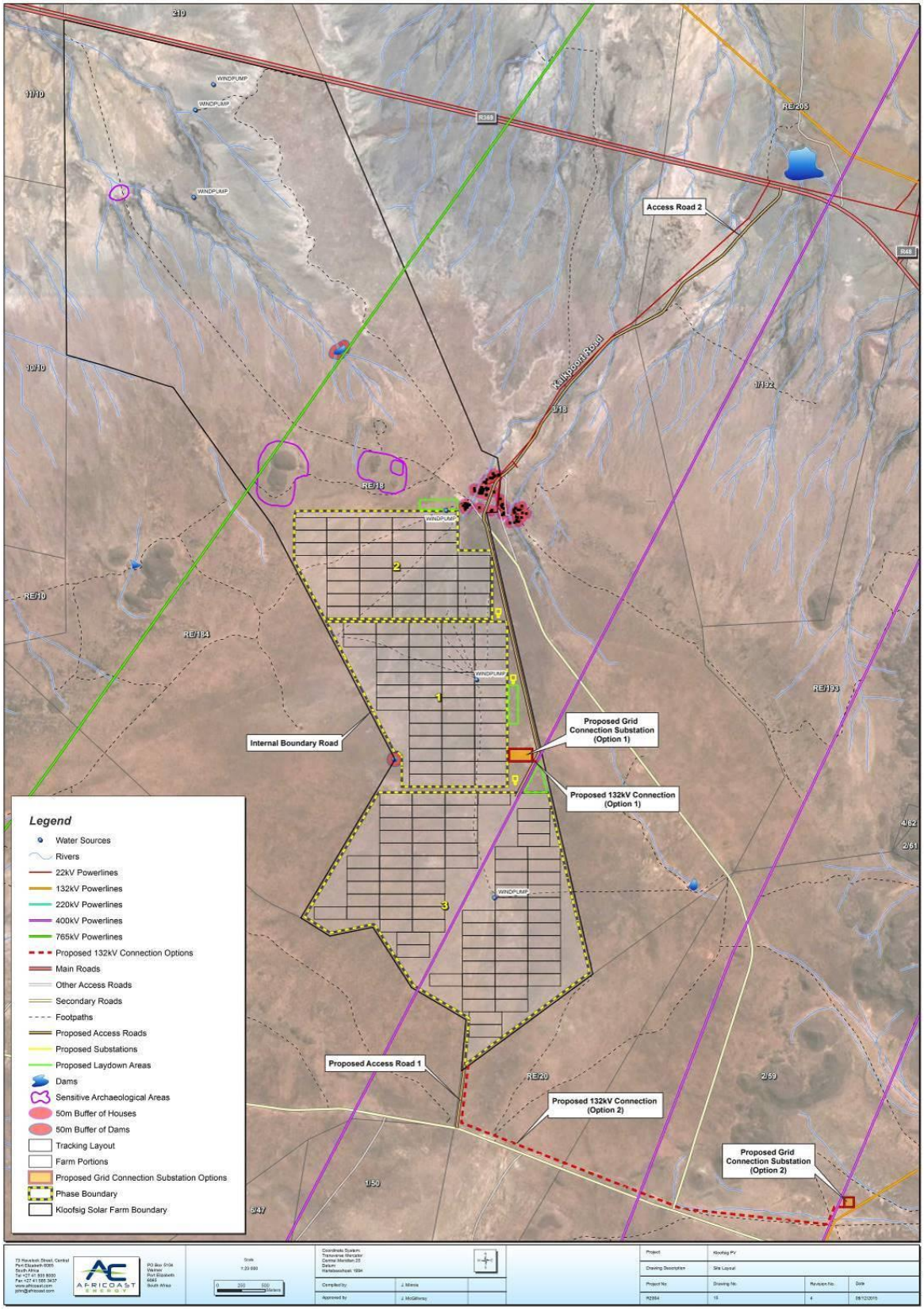

Figure 5: Close-up satellite image of Kalkpoort RE/18 (black polygon), showing the locations of Phases 1-3 of the final proposal for development (map provided by SRK Consulting).

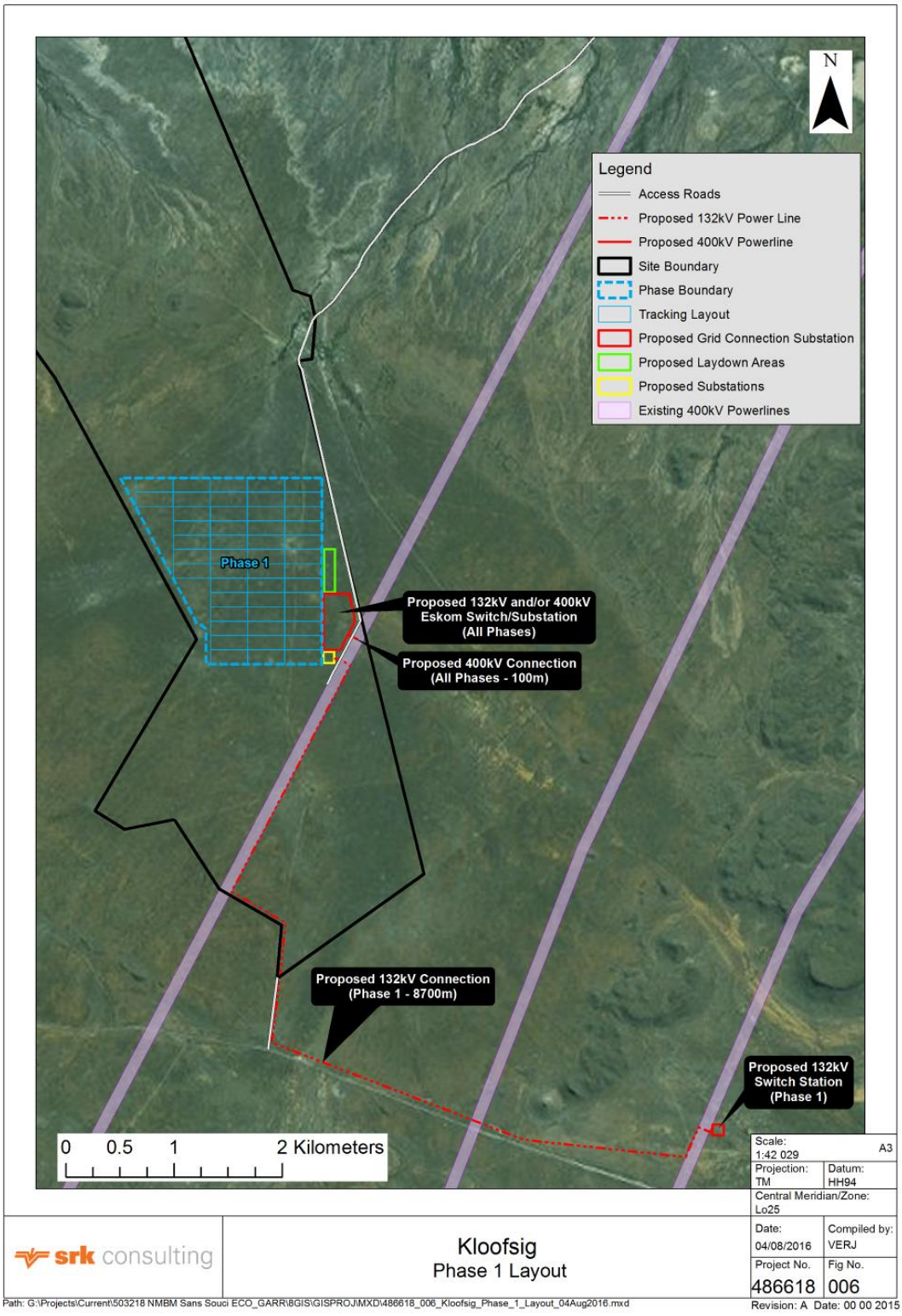

Figure 6: Location of the proposed Kloofsig Phase 1 development on Portion RE/18 on the Farm Kalkpoort. Note the position of the proposed 132kV connection power line and switch station (map provided by SRK Consulting).

2. ASSIGNMENT

Eco-Agent Ecological Consultants CC was appointed by SRK Consulting to assess the vegetation and wetlands / aquatic habitat and undertake a mammal, reptile and amphibian study of the area of the proposed Kloofsig Phase 1 development (Figure 6) on the Farm Kalkpoort RE/18, Renosterberg Local Municipality, Northern Cape Province. The results of an avifaunal study are given in a separate report.

The assignment is interpreted as follows: Compile a study of the vegetation, flora, wetlands and vertebrate fauna of the site, with emphasis on Red Data plant and vertebrate species that occur or may occur on the site. Indicate ecological sensitive areas on the site. In order to compile this, the following had to be done:

2.1. Initial preparations:

- Obtain all relevant maps and information on the natural environment of the concerned area.
- This includes information on Red Data plant and vertebrate species that may occur in the area.

2.2. Vegetation and habitat survey:

- List the plant species (trees, shrubs, grasses and herbaceous species) present for plant community and ecosystem delimitation.
- Identify potential red data plant species, alien plant species, and medicinal plants.

2.3. Plant community delimitation and description

- Process data (vegetation and habitat classification) to determine vegetation types (= plant communities) on an ecological basis.
- Describe the habitat and vegetation.
- Determine the sensitivity of the site for biodiversity, veld condition and presence of rare or protected species.
- Prepare a vegetation map of the area.
- Prepare a sensitivity map of the plant communities present, if relevant.

2.4. Faunal assessment

- Compile lists of current or possible occurrences of vertebrate species.

- Obtain lists of the Red Data vertebrates (mammals, birds, reptiles and amphibian) that can be expected in the area.
- Assess the quantitative and qualitative condition of suitable habitat for the Red Listed vertebrates that may occur in the area.
- Assess the possibility of Red Listed fauna being present on the study site.

2.5. Wetland and aquatic assessment:

- Conclusively identify the presence or absence of wetland / aquatic conditions as prescribed by the DWAF (2005) delineation guideline;
- Should wetland(s) be present, Identify the outer edge of the wetland temporary zone, or edge of the riparian zone;
- Classify the wetland or riparian areas according to the system proposed in the national wetlands inventory if relevant,
- Indicate the Present Ecological State (PES), Ecological Importance and Sensitivity (EIS) and relative functional importance of the wetland or riparian areas;
- Indicate wetland buffer zones;

2.6. General

- Identify and describe particular ecologically sensitive areas.
- Identify problem areas in need of special treatment or management, e.g. bush encroachment, erosion, water pollution, degraded areas, reclamation areas.
- Make recommendations on aspects that should be monitored during development.

3. RATIONALE

It is widely recognised that the natural resources on Earth are essential in providing the ecological processes and life support systems that maintain healthy and viable populations of plants and animals, including humans. Therefore, for any sustainable development to take place, all possible impacts of such development on the environment must be considered before it can be approved by the relevant authorities. This has led to various and increasing legislation that protects the natural environment in South Africa. In 1992, the Convention of Biological Diversity (CBD), a landmark international convention, was signed by >90 % of members of the United Nations. In South Africa, the Environmental Conservation Act (ECA, Act 73 of 1989), the National Environmental Management Act (NEMA, Act 107 of 1998) and the National Environmental Management Biodiversity Act (NEMBA, Act 10 0f 2004) ensure the protection of ecological processes, natural systems and natural beauty, as well as the preservation of biotic diversity within the natural environment. They also ensure the protection of the environment against disturbance, deterioration, defacement or destruction as a result of man-made structures, installations, processes, products or activities. In support of these Acts, a draft list of Threatened Ecosystems was published (Government Gazette 2009), as part of the NEMBA (Act 10 of 2004). Details of these Threatened Ecosystems have been described by SANBI & DEAT (2009) and a list of Threatened or Protected Species (ToPS) regulations is also available (NEMBA Notice 388 of 2013). International and national Red Data lists have also been produced for various threatened plant and animal taxa.

At a proposed development site, all components of the ecosystems, abiotic (e.g. geology, topography, climate) and biotic (e.g. vegetation, animals) are interrelated and interdependent. A holistic approach is therefore imperative to include effectively the development, utilisation and, where necessary, conservation of the given natural resources within an integrated development plan that will address the needs of a modern human population (Bredenkamp & Brown 2001).

This makes it necessary to make a thorough inventory of the biodiversity on the site, and to evaluate the ecosystems, habitats and possibility of threatened species. This

inventory should then serve as a scientific and ecological basis for planning, initiating, managing and, where necessary, terminating the development.

This development of a solar array that will provide significant amounts of renewable energy to the national grid offers future relief for electricity shortages facing South Africa. If the array does not make a significant impact on the flora and fauna of the site, it would seem an attractive national and local initiative, given the ideal location of the site within the wide extent of similar habitat and with respect to flat topography, ample sunlight and adjacent transmission lines. The Vanderkloof Dam with its major hydroelectric power station already forms the start of what might become an important natural area for renewable energy production.

Definitions and Legal Framework

Authoritative legislation that lists impacts and activities on biodiversity and wetlands and riparian areas that requires authorisation includes:

- National Environmental Management Act, 1998 (Act No. 107 of 1998);
- National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004).
- Environment Conservation Act, 1989 (Act 73 of 1989);
- Conservation of Agriculture Resources Act, 1983 (Act 43 of 1983);
- National Water Act, 1998 (Act 36 of 1998);
- National Forests Act, 1998 (Act 84 of 1998);
- National Environmental Management: Protected Areas Act 2003 (Act 57 Of 2003) (as Amendment Act 31 of 2004 and Amendment Act 15 of 2009)
- Government Notice Regulation 982, 983, 984 and 985 of 4 December 2014 (NEMA).

In summary:

- Vegetation, Flora, fauna and ecosystems are protected by National Environmental Management Act, 1998 (Act No. 107 of 1998) and the National Environmental Management: Biodiversity Act, 2004 (Act 10 of 2004), which includes the ToPS species.
- Wetlands and other watercourses are protected water resources in the National Water Act (NWA), Act 36 of 1998.

- Development or transformation of a watercourse is regarded as a water use, which can only be allowed through an approved Water Use License, irrespective of the condition of the affected watercourse.
- The NWA defines water use in a watercourse specifically related to wetlands and riparian areas as broad impacts that include the following:
    - impeding or diverting the flow of water in a watercourse (Section 21 c); and
    - altering the bed, banks, course or characteristics of a watercourse (Section 21 i);
- A DWA stipulation published in Government Gazette No 32805 on 18 December 2009 also require that a Water Use License should be applied for when any wetlands are present within a 500 m radius of water use activities as defined by section 21 (c) and section 21 (i) of the NWA.
- Wetlands are also protected in other environmental legislation, such as the National Environmental Management Act (NEMA), Act 107 of 1998. The act lists several activities that require authorisation before they can be implemented.
- NEMA lists various activities that require authorisation, when the activity is located within 32 m or less from the edge of a wetland or other watercourse.

In a South African legal context, the term watercourse is often used rather than the terms wetland or river. The National Water Act (NWA) (1998) includes wetlands and rivers into the definition of the term watercourse.

Watercourse means:

- A river or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which water flows, and
- Any collection of water which the Minister may, by notice in the Gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

Riparian habitat is the accepted indicator used to delineate the extent of a river's footprint (DWAF, 2005). The National Water Act, 1998 (Act No. 36 of 1998), defines a riparian habitat 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.”.

In contrast, the National Water Act, 1998 (Act 36 of 1998) defines a wetland as “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.”(see also Ollis *et al*. 2013, NEMA Government Notices 983, 984, 985, December 2014).

There are guidelines and local policies for the determination of buffer zones from a wetland or watercourse (Macfarlane *et al.* 2010), however generally 32 m is still regarded as a standard for buffer zone (Ezemvelo IEM, 2011; Biodiversity Act, 2004 (Act 10 of 2004), and particularly the recently policy published in Regulation 983, Government Gazette 38282, December 2014).

4. SCOPE AND OBJECTIVES OF THE STUDY

- To identify and map the vegetation units as ecosystems that occur on the site,
- To assess the ecological sensitivity of these ecosystems comment on ecologically sensitive areas, in term of their biodiversity and where needed ecosystem function,
- To map and describe possible wetlands / aquatic systems that are present on the site and determine their Present Ecological State (PES), Ecological Importance and Sensitivity (EIS) and relative functional importance;
- To assess qualitatively and quantitatively the significance of the fauna habitat components and current general conservation status of the site,
- To comment on connectivity with natural vegetation and habitats on adjacent sites,
- To recommend suitable buffer zones, if relevant,
- To provide a list of plant and vertebrate fauna species that do or might occur on site and that may be affected by the development, and to identify species of conservation concern,
- To highlight potential impacts of the proposed development on vegetation, fauna and flora of the study site, and
- To provide management recommendations that might mitigate negative and enhance positive impacts, should the proposed development be approved.

5. STUDY AREA

5.1 Regional setting

The study site lies within natural vegetation on the southern rim of the Gariep River valley and drains down into the river below (Figures 1 & 2). The most prominent mountains in the area are the Rhenosterberg to the east, within which the Vanderkloof (previously P. K. le Roux) Dam, the second-largest in South Africa by capacity, has been constructed. Its wall is visible about 28 km east of the site. The river in this area forms the boundary between the Free State (north) and Northern Cape (south) Provinces. The towns nearest to the site are Petrusville 16 km to the southeast and Orania (17 km) and Kraankuil (35 km) to the northwest, besides the recreational resort of Van Der Kloof above the dam wall. The principal roads in the area are the R48 that passes Petrusville en route north from De Aar across the Havenga Bridge to Luckoff in the Free State, the R388 that runs south from Hopetown on the N12 and passes through Kraankuil, and the R369 that runs south of the Gariep River from Prieska on the N10 via Hopetown, Orania and Petrusville to Colesberg on the N1. The R369 also forms the northern boundary of the site, while a minor secondary road that provides the shortest route between Petrusville and Kraankuil station passes just south of the site, which might be relevant for transporting materials on the Cape Town-Kimberley railway line.

5.2 Physical Environment

5.2.1 Regional Climate

Temperature on site have been recorded as low as -11^{o}C in the austral winter to over 40^{o}C in summer, and this Nama-Karoo habitat expects only 200-250 mm of rain annually, but with annual variations from near drought to occasional widespread flooding. Rain falls mainly as orographic thundershowers in the summer and autumn, but with more regular frontal rain in recent years (John Havenga (land owner), pers. comm.).

5.2.2 Geology and soils

The site must historically have been almost flat with shallow wind-blown soils over a hard calcrete base, but this base has been eroded by flows of rainwater making their

way north to the Gariep River. The surface geology of the site appears mostly as shallow soils, but deeper below steep slopes around protruding hills and below calcrete shelves. Low rounded rocky hills in the west of the site and a ridge in the east protrude as dolerite intrusions across the centre of the site, part of the same mudstones, shales and dolerite boulders of the Rhenosterberg to the east and the other scattered hills and buttes across the western flats. Eroded alluvial washes, which come off the calcrete flats to the south, produce a build-up of grey sands in the steeper drainage lines heading north to the Gariep River. The calcrete base is penetrated at scattered spots by burrows of fossorial mammals and the whole area supports high densities of termite mounds, except on the isolated calcrete plateau in the north and adjacent drainage washes where densities are lower.

5.2.3 Topography and drainage

The average elevation of the general area is about 1100-1400 meters above sea level (m a.s.l.), with some of the hills and mountains rising 200-300 m above the surrounding plains. All drainage in the area is directed eventually into the Gariep River, the largest watercourse in the area, reaching it before its confluence with the Vaal River. The generally flat to undulating terrain often produces long and meandering watercourses. The site slopes only slightly to the north (1243-1204 m a.s.l.), but sufficiently for the water to converge north of the study site (the site of the proposed Phase 2 development) and flow towards the 4-5-m deep Kalk Poort just north of the farmhouse (situated north-east of the proposed Phase 2 development). The very small watercourses (considered as occasional washes" on site were mostly dry. Small pans exist on the western boundary and at the northernmost watering point, but were dry during the visit.

5.2.4 Land Use

Most of the farms in the area, as for the site, conduct extensive livestock and game management on natural rangelands. Closer to the river are farms with more intensive agriculture, based on crops irrigated by centre-point pivots with water from the river and a canal from the dam. Apparently, the site is suffering from the worst drought in 50 years, only slightly alleviated by modest recent rains, so the ground cover

between the woody shrubs appears sparse and the stocking rates of livestock and game low.

5.2.5 Vegetation Types

The site falls close to the junction of three major biomes, the Nama-Karoo, Grassland and Savanna. The site consists of the Northern Upper Karoo vegetation unit (NKu 3 of Mucina & Rutherford 2006), but the drainage lines running northwards support elements the southwest limits of Kimberley Thornveld (SVk 4). Overall, the study site is dominated by small shrubs and succulents, most below 50 cm, with signs that sparse grass cover fills the bare areas between after sufficient rain. Alien trees, mainly poplars and mesquite, are planted around watering points.

5.2.6 Conservation status of habitats

The vegetation on and around the site is classified as Least Threatened, mainly because they fall within areas that have substrates unsuitable for and therefore not transformed by tilling, and also because they fall in drier areas of the country with low population densities and less urbanisation. Two significant provincial nature reserves (NRs) that occupy much of the south bank of the Vanderkloof Dam, and the riverine and riparian corridor of the Gariep River are important nearby sources for the site of terrestrially dispersing species. Rolfontein (80 km^2, established in 1970) is closest to the site in the mountains above the wall, and Doornkloof (94 km^2, established 1981) is further east but includes 10km of the Seekoei River before it enters the dam.

6. METHODS

Prior to the field visits, a desktop study of the available literature and relevant reports was made.

The EcoAgent team (Prof G.J. Bredenkamp (botanist, ecologist) Dr I.L. Rautenbach (mammalogist), Dr A. Kemp (ornithologist, ecologist) and Mr J.C.P. van Wyk (herpetologist) conducted a site visit on 17-19 April 2015, and Prof Bredenkamp and Dr Rautenbach conducted a further site visit 6-8 October 2016. The entire site was travelled by 4x4 vehicle and investigated on foot by walking random transects, to record plant community type and fauna and flora diversity.

6.1. Flora

6.1.1 Vegetation and flora

The vegetation was stratified into relatively homogeneous units on recent aerial photographs (Google Earth) of the area. At several sites a description of the dominant and characteristic species was made. These descriptions were based on total floristic composition, following established vegetation survey techniques (Mueller-Dombois & Ellenberg 1974; Westhoff & Van der Maarel 1978). Data recorded included a list of the plant species present, including trees, shrubs, grasses and forbs. Comprehensive species lists were therefore derived for each plant community / ecosystem present on the site. These vegetation survey methods have been used as the basis of a national vegetation survey of South Africa (Mucina *et al*. 2000) and are considered to be an efficient method of describing vegetation and capturing species information. Notes were additionally made of any other features that might have an ecological influence.

The identified systems are not only described in terms of their plant species composition, but also evaluated in terms of the potential habitat for red data plant species.

Red data plant species for the area were obtained from the SANBI data bases, with updated threatened status, (Raimondo *et al.* 2009), while a list of Threatened or Protected Species (TOPS) regulations is also available (NEMBA Gvernment Notice

388 of 2013). These lists were then evaluated in terms of habitat available on the site, and also in terms of the present development and presence of man in the area.

Alien invasive species, according to the Conservation of Agricultural Resources Act (Act No.43 of 1983) as listed in Henderson (2001), are indicated.

The field observations were supplemented by literature studies from the area (Werger, 1980, Palmer 1989, Bezuidenhout, 1994, 1995, Smit, 2000).

6.1.2 Plant Conservation Priority and Ecological Sensitivity

The following **conservation priority** / ecological sensitivity categories were used for each site:

High: Ecologically sensitive and valuable land with high species richness and/or sensitive ecosystems or red data species that should be conserved and no developed allowed.

Medium-high: Land where sections are disturbed but which is in general ecologically sensitive to development/disturbances.

Medium: Land on which low impact development with limited impact on the vegetation / ecosystem could be considered for development. It is recommended that certain portions of the natural vegetation be maintained as open space.

Medium-low: Land of which small sections could be considered to conserve but where the area in general has little conservation value.

Low: Land that has little conservation value and that could be considered for developed with little to no impact on the vegetation.

In terms of sensitivity the following criteria applies:
High and Medium-High conservation priority categories mentioned above are considered to have a High sensitivity and development should not be supported.

Medium, Medium-Low and Low conservation priority categories mentioned above are considered to have a Low sensitivity and development may be supported. Portions of vegetation with a Medium conservation priority should be conserved.

6.1.3 Species Richness

Species Richness is interpreted as follows: Number of indigenous species recorded in the sample plots representing the plant community. Alien woody species and weeds are not included.

No of species	Category
1-24	Low
25-39	Medium
40-59	High
60+	Very High

6.2. Mammals

The site visits were conducted on 17-19 April 2015 and 6-8 October 2016. During these visits the observed and derived presence of mammals associated with the recognized habitat types of the study site, were recorded. This was done with due regard to the well recorded global distributions of Southern African mammals, coupled to the qualitative and quantitative nature of recognized habitats.

Phase 1 of the proposed development is flanked by the terrains scheduled for Phase 2 immediately to the north and Phase 3 to the south. The 500 meters of properties adjoining to the collective sites was scanned for important fauna habitats.

6.2.1. Field Survey

During the site visits mammals were identified by visual sightings by driving all available roads by 4x4 vehicle and through random transect walks. No trapping or mist netting was conducted, as the terms of reference did not require such intensive work. In addition, mammals were also identified by means of spoor, droppings, burrows or roosting sites. Locals were interviewed to confirm occurrences or absences of species.

Three criteria were used to gauge the probability of occurrence of vertebrate species on the study site. These include known distribution range, habitat preference and the qualitative and quantitative presence of suitable habitat.

6.2.2. Desktop Survey

As many mammals are either secretive, nocturnal, hibernators and/or seasonal, distributional ranges and the presence of suitable habitats were used to deduce the presence or absence of these species based on authoritative tomes, scientific literature, field guides, atlases and data bases. This can be done with a high level of confidence irrespective of season. During the field work phase of the project, this derived list of occurrences is audited.

The probability of occurrences of **mammal** species was based on their respective geographical distributional ranges and the suitability of on-site habitats:

- **High probability** would be applicable to a species with a distributional range overlying the study site as well as the presence of prime habitat occurring on the study site. Another consideration for inclusion in this category is the inclination of a species to be common, i.e. normally occurring at high population densities.

- **Medium probability** pertains to a mammal species with its distributional range peripherally overlapping the study site, or required habitat on the site being sub-optimal. The size of the site as it relates to its likelihood to sustain a viable breeding population, as well as its geographical isolation is also taken into consideration. Species categorized as *medium* normally do not occur at high population numbers, but cannot be deemed as rare.

- **Low probability** of occurrence will mean that the species' distributional range is peripheral to the study site and habitat is sub-optimal. Furthermore, some mammals categorized as *low* are generally deemed to be rare.

6.2.3. Specific Requirements

During the site visits, the site was surveyed and assessed for the potential occurrence of Red Data and/or wetland-associated species such as:

- Juliana's golden mole (*Neamblosomus juliana*),
- Highveld golden mole (*Amblysomus septentrionalis*),
- Rough-haired golden mole (*Chrysospalax villosus*),
- African marsh rat (*Dasymys incomtus*),
- Angoni vlei rat (*Otomys angoniensis*),
- Vlei rat (*Otomys irroratus*),
- White-tailed rat (*Mystromys albicaudatus*),
- A number of shrews such as the dwarf shrew (*Suncus* sp),
- Southern African hedgehog (*Atelerix frontalis*),
- A number of bats such as the Short-eared trident bat (*Cloeotis percivali*),
- African clawless otter (*Aonyx capensis*),
- Spotted-necked otter (*Lutra maculicollis*),
- Marsh mongoose (*Atilax paludinosus*),
- Brown hyena (*Parahyaena brunnea*),

6.2.4. Assessment criteria

Conservation status of habitats within the study site is subjectively assigned to one of five levels of sensitivity, i.e.

High: Ecologically sensitive and valuable land, with high species richness, sensitive ecosystems or Red Data species, that should be conserved and no development allowed.

Medium-high: Land where sections are disturbed but that is still ecologically sensitive to development/disturbance.

Medium: Land on which low-impact development with limited impact on the ecosystem could be considered, but where it is still recommended that certain portions of the natural habitat be maintained as open spaces.

Medium-low: Land on which small sections could be considered for conservation but where the area in general has little conservation value.

Low: Land that has little conservation value and that could be considered for developed with little to no impact on the habitats or avifauna.

6.3. Herpetofauna

6.3.1. Field Surveys

The study site visits were conducted on 17-19 April 2015 and 6-8 October 2016. During the site visits, reptiles and amphibians were identified by visual sightings through random transect walks. Amphibian diversity was also established by means of acoustic identification. No trapping was conducted, as the terms of reference did not require such intensive work**.** The observed and derived presence of reptiles and amphibians (herpetofauna) associated with the recognised habitat types of the study site, was recorded. This was done with due regard to the well-recorded global distributions of Southern African vertebrates, coupled with the qualitative and quantitative nature of recognised habitats. The adjoining properties were scanned for important fauna habitats.

Three criteria were used to gauge the probability of occurrence of reptiles and amphibian species on the study site. These include known distribution range, habitat preference and the qualitative and quantitative presence of suitable habitat.

6.3.2. Desktop Surveys

As the majority of reptiles and amphibians are either secretive, nocturnal, poikilothermic and/or seasonal. Distributional ranges and the presence of suitable habitats were used to deduce the presence or absence of these species based on authoritative tomes, scientific literature, field guides, atlases and data bases. This can be done with a high level of accuracy irrespective of season.

The probability of the occurrence of **reptile and amphibian** species was based on their respective geographical distributional ranges and the suitability of on-site habitats.

High probability would be applicable to a species with a distributional range overlying the study site as well as the presence of prime habitat occurring on the study site. Another consideration for inclusion in this category is the inclination of a species to be common to the area, i.e. normally occurring at high population densities.

Medium probability pertains to a reptile or amphibian species with its distributional range peripherally overlapping the study site, or required habitat on the site being sub-optimal. The size of the site as it relates to its likelihood to sustain a viable

breeding population, as well as its geographical isolation is also taken into consideration. Species categorized as medium normally do not occur at high population numbers, but cannot be deemed as rare.

Low probability of occurrence will imply that the species' distributional range is peripheral to the study site and habitat is sub-optimal. Furthermore, some reptiles and amphibians categorized as *low* are generally deemed to be rare.

Based on the field observations and impressions of habitats gathered during the site visit, as well as publications, such as FitzSimons' Snakes of Southern Africa (Broadley, 1990), Field Guide to Snakes and other Reptiles of Southern Africa (Branch, 1998), A Guide to the Reptiles of Southern Africa (Alexander and Marais, 2007), Amphibians of Central and Southern Africa (Channing, 2001), Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland (Minter, *et al*, 2004) and A Complete Guide to the Frogs of Southern Africa (Du Preez & Carruthers, 2009), a list of species which may occur on the site was compiled. The latest taxonomic nomenclature was used. Vegetation type was defined according to the standard handbook by Mucina and Rutherford (eds) (2006), while the vegetation of the site is described in a separated chapter in this report.

6.3.3. Specific Requirements

During the visit the site was surveyed and assessed for the potential occurrence of Red Data reptile and amphibian species in Mpumalanga (Alexander and Marais, 2007; Minter, *et al*, 2004, Du Preez & Carruthers, 2009, 2009; Measey (ed.) 2011 and Carruthers and Du Preez, 2011), such as:

During the visit the site was surveyed and assessed for the potential occurrence of Red Data species such as:

- Desert Rain Frog (*Breviceps macrops*);
- Giant Bullfrogs (*Pyxicephalus adspersus*);
- Good's Gecko (*Pachydactylus goodi*);
- Karoo Caco (*Cocosternum karooicum*);
- Karoo Dwarf Tortoise (*Homopus boulengeri*);
- Large-Scaled Girdled Lizard (*Cordylus macropholis*);
- Leatherback turtle (*Dermochelys coriacea*);
- Lomi's Blind Legless Skink (*Typhlosaurus lomiae*);
- Namaqua Stream Frog (*Strongylopus springbokensis*);
- Namib Web-Footed Gecko (*Pachydactylus rangei*);
- Plain Mountain Adder (*Bitis inornata*)

- Richtersveld Pygmy Gecko (*Goggia gemmula*);
- Rooiberg Girdled Lizard (*Cordylus imkeae*);
- Speckled Dwarf Tortoise (*Homopus signatus*);

6.4 Wetland and aquatic assessment

Initial preparations:

For background information, the relevant maps, aerial photographs and other information on the natural environment of the concerned area were obtained.

The following approach was adopted:

- Mark all the identified wetlands on the site and within 500 m of the proposed development on provided high resolution images and on Google Earth images of the area – these are needed in terms of the DWA stipulation published in Government Gazette No 32805 on 18 December 2009 that requires that a Water Use License should be applied for when any wetlands are present within a 500 m radius of water use activities as defined by section 21 (c) and section 21 (i) of the NWA;
- Visit all the wetlands on the site and along proposed power lines, and do a wetland and quatic system delineation and assessment;

Site visit

The EcoAgent team (Prof G.J. Bredenkamp, Dr I.L. Rautenbach, Dr A.C. Kemp and Mr J.C.P. van Wyk conducted a site visit on 17-19 April 2015, and Prof Bredenkamp and Dr Rautenbach conducted a further site visit 6-8 October 2016. Some rains fell prior to the April survey and the vegetation surveys are regarded as successful. Although the area was generally fairly dry during October, the vegetation was in good condition and this survey was also considered to be adequate. All perceived wetland and aquatic systems were visited for the assessment. Coordinates were taken at localities of note.

Wetland assessment

The **delineation** method documented by the Department of Water affairs and Forestry in their document “A practical field procedure for identification and delineation of wetlands and riparian areas” (DWAF, 2005), was followed. These guidelines describe the use of indicators to determine the outer edge of the wetland and riparian areas, such as soil and vegetation as well as the terrain unit indicator.

A hand held Garmin Montana GPS was used to capture GPS co-ordinates in the field. Google maps and 1:50 000 cadastral maps were used as reference material for the mapping of the wetland boundaries. These were converted to digital image backdrops and delineation lines (wetland boundaries) were imposed accordingly after the field survey.

The **wetland classification** follows the guidelines described by (Ollis *et al.* 2013).

Present Ecological State (PES) is used to determine the current ecological condition of the resource (Macfarlane *et al.* 2007). This is assessed relative to the deviation from the Reference State which is the natural or pre-impacted condition of the system. The reference state refers to the natural dynamics of the wetland system prior to development. PES categories for every component are integrated into an overall PES for the wetland being investigated. This integrated PES is also referred to as the EcoStatus of the wetland (Grobler 2013).

7. RESULTS: VEGETATION AND FLORA

7.1 General remarks on the vegetation

The entire site is Nama Karoo, consisting of the Northern Upper Karoo vegetation unit (NKu 3 of Mucina & Rutherford 2006). As far as vegetation structure and floristic composition are concerned, the Northern Upper Karoo vegetation unit within the site is very homogeneous. Overall, the study site is dominated by small karroid shrubs, most below 50 cm, with signs that sparse grass cover fills the bare areas between after sufficient rain. Four different karoo plant communities were recognised, mapped and described. A further mapping unit include the wetlands / aquatic systems, including windpumps and associated water points. The plant species composition of the plant communities recognised is mostly quite similar, especially as far as dominant plant species are concerned.

Two small, dry pans are present, one located at the fenceline in the south-western corner of the site, the other transformed by a windpump and sheep kraal. Indigenous trees mainly *Searsia lancea*, and alien trees, mainly *Populus*, were planted around watering points, growing much taller than the natural karoo vegetation. A dry drainage line occurs along the proposed 132kV power line that will connect the array to the national grid.

7.2 Classification of the vegetation

Four plant communities and wetlands:

Plant community	**Sensitivity**
1. Highland karoo on red soil	Medium-Low
2. Plains karoo on calcareous soil	Low
3. Bottomland karoo	Low
4. Small ridge	Medium-Low
5. Drainage line, pans and windpumps	Low to High

The distribution of the plant communities and wetland systems are shown in Figure 7, while the ecological sensitivity is shown in Figure 8>

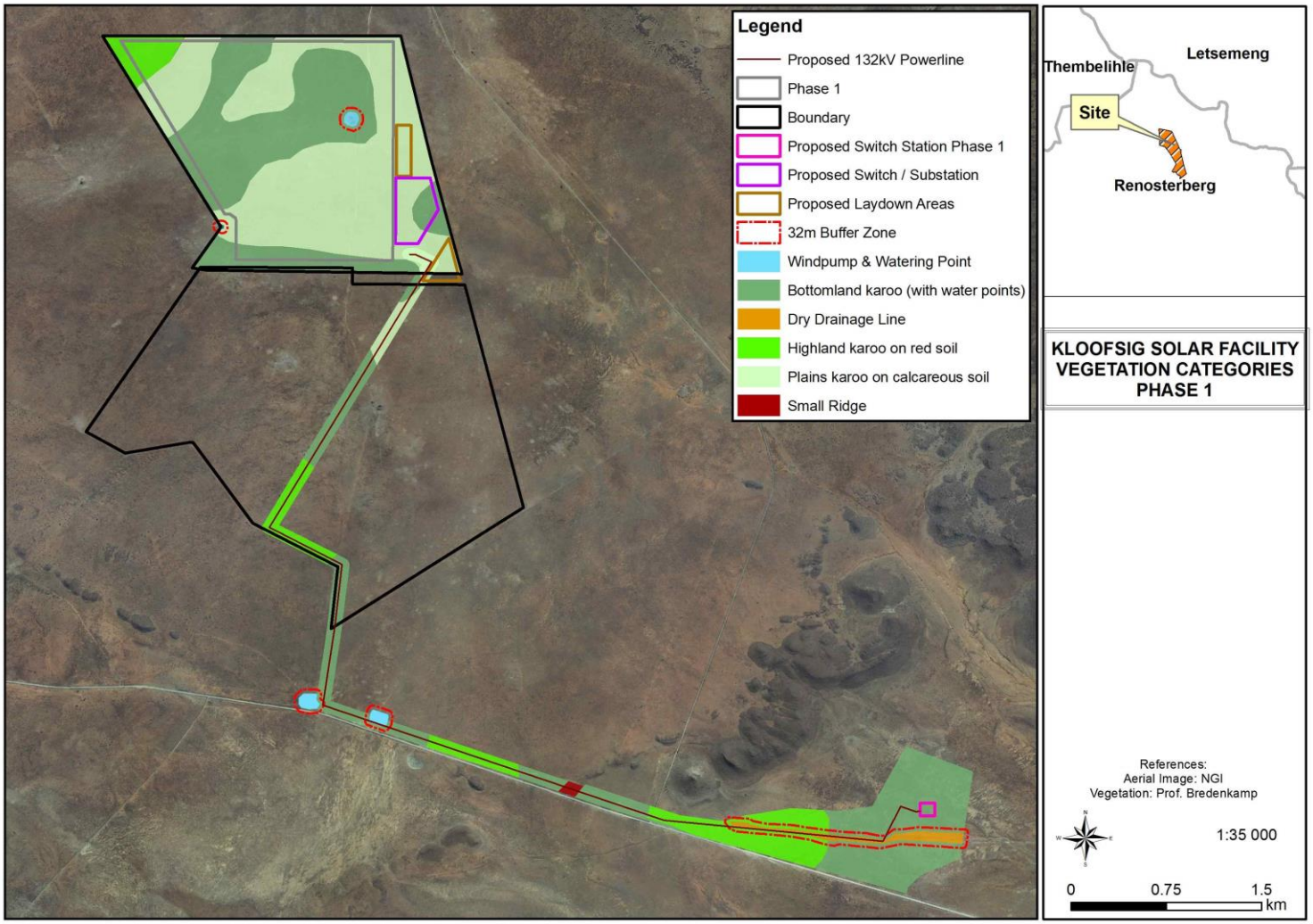

Figure 7a. Vegetation map of the solar panel study site and powerline (old alignment)

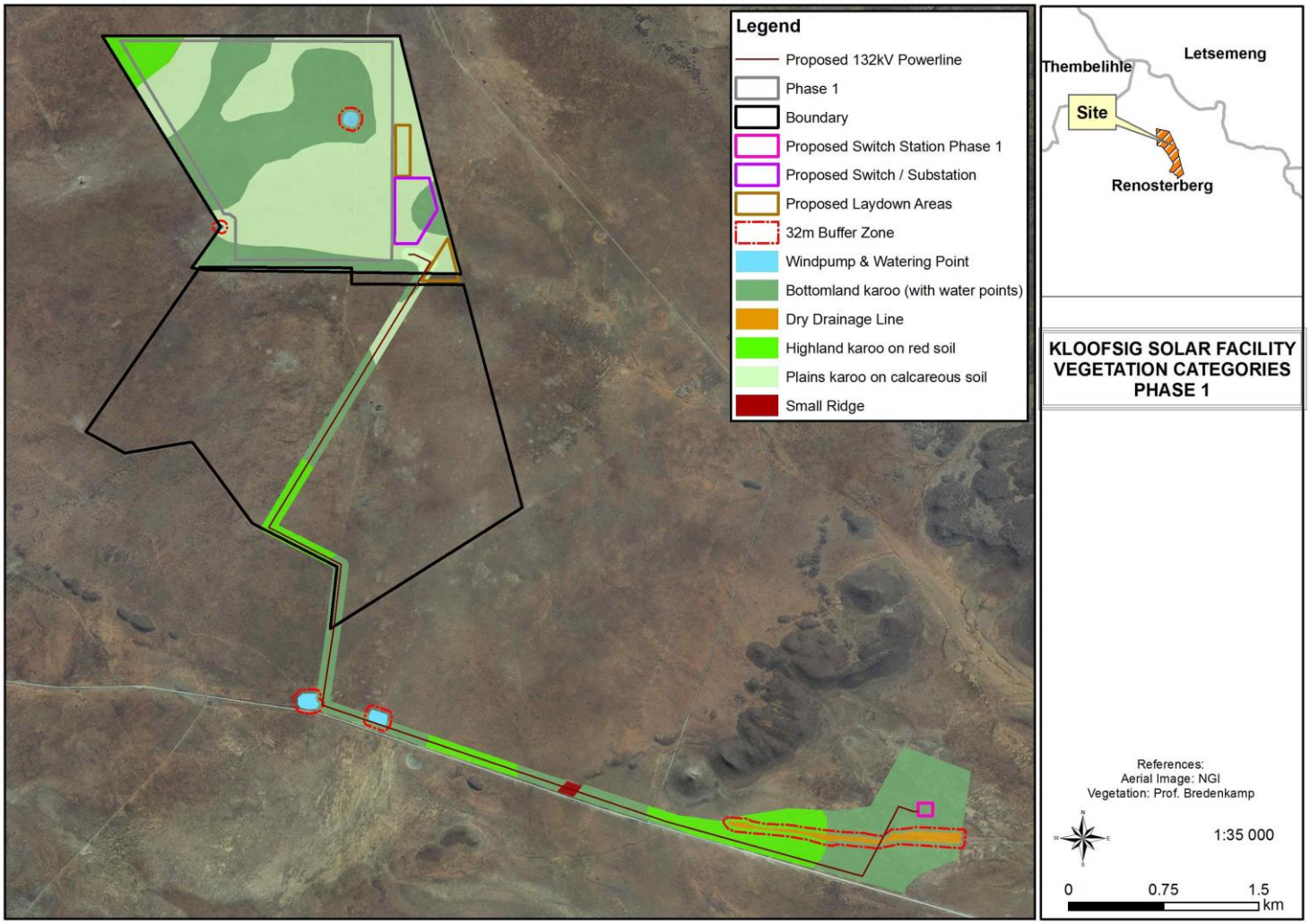

Figure 7b: Vegetation map of the solar panel study site and powerline (new alignment)

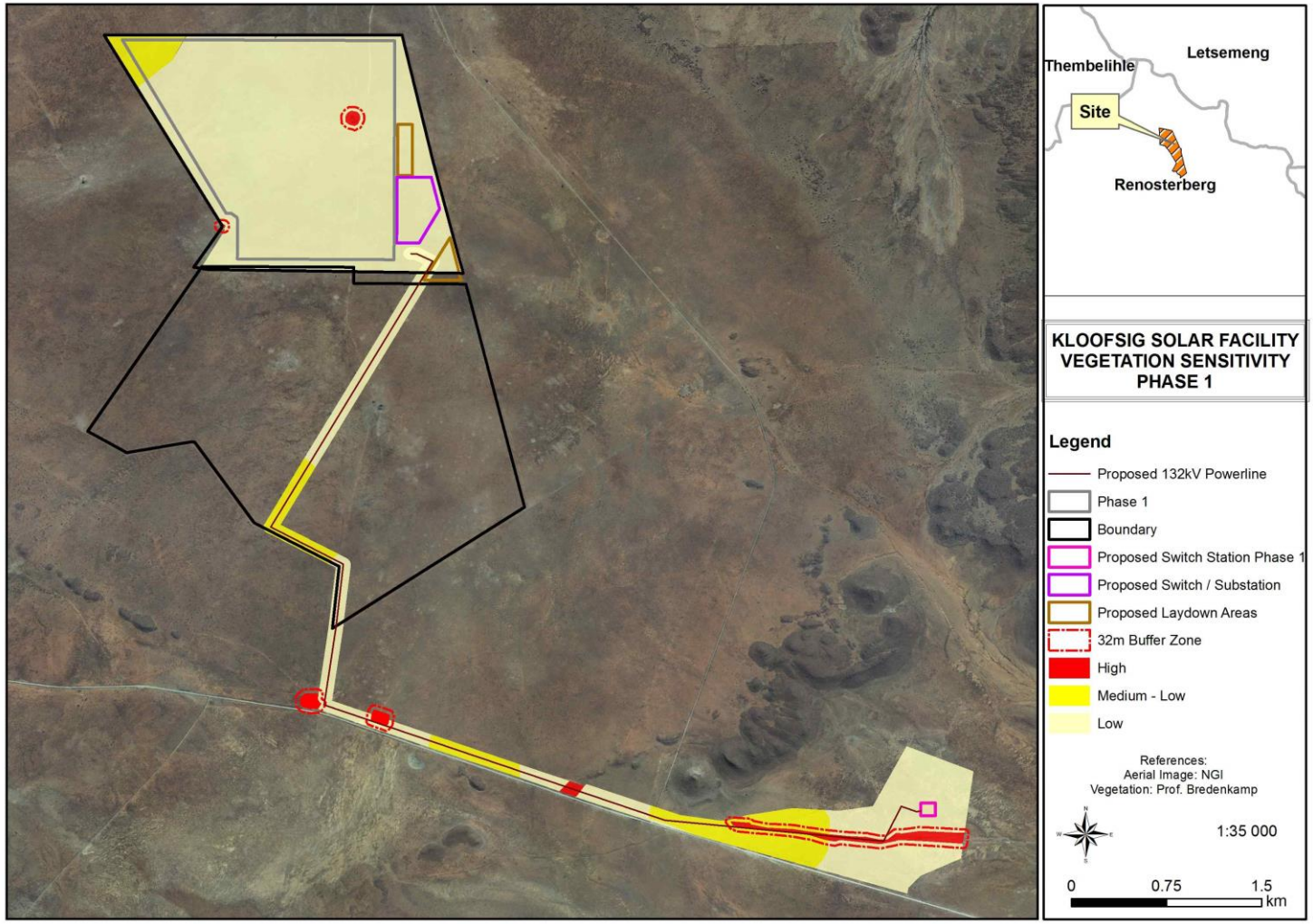

Figure 8a: Sensitivity map of the solar panel study site and proposed powerline (old alignment)

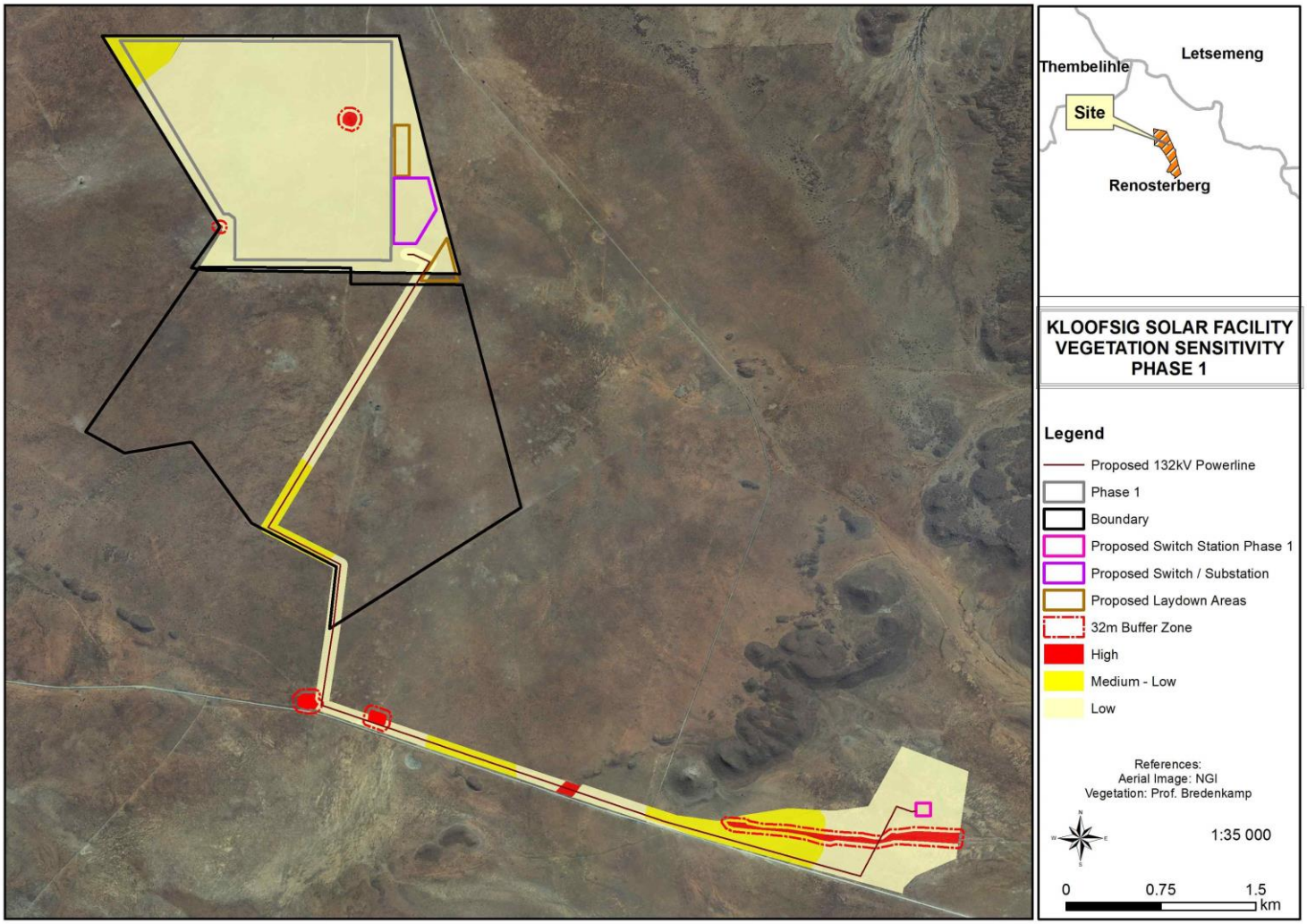

Figure 8b: Sensitivity map of the solar panel study site and proposed powerline (~~old~~ new alignment)

7.3 Description of the plant communities

The distribution of the plant communities identified in this study is shown in the vegetation map (Figures 7a & b) while the sensitivity of the plant communities is indicated in Figures 8a & b.

The site is covered by Nama Karoo vegetation, dominated by dwarf karroid shrubs with some scattered grass. The following plant species occur in the area in which the site is located:

Trees and Shrubs

Lycium cinereum
Lycium horridum
Lycium oxycarpum
Lycium schizocalyx
Rhigosum obovatum

Dwarf shrubs

Aptosimum marlothii
Atriplex semibaccata
Chrysocoma ciliata
Eberlanzia ferox
Eriocephalus ericoides
Eriocephalus spinescens
Felicia filifolia
Euryops asparagoides
Gnidia polycephala
Hertia pallens
Helichrysum dregeanum
Hermannia cuneifolia
Hermannia linearifolia
Hermannia spinosa
Indigofera sessilifolia
Lightfootia nodosa
Limeum aethiopicum
Osteospermum leptolobum
Osteospermum spinescens
Monechma incanum
Phymaspermum parvifolium
Plinthus karooicus
Polygala ephedroides
Pentzia calcarea
Pentzia incana
Pentzia globosa
Pentzia lanata
Pentzia sphaerocephala
Pteronia glauca
Pteronia sordida
Pterothrix spinescens
Rosenia humilis
Salsola glabrescens
Salsola tuberculata
Thesium hystrix
Zygophyllum gilfillanii

Zygophyllum incrustatum

Grasses

Aristida adscensionis
Aristida congesta
Aristida diffusa
Eragrostis obtusa
Eragrostis lehmanniana
Fingerhuthia africana
Heteropogon contortus
Schmidtia pappophoroides
Sporobolus fimbriatus
Stipagrostis obtusa
Tragus berteronianus

Forbs

Aptosimum procumbens
Aptosimum spinescens
Barleria rigida
Berkheya annectens
Cullen obtusifolia
Dimorphotheca cuneata
Felicia muricata
Felicia ovata
Geigeria ornativa
Moraea pallida
Leucas capensis
Pollichia campestris
Selago saxatilis
Sutera atropurpurea
Sutera pinnatifida
Sutera virgulosa
Dicoma capensis
Gazania krebsiana
Walafrida saxatilis

Differences in the ecology and vegetation of the mapping units are mainly associated with slight differences in soil and drainage pattern, and also grazing pressure.

7.3.1 Highland karoo on red soil

A small patch of this plant community occurs in the north-western corner of the site and also along the proposed connection power line south of the Kloofsig Phase 1 site (Figures 7a & 7b).The soil is deep red sand, with little calcrete visible on the soil surface (Figure 9). The vegetation is open bossieveld karoo with many bare patches. At the time of the survey the grass layer was poorly developed, very shortly grazed, with new growth commencing after recent rains. Most of the general karroid dwarf shrubs and grass species occur in this area, though the somewhat taller-growing *Rhigosum trichotomum* is often prominent.

Figure 9: Highland karoo on red soil

The most prominent species include:

Trees and Shrubs

Diospyros pallens	*Lycium cinereum*	
Euryops subcarnosus	*Rhigosum trichotomum*	d

Dwarf shrubs

Aptosimum marlothii	*Plinthus karooicus*	
Chrysocoma ciliata	*Pentzia incana*	d
Eberlanzia sp	*Pentzia globosa*	
Eriocephalus ericoides	*Pentzia sphaerocephala*	
Indigofera sessilifolia	*Pteronia glauca*	
Lightfootia nodosa	*Thesium hystrix*	
Monechma incanum	*Zygophyllum gilfillanii*	

Grasses

Aristida adscensionis
Aristida congesta
Aristida diffusa
Cenchrus ciliaris
Eragrostis obtusa
Eragrostis lehmanniana d
Fingerhuthia africana
Heteropogon contortus
Schmidtia pappophoroides d
Stipagrostis obtusa
Tragus berteronianus

Forbs

Aptosimum procumbens
Barleria rigida
Chascanum pumilum
Dicoma schinzii
Geigeria ornativa
Indigofera sp
Portulaca kermesina
Stylosanthes fruticosa
Talinum caffrum

Highland karoo on red soil			
Status	Short karoo bossieveld		
Soil	Red and sandy loam	**Rockiness %**	0-5% mosly calcrete
Conservation priority:	Low	**Sensitivity:**	Medium-Low
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Rhigozum trichotomum, Pentzia incana, Schmidtia pappophoroides, Eragrostis lehmanniana*		

Discussion

This plant community is widespread and not rare. Only a very small patch is present on the Kloofsig Phase 1 study site, while further patches occur in the proposed power line transect south of the site. The species richness is high, though none of these species is considered to be rare, threatened or protected. Sensitivity is considered to be medium-low. The proposed development can be supported on this vegetation.

7.3.2 Plains karoo on calcareous soil

This vegetation is widely distributed over the Kloofsig Phase 1 site and is particularly prominent south-eastern plains in the study site (Figure 7a & b). The soil is shallow, light brown sandy loam over calcrete and much calcrete is visible on the soil surface. The vegetation is very typical short bossieveld entirely dominated by karroid dwarf shrubs (Figure 10). At the time of the survey the vegetation was grazed by sheep. Very little grass was visible, though new grass growth just appeared after recent rains.

Figure 10: Plains karoo on calcareous soil

The most prominent species include:

Trees and Shrubs

Lycium horridum
Lycium oxycarpum
Lycium schizocalyx

Dwarf shrubs

Aptosimum marlothii
Atriplex semibaccata
Chrysocoma ciliata
Eriocephalus ericoides
Eriocephalus spinescens
Felicia filifolia
Euryops asparagoides
Gnidia polycephala
Hertia pallens
Helichrysum dregeanum
Hermannia cuneifolia
Hermannia spinosa
Lightfootia nodosa
Limeum aethiopicum
Osteospermum leptolobum
Osteospermum spinescens
Monechma incanum
Phymaspermum parvifolium
Plinthus karooicus
Polygala ephedroides
Pentzia calcarea
Pentzia incana
Pentzia globosa
Pentzia sphaerocephala

Pteronia glauca
Pterothrix spinescens
Rosenia humilis
Salsola glabrescens
Thesium hystrix
Zygophyllum gilfillanii
Zygophyllum incrustatum

Grasses

Aristida adscensionis
Aristida congesta
Eragrostis obtusa
Eragrostis lehmanniana d
Fingerhuthia africana
Heteropogon contortus
Stipagrostis obtusa
Tragus berteronianus

Forbs

Aptosimum procumbens
Aptosimum spinescens
Barleria rigida
Berkheya annectens
Dimorphotheca cuneata
Felicia muricata
Felicia ovata
Moreae pallida
Pollichia campestris
Selago saxatilis
Sutera pinnatifida
Sutera virgulosa
Dicoma capensis
Gazania krebsiana
Walafrida saxatilis

Plains karoo on calcareous soil			
Status	Short karoo bossieveld		
Soil	Sandy loam, some limestone on soil surface	**Rockiness %**	1-15% limestone
Conservation priority:	Low	**Sensitivity:**	Low
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Pentzia incana, Chrysocoma ciliata*		

Discussion

This plant community is very widespread and not rare. The species richness is high, though none of these species is considered to be rare, threatened or protected. Sensitivity is considered to be low. The proposed development can be supported on this site.

7.3.3 Bottomland karoo

This vegetation occurs in the somewhat lower-lying central parts of the study site (Figures 7a & b). The windpump for a watering point for sheep is located within this vegetation. This development destroyed a small pan that was present here. The soil is reddish-brown with calcrete often abundant on the soil surface. At the time of the survey this area seemed to be somewhat moister than the adjacent, higher-lying plant communities, but no typical plant species indicating any wetland conditions were noted. The vegetation is very similar to that of the Plains karoo (Paragraph 2 above), but seems to be more overgrazed by domestic livestock (Figure 11). Dwarf karroid shrubs are dominant and grass species are very short, just appearing after the recent rains.

It is important to mention that the northern parts of this plant community, especially parts situated north of Phase 1 (some areas of the planned Phase 2) becomes flooded during heavy rains. However, these areas are not regarded as wetlands or any other aquatic system, as this area is very flat and covered with normal karoo vegetation, with no typical wetland characteristics. The floodwater slowly drains northwards down the very slight slope, and eventually into a drainage line through the Kalkpoort, situated north-east of the farmhouse and outside the boundary Portion 18 of the Farm Kalkpoort.

Figure 11: Somewhat trampled Southern bottomland karoo

The most prominent species include:

Trees and Shrubs

Lycium horridum
Lycium oxycarpum
Lycium schizocalyx

Dwarf shrubs

Atriplex semibaccata
Chrysocoma ciliata
Eriocephalus ericoides
Eriocephalus spinescens
Felicia filifolia
Euryops asparagoides
Hertia pallens
Helichrysum dregeanum
Hermannia spinosa
Lightfootia nodosa
Limeum aethiopicum
Osteospermum spinescens
Monechma incanum
Plinthus karooicus
Polygala ephedroides
Pentzia calcarea
Pentzia incana
Pentzia globosa
Pteronia glauca
Pterothrix spinescens
Rosenia humilis
Salsola glabrescens
Thesium hystrix
Zygophyllum gilfillanii
Zygophyllum incrustatum

Grasses

Aristida adscensionis
Aristida congesta
Eragrostis obtusa
Eragrostis lehmanniana d
Stipagrostis obtusa
Tragus berteronianus

Forbs

Aptosimum spinescens
Barleria rigida
Berkheya annectens
Dimorphotheca cuneata
Felicia ovata
Selago saxatilis
Sutera pinnatifida
Dicoma capensis
Walafrida saxatilis

Bottomland karoo			
Status	Somewhat trampled karoo bossieveld		
Soil	Sandy loam with lime	**Rockiness %**	1-15% calcrete
Conservation priority:	Low	**Sensitivity:**	Low
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Lycium* spp, *Chrysocoma ciliata Pentzia* spp		

Discussion

Although this plant community occurs widespread, it is restricted to the slightly bottomland situations within the slightly undulating landscape. These areas are also often more grazed than the slightly higher upland areas. The species richness is high, though none of these species is considered to be rare, threatened or protected. Sensitivity is considered to be low. The proposed development can be supported on this site.

7.3.4 Small Ridge

A small ridge occurs along the transect of the proposed power line south of the Kloofsig Phase 1 site, along the gravel road. Large boulders and a few shrubs are prominent features of this small ridge (Figure 12), and as this area is very small, only few plant species were noted (Figure 7a & b).

Figure 12: The small ridge along the gravel road on the transect of the proposed power line south of the Kloofsig Phase 1 site.

Trees and shrubs

Searsia burchellii
Lycium boscifolium

Dwarf Shrubs

Asparagus striatus
Chrysocoma ciliata
Eriocephalus ericoides
Eriocephalus spinescens
Filicia filifolia
Pentzia incana

Grasses

Digitaria eriantha
Cenchrus ciliaris
Eragrostis lehmanniana

Forbs

Berkheya annectens
Gnidia polycephala
Solanum sp

Small ridge			
Status	Disturbed ridge area		
Soil	Sandy with large boulders	**Rockiness %**	1-15% dolerite boulders
Conservation priority:	Low	**Sensitivity:**	Medium-Low
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Searsia burchellii*		

Discussion

This is a small disturbed ridge over which the proposed power line will have to go. It is suggested that the pylons be constructed on flatter not-rocky plains on the sides of the hill.

7.3.5 Pans and Drainage line

(See Wetland and Aquatic Assessment in Section 10)

- A windpump with water point and with sheep kraals were constructed on the site of a small pan within the Bottomland karoo (Figures 7a & b). In this process the pan was excavated and transformed. At the windpump and watering point for livestock woody species such as *Searsia lancea, Vachellia karroo* and *Lycium cinereum* and a single planted *Punica granatum* are prominent (Figure 13). Annual weeds e.g. *Argemone mexicana* may be present.

Figure 13: The Transformed pan with windpump, water point and livestock kraals

- A further small dry natural pan occurs just outside the study site, close to the south-western corner of the site, but is excluded from the development area as it is located at least 50 m from the footprint of the proposed development (Figures 7a & b). This pan is on the boundary of the adjacent farm with the fence crossing the pan (Figure 14). At this pan the plant species are mostly the dwarf shrub *Chrysocoma ciliata,* the grass *Eragrostis* sp and the weedy forbs *Portulacca* sp and *Malva* sp.

Figure 14: The dry endorheic pan on the boundary fenceline

Pans and Drainage line			
Status	Short karoo veld in pan and few alien species at watering point		
Soil	Sandy loam	**Rockiness %**	0
Conservation priority:	Pan on fenceline – Medium-High Transformed Pan – Low Drainage line - High	**Sensitivity:**	Pan on fenceline – High Transformed Pan - Low Drainage line - High
Agricultural potential:	Low	**Need for rehabilitation**	Low
Dominant spp.	*Chrysocoma, Searsia lancea, Eriocephalus* sp		

The most prominent species of the pans include:

Trees and Shrubs

Asparagus striatus		*Searsia lancea*	
Lycium boscifolium		*Vachellia karroo*	d
Lycium cinereum		*Ziziphus mucronata*	

Dwarf shrubs

Argemone mexicana	W	*Felicia filifolia*	
Chrysocoma ciliata		*Monechma incanum*	
Eriocephalus ericoides		*Pentzia incana*	

Grasses

Eragrostis sp		*Sporobolus fimbriatus*	
Fingerhuthia africana			

Forbs

Argemone mexicana	W	*Oxalis* sp	
Atriplex lindlei		*Portulacca* sp	
Galenia procumbens		*Salsola calluna*	
Malva sp	W	*Talinum caffrum*	
Moraea pallida		*Xanthium spinosum*	W

- A well developed drainage line occurs along the proposed alignment of the power line to the south of the site connecting the array with the existing Eskom grid (Figures 7a & b). The adjacent Bottomland karoo occurs up to the edge of the drainage line, with scattered larger *Eriocephalus* individuals growing on the edge (Figure 15).

Figure 15: A view of the drainage line.

Discussion

The drainage line and pans are considered sensitive ecosystems and no development should occur within 32 m of any of these water courses (Government Notice Regulation 982, 983, 984 and 985 of 4 December 2014 (NEMA 1998)). The pan on the boundary fence is actually excluded from the development as it is located at least 50 M from the development footprint. The one pan within the site had been totally transformed and has no conservation value. (See also Wetland Assessment Section 10)

The initial alignment of the proposed power line was of concern, as it was often closer than 32 m from the drainage line (Figure 8a). It was suggested that the power line be moved southwards to run along the road. EcoAgent was informed that this suggestion was accepted by the developer (Figure 8b).

7.4 Species of Conservation Concern

A list of Species of Conservation Concern for the Grids 2924DC Havengabrug and 3024BA Petrusville was obtained from the database on the SANBI website. Threatened species are those that are facing high risk of extinction, indicated by the categories Critically Endangered (CE), Endangered (EN) and Vulnerable (VU). Species of Conservation Concern include the Threatened Species, but additionally have the categories Near Threatened (NT), Data Deficient (DD), (DDT = lack of taxonomic data), Critically Rare (CR), Rare (R) and Declining (D). This is in accordance with the new Red List for South African Plants (Raimondo *et al*. 2009).

The database showed that 181 plant species have been recorded form the two Grids 2924DC Havengabrug and 3024BA Petrusville. No species of conservation concern are listed.

7.5 Protected species

No nationally protected species occur on the site.

7.6 Discussion and Conclusion

From a vegetation and plant species perspective, the entire site for the Kloofsig Phase 1 development is suitable for the proposed development. The more sensitive pan located close to the south-westen boundary is actually excluded from the development area, while the other very small pan at the windpump is already transformed and of no conservation value. The new alignment of the power line along the road is more than 32 m from the drainage line (Figures 7b and 8b). The power line will have to cross the draiage line to reach the proposed substation, though the pylons should not have any affect on the drainage line.

8. RESULTS: MAMMALS

Acocks (1988), Mucina and Rutherford (2006), Low & Rebelo (1996), Knobel and Bredenkamp (2006), SANBI & DEAT (2009) discuss the peculiar natural plant associations of the study area in broad terms. Rautenbach (1978 & 1982) found that mammal assemblages can at best be correlated with botanically defined biomes, such as those by Low and Rebelo (1996 & 1998), and latterly by Mucina and Rutherford (2006) as well Knobel and Bredenkamp (2006). Hence, although the former's work has been superseded by the work of the latter two, the definitions of biomes are similar and both remain valid for mammals and are therefore recognized as a reasonable determinant of mammal distribution.

The local occurrences of mammals are, on the other hand, closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupiculous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of mammal species by evaluating the habitat types within the context of global distribution ranges. Sight records and information from residents or knowledgeable locals audit such deductions.

8.1 Mammal Habitat Assessment

The study site is characterised by Karroo dwarf scrub typical of the Northern Upper Karoo vegetation unit (as defined by Mucina & Rutherford 2006). Generally the shrub (as well as grass in-between Karoid scrub) is not higher than 50cm in height. The powerline to be built to connect the power to the existing network, will traverse similar habitat.

The terrestrial habitat is spatially predominant. The entire site of the proposed Phase 1 development consists of terrestrial 'bossie veld' (Karoid scrub and grass), which is where the development is planned. Cover and nourishment is adequate for small mammals, as well as for domestic stock as well as for the observed game species.
From a mammal habitat perspective it should thus be pointed out that only a terrestrial habitat is present. A manmade dam filled by a windmill occurs on the site (Figure 13).

Termitaria abound (Figure 16).

Figure 16: An example of a termitarium

A prevailing perception is that mammal populations are at a nadir, probably as result of the present drought. In spite of of the drought the conservation status of the entire Phase 1 development site is rated as good due to good range management.

There are no caves suitable for cave bats, but there may be rock crevice, overhangs, culverts or even large aardvark burrows that harbour rhinolophids, hipposiderids or nycterids.

The 500 meters of adjoining properties are rather similar to that the veld conditions described for the study site. The low stranded fences on farms themselves are not a deterrent to connectivity, but jackal-fenced boundaries offer a barrier to some medium-sized species incapable of burrowing underneath the obstacle.

8.2 Observed and Expected Mammal Species Richness

Of the 43 mammal species expected to occur on the study site (Table 8.1), no less than 27 were confirmed during the site visit (Table 8.2). It should be noted that potential occurrences is interpreted as to be possible over a period of time as result

of expansion and contractions of population densities and ranges which stimulate migration. All feral mammal species expected to occur on the study site (e.g. house mice, house rats, dogs and cats) were omitted from the assessment since these species normally associate with human settlements and cannot be considered when assessing the conservation status of the site.

Locally not too many large mammals became extirpated over time (lion, spotted hyenas, blue wildebeests, black rhinos, plains zebra) since the region is not conducive to the occurrence of the 'conventional' Big Five' / charismatic species such as elephants, buffalo, white rhinos, giraffes, hippos). Endemic large mammals have long since been extirpated to favour agricultural interests, in this instance grazing for domestic stock. Most of the mammals narrowly reliant on arboreal habitat (tree-living), rupiculous habitat (rock-living) and all species adapted to a wetland habitat have a priori been omitted from the list of potential occurrences. The 43 mammals deduced to occur on the study site within only one well developed and extensive habitat is remarkable species richness. However, such large species diversity is to be expected on an extensive site with a largely undisturbed biosphere.

The species richness is biased towards a western species assemblage adapted to more arid regions. Species like the round-eared elephant shrew, a number of gerbils, ground squirrels, two whistling rat species, bat-eared and Cape foxes, black-footed cats, suricates, springbuck and others are characteristic arid-region species.

Most of the species of the resident diversity (Table 1) are common and universal in distribution (viz. scrub hares, mole rats, springhares, grass mice, multimammate mice, Highveld gerbils, the bats listed, genets, yellow and slender mongooses, duiker, steenbok and others). However, others are not common: a number of gemsbok has been reintroduced and there are a number of red Data mammals discussed below.

Many of the medium-sized mammals persisted on the farm such as aardvarks, warthog, springbuck, kudus, duikers, steenbok, jackal species and others.

It would appear that the number of bat species and population densities are low. Egyptian free-tailed bats prefer to roost in narrow crevices to escape predation by

day, and because of their wing structure require at least one meter of freefall when emerging from the roost to build up the required airspeed to become airborne. There may be suitable roosting sites in the nearby rocky ridges and some of the buildings at the homestead. The study site falls within the distributional range of Egyptian slit-faced bats and Dent's horseshoe bats. However, these whispering bats require deep and moist caves or structures to survive; these prerequisites are often met by deep aardvark burrows.

Although the owners have not recorded the presence of brown hyenas, this scavenger is listed under the precautionary principle since they are known to roam wide and far. Black-footed cats, caracal and black-backed jackals are also reported to occur on the site. Mongooses, the small-spotted genet, the bat-eared and Cape foxes normally persist with impunity because of their reticent habits and catholic diets. The genetic integrity of African wild cats are a source of concern closer to centres of civilisation since this species freely interbreed with domestic cats; this should not be a concern on this study site.

Relative high species richness is due to the extensive size of the remaining natural areas on the site and of adjoining natural areas. The high species richness of the combined properties is enhanced by a high connectivity allowing near-to-natural migration. Veld fires are avoided and this means that the quality of environmental conservation from a mammal perspective can be ranked a good. Connectivity with neighbouring areas is high and migration is virtually unhindered. The many drainage lines and especially the off-site streams function as important dispersal corridors.

8.3 Red Listed Mammals

All Red Data species listed in Table 1 as Critically Endangered, Rare, Near Threatened or Data Deficient are discerning species and became endangered as result of the deterioration of their preferred habitats.

The lesser red musk shrew has never been studied in its natural environment. No empirical data exist to gauge its conservation status, and as a consequence it is ranked as a "Data Deficient (DD)" Red Data species.

In districts with higher human populations, hedgehogs fall prey to human sentiments and the predatory instincts of their pets. As a consequence the conservation status of these endearing little insectivores with their passive defensive modes declined to a "Near Threatened" Red Data ranking. Brown hyenas, and to a lesser extent honey badges, have an undeserved stigma as sheep killers and as a consequence they are prosecuted. Coupled to that declining space to maintain territories can also be offered as a reason for their "Near Threatened" Red Data ranking. It is submitted that the study site and district offer better survival opportunities for all three species.

No other Red Data or sensitive species are deemed present on the site, either since the site is too disturbed, falls outside the distributional ranges of some species, or does not offer suitable habitat(s).

Mammals protected by the Biodiversity Act No 10 of 2004

Protected species: South African hedgehog
Black-footed cat
Brown hyena
Honey badger

Mammals protected by the Regulations of the Northern Cape Conservation Act 9 of 2009

All indigenous species are protected and are differentially listed in Schedule 1 (specially protected species), Schedule 2 (Protected species) and Schedule 3 (common indigenous species). Schedule 4 list vervet monkeys, baboons, caracals and black-backed jackals and as Damage Causing Mammals. Schedule 6 list Invasive Species, none of whom are recorded on the study site.

Table 8.1: Mammal diversity. The species observed or deduced to occupy the site. (Systematics and taxonomy as proposed by Bronner *et al.* [2003] and Skinner and Chimimba [2005])

	SCIENTIFIC NAME	ENGLISH NAME
*	*Macroscelides proboscideus*	Round-eared elephant shrew
√	*Orycteropus afer*	Aardvark
√	*Lepus capensis*	Cape hare
√	*Lepus saxatilis*	Scrub hare (ribbok haas)
√	*Cryptomys hottentotus*	African mole rat
√	*Hystrix africaeaustralis*	Cape porcupine
√	*Pedetes capensis*	Springhare
√	*Xerus inaurus*	South African ground squirrel
*	*Rhabdomys pumilio*	Four-striped grass mouse
*	*Mastomys coucha*	Southern multimammate mouse
*	*Parotomys brantsii*	Brant's whistling rat
*	*Parotomys littledalei*	Littledale's whistling rat
*	*Desmodillus auricularis*	Cape short-tailed gerbil
√	*Gerbillurus paeba*	Hairy-footed gerbil
√	*Gerbilliscus brantsii*	Highveld gerbil
*	*Saccostomus campestris*	Pouched mouse
*	*Malacothrix typica*	Gerbil mouse
?	*Dendromus melanotis*	Grey pygmy climbing mouse
DD*	*Crocidura hirta*	Lesser red musk shrew
NT√	*Atelerix frontalis*	Southern African hedgehog
?	*Tadarida aegyptiaca*	Egyptian free-tailed bat
?	*Nycteris thebaica*	Egyptian slit-faced bat
?	*Rhinolophus denti*	Dent's horseshoe bat
√	*Proteles cristatus*	Aardwolf
NT?	*Parahyaena brunnea*	Brown hyena
√	*Caracal caracal*	Caracal
√	*Felis silvestris*	African wild cat
√	*Felis nigripes*	Black-footed cat
√	*Genetta genetta*	Small-spotted genet
√	*Suricata suricatta*	Suricate
√	*Cynictis penicillata*	Yellow mongoose
√	*Galerella sanguinea*	Slender mongoose
√	*Otocyon megalotis*	Bat-eared fox
√	*Vulpes chama*	Cape fox
√	*Canis mesomelas*	Black-backed jackal
NT?	*Mellivora capensis*	Honey badger
?	*Ictonyx striatus*	Striped polecat
√	*Phacochoerus africanus*	Common warthog
√	*Tragelaphus strepsiceros*	Kudu
√	*Oryx gazella*	Gemsbok
√	*Sylvicapra grimmia*	Common duiker
√	*Antidorcas marsupialis*	Springbok
√	*Raphicerus campestris*	Steenbok

√ ***Definitely there or have a high probability to occur;***

***** *Medium* probability to occur based on ecological and distributional parameters;

? *Low* probability to occur based on ecological and distributional parameters.

Red Data species rankings as defined in Friedmann and Daly's S.A. Red Data Book / IUCN (World Conservation Union) (2004) are indicated in the first column: CR= Critically Endangered, En = Endangered, V = Vulnerable, LR/cd = Lower risk conservation dependent, LR/nt = Lower Risk near threatened, DD = Data Deficient. All other species are deemed of Least Concern.

Table 8.2: Mammal species positively confirmed from the study site, observed indicators and habitat.

SCIENTIFIC NAME	ENGLISH NAME	OBSERVATION INDICATOR	HABITAT
O. afer	Aardvark	Burrows	Loose textured soils
L. capensis	Cape hare	Reported by owners	Valley floors – short grass
L. saxatilis	Scrub hare	Reported by owners	Valley floors – short grass
C. hottentotus	African mole rat	Tunnel system	Sandy terrain
H. africaeaustralis	Cape porcupine	Reported by owners	Universal
P. capensis	Springhare	Reported by owners	Sandy terrain
X. inaurus	S.A. ground squirrel	Sight record	Sandy terrain
A. frontalis	S.A. hedgehog	Reported by owners	Good vegetative cover
C. caracal	Caracal	Reported by owners	Universal
F. nigripes	Black-footed cat	Reported by owners	Grassy plains
G. genetta	Small-spotted genet	Reported by owners	Plains away from water
S. suricatta	Suricate	Sight record	Sandy plains
C. penicillata	Yellow mongoose	Sight record	Universal & good cover
O. megalotis	Bat-eared fox	Reported by owners	Universal & good cover
V. chama	Cape fox	Reported by owners	Universal & good cover
C. mesomelas	Black-backed jackal	Reported by owners	Universal
P. africanus	Common warthog	Reported by owners	Plains
T. strepsiceros	Kudu	Reported by owners	Wooded areas
O. gazella	Gemsbok	Sight record	Grassy plains
S. grimmia	Common duiker	Reported by owners	Grassy plains
A. marsupialis	Springbok	Sight record	
R. campestris	Steenbok	Sight record	

The presence of these species is not extraordinary for an extensive farm and adjoining district managed in a near-natural ecological state to facilitate sheep grazing. The black-footed cat is considered to be a Red Data species, but its conservation risk on the study site is low. Gemsbok has been re-introduced, but springbok, kudu, duiker, steenbok, grey rhebuck and mountain reedbuck are still naturally occurring. Some of the species are nomadic (baboons), but most species are rather territorial. Caracal and black-backed jackals are notorious for preying on sheep lambs and are actively pursued by farmers (with limited success).

8.4. Conclusion: Mammals

It is suggested that the site is not entirely cleared in order to ensure a degree of biological species diversity preservation and also to manage erosion; the < 50cm high vegetation should surely not affect construction and operation of the arrays of panels. This approach would expedite eventual rehabilitation and allows some small vertebrates to survive – as such minimize the environmental impact of the development. The shade cast by the solar panels will result in localised habitat changes which in turn will affect terrestrial vertebrate species, although the details of such changes cannot be confidently predicted.

On a micro-scale, the shade cast by each of the panels in the arrays of voltaic units can be expected to alter the floral composition by replacing plants adapted the sunny and arid exposed Karroo conditions with extremes in ambient temperatures, to those amenable to shady conditions. Some plants will survive the development, especially along strips not influenced by shade. The entire footprint of Phase 1 will environmentally be altered. However, the nature and extent of a habitat transformation is undocumented.

Logic dictates that larger and medium-sized mammals will migrate from the site. It is predicted that habitat-discerning small mammals will be more affected by the development, even to the point of being displaced. Small mammals with wide habitat tolerances will probably not be affected to the same degree.

No sensitive areas / systems are red-flagged.

The spatial loss of habitat is not seen as excessive considering the extensive character of the region. However, on a local and especially regional scale no vertebrate species will come under threat, although the effect of the development should be measureable at population levels.

The conservation status of the study site is rated Medium: i.e. “Land on which low-impact development with limited impact on the ecosystem could be considered, but where it is still recommended that certain portions of the natural habitat be maintained as open spaces”. This opinion is based on the extensive near-pristine adjoining areas and in the district, as well as the recommendation that the development site is not cleared and indigenous vegetation is allowed to adapt to the shaded and non-shaded portions of the development.

9. RESULTS: HERPETOFAUNA

9.1. Herpetofauna Habitat Assessment

The site is situated within the Nama Karoo biome, within the Northern Upper Karoo vegetation unit (NKu 3, Mucina & Rutherford 2006). The topography of the site is generally a flat sandy plain. Within the site the vegetation structure and floristic composition is homogeneous, dominated by small karroid shrubs, mostly less 50 cm tall, with sparse grass cover between the karroid shrubs after sufficient rain (Figures 9 & 10).

Most of the study site comprises natural habitat in a fair condition. The veld is however grazed by livestock (sheep) and game (kudu and springbok, gemsbuck). Limited alien trees, mainly poplars and mesquite, are only found at watering points, growing taller than the natural vegetation.

The local occurrences of reptiles and amphibians are closely dependent on broadly defined habitat types, in particular terrestrial, arboreal (tree-living), rupiculous (rock-dwelling) and wetland-associated vegetation cover. It is thus possible to deduce the presence or absence of reptile and amphibian species by evaluating the habitat types within the context of national distribution ranges. From a herpetological habitat perspective the study site offers mainly terrestrial, and very limited aquatic, rupicolous and arboreal habitat. During both site visits, plant cover was dry, as such providing some refuge for terrestrial herpetofauna. Moribund termitaria, which provide ideal retreats for small reptiles and amphibians, are present in large numbers on the study site. In some areas on the study site, scattered calcareous rocks were found in the veld, providing some limited rupicolous habitat for herpetofauna.

Indigenous trees are rare on the study site, e.g. sweet thorns (*Vachellia karoo*), Karoo kunibush (*Searsia burchellii)* and karee *(Searsia lancea),* occur sparsely on the study site, too limited to provide real arboreal habitat. A few dead logs, which provide some habitat for small herpetofauna, also occur sparsely on the study site.

Some natural rupicolous habitat in the form of dolerite hills/kopjes occur north of the study site. Further north are temporary pans and man-made dams in a drainage lines, but within the study site are only two endorheic pans, one at the boundary

fence of the Kloofsig Phase 1 site and the other destroyed by a wind pump and kraal. These water sources do provide limited and seasonal breeding habitat for frog species and water-dependent reptile species that prefer temporary water sources.

The 500 metres of adjoining land to the study site are similar to the study site.

Connectivity as a whole is moderate and some opportunities for migration exist to the north and east. The conservation ranking of the site is defined as “good”, and connectivity as “good”.

9.2 Observed and Expected Herpetofauna Species Richness

The Northern Cape is renowned for its biodiversity and the herpetofauna is no exception to the rule. It is especially true for reptiles in general and lizards in particular. Many species in this province are endemic. However, the Northern Cape Province is South Africa largest province and the study site lies far from the centres of endemism, which are mainly centred near or around Namaqualand (Succulent Karoo biome). There is a far bigger association with herpetofauna from the south-western Free State Province. This resulted that the study site falls outside the natural range of these endemics.

Of the 30 reptile species which may occur on the study site (Table 9.1), five were confirmed during the site visit (Table 9.2) and of the possible nine amphibian species which may occur on the study site; none were confirmed during the site visit.

Most of these herpetofauna species are robust generalists with the ability to capitalise on disturbed environments. It should be noted that potential occurrence is interpreted as being possible over a period of time, as a result of expansions and contractions of population densities and ranges which stimulate migration.

The American red-eared terrapin (*Trachemys scripta elegans*) and the Brahminy blind snake (*Ramphotyphlops braminus*) are the only two feral reptile or amphibian species known to occur in South Africa (De Moor and Bruton, 1988; Picker and Griffiths, 2011), but with only a few populations, they are not expected to occur on this particular site.

The species assemblage is typical of what can be expected in extensive natural areas with sufficient habitat to sustain populations. Most of the species of the resident diversity (Table 9.1) are fairly common and widespread (viz. leopard tortoise, Bibron's gecko, Cape gecko, Namaqua spotted sand lizard, spotted sandveld lizard, common house snake, Karoo sand snake mole snake, Cape cobra, Cape skink, western rock skink variegated skink).

The species richness is relatively high due to the large size and fairly pristine nature of the study site, in spite of the fact that almost the entire area consisit of only one habitat type.

Systematic arrangement and nomenclature used in Table 1 are according to Branch (1998), Minter, *et.al* (2004), Alexander & Marais (2007), Du Preez & Carruthers (2009) and Bates, *et.al* (2014).

Table9.1: Reptile and Amphibian species that may occuron the site.

	SCIENTIFIC NAME	**ENGLISH NAME**
	CLASS: REPTILIA	**REPTILES**
	Order: TESTUDINES	**TORTOISES & TERRAPINS**
	Family:Testudinidae	**Tortoises**
?	*Homopus femoralis*	Greater Dwarf Tortoise
?	*Psammobates tentorius*	Tent Tortoise
√	*Stigmochelys pardalis*	Leopard Tortoise
	Order: SQUAMATA	**SCALE-BEARING REPTILES**
	Suborder:LACERTILIA	**LIZARDS**
	Family: Gekkonidae	**Geckos**
√	*Chondrodactylus bibronii*	Bibron's Gecko
√	*Pachydactylus capensis*	Cape Gecko
?	*Pachydactylus mariquenis*	Common Banded Gecko
?	*Pachydactylus oculatus*	Golden Spotted Gecko
?	*Ptenopus garrulous*	Common Barking Gecko
	Family: Amphisbaenidae	**Amphisbaenians**
*	*Monopeltis capensis*	Dusky Worm lizard
	Family:Lacertidae	**Old World Lizards or Lacertids**
√	*Nucras intertexta*	Spotted Sandveld Lizard
√	*Pedioplanis namaquensis*	Namaqua Sand Lizard
	Family: Scincidae	**Skinks**
√	*Trachylepis capensis*	Cape Skink
√	*Trachylepis sulcata sulcata*	Western Rock Skink
√	*Trachylepis variegate*	Variegated Skink
	Family: Agamidae	**Agamas**

√	*Agama aculeata aculeate*	Western Ground Agama
	Suborder: SERPENTES	**SNAKES**
	Family: Typhlopidae	**Blind Snakes**
*	*Rhinotyphlops lalandei*	Delalande's Beaked Blind Snake
	Family: Leptotyphlopidae	**Thread Snakes**
?	*Leptotyphlops scutifrons*	Peter's Thread Snake
	Family: Viperidae	**Adders**
√	*Bitis arietans*	Puff Adder
	Family: Lamprophiidae	
√	Boaedon capensis	Common House Snake
*	Lycophidion capense	Cape Wolf Snake
√	*Psammophis notostictus*	Karoo Sand Snake
?	*Psammophis trinasalis*	Fork-Marked Sand Snake
?	*Psammophylax rhombeatus*	Spotted Grass Snake
?	*Duberria lutrix lutrix*	South African Slug-Eater
?	*Prosymna sundevallii*	Sundevall's Shovel-Snout
√	*Pseudaspis cana*	Mole Snake
	Family: Elapidae	**Cobras, Mambas and Others**
*	*Aspidelaps lubricus*	Coral Shield Cobra
√	*Naja nivea*	Cape Cobra
	Family: Colubridae	
?	*Crotaphopeltis hotamboeia*	Red-Lipped Snake
?	*Dasypeltis scabra*	Rhombic Egg Eater
	Class: AMPHIBIA	**AMPHIBIANS**
	Order: ANURA	**FROGS**
	Family: Bufonidae	**Toads**
*	*Amietaophrynus gutturalis*	Guttural Toad
*	*Poyntonophrynus vertebralis*	Southern Pygmy Toad
*	*Vandijkophrynus gariepensis*	Karoo Toad
	Family: Hyperoliidae	**Reed frogs**
?	*Kassina senegalesis*	Bubbling Kassina
	Family: Breviceptidae	**Rain frogs**
?	*Breviceps adspersus*	Bushveld rain Frog
	Family: Pipidae	**Clawed Frogs**
?	*Xenopus laevis*	Common Platanna
	Family: Pyxicephalidae	
√	*Cocosternum boettgeri*	Boettger's Caco
?NT	*Pyxicephalus adspersus*	Giant Bullfrog
?	*Tomopterna cryptotis*	Tremolo Sand Frog

√ Definitely there or have a *high* probability of occurring;
***** *Medium* probability of occurring based on ecological and distributional parameters;
? *Low* probability of occurring based on ecological and distributional parameters.

Red Data species rankings as defined in Branch, The Conservation Status of South Africa's threatened Reptiles': 89 – 103..In:- G.H.Verdoorn & J. le Roux (editors), 'The State of Southern Africa's Species (2002) and Minter, et.al, Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland (2004) are indicated in the first column: CR= Critically Endangered, En = Endangered, Vu = Vulnerable, NT = Near Threatened, DD = Data Deficient. All other species are deemed of Least Concern.

Table 9.2: Reptile and Amphibian species positively confirmed on the study site, observed indicators and habitat.

SCIENTIFIC NAME	ENGLISH NAME	OBSERVATION INDICATOR	HABITAT
Stigmochelys pardalis	Leopard Tortoise	Sight record of two adult females and one shell.	Terrestrial habitat
Chondrodactylus bibronii	Bibron's Gecko	Sight record of one adult and several juveniles among building rubble.	Man-made rupicolous habitat
Pedioplanis namaquensis	Namaqua Sand Lizard	Sight records of numerous fast-moving individuals	Terrestrial habitat, sandveld with scattered bushes
Nucras intertexta	Spotted Sandveld Lizard	Sight record of two individuals	Terrestrial habitat, sandveld with scattered bushes
Psammophis notostictus	Karoo Sand Snake	Sight record of single individual	Terrestrial habitat, sandveld with scattered bushes

The leopard tortoise, Bibron's gecko, Namaqua sand lizard, spotted sandveld lizard and Karoo sand snake listed in Table 2 should be common within the study site and elsewhere in its range.

9.3 Red Listed Reptiles

The study site area falls outside the natural range of speckled padloper, Namaqua day Gecko, Namaqua plated lizard, Lawrence's girdled lizard, Armadillo girdled lizard, Lomi's blind legless skink, Namaqua dwarf adder, Fisk's house snake and the Southern African python and these species should not occur on the study site.

No Red Data reptile should occur on the study site.

9.4 Red Listed Amphibians

The study site area falls outside the natural range of the desert rain frog, Namaqua stream frog and the Karoo caco and these species should not occur on the study site. There are no temporary water bodies, where bullfrogs are most likely to breed, on the study site or in the surrounding 500 metres buffer area. Bullfrogs prefer these temporary pans in order to avoid predation from fish, and for tadpoles to swim in schools and stay in the warm, shallow water during the day for rapid development (Van Wyk *et al*., 1992).

Despite the lack of water, the sandy red soil of the study is suitable as a dispersal area, which combines feeding and aestivation. It is essential that the soil should be suitable for burrowing on a daily basis during the short activity period at the beginning of the rainy season and for deeper retreats during the resting periods.

Giant bullfrogs have been patchily collected in the general area of the Northern Cape Province. Giant bullfrogs are only active for short period of time of the year and the area around Hope Town has not been thoroughly surveyed for herpetofauna. A small possibility exists that a few individuals, at best, in optimum conditions, may use the study site for feeding or aestivation.

It is important to note that in the latest literature (Measey (ed.) 2011 and Carruthers & Du Preez, 2011); the giant bullfrog's status has changed officially from Near Threatened (Minter *et al*, 2004) to Least Concern in South Africa.

No Red Data amphibian should occur on the study site.

9.5 Conclusions

In general the study site is a homogenous environment that contains one large herpetofauna habitat, namely terrestrial karoo.

Of the 39 herpetofauna species recorded and/or expected on the site none has threatened status, but there is a slight chance that the contentious Giant Bullfrog may at times occur within the study site.

From a herpetological perspective, all water bodies like the temporary pan must be regarded as sensitive. Especially in an arid area such as the study site, water bodies should be designated sensitive areas and excluded from any development. The pan is excluded from the development.

The PV array is not considered a direct threat to any reptile or amphibian species, and the impact in space may be considered as small, within on the widespread karoo plains habitat.

Except for some fossorial species, the development is expected to have a small impact on herpetofauna and their environment, once the disruption of construction is over.

10. RESULTS WETLAND AND AQUATIC ASSESSMENT

10.1 General Characteristics

In terms of the definitions given in the National Water Act, 1998 (Act No. 36 of 1998), two pans and a drainage line were identified on the Kloofsig Phase 1 site or within 500 m of the site boundary, or along the transect of the proposed power lines (Figure 7). Windpumps with water points are also indicated.

The following wetland or aquatic systems were identified:

1. A **dry Natural pan** is present just outside the south-western corner of the site, (both sides of the farm boundary fenceline). This pan is excluded from the proposed development (Figures 7, 14 and 18).
2. Another pan also occurred on the site, but was **transformed** due to construction of a windpump, a water point for livestock and a sheep kraal (Figures 7 & 13).
3. A **dry drainage line** is present north of and parallel to the eastern part of the powerline to the south of the site. This powerline will have to cross the drainage line to reach the proposed substation switch/substation south-east of the site (Figures 7 & 15).

In addition to these wetlands/aquatic systems the two windpumps south of the site, close to the road and close to the proposed power line alignment are indicated in Figures 7 & 8. Although indicated as sensitive in Figure 8, this was done only because they are considered as watering points for livestock, outside the property of the development. This should not be regarded as a limitation to the proposed power line.

The wetlands and/or aquatic systems were very dry at the time of the surveys, had no surface water and did not show any obvious zonation. All these systems are temporal / intermittent.

It is important to mention that the northern parts of this plant community, especially parts situated north of Phase 1 (some areas of the planned Kloofsig Phase 2) becomes flooded during heavy rains. However, these areas are not regarded as wetlands or any other

aquatic system, as this area is very flat and covered with normal karoo vegetation, with no typical wetland characteristics. The floodwater slowly drains northwards down the very slight slope, and eventually into a drainage line through the Kalkpoort, situated north-east of the farmhouse and outside the boundary Portion 18 of the Farm Kalkpoort.

10.2 Description and Classification of the identified wetlands and aquatic systems

A classification system developed for the National Wetlands Inventory is based on the principles of the hydro-geomorphic (HGM) approach to wetland classification (Ewart-Smith *et al*. 2006). This classification system was further developed and refined and a new classification system, the "Classification System for Wetlands and other Aquatic Ecosystem in South Africa" was published (Ollis *et al.* 2013).

The current wetland study follows this new classification system, by attempting to classify the wet area on the site in terms of a functional unit in line with 6 category levels recognised in the classification system proposed (Ollis *et al*. 2013).

Level 1: All three wetland / aquatic systems are Inland Systems

Level 2: Regional Setting

DWA Ecoregion

According to the DWA Level 1 Ecoregions all three wetland / aquatic systems fall under the Nama Karoo Ecoregion (Kleynhans *et al*. 2005). The topography of the area is a plain with low relief, vegetation is exclusively Nama Karoo. Water from the study site eventually flows into the the Orange River, smaller rivers are seasonal. The Mean annual precipitation is low and the stream frequency is therefore low. In the site area the slopes are <5%.

Bioregions

The site falls within the Upper Karoo Bioregion of Mucina & Rutherford (2006). According to the most recent vegetation map of South Africa the vegetation on the study site is in the Northern Upper Karoo.

Level 3: Landscape setting

The landscape setting of all three wetlands / aquatic systems is considered to be a **plain** (Ollis *et al*. 2013).

Level 4: Hydrogeomorphic Unit (HGM unit)

Both the pans are **Endorheic Depressions without channelled inflow**. They are very dry and only occasionally after high rainfall events have surface water for a very short period.

The Drainage Line is a small dry river with a distinc channel with periodic unidirectional flow (Ollis *et al.* 2013). (See also descriptions provided under Section 7.3.5 above)

1 Dry Natural Pan

This pan is located outside the proposed development area (Figures 7a & b), close to the south-western corner of the Kloofsig Phase 1 area (Figure 14 & 18). The farm boundary fence runs through this pan (Figure 18). The pan is more 50 m from the developmeny footprint (Figure 5).

bb

Figure 18: The Dry Natural Pan. Note the farm boundary fence.

2. Transformed Pan

This pan is located in the central-eastern part of the Kloofsig Phase 1 site, at approximately 30°00'32"S; 24°33'31"E (Figures 7a & b, 13 & 19). This pan was totally transformed by a borehole with windpump, sheep kraals, and drinking trough and some excavations.

3. Drainage Line

The Drainage Line is located north of the eastern part of the proposed powerline to the south of the site. This powerline will have to cross the drainage line to reach the proposed substation. The drainage line has no riparian zone and karoo vegetation occurs up to the edge of the channel (Figure 15).

Figure 19: The water point for livestock, alien trees and windmill on the Transformed Pan on the Phase 1 on the Plains Karoo on Calcareous Soil. The calcareous nature of the soil is evident.

Level 5: Hydrological Regime -

The flooding or inundation of the system is unknown, but the the Dry Natural Pan may become intermittently wet after good rains. The Dry Drainage Line will have water for a short period only after good rains.

Level 6: Descriptors:

The pan vegetation can be described as natural, with sparse vegetation (Figure 18). The Drainage line is a natural canal with karoo vegetation up to its edge (Figure 15).

10.3 Wetland Condition (WET-Health) Present Ecological Status PES)

Wetland Condition is defined as a measure of the deviation of wetland structure and function from its natural reference condition (Macfarlane *et al*. 2007).

In the current assessment the hydrological, geo-morphological and vegetation integrity was assessed for the wetland or aquatic system units associated with the study site and the power line south of the study site to Eskom 132 kV Switch Stration, to provide a Present Ecological Status (PES) score (Macfarlane *et al*. 2007). In terms of wetland functionality and status, health categories used by WET-Health are indicated in the Table below.

Table 1: Health categories used by WET-Health for describing the integrity of wetlands (Kleinhans *et al*. 1999, Macfarlane *et al*. 2007)

DESCRIPTION	PES SCORE	MANAGEMENT
Unmodified, natural.	A	Protected systems; relatively untouched by human hands; no discharges or impoundments allowed
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place, but the ecosystem functions are essentially unchanged.	B	Some human-related disturbance, but mostly of low impact
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact and the basic ecosystem functions are still predominantly unchanged.	C	Multiple disturbances associated with need for socio-economic development, e.g. impoundment, habitat modification and water quality degradation
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	D	
The change in ecosystem processes and loss of natural habitat and biota is serious. The loss of natural habitat, biota and basic ecosystem functions is extensive	E	Often characterized by high human densities or extensive

Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.	F	resource exploitation. Management intervention is needed to improve health, e.g. to restore flow patterns, river habitats or water quality

The natural pan and drainage line wetland systems can be regarded to have a Present Ecological Score (PES) of C, which means that it was moderately modified (e.g. fence through the middle, grazed) but the natural habitat remains predominantly intact. In the case of the transformed pan modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota. The PES in this case is regarded as F. In the worst instances the basic ecosystem functions have been destroyed and the changes are irreversible.

10.4 Ecological Importance and Sensitivity (EIS)

Ecological importance is an expression of a wetland's importance to the maintenance of ecological diversity and functioning on local and wider spatial scales. Ecological sensitivity refers to the system's ability to tolerate disturbance and its capacity to recover from disturbance once it has occurred (DWAF, 1999). This classification of water resources allows for an appropriate management class to be allocated to the water resource and includes the following:

- Ecological Importance in terms of ecosystems and biodiversity;
- Ecological functions; and
- Basic human needs.

Table 2: Ecological Importance and Sensitivity rating scale used for calculation of EIS scores (DWAF, 1999)

Ecological Importance and Sensitivity Categories	Rating	Recommended Ecological Management Class
Very High Wetlands that are considered ecologically important and sensitive on a national 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 in major rivers	>3 and <=4	A

High Wetlands that are considered to be ecologically important and sensitive on a provincial level. 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	B
Moderate **Wetlands that are considered to be ecologically important and sensitive on a 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 in major rivers**	**>1 and <=2**	**C**
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 in major rivers	>0 and <=1	D

Results:

Table 3: The Present Ecological Status (PES) and Environmental Importance and Sensitivity (EIS) of the wetlands and aquatic systems in the study area.

Wetland Number	**Short description**	**PES** Refer to Table 1	**EIS** Refer to Table 2
1	Dry Natural Pan	C Moderately modified	C Moderate
2	Transformed Pan	F Modifications critical	D Low
3	Drainage Line	C Moderately modified	C Moderate

The Ecological Importance and Sensitivity of the Dry Natural Pan and the Drainage Line is regarded as being in Moderate (Class C) (Table above) while that of the Transformed Pan is regarded as Low. The latter pan is not ecologically important and sensitive on any scale. The biodiversity of these watercourses is ubiquitous and not sensitive to flow and habitat modifications.

10.5 Buffer Zones

A buffer zone is normally applicable to wetland areas. A buffer zone is defined as a strip of land surrounding a wetland or riparian area in which activities are controlled or restricted (DWAF, 2005). A development can have several impacts on the surrounding environment and on a wetland or riparian area. The development changes habitats, the ecological environment, infiltration rate, amount of runoff and runoff intensity of the site, and therefore the water regime of the entire site. A development in or adjacent to a wetland area will change normal water flow to and/or from the wetland, and may increase storm water flow during a rainfall event. An increased volume of stormwater runoff, peak discharges, and frequency and severity of flooding is therefore often characteristic of transformed catchments.

Buffer zones have been shown to perform a wide range of functions and have therefore been widely proposed as a standard measure to protect water resources and their associated biodiversity. These include (i) maintaining basic hydrological processes; (ii) reducing impacts on water resources from upstream activities and adjoining land-uses; (iii) providing habitat for various aspects of biodiversity.

Despite limitations, buffer zones are well suited to perform functions such as sediment trapping, erosion control and nutrient retention which can significantly reduce the impact of activities taking place adjacent to water resources. Buffer zones are generally proposed as a standard mitigation measure to reduce impacts of land-uses / activities that are planned adjacent to water resources.

A brief description of each of the functions and associated services is outlined in the Table below:

Table 4: Generic functions of buffer zones relevant to the study site (adapted from Macfarlane *et al.*, 2010)

Primary	Buffer Functions
Maintaining basic aquatic and values.	• Groundwater recharge: Seasonal flooding into wetland areas allows infiltration to the water table and replenishment of groundwater. This groundwater will often discharge during the dry season providing the base flow for streams, rivers, and wetlands. • Flood attenuation: Wetland vegetation increases the roughness of stream margins, slowing down flood-flows. This may therefore reduce flood damage in downstream areas. Vegetated buffers have therefore been promoted as providing cost-effective alternatives to highly engineered structures to reduce erosion and control flooding, particularly in urban settings.
Reducing impacts from upstream activities and adjoining land-uses	• Storm water attenuation: Flooding into the buffer zone increases the area and reduces the velocity of storm flow. Roots, braches and leaves of plants provide direct resistance to water flowing through the buffer, decreasing its velocity and

	thereby reducing its erosion potential. More water is exchanged in this area with soil moisture and groundwater, rather than simply transferring out of the area via overland flow. • Sediment removal: Surface roughness provided by vegetation, or litter, reduces the velocity of overland flow, enhancing settling of particles. Buffer zones can therefore act as effective sediment traps, removing sediment from runoff water from adjoining lands thus reducing the sediment load of surface waters. • Removal of toxics: Buffer zones can remove toxic pollutants, such hydrocarbons that would otherwise affect the quality of water resources and thus their suitability for aquatic biota and for human use. • Nutrient removal: Wetland vegetation and vegetation in terrestrial buffer zones may significantly reduce the amount of nutrients (N & P), entering a water body reducing t excessive outbreaks of microalgae that can have an adverse effect on both freshwater and estuarine environments. • Removal of pathogens: By slowing water contaminated with faecal material, buffer zones encourage deposition of pathogens, which soon die when exposed to the elements.

Local government policies require that protective wetland buffer zones be calculated from the outer edge of the temporary zone of a wetland and river buffer zones be calculated from the outer edge of the riparian zone.

There are guidelines and local policies for the determination of buffer zones from a wetland or watercourse Macfarlane *et al.* (2010), however generally 32 m is regarded as a standard for buffer zone (Ezemvelo IEM, 2011; Biodiversity Act, 2004 (Act 10 of 2004), and particularly the recently policy published in Regulation 983, Government Gazette 38282, December 2014).

The proposed development is about 50 m from the edge of the Natural Pan. The Transformed Pan area will be developed. The proposed power line south of the site runs parallel and often close to the Drainage Line, and the power line will have to cross the Drainage Line.

11. ENVIRONMENTAL IMPACT ASSESSMENT

11.1 Impact Rating Methodology

The assessment of impacts will be based on the professional judgement of specialists at SRK Consulting, fieldwork, and desk-top analysis. The significance of potential impacts that may result from the proposed development will be determined in order to assist the Department of Economic Development, Environmental Affairs and Tourism (DEDEAT) in making a decision.

The significance of an impact is defined as a combination of the consequence of the impact occurring and the probability that the impact will occur. The criteria used to determine impact consequences are presented in Table 11.1.

Table 11.1: Criteria used to determine the Consequence of the Impact

Rating	Definition of Rating	Score
A. Extent– the area over which the impact will be experienced		
None		0
Local	Confined to project or study area or part thereof (e.g. site)	1
Regional	The region, which may be defined in various ways, e.g. cadastral, catchment, topographic	2
(Inter) national	Nationally or beyond	3
B. Intensity– the magnitude of the impact in relation to the sensitivity of the receiving environment		
None		0
Low	Site-specific and wider natural and/or social functions and processes are negligibly altered	1
Medium	Site-specific and wider natural and/or social functions and processes continue albeit in a modified way	2
High	Site-specific and wider natural and/or social functions or processes are severely altered	3
C. Duration– the time frame for which the impact will be experienced		
None		0
Short-term	Up to 2 years	1
Medium-term	2 to 15 years	2
Long-term	More than 15 years	3

The combined score of these three criteria corresponds to a **Consequence Rating**, as follows:

Table 11.2: Method used to determine the Consequence Score

Combined Score (A+B+C)	0 – 2	3 – 4	5	6	7	8 – 9
Consequence Rating	Not significant	Very low	Low	Medium	High	Very high

Once the consequence has been derived, the probability of the impact occurring will be considered using the probability classifications presented in Table 11.3.

Table 11.3: Probability Classification

Probability– the likelihood of the impact occurring	
Improbable	< 40% chance of occurring
Possible	40% - 70% chance of occurring
Probable	> 70% - 90% chance of occurring
Definite	> 90% chance of occurring

The overall **significance** of impacts will be determined by considering consequence and probability using the rating system prescribed in the table below.

Table 11.4: Impact Significance Ratings

Significance Rating	Possible Impact Combinations		
	Consequence		Probability
Insignificant	Very Low	&	Improbable
	Very Low	&	Possible
Very Low	Very Low	&	Probable
	Very Low	&	Definite
	Low	&	Improbable
	Low	&	Possible
Low	Low	&	Probable
	Low	&	Definite
	Medium	&	Improbable
	Medium	&	Possible
Medium	Medium	&	Probable
	Medium	&	Definite
	High	&	Improbable
	High	&	Possible
High	High	&	Probable
	High	&	Definite
	Very High	&	Improbable

Significance Rating	Possible Impact Combinations		
	Consequence		Probability
	Very High	&	Possible
Very High	Very High	&	Probable
	Very High	&	Definite

Finally, the impacts will also be considered in terms of their status (positive or negative impact) and the confidence in the ascribed impact significance rating. The system for considering impact status and confidence (in assessment) is laid out in the table below.

Table 11.5: Impact status and confidence classification

Status of impact	
Indication whether the impact is adverse (negative) or beneficial (positive).	+ ve (positive – a 'benefit')
	– ve (negative – a 'cost')
Confidence of assessment	
The degree of confidence in predictions based on available information, SRK's judgment and/or specialist knowledge.	Low
	Medium
	High

The impact significance rating should be considered by authorities in their decision-making process based on the implications of ratings ascribed below:

- **Insignificant:** the potential impact is negligible and will not have an influence on the decision regarding the proposed activity/development.
- **Very Low:** the potential impact is very small and should not have any meaningful influence on the decision regarding the proposed activity/development.
- **Low:** the potential impact may not have any meaningful influence on the decision regarding the proposed activity/development.
- **Medium:** the potential impact should influence the decision regarding the proposed activity/development.
- **High:** the potential impact will affect the decision regarding the proposed activity/development.
- **Very High:** The proposed activity should only be approved under special circumstances.

Practicable mitigation measures will be recommended and impacts will be rated in the prescribed way both with and without the assumed effective implementation of mitigation measures. Mitigation measures will be classified as either:

- **Essential**: must be implemented and are non-negotiable; or
- **Optional:** must be shown to have been considered and sound reasons provided by the proponent, if not implemented.

11.2 Results:

11.2.1 Impacts on vegetation and flora:

The main concern with PV energy facilities is habitat loss resulting in the displacement of vegetation and plant and fauna species from the site. Impacts on vegetation and flora during construction, operation and decommission are tabled and described below.

Impact Table 1: Impact on vegetation of the proposed Kloofsig Phase 1 PV array during the Construction Phase

Impact on vegetation and flora	Mitigation	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Habitat destruction for PV facility and associated structures, including the powerline serivtude	Without mitigation	Local 1	High 3	Long-term 3	**High 7**	Definite	**High**	-ve	High
	With mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Definite	**Medium**	-ve	Medium
Loss of plant species	Without mitigation	Local 1	High 3	Long- term 3	**High 7**	Definite	**High**	-ve	High
	With mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Definite	**Medium**	-ve	Medium
Loss of red data, protected or other plant species of concern	Without mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Improbable	**Very Low**	-ve	Medium
	With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Improbable	**Very Low**	-ve	Medium
Change in plant species composition: increase in weedy species	Without mitigation	Local 1	Medium 2	Medium term 2	**Low 5**	Definite	**Low**	-ve	Medium
	With mitigation	Local 1	Medium 2	Short term 1	**Very Low 4**	Definite	**Very Low**	-ve	Medium
Impact of fuel and chemical spills on vegetation	Without mitigation	Local 1	Low 1	Short term 1	**Very Low 3**	Possible	**Insignificant**	-ve	Medium
	With mitigation	Local 1	Low 1	Short term 1	**Very Low 3**	Possible	**Insignificant**	-ve	Medium

11.2.1.1 Description of Impacts and mitigation on vegetation and flora during the Construction Phase

- The general effect of construction of the photovoltaic panels including the associated infrastructure and access roads needed for the construction activities on the site, is that the vegetation and faunal habitat of the construction area will be destroyed, or at least highly disturbed, resulting in a general loss of plant and faunal species from the specific development site. The intensity and significance of this impact is regarded to be **High**.
- The absence of protected and red listed plant species within the study site was confirmed during the site investigation. Therefore the intensity and significance of the impact on these plant species are regarded as **Low and Very Low** respectively. When considering the relatively small footprint of the proposed development site, it is highly unlikely that this proposed development will cause any loss of threatened flora or faunal taxa on a regional scale.
- Due to the construction activities and resulting loss of natural vegetation and plant species, a change in plant species composition is expected, mainly due to the increase of weedy species. These weedy species are pioneers albe to establish and grow in disturbed or denuded areas. Although this is definitely expected to happen, the significance is low, as it is relatively easy to control.
- The general effect of the construction of powerlines on the habitats and vegetation in the powerline servitude is low due to the small areas involved, basically the footprint at the base of each support pole/pylon. However, such lines require a wider servitude. An access road normally runs along this servitude, for construction and subsequent maintenance, and vegetation is removed or kept short. This impact is for both the construction and operational phases.
- The impact of pollution by fuel and chemical splills is regarded as being insignificant, though should accidental spills occur this should be remediated immediately.

Mitigation of impacts on vegetation and flora during the Construction Phase

- Restrict construction activities to the development site. Minimize areas cleared for construction and building activities, including the powerline servitude and all areas used by staff during construction. Wherever possible, any activities that

can damage vegetation (e.g. tracks, unloading, storage, construction etc.) should be limited to specific allocated local sites and only within the footprint of the development area. Clearly demarcate activity-specific construction areas to control and limit movement of personnel, vehicles and materials to contain the extent of the impacts to the lowest level possible.

- Avoid clearing the corridors between the panels.
- Keep the number of access routes and temporary routes within the development site to a minimum to decrease the land area that will be transformed, thus reducing impacts and remediation.
- Conserve the (limited) areas that will not be developed to retain as much as possible natural habitat for flora and fauna.
- Sequential construction strategy i.e. phasing the construction of the site (rows of panels) and rehabilitating immediately after each phase. Not leaving bare soil surfaces exposed to erosion for lengthy periods.
- Although no rare, red data or protected plant species were observed during the field survey, and no such species are listed in red data or protected plant data bases for the two Grids 2924DC Havengabrug and 3024BA Petrusville, any individuals of succulent (e.g. Aloes) or geophytic (bulb) plant species. that may be found during construction, Succulents and geophytes can be kept in atemporary nursery to be used later re-vegetation programs, as the survival of these species when re-planted will be more likely than that of the dominant dwarf shrubs. Rescued plants can also be relocated at suitable sites (e.g. farm houses, site gate or site offices etc.).
- Harvesting or removal – other than for rescue purposes- of any plant material is strictly prohibited. Staff shall only assist with the (necessary) removal of possible plant species, if requested to do so, under supervision.
- Prevent introduction of alien woody plant species. Be aware of the fact that seeds of invasive plants can be transported by vehicles as well as staff clothing. Eradicate invasive species. Declared alien species that may become established during construction and operation phases must be identified and managed in accordance with the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983), the implementation of a monitoring programme in this regard is recommended, being the responsibility of the ECO.
- Re-vegetate exposed soils as soon as possible to stabilise the top soils, or apply rock fragments or other suitable material (e.g. plant material that was removed by

clearing) to reduce the exposure of top soils to events that may initiate excessive erosion. Use only indigenous (to the area) plant material. Rehabilitate as a continual process, to maximize viability of the natural seed bank and reduce loss of top soil during storage. If possible, space panel rows sufficiently to enable patches of vegetation between the rows to remain relatively intact and only minimally affected by shading. There is currently no guideline though it would be ideal if strips of vegetation between panel rows could remain in full sun for most of the day. This will assist in providing seed banks for vegetation recovery after decommision.

- Clear accidental spillage of fuel or chemicals immediately. Provide adequate change and ablution facilities and prohibit the use of natural areas as toilets as this can damage vegetation and faunal habitats.

Impact Table 2: Impact on vegetation of the proposed Kloofsig Phase 1 PV array during the Operational Phase

Impact on vegetation	Mitigation	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Change in plant species composition: increase in weedy species	Without mitigation	Local 1	High 3	Medium term 2	**Medium 6**	Definite	**Medium**	-ve	Medium
	With mitigation	Local 1	Medium 2	Medium term 2	**Low 5**	Definite	**Low**	-ve	Medium
Impact of fuel and chemical spills on vegetation	Without mitigation	Local 1	Low 1	Short term 1	**Very Low 3**	Possible	**Insignificant**	-ve	Medium
	With mitigation	Local 1	Low 1	Short term 1	**Very Low 3**	Possible	**Insignificant**	-ve	Medium
Impact of shading on vegetation and plant species	Without mitigation	Local 1	High 3	Long-term 3	**High 7**	Definite	**High**	-ve	High
	With mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Definite	**Medium**	-ve	Medium

11.2.1.2 Description if Impacts and mitigation on vegetation and flora during the Operational Phase

- Karoo plant species grow in full, bright sunlight and are not shade tolerant. It is therefore expected that the plant species composition will change, many karoo plant species will die when they are most of the time in the shade. This will have a definite impact on the plant species composition on the site, especially in the shade casted by the panels.
- Shading is not considered to have a great influence on any protected or red data plant species of conservation concern, as no red data or protected plant species were recorded during the field surveys.
- Due to the loss of natural vegetation and plant species, and the mentioned shading effect, a change in plant species composition is expected, mainly due to the increase of weedy species. These weedy species are pioneers albe to establish and grow in disturbed or denuded areas and also in shaded areas. Although this is definitely expected to happen, the significance is low, as it is relatively easy to control herbaceous weeds.
- The impact of pollution by fuel and chemical splills is regarded as being insignificant, though should accidental spills occur this should be remediated immediately.

Mitigation of impacts during the Operational Phase

- Prevent introduction of alien woody plant species. Be aware of the fact that seeds of invasive plants can be transported by vehicles as well as staff clothing. Eradicate invasive species. Declared alien species that may become established during construction and operation phases must be identified and managed in accordance with the Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983), the implementation of a monitoring programme in this regard is recommended, being the responsibility of the ECO.
- Eradicate and control all weed species that establish in the area. This can be done mechanically or chemically by herbicides. Ensure that remaining natural indigenous plant species are not killed by the application of herbicides.
- The impact of pollution by fuel and chemical splills is regarded as being insignificant, though should accidental spills occur this should be remediated immediately.

Impact Table 3: Impact on vegetation of the proposed Kloofsig Phase 1 PV array during the decommissioning Phase

Impact on vegetation	Mitigation	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Habitat destruction due to access to demolishment of the PV array area [KK1]	Without mitigation	Local 1	High 3	Medium-term 2	**Medium 6**	Definite	**Medium**	-ve	High
	With mitigation	Local 1	Medium 2	Medium-term 2	**Low 5**	Definite	**Low**	-ve	Medium
Substrate repair and vegetation restoration	Without mitigation	Local 1	Medium 2	Long-term 2	**Low 5**	Definite	**Low**	+ve	High

11.2.1.3 Description if Impacts and mitigation on vegetation and flora during the Decommission Phase

- . The idea is that rehabilitation of the site at decommission should lead to the re-eastablishment of the original indigenous plant species composition of the plant community that was affected by the development. Should this realise decommission will have a positive impact on the environment.
- A negative impact is, however, that contractors responsible for the decommission and breakdown of the panels and other infrastructure may cause considerable damage to the substrate and any remaining natural vegetation, by using heavy machinery and vehicles and acting irresponsibly.

Mitigation of impacts during the Decommission Phase

- Ensure that contractors are contractually bound to responsible repair of the environment. Clearing of constructed materials should be complete, with no rubble or waste be left on the site.

11.2.2 Impacts on vertebrate fauna (mammals and herpetofauna):

Development of a PV array runs the risk of interfering with ecosystem function, such as removal of vegetation as source of food and shelter, breeding habitat and also reduction in water quality, soil pollution or underground water contamination. These in turn will impact negatively on vertebrate species, fauna species richness and population numbers.

The expected impacts on fauna are presented in the following impact tables and descriptions.

Impact Table 4: Impact on fauna of the proposed Kloofsig Phase 1 PV array during the Construction Phase -

Impact on fauna	Mitigation	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Loss of mammal and herpetofaunal species	Without mitigation	Local 1	High 3	Long-term 3	**High 7**	Possible	**Medium**	-ve	Medium
	With mitigation	Local 1	Medium 2	Medium-term 2	**Low 5**	Possible	**Very Low**	-ve	Medium
Loss of mammal and herpetofaunal habitat and ecosystem function	Without mitigation	Local 1	High[KK2] 3	Long-term 3	**High 7**	Definite	**High**	-ve	High
	With mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Definite	**Medium**	-ve	Medium
Pollution, ground and surface water pollution, fuel and chemical spills	Without mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Possible	**Very Low**	-ve	Medium
	With mitigation	Local 1	Low 1	Medium-term 2	**Very Low 4**	Possible	**Insignificant**	-ve	Medium
Air pollution[KK3]	Without mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Possible	**Very Low**	-ve	Low
	With mitigation	Local 1	Low 1	Medium-term 2	**Very Low 4**	Possible	**Insignificant**	-ve	Low
Noise and lighting	Without mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Possible	**Low**	-ve	Medium

	With mitigation	Local 1	Low 1	Medium-term 2	**Very Low**	Probable	**Very Low**	-ve	Medium
Power lines, collision, electrocution[KK4]	Without mitigation	Local 1	Low 1	Long- term 3	**Low** **5**	Improbable	**Very Low**	-ve	High
	With mitigation	Local 1	Low 1	Long-term 3	**Low** **5**	Improbable	**Very Low**	-ve	High
Increased human activities, illegal hunting, poaching	Without mitigation	Local 1	Medium 2	Medium-term 2	**Low** **5**	Possible	**Very Low**	-ve	Medium
	With mitigation	Local 1	Low 1	Medium term 1	**Very Low** **4**	Possible	**Insignificant**	-ve	Medium
Exposure to erosion, surface water runoff[KK5]	Without mitigation	Local 1	Low 1	Medium-term 2	**Very Low** **4**	Possible	**Insignificant**	-ve	High
	With mitigation	Local 1	Low 1	Short-term 1	**Very Low** **3**	Possible	**Insignificant**	-ve	High

11.2.2.1 Description of imacts and mitigation on fauna during the construction phase

The general effect of construction of the photovoltaic panels including the associated infrastructure and access roads needed for the construction activities on the site, is that the faunal habitats and associated ecosystem functions will be destroyed, or at least highly disturbed, resulting in a general loss of faunal species from the specific development site. *In situ* populations of these species may no longer be able to find suitable habitat on the site or surrounding land. This could possibly lead to a decline in population numbers, but not to regional extinctions.

- The intensity of faunal habitat destruction by constructing the panels and associated infrastructure including the use of heavy motor vehicle on the study site is regarded as High while the significance of this impact is regarded to be **Medium**.
- The surest way of loosing faunal (mammal and herpetofauna) species, is the lost of habitat. Where-as larger faunal species may migrate to adjacent suitable habitats, smaller species are not able to do this and will be lost, either by lack of suitable habitat, or direct kills. The intensity of loss of faunal species is regarded as High while significance of this impact is regarded to be **High**.
- Little or no pollution is expected on the site, therefore the imact of pollution of ground and surface water, as well as of air pollution on fauna are Insignificant or Very Low, and the impacts of noise and lighting are also Low or Very Low. Light may in a small way attract or retard faunal species on the site.
- From a fauna perspective the impact of construction of powerlines is restricted to bats. Although many individuals of several bat species may fly over the site during the night, this impact is regarded as very low. Lighting will attract flying insects, which in turn will attract bats. However, incidents of bats colliding with powerlines are not known.
- Increased human activities during the construction phase may lead to killing of faunal species, especially reptiles. The site is vulnerable to hunting/trapping by construction workers. Harassing and hunting by construction workers could be a risk, though it is expected that the larger fauna will emigrate from the site. The

impact of human activities on fauna on the site is therefore regarded as Very Low to Insignificant.

- Erosion of the soil surface due to surface vegetation being removed, causing .exposed soil conditions where rainfall and high winds can cause mechanical erosion. Damage to basal cover will further detract from species richness and population numbers of both plant and fauna species. The increased amounts of surface water runoff from hard / bare surfaces within the developments may increase the chance of flash floods. Within the drought-prone area the impact of water runoff and erosion is regarded as Insignificant.

Mitigation of impacts on fauna during the Construction Phase

- To avoid illegal hunting or poaching of animals and unessesary killing of small animals (mammals and herpetofauna), education of the construction staff about the value of wildlife and environmental sensitivity is needed. The contractor/contractors must ensure that no animals are disturbed, trapped, hunted or killed during the construction phase. Conservation-orientated clauses should be built into contracts for construction personnel, complete with penalty clauses for non-compliance.
- Since the completed facility will probably be security-fenced, commence with the fencing in order to restrict the movement of construction vehicles and construction personnel.
- Restrict construction activities to the development site. Minimize areas cleared for construction and building activities, including the powerline servitude and all areas used by staff during construction. Wherever possible, any activities that can damage vegetation (e.g. tracks, unloading, storage, construction etc.) should be limited to specific allocated local sites and only within the footprint of the development area. Clearly demarcate activity-specific construction areas to control and limit movement of personnel, vehicles and materials to contain the extent of the impacts to the lowest level possible.
- Avoid clearing the corridors between the panels.
- Keep the number of access routes and temporary routes within the development site to a minimum to decrease the land area that will be transformed, thus reducing impacts and remediation.
- Conserve the (limited) areas that will not be developed to retain as much as possible natural habitat for fauna.

- Sequential construction strategy i.e. phasing the construction of the site (rows of panels) and rehabilitating immediately after each phase. Not leaving bare soil surfaces exposed to erosion for lengthy periods.
- Control all waste dumping and pollution.
- Bats (and Birds) and invertebrates flying at night are attracted to lights, and these should be kept to a minimum. Outside lighting should be designed to minimize impacts on fauna. Fluorescent and mercury vapour lighting should be avoided and sodium vapour (yellow) lights should be used wherever possible.
- Ensure that powerlines are made safe to bats and birds by applying standard Eskom measures.

11.2.2.2 Description of impacts and mitigation on fauna during the operational phase

- Increased human activities during the operational phase may lead to killing of faunal species, especially small mammals and herpetofauna. The site is vulnerable to hunting/trapping by workers. Harassing and hunting by workers could be a risk, though it is expected that the larger fauna will emigrate from the site. The impact of human activities on fauna on the site is therefore regarded as Very Low to Insignificant.
- Little or no pollution is expected on the site, therefore the imact of pollution of ground and surface water, as well as of air pollution on fauna are Insignificant or Very Low, and the impacts of noise and lighting are also Low or Very Low. Light may in a small way attract or retard faunal species on the site.
- From a fauna perspective the impact of presence of powerlines is restricted to bats. Although many individuals of several bat species may fly over the site during the night, this impact is regarded as very low. Lighting will attract flying insects, which in turn will attract bats. However, incidents of bats colliding with powerlines are not known.

Impact Table 5: Impact on fauna of the proposed Kloofsig Phase 1 PV array during the Operational Phase –

Impact on fauna	Mitigation	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Increased human activities, illegal hunting, poaching	Without mitigation	Local 1	Medium 2	Medium-term 2	**Low 5**	Possible	**Very Low**	-ve	Medium
	With mitigation	Local 1	Low 1	Medium term 1	**Very Low 4**	Possible	**Insignificant**	-ve	Medium
Pollution, ground and surface water pollution, fuel and chemical spills	Without mitigation	Local 1	Medium 2	Long-term 3	**Medium 6**	Possible	**Low**	-ve	Medium
	With mitigation	Local 1	Low 1	Medium-term 2	**Very Low 4**	Possible	**Insignificant**	-ve	Medium
Noise and lighting	Without mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Probable	**Low**	-ve	Medium
	With mitigation	Local 1	Low 1	Long-term 3	**Low 5**	Probable	**Low**	-ve	Medium
Power lines, collision, electrocution	Without mitigation	Local 1	Low 1	Long- term 3	**Low 5**	Improbablee	**Low**	-ve	High
	With mitigation	Local 1	Low1	Long-term 3	**Low 5**	Improbable	**Low**	-ve	High

Mitigation of impacts on fauna during the Operation Phase

- To avoid illegal hunting or poaching of animals and unessesary killing of small animals (mammals and herpetofauna), education of the operation staff about the value of wildlife and environmental sensitivity is needed. The contractors must ensure that no animals are disturbed, trapped, hunted or killed during the operation phase. Conservation-orientated clauses should be built into contracts for personnel, complete with penalty clauses for non-compliance.
- Control all waste dumping and pollution.
- Bats (and Birds) and invertebrates flying at night are attracted to lights, and these should be kept to a minimum. Outside lighting should be designed to minimize impacts on fauna. Fluorescent and mercury vapour lighting should be avoided and sodium vapour (yellow) lights should be used wherever possible.
- Ensure that powerlines are made safe to bats by applying standard Eskom measures.

11.2.2.3 Description of impacts and mitigation on fauna during the decommission phase

- Human activities during the decommission phase may lead to killing of faunal species, especially small mammals and herpetofauna. Harassing and hunting by workers could be a risk. The impact of human activities on fauna on the site is therefore regarded as Very Low to Insignificant.
- Clearing of constructed materials should be complete, with no rubble or waste be left on the site.

Mitigation

- To avoid illegal hunting or poaching of animals and unessesary killing of small animals (mammals and herpetofauna), education of the decommission staff about the value of wildlife and environmental sensitivity is needed. The contractors must ensure that no animals are disturbed, trapped, hunted or killed during the decomission phase. Conservation-orientated clauses should be built into contracts for personnel, complete with penalty clauses for non-compliance.
- Control all waste dumping and pollution.

Impact Table 6: : Impact on fauna of the proposed Kloofsig Phase 1 PV array during the decommissioning Phase –

Impact on fauna	Mitigation	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Destruction due to access to demolishment of the PV array area	Without mitigation	Local 1	High 3	Medium-term 2	**Medium 6**	Definite	**Medium**	-ve	High
	With mitigation	Local 1	Medium 2	Medium-term 2	**Low 5**	Definite	**Low**	-ve	Medium
Human activities, illegal hunting, poaching	Without mitigation	Local 1	Medium 2	Medium-term 2	**Low 5**	Possible	**Very Low**	-ve	Medium
	With mitigation	Local 1	Low 1	Medium term 1	**Very Low 4**	Possible	**Insignificant**	-ve	Medium
Substrate repair and vegetation restoration	Without mitigation	Local 1	Medium 2	Medium-term 2	**Low 5**	Definite	**Low**	+ve	High

11.2.3 Impacts on wetlands and Aquatic Sytems:

Wetlands and aquatic systems are very limited on the study site.

Possible impacts that the construction and/or operation of the proposed development of the Kloofsig Phase 1 PV array may have on the identified wetlands / aquatic systems include:

- Destruction of wetland / aquatic system habitat during construction and or operation.
- Sedimentation into wetlands / aquatic systems during construction and operation.
- Pollution into wetlands and potential to affect water quality during construction and operation.

11.2.3.1 Impact and mitigation: Destruction of wetland / aquatic habitats during construction

This impact is applicable to the construction phase only.

Table 7: Wetland 1, Dry Natural Pan

Wetland No 1	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral[KK6]	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant** **2**	improbable	**Insignificant**	neutral	High

This wetland is at least 50 m from the proposed development footprint and the construction of the proposed **Phase 1 PV array** will not have any impact on this wetland.

Mitigation:

Fence off the pan and buffer zone area (32 m from the outer edge of the pan) from the development area to avoid entry of workers into the pan area.

Table 8: Wetland 2, Transformed Pan

Wetland No 2	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Without mitigation	Local 1	High 3	Short-term 1	**Low** 5	Definite	**Low**	negative	High
With mitigation Avoid borehole area	Local 1	None 0	Short-term 1	**Not significant** **2**	improbable	**Insignificant**	neutral	High

This pan is already transformed and even without mitigation (which is only possible by avoiding the borehole area), the significance of the impact on the (now not existing) pan is Low.

Table 9: Wetland 3, Drainage Line

Wetland No 3	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low** 3	possible	**Insignificant**	neutral	Medium
With mitigation Move power line slightly away from drainage line	Local 1	None 0	Short-term 1	**Not significant** **2**	improbable	**Insignificant**	neutral	High

The original alignment of the powerline was often located within the 32 m buffer zone of the drainage line (Figures 7a and 8a). In spite of the insignificant impact that the pylons of this powerline could have had during the construction and operation phases of the proposed development, the alignment was moved slightly southwards (Figures 7b and 8b), and this will eliminate any impacts.

It should, however, be noted that the powerline will have to cross the drainage line, but will easily span over the drainage line without any impacts.

11.2.3.2 Impact and mitigation: Sedimentation into wetlands / aquatic systems during construction and operation

Table 10: Wetland 1, Dry Natural Pan

Wetland No 1	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Construction Phase								
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** **2**	improbable	**Insignificant**	neutral	High
With mitigation Avoid borehole area	Local 1	None 0	Short-term 1	**Not significant** **2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low** **4**	improbable	**Insignificant**	neutral	High

This natural pan is located at least 50 m from the proposed development footprint. It is clear that sedimentation from the proposed development will not have any impact on this wetland during the construction or operational phases.

Table 11: Wetland 2, Transformed Pan

Wetland No 2	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low** **3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant** **2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low** **4**	improbable	**Insignificant**	neutral	High

This pan is already destroyed and even without mitigation (which is only possible by avoiding the borehole area), the impact is Insignificant.This pan has no ecological significance.

Table 12: Wetland 3, Drainage Line

Wetland No 15	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Construction Phase								
Without mitigation	Local 1	None 0	Short-term 1	**Not significant** 2	improbable	**Insignificant**	neutral	High
With mitigation Move power line southwards	Local 1	None 0	Short-term 1	**Not significant** **2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low** **4**	improbable	**Insignificant**	neutral	High

It is not foreseen that the powerline will cause any sedimentation of the drainage line.

11.2.3.3 Impact and mitigation: Pollution into wetlands and potential to affect water quality during construction and operation

Table 13: Wetland 1, Dry Natural Pan

Wetland No 1	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low** **3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant** **2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low** **4**	improbable	**Insignificant**	neutral	High

This natural pan wetland is located at least 50 m from the proposed development footprint. No pollution is foreseen.

Table 14: Wetland 2, Transformed Pan

Wetland No 2	Spatial extent	Intensity	Duration	Consequence	Probability	Significance	Status	Confidence
Construction Phase								
Without mitigation	Local 1	Low 1	Short-term 1	**Very Low** **3**	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Short-term 1	**Not significant** **2**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	None 0	Long-term 3	**Very Low** 4	improbable	**Insignificant**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low** **4**	improbable	**Insignificant**	neutral	High

This pan is already transformed and developed - no pollution is foreseen.

Table 15: Wetland 3, Drainage Line

Wetland No 3	*Spatial extent*	*Intensity*	*Duration*	*Consequence*	*Probability*	*Significance*	*Status*	*Confidence*
Construction Phase								
Without mitigation	Local 1	Medium 2	Short-term 1	**Very Low** 4	possible	**Insignificant**	neutral	High
With mitigation Move line southwards	Local 1	Low 1	Short-term 1	**Very Low** **3**	improbable	**Insignificant**	neutral	High
Operational Phase								
Without mitigation	Local 1	Low 1	Long-term 3	**Low** 5	improbable	**Very Low**	neutral	High
With mitigation	Local 1	None 0	Long-term 3	**Very Low** **4**	improbable	**Insignificant**	neutral	High

During the short construction phase some pollution caused by machinery could have possible, though insignificant along the original (old) alignment (Figures 7a and 8a). Along the new alignment no pollution of the of the drainage line will occur.

11.3 Cumulative impacts

Increase in local and regional fragmentation and isolation of habitats

The general region is characterised by low levels of transformation and the introduction of the new developments is not perceived as having a significant cumulative effect. Existing developments at or close to the study site include the main road, Eskom lines and substation and a close-by farm.

Further development of Kloofsig Phases 2 and 3 will increase the cumulative impact, as more natural karoo vegetation will be destroyed. However, the total area planned for all three the Kloofsig developments is small in relation to the vast surrounding karoo vegetation. Therefore, although the impact on fauna and flora on the local sites of the three phases will be high, the impact on the vegetation and fauna of the region will be low.

12. CONCLUSION

The Kloofsig Phase 1 site is located in the Northern Upper Karoo vegetation unit (NKu 3 of Mucina & Rutherford 2006). The SANBI database showed that 181 plant species have been recorded form the two Grids 2924DC Havengabrug and 3024BA Petrusville. No species of conservation concern are listed, and the likeliness of such species being present on site is low to none.

The selected site is relatively easily accessible, is close to a road and with an access track, and there are already different powerline to which the grid can be connected, thus providing some of the basic infrastructure needed.

The vegetation consists of typical Karoo bossieveld, which is the backbone of agricultural practices in the region. The site supports five plant communities of karoo veld, with very limited drainage lines and pans. The drainage line and pans are condidered to be ecologically sensitive, though these are very small and mostly avoided by the development.

The pan on the south-western boundary of the site has a buffer of at least 50 m where no development will occur. The other pan on the site was totally transformed by a borehole, windpump and livestock kraals, and has no ecological or conservation value. The proposed powerline (new alignment) will not impact on the drainage line.

The vegetation on the larger part of the site has low to medium-low conservation value and sensitivity. More sensitive areas to the north of the property have been excluded from the proposed development.

The proposed development will have a negative effect on the general vegetation on the site in that large parts of the vegetation will have to be destroyed for the construction of the facility, and during the operational phase shading will affect the vegetation negatively.

However, the construction of the solar farm will be restricted to the relatively small surface area proposed for the Kloofsig Phase 1 development. As the proposed site for the development is very small when compared to the vast natural karoo veld surrounding the property, the impacts on vegetation and plant species on a regional basis are considered to be insignificant.

From a vegetation and fauna, as well as wetland point of view the area within the Kloofsig Phase 1 study site and proposed new powerline, the proposed development can be supported, though it is imperative that, should the development proceed, be carried out in a way to minimise not only species loss, but also the alteration and loss of habitats.

13 LIMITATIONS, ASSUMPTIONS AND GAPS IN KNOWLEDGE

The team has sufficient experience and ample access to information sources to confidently compile lists of biota such as presented herein to support conclusions and suggested mitigation measures based on site visits. In instances where doubt exists, a species is assumed to be a possible occupant (viz. shrews); -this approach renders the conclusions to be robust. In instances where the possible occurrence has significant ecological implications, further investigations are recommended. In view of the latter, it is highly unlikely that an intensive survey (trapping, netting, drift fences) to augment this site visit will add significantly to the data base, and the additional costs are unlikely to warrant the benefit.

Even though every care is taken to ensure the accuracy of this report, environmental assessment studies are limited in scope, time and budget. Discussions and proposed mitigations are to some extent made on reasonable and informed assumptions built on *bone fide* information sources, as well as deductive reasoning. Deriving a 100% factual report based on field collecting and observations can only be done over several years and seasons to account for fluctuating environmental conditions and migrations. Since environmental impact studies deal with dynamic natural systems, additional information may come to light at a later stage. EcoAgent can therefore not accept responsibility for conclusions and mitigation measures made in good faith based on own databases or on the information provided at the time of the directive. This report should therefore be viewed and acted upon with these limitations in mind.

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Taylor, P.J. 2000. *Bats of Southern Africa. University of Natal Press*: Pietermaritzburg.

The Conservation of Agricultural Resources Act, 1983 (Act No. 43 of 1983)

The Environmental Conservation Act, 1989 (Act No. 73 of 1989)

The National Environment Management Act, 1998 (Act No. 107 of 1998)

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The National Forests Act, 2006 (Act No. 84 of 1998 as amended). Government Gazette RSA Vol. 897, 29062, Cape Town, 8 Sept 2006.

The Natural Scientific Professions Act (Act No. 27 of 2003).

Van Wyk, J.C.P., Kok, D.J. & Du Preez, L.H. 1992. Growth and behaviour of tadpoles and juveniles of the African Bullfrog, *Pyxicephalus adspersus* Tschudi 1838. *J Herp. Assoc. Afr*. 40:56.

Werger, M.J.A. 1980. *A phytosociological study of the Upper Orange River Valley. Mem. Bot. Surv. S. Afr. 46:1-98.*

15. APPENDICES

15.1: CHECKLIST OF SPECIALIST REPORT

EIA REGULATIONS 2014 GNR 982 Appendix 6 CONTENT OF THE SPECIALIST REPORTS	Required at Scoping/Desk-top Phase	Required at BA/EIA Phase	Cross-reference in this scoping report
(a) details of— the specialist who prepared the report; and the expertise of that specialist to compile a specialist report including a curriculum vitae;	**X**	**X**	Appendix 16.3
(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	**X**	**X**	Appendix 16.1
(c) an indication of the scope of, and the purpose for which, the report was prepared	**X**	**X**	Sections 2 and 4
(d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	**X**	**X**	Section 6
(e) a description of the methodology adopted in preparing the report or carrying out the specialised process;	**X**	**X**	Section 6,
(f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;	**X**	**X**	Sections 7, 8, 9, and 10
(g) an identification of any areas to be avoided, including buffers;	**X**	**X**	Section 7 and 10
(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	**X**	**X**	Sections 7 and 10

EIA REGULATIONS 2014 GNR 982 Appendix 6 CONTENT OF THE SPECIALIST REPORTS	Required at Scoping/Desk-top Phase	Required at BA/EIA Phase	Cross-reference in this scoping report
(i) a description of any assumptions made and any uncertainties or gaps in knowledge;	**X**	**X**	Section 14
(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;	**X**	**X**	Section 11
(k) any mitigation measures for inclusion in the EMPr		**X**	Section 12
(l) any conditions for inclusion in the environmental authorisation;		**X**	Sections 7, 10 and 13
(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;		**X**	No
(n) a reasoned opinion— i. as to whether the proposed activity or portions thereof should be authorised; and ii. if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;		**X**	Section 13 and Exexutive Summary,
(o) a summary and copies of any comments received during any consultation process and where applicable all responses	**X**	**X**	N/A

EIA REGULATIONS 2014 GNR 982 Appendix 6 CONTENT OF THE SPECIALIST REPORTS	Required at Scoping/Desk-top Phase	Required at BA/EIA Phase	Cross-reference in this scoping report
thereto; and			
(p) any other information requested by the competent authority	**X**	**X**	None

15.2.1 DECLARATION OF INTEREST

environmental affairs
Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF SPECIALIST AND DECLARATION OF INTEREST

	(For official use only)
File Reference Number:	12/12/20 or 12/9/11/I
NEAS Reference Number:	DEA/EIA
Date Received:	

Application for authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998), as amended and the Environmental Impact Assessment Regulations, 2010

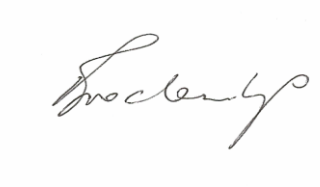
PROJECT TITLE

A vegetation and fauna biodiversity assessment for the proposed Phase 1 Kloofsig photovoltaic power (PV) energy generation, on the Farm Kalk Poort RE/18, Hopetown, Northern Cape Province

Specialist:	Prof George J Bredenkamp
Contact person:	Prof George J Bredenkamp
Postal address:	PO Box 25533 Monument Park

Postal code:	0105		
Telephone:	0124202525		0825767046
E-mail:	ecoagent@mweb.co.za george@ecoagent.co.za		
Professional affiliation(s) (if any)	PrSciNat Honorary Life Member of the South African Assiciation of Botanists (SAAB) Honorary Life Member of the Botanical Society of South Africa (BotSoc)		

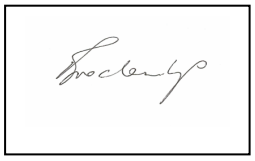
Project Consultant:	SRK Consulting (South Africa) (Pty) Ltd		
Contact person:	Karien Killian		
Postal address:	Ground Floor, Bay Suites, 1a Humewood Road, Port Elizabeth, 6001 P O Box 214842, Port Elizabeth, 6000		
Postal code:	6000		
Telephone:	0861626222		
E-mail:	kkillian@srk.co.za		



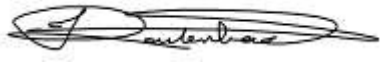
15.2.2 DECLARATION OF INDEPENDENCE

I, George Johannes Bredenkamp, Id 4602105019086, declare that I am the owner of Eco-Agent CC, CK 95/37116/23, and we (George Johannes Bredenkamp Id4602105019086, Ignatius Lourens Rautenbach Id4212015012005, and Jacobus Casparus Petrus van Wyk Id6808045041084) furthermore declare that we

-
- Are suitably qualified and are registered as per prerequisites of the Natural Scientific Professions Act No. 27 of 2003, and this project is our own work from its inception, reflects exclusively our observations and unbiased scientific interpretations, and was executed to the best of our ability
- Abide by the Code of Ethics of the S.A. Council for Natural Scientific Profession;
- Act as independent specialist consultants respectively in the fields of ecology, vegetation science and botany, as well as in mammalogy, ornithology and herpetology;
- Are assigned as specialist consultants by SRK Consulting for the proposed project "**A vegetation and fauna biodiversity assessment for the proposed Phase 1 Kloofsig photovoltaic power (PV) energy generation, on the Farm Kalk Poort RE/18, Hopetown, Northern Cape Province**" described in this report;
- Do not have or will not have any financial interest in the undertaking of the activity other than remuneration for work performed;
- Have or will not have any vested interest in the proposed activity proceeding;
- Have no and will not engage in conflicting interests in the undertaking of the activity;
- Undertake to disclose to the client and the competent authority any material information that have or may have the potential to influence the decision of the competent authority required in terms of the Environmental Impact Assessment Regulations 2014;
- Will provide the client and competent authority with access to all information at our disposal, regarding this project, whether favourable or not.



GJ Bredenkamp



I. L. Rautenbach

JCP van Wyk

15.3: CURRICULII VITAE

Abridged Curriculum Vitae: George Johannes Bredenkamp

Born: 10 February 1946 in Johannesburg, South Africa.

Citizenship: South African

Marital status: Married, 1 son, 2 daughters

Present work address

Department of Botany, University of Pretoria, Pretoria, 0002, South Africa

Tel:(27)(12)420-3121 Fax: (27)(12)362 5099

E-Mail: gbredenk@postino.up.ac.za

or

EcoAgent CC

PO Box 25533, Monument Park, 0105, South Africa

Tel: (27)(12) 346 3180

Fax: (27)(12) 460 2525

Cell 082 5767046

E-Mail: ecoagent@mweb.co.za

Qualifications:

1963 Matriculation Certificate, Kemptonpark High School

1967 B.Sc. University of Pretoria, Botany and Zoology as majors,

1968 B.Sc. Hons. (cum laude) University of Pretoria, Botany.

1969 T.H.E.D. (cum laude) Pretoria Teachers Training College.

1975 M.Sc. University of Pretoria, Plant Ecology .

1982 D.Sc. (Ph.D.) University of Pretoria, Plant Ecology.

Theses: (M.Sc. and D.Sc.) on plant community ecology and wildlife management in nature reserves in South African grassland and savanna.

Professional titles:

- MSAIE South African Institute of Ecologists and Environmental Scientists
  - 1989-1990 Council member
- MGSSA Grassland Society of Southern Africa

- 1986 Elected as Sub-editor for the Journal
- 1986-1989 Serve on the Editorial Board of the Journal
- - 1990 Organising Committee: International Conference: Meeting Rangeland challenges in Southern Africa
- 1993 Elected as professional member

• PrSciNat. South African Council for Natural Scientific Professions **Registration Number 400086/83**

- 1993-1997 **Chairman** of the Professional Advisory Committee: Botanical Sciences
- 1993-1997: **Council** Member
- 1992-1994: Publicity Committee
- 1994-1997: Professional Registration Committee

Professional career:

- Teacher in Biology 1970-1973 in Transvaal Schools
- Lecturer and senior lecturer in Botany 1974-1983 at University of the North
- Associate professor in Plant Ecology 1984-1988 at Potchefstroom University for CHE
- Professor in Plant Ecology 1988-2008 at University of Pretoria.
- 2009 – current Professor Extra-ordinary in the Dept of Plant Science, University of Pretoria
- • Founder and owner of the Professional Ecological Consultancy firms Ecotrust Environmental Services CC and Eco-Agent CC, 1988-present.

Academic career:

• Students:

- Completed post graduate students: M.Sc. 53; Ph.D. 14.
- Presently enrolled post-graduate students: M.Sc. 4; Ph.D. 2.

• Author of:

- 175 scientific papers in refereed journals
- >150 papers at national and international congresses
- >250 scientific (unpublished) reports on environment and natural resources

- 17 popular scientific papers.
- 39 contributions in books

• Editorial Committee of
  - South African Journal of Botany,
  - Journal Grassland Society of Southern Africa,
  - Bulletin of the South African Institute of Ecologists.
  - Journal of Applied Vegetation Science.(Sweden)
  - Phytocoenologia (Germany)
  -

• FRD evaluation category: C2 (=leader in South Africa in the field of Vegetation Science/Plant Ecology)

Membership:

• International Association of Vegetation Science.
• British Ecological Society
• International Society for Ecology (Intecol)
• Association for the Taxonomic study of the Flora of Tropical Africa (AETFAT).
• South African Association of Botanists (SAAB)
  1988-1993 Elected to the **Council** of SAAB.
  1989-1990 Elected as **Chairman** of the Northern Transvaal Branch
  1990 Elected to the Executive Council as **Vice-President**
  1990- Sub-editor Editorial Board of the Journal
  1991-1992 Elected as **President** (2-year period)
  1993 **Vice-President** and Outgoing President
• Wildlife Management Society of Southern Africa
• Suid-Afrikaanse Akademie vir Wetenskap en Kuns
  (=South African Academy for Science and Art).
• Wildlife Society of Southern Africa
  1975 - 1988: Member
  1975 - 1983: Committee member, Pietersburg Centre
  1981 - 1982: **Chairman**, Pietersburg Centre
• Dendrological Society of Southern Africa
  1984 - present: Member

1984 - 1988: Committee member, Western Transvaal Branch

1986 - 1988: **Chairman**, Western Transvaal Branch

1987 - 1989: Member, Central Committee (National level)

1990 - 2000: Examination Committee

• Succulent Society of South Africa

1987 - 2000

• Botanical Society of South Africa

2000 – present: Member

2001- 2008: Chairman, Pretoria Branch

2002 – 2006: Chairman, Northern Region Conservation Committee

2002- 2007: Member of Council

Special committees:

• Member of 10 special committees re ecology, botany, rangeland science in South Africa.

• Member of the International Code for Syntaxonomical Nomenclature 1993-present.

Merit awards and research grants:

1968 Post graduate merit bursary, CSIR, Pretoria.

1977-1979 Research Grant, Committee re Research Development, Dept. of Co-operation and Development, Pretoria.

1984-1989 Research Grant, Foundation for Research Development, CSIR, Pretoria.

1986-1987 Research Grant, Dept. of Agriculture and Water Supply, Potchefstroom.

1990-1997 Research Grant, Dept. of Environmental Affairs & Tourism, Pretoria.

1991-present Research Grant, National Research Foundation , Pretoria.

1991-1993 Research Grant, Water Research Commission.

1999-2003 Research Grant, Water Research Commission.

2006 South African Association of Botanists Silver Medal for outstanding contributions to South African Botany

Abroad:

1986 Travel Grant, Potchefstroom University for Christian Higher Education, Potchefstroom

Visits to Israel, Italy, Germany, United Kingdom, Portugal.

1987 Travel Grant, Potchefstroom University for Christian Higher Education, Potchefstroom.

Visits to Germany, Switzerland, Austria, The Netherlands, United Kingdom.

1990 Travel Grant, FRD.

Visit to Japan, Taiwan, Hong-Kong.

1991 Travel Grant, FRD.

Visits to Italy, Germany. Switzerland, Austria, France, The Netherlands, United Kingdom.

1993 Travel Grant, University of Pretoria.

Visits to the USA, Costa Rica, Czech Republic, Austria.

1994 Travel Grant FRD.

Visits to Switzerland, The Netherlands, Germany, Czech Republic.

1995 Travel Grant FRD, University of Pretoria

Visits to the USA

1996 Travel Grant, University of Pretoria

Visit to the UK.

1997 Travel Grant University of Pretoria, Visit Czech Republic, Bulgaria

1998 Travel Grant, University of Pretoria, Visit Czech Republic, Italy, Sweden

1999 Travel Grant, University of Pretoria, Visit Hungary, Spain, USA

2000 Travel Grant, University of Pretoria, Visit Poland, Italy, Greece.

2001 Travel Grant, NRF, Visit Brazil

2006 German Grant Invited lecture in Rinteln, Germany

Consultant

Founder and owner of Ecotrust Environmental Services CC and Eco-Agent CC

Since 1988 **>250** reports as consultant on environmental matters, including:

- Game Farm and Nature Reserve planning,
- Environmental Impact Assessments,
- Environmental Management Programme Reports,
- Vegetation Surveys,
- Wildlife Management,
- Veld Condition and Grazing Capacity Assessments,

Red Data analysis (plants and animals).

Abridged Curriculum Vitae: Ignatius Lourens Rautenbach

Identity number 421201 5012 00 5

Gender Male

Date of birth 1 December 1942

Nationality South African

Home languages Afrikaans, fluent in English

Postal address 45 Helgaard Street, Kilner Park, Pretoria, RSA 0186.

Tel no +27 12 3334112, Cell 082 3351288

E-mail **naasrauten@mweb.co.za**

Former position Retired Director: Planning, Northern Flagship Institute

Present position Consultant – Specialist Environmental Assessments,

Project management Research –EIAs, writing, woodworking, photo-recording

Qualifications **B.Sc**. (UP), **T.H.E.D** (Pta TTC), **M.Sc.** (UP), **Ph.D**.(Un. Natal)

Honours

Associate of the Photographic Society of South Africa

Master photographer at club level

Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400300/05

Notable Research Contribution

In-depth survey of the Mammals of the Transvaal

Notable Literary Contribution

Rautenbach, Naas & Annalene Rautenbach. 2008. *Photography for Focused Beginners.* 302pp with 250 images. Green Door Studio, Pretoria.

Formal Courses

Computer Literacy, Project Management, Contract Design, Senior Management

Employment history

May 2001 - Present Self-employed, collaborator with du Plessis & Associates [display design and construction], Galago Ventures [environmental impact assessment], technical writing, and photography

April 1999 - August 2001 Director: Planning, Northern Flagship Institution

Jan 1991 - April 1999 Executive Director, Transvaal Museum

July 1967 - Dec 1990 Curator (in charge) of the Division of Mammalogy, Transvaal Museum. Promoted to Specialist Scientist rank as of June 1985

March - June 1967 Research student at the Mammal Research Institute of the Zoology Department, University of Pretoria

July 1966, Nov l966 - Febr 1967 Member of the Smithsonian Institution's field teams as part of the 'African Mammal Project'

1966: Part-time research assistant to Prof. J. Meester, University of Pretoria

1962 - 1965 Temporary assistant during University holidays in the Nematology laboratories, Agricultural Technical Services

1992 - 2001 Founder member and non-executive director of the Board of Trustees of the Museum Park Section 21 Company

1993 - 2001 Founder member and Trustee of the privatised Museums Pension Fund

1997 - 2001 Non-executive director of the Tswaing Section 21 Company

Professional Achievement

Managed a research institute of 125 members of staff. Solicited numerous grants totalling ≥ R1 000 000. Initiated and overseen building programmes of R30 million at Transvaal Museum. Conceptualised and managed 12 display programmes.

Research:

Author and co-author of 85 scientific publications on mammalogy in peer reviewed subject journals, 18 Popular articles, 10 Books, and >400 contractual EIA research reports. Extensive field work and laboratory experience in Africa, Europe, USA, Alaska, Brazil and Mexico. B-rated by FRD as scientist of international status

Public Recognition

Public speaking *inter alia* Enrichment Lecturer on board the 6* SS Silver Wind, radio talks, TV appearances

Hobbies

Technical writing, photography, field logistics, biological observations, wood working, cooking, designs

Abridged Curriculum Vitae: Jacobus Casparus Petrus van Wyk

Identity number	680804 5041 08 4
Gender	Male
Date of birth	4 August 1968
Nationality	South African
Home languages	Afrikaans, fluent in English

Postal address P.O. Box 25085, Monument Park, Pretoria, 0105.
Tel no +27 12 347 6502, Cell +27 82 410 8871
E-mail **jcpvanwyk@absamail.co.za**

Present position Co-Department Head, Environmental Education & Life Sciences, Hoërskool Waterkloof

Consultant Specialist Environmental Assessments, EIAs, writing, photo-recording

Qualifications **B.Sc**. (U.F.S.) **B.Sc. (Hon.)** (U.F.S.), **H.E.D** (U.O.F.S.), **M.Sc.** (U.F.S.)

Honours Foundation of Research Development bursary holder
Professional Natural Scientist (Zoology) – S.A Council for Natural Scientific Professions, Registration # 400062/09

Notable Research Contribution In-depth field study of the giant bullfrog

Formal Courses Attended Outcomes Based Education, University of the South Africa (2002)
Introductory Evolution, University of the Witwatersrand (2008)
OBE, GET & FET training, 2002-2008, Education Department

Employment history

2000 – Present Co-Department Head for Environmental Education & Life Sciences, Hoërskool Waterkloof, Pretoria.

1995 - 1999 Teaching Biology (Grades 8 – 12) and Physics / Chemistry (Grades 8 – 9) at the Wilgerivier High School, Free State. Duties included teaching, mid-level management and administration.

July 1994 – Dec 1994 Teaching Botany practical tutorials to 1st year students at the Botany & Zoology Department of the Qwa-Qwa campus of the University of Free State, plant collecting, amphibian research

1993 - 1994 Mammal Research Institute (University of Pretoria) research associate on the Prince Edward Islands: topics field biology and population dynamics of invasive alien rodents, three indigenous seals, invertebrate assemblages, censussing king penguin chicks and lesser sheathbills, and marine pollution

1991 - 1993 Laboratory demonstrator for Zoological and Entomological practical tutorials, and caring for live research material, University of the Free State

1986 - 1990 Wildlife management and eco-guiding, Mt. Everest Game Farm, Harrismith

Professional Achievement

Research: Author and co-author of 50 scientific publications in peer-reviewed and popular subject journals, and 22 contractual EIA research reports. Extensive field work and laboratory experience in Africa

Public Recognition: Public speaking *inter alia* radio talks, TV appearances

Hobbies: Popular writing, travel, marathon running, climbing (viz Kilimanjaro), photography, biological observations, public speaking.