Annex G.6

General Ecology Specialist Report

PROPOSED ESTABLISHMENT OF THE GAMSBERG ZINC MINE, CONCENTRATOR PLANT AND ASSOCIATED INFRASTRUCTURE NEAR THE TOWN OF AGGENEYS, NORTHERN CAPE

FAUNA & FLORA SPECIALIST REPORT FOR ESIA

PRODUCED FOR ERM

ON BEHALF OF VEDANTA

BY

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EXECUTIVE SUMMARY

Vedanta, the owner of Black Mountain Mining intends to start mining the Gamsberg zinc reserve. Vedanta intends to build an open pit for the mine as well as an associated concentrator plant. A variety of associated infrastructure is required including an extension to the waste water treatment works at Aggeneys, additional housing for staff at Aggeneys, a switching yard and an overhead power line to provide power to the facility and an offtake pipeline from the Pella-Aggeneys water pipeline. The purpose of this study is to provide an ecological assessment of the above infrastructure for the ESIA of the proposed Gamsberg Zinc Mine. This assessment deals only with the peripheral infrastructure whereas the on-site pit and concentrator plant are covered by another assessment.

The different development components were assessed in the field over the course of several site visits. Full flora lists for each development footprint were gathered and active searches and surveys of fauna were conducted. The results indicate that all the development components are restricted to the Bushmanland Sandy Grassland and the Bushmanland Arid Grassland vegetation types. These are not highly sensitive vegetation communities and few species of conservation concern were observed within the development footprint. As the sites are restricted to homogenous sandy lowlands, faunal diversity within the sites is also relatively low.

The housing development is the most extensive of the development components and would occupy an extent of approximately 50ha, adjacent to the existing town. The other components would each result in the loss of less than 10ha of currently intact habitat. A number of different potential impacts were identified as being associated with each of the development components and assessed. A summary assessment is provided below. The construction phase impacts of the housing development on fauna and flora cannot be mitigated on account of the permanent loss of habitat which results from this development. During the operational phase all impacts associated with each of components are however of minor significance after mitigation.

In terms of the mitigation measures recommended to reduce the likely impact of the development, the following specific measures are recommended:

- Translocation of species of conservation concern prior to the commencement of construction.
- Phased construction so that there are not extensive disturbed areas present for extended periods of time which might pose a threat of wind and water erosion.
- Topsoil stockpiling, to be replaced after construction to encourage the natural regeneration of the vegetation within the development footprint.
- The overhead power line should be fitted along its length with bird flight diverters to reduce mortalities of susceptible bird species.

Provided that the mitigation measures as suggested can be implemented, then the overall impact of the development would be of low overall long-term significance and it is not likely that the development would result in an overall net loss of biodiversity or long-term degradation of the receiving environment.

Summary assessment of the pre- and post-mitigation impacts associated with the construction and operation phases of the various development components.

Element/Impact	**Construction**		**Operation**	
	Pre-mitigation	Post-mitigation	Pre-mitigation	Post-mitigation
Waste Water Treatment Works				
Avifauna impacts	Moderate	Minor	Moderate	Minor
Housing development				
Impact on vegetation	Moderate	Moderate	Minor	Minor
Impact on fauna	Moderate	Moderate	Minor	Minor
Impact on avifauna	Moderate	Minor	Minor	Minor
Power Line				
Impact on vegetation	Moderate	Minor	Minor	Minor
Impact on avifauna	Moderate	Minor	Minor	Minor
Water Offtake Pipeline				
Impact on vegetation	Moderate	Minor	Minor	Minor
Impact on fauna	Moderate	Minor	Minor	Minor

DECLARATION OF CONSULTANTS INDEPENDENCE

The author of this report, Simon Todd, does hereby declare that he is an independent consultant appointed by ERM and has no business, financial, personal or other interest in the activity, application or appeal in respect of which he was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of the specialist performing such work. All opinions expressed in this report are his own.

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1 INTRODUCTION

Vedanta, the owner of Black Mountain Mining intends to start mining the Gamsberg zinc reserve. Although a number of feasibility studies have examined the potential viability of mining the large but low grade reserve, a viable approach has only recently been identified. Similarly, an EIA process was previously undertaken in 2000 and approval was received for the proposed project in 2001. However, as the validity period of the authorisation has expired, it is the intention of Black Mountain Mining to recommence the ESIA process.

The proposed project will include the following project components:

- Establishment of the Gamsberg Zinc Mine with an expected output capacity of approximately 10 million tons per year (beneficiation tonnage). The proposed mine is expected to have a life span of approximately 20 years (assuming open pit mining technique).
- Construction of a Zinc Concentrator Plant with a total processing capacity of 10 million tons per year.
- In order to manage the waste streams generated from the mining process, Vedanta intends to construct 1 tailings dam and 1 waste rock dump.
- In order to fulfill the water requirements of the proposed zinc mine, Vedanta intend to upgrade the existing water pipeline from the Pella abstraction point along the Orange River to the proposed mine. The expected water requirements for the entire project (including housing, mining, concentrator etc.) are approximately 9,125 m3/ annum.
- In order to meet the energy requirements of the proposed project, Vedanta intends to either construct a 220 kv/ 66kv substation along the northern border of the N14 and a 66 kV/ 11 kV substation along the southern border of the N14. The two substations will be connected with two new 66 kV distribution lines. Alternatively, Vedanta intends to construct two 66 kV distribution lines from the existing Aggeneys substation to a new 66 kV/ 11 kV substation at the proposed mine (refer to locality map for approximate positions).
- The proposed project is expected to result in the creation of construction and operational phase employment opportunities. In order to house the expected workforce, Vedanta intends to construct additional housing in the town of Aggeneys.

There are a number of different ecological specialists working on the ESIA, dealing with various aspects and components of the development. The components being covered under this study include the following elements:

- New housing development in Aggeneys.
- Expansion for additional capacity at the Aggeneys waste water treatment works.
- Water offtake pipeline from the Orange River - Aggeneys pipeline to the mine.

- Power line and substation/switching yard from the existing Eskom infrastructure to the mine

Furthermore, the upgrade of the existing water pipeline from the Pella abstraction point along the Orange River to Aggeneys has been split from the Gamsberg ESIA on account of the applicant being the Pella Water Board rather than Black Mountain Mining. A Basic Assessment process for the pipeline has been conducted and Simon Todd Consulting provided the fauna and flora specialist report for the pipeline. This report should be read in conjunction with the Pella Water Board ecological report, which provides a detailed description of the affected environment and the various habitats encountered in the study area. Those aspects covered in the Pella Water Board ecological specialist study will not be repeated here.

The purpose of this study is to characterise and describe the terrestrial environment, habitats and species present within the affected development areas and provide an assessment of the likely impacts of the development. As each component is of a separate nature with potentially different impacts, each element is assessed independently.
The broad terms of reference for the assessment include the following:

- Assess and detail the potential impacts of the proposed development elements on both vegetation and fauna at the site
- Outline possible mitigation measures, rehabilitation procedures and or vegetation removal procedures that would reduce the potential impacts of the development.
- Identify and rate the significance of potential impacts and outline additional management guidelines.

The detailed terms of reference for the study are described below.

1.1 SCOPE OF STUDY

Vegetation Study

- Carry out fieldwork to locate and describe the current state of vegetation on the Study Area, key focus on the impact footprint(s) for site, so that there is a baseline description/status quo against which impacts can be identified and measured.
- Determine the species present and localities within each vegetation types.
- Generate a vegetation map showing the site in relation to any Critical Biodiversity Areas and links to ecological corridors and support areas, vegetation sensitivity, disturbed, transformed and potential "no-go" areas.
- Determine whether the Study Area falls wholly or partially within the distribution range of species listed as Vulnerable, Endangered or Critically Endangered and Protected.
- Provide site photos that show the current state of the vegetation (i.e. natural, transformed, disturbed etc.) Identify and describe the conservation value and

conservation planning frameworks relevant to this site (Regional Planning) for represented vegetation units.

- A detailed list of species of special concern.
- An indication of the irreplaceability value of vegetation types present on site.
- Describe the areas where indigenous vegetation has been transformed.
- Determine alien species present; their distribution within the Study Area and recommended management actions.
- A description of different micro-habitats, and the species associated with those habitats.
- Note and record the position of unusually large specimens of trees.
- Describe the potential direct, indirect and cumulative negative and positive impacts of the proposed activity on vegetation species during the construction, operation and decommissioning phases of the project.
- Identification of issues and potential direct, indirect and cumulative biodiversity impacts, which are to be considered in combination with any additional relevant issues that may be raised through the public consultation process. These include:
    - The cumulative impact of clearing for the construction of solar facilities on floral species of concern both on the farm and in the greater area.
- Disclose any gaps in information or assumptions made.
- Recommendations for mitigatory measures to minimise impacts identified.
- An outline of additional management guidelines.
- Provide monitoring requirements, mitigation measures and recommendations in a table format as input into the Environmental Management Plan (EMP), as well as generic rehabilitation and re-vegetation guidelines.

Faunal Study

- Carry out fieldwork to describe and assesses the current state of terrestrial fauna in the area so that there is a baseline description/status quo against which impacts can be identified and measured.
- Conduct a faunal assessment that can be integrated into the ecological study.
- Describe the existing impacts of current land use as they affect the fauna.
- Describe the different micro-habitats, and the species associated with those habitats.
- Describe the potential direct, indirect and cumulative negative and positive impacts of the proposed activity on inhabitant and reliant faunal species during the construction, operation and decommissioning phases of the project.
- Provide a detailed fauna sensitivity map of the site, including mapping of faunal community disturbance, transformation and potential "no-go" areas on site.
- Clarify species of special concern (SSC) and that are known to be:
    - endemic to the region;
    - that are considered to be of conservational concern;
    - that are in commercial trade (CITES listed species);
    - or, are of cultural significance.

- A description of species composition and conservation status in terms of protected, endangered or vulnerable faunal species.
    - This description will include species which are likely to occur within, traverse across or forage within the proposed project area, as well as species which may not necessarily occur on site, but which are likely to be impacted upon as a result of the proposed development.
- Identification of issues and potential direct, indirect and cumulative biodiversity impact which are to be considered in combination with any additional relevant issues that may be raised through the public consultation process. These include:
    - The cumulative impact of clearing for the construction of solar facilities on faunal species of concern both on the farm and in the greater area.

General Considerations:

- Disclose any gaps in information or assumptions made.
- Recommendations for mitigatory measures to minimise impacts identified.
- An outline of additional management guidelines.
- Provide monitoring requirements, mitigation measures and recommendations in a table format as input into the Environmental Management Plan (EMP) for faunal related issues.

A description of the potential impacts of the development and recommended mitigation measures are to be provided which will be separated into the following project phases:

- Construction
- Operational phases

2 *REGULATORY AND LEGISLATIVE OVERVIEW*

A summary of the relevant portions of the Acts which govern the activities and potential impacts to the environment associated with the development are listed below. Provided that standard mitigation and impact avoidance measures are implemented, not all the activities listed in the Acts below would actually be triggered.

National Environmental Management Act (NEMA) (Act No 107, 1998):

NEMA requires that measures are taken that "prevent pollution and ecological degradation; promote conservation; and secure ecologically sustainable development and use of natural resources while promoting justifiable economic and social development." In addition:

- That the disturbance of ecosystems and loss of biological diversity are avoided, or where they cannot be altogether avoided, are minimised and remedied:

- That a risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions; and
- Sensitive, vulnerable, highly dynamic or stressed ecosystems, such as coastal shores, estuaries, wetlands, and similar systems require specific attention in management and planning procedures, especially where they are subject to significant human resource usage and development pressure.

Environment Conservation Act (ECA) (No 73 of 1989 Amendment Notice No. R1183 of 1997)

This Act provides for the effective protection and controlled utilisation of the environment. This Act has been largely repealed by NEMA, but certain provisions remain, in particular provisions relating to environmental impact assessments. The ECA requires that developers must undertake Environmental Impact Assessments (ESIA) for all projects listed as a Schedule 1 activity in the ESIA regulations.

National Environmental Management: Biodiversity Act (NEMBA) (Act 10 of 2004):

The National Environmental Management: Biodiversity Act (Act 10 of 2004) (NEMBA) provides for listing threatened or protected ecosystems, in one of four categories: critically endangered (CR), endangered (EN), vulnerable (VU) or protected. The Draft National List of Threatened Ecosystems (Notice 1477 of 2009, Government Gazette No 32689, 6 November 2009) has been gazetted for public comment. The list of threatened terrestrial ecosystems supersedes the information regarding terrestrial ecosystem status in the NSBA 2004. In terms of the ESIA regulations, a basic assessment report is required for the transformation or removal of indigenous vegetation in a critically endangered or endangered ecosystem regardless of the extent of transformation that will occur. However, all of the vegetation types within and surrounding the study site are classified as Least Threatened.

The Act provides for listing of species as threatened or protected, under one of the following categories:

- **Critically Endangered:** any indigenous species facing an extremely high risk of extinction in the wild in the immediate future.
- **Endangered:** any indigenous species facing a high risk of extinction in the wild in the near future, although it is not a critically endangered species.
- **Vulnerable:** any indigenous species facing an extremely high risk of extinction in the wild in the medium-term future; although it is not a critically endangered species or an endangered species.
- **Protected species:** any species which is of such high conservation value or national importance that it requires national protection. Species listed in this category include, among others, species listed in terms of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES).

NEM:BA also deals with endangered, threatened and otherwise controlled species, under the TOPS Regulations (Threatened or Protected Species Regulations). These regulations deal with the hunting industry as well as any other activities which involve the cultivation, keeping or impacting listed species. A permit is required for any listed activities involving protected or endangered species. These permits are usually administered by the provincial authorities and may take the form of an Integrated Permit, which covers both the provincial and national TOPS requirements.

Apart from the TOPS regulations NEM:BA also provides for the regulation of certain activities, known as Restricted Activities. These activities may not proceed without environmental authorization. Those relevant to the current study are listed below.

Under the **Environmental Impact Assessment Regulations Listing Notice 1 of 2010** (No. R.544) the following activities are likely to be triggered:

Activity 1. The construction of facilities or infrastructure, including associated structures or infrastructure, for –

(k) the bulk transportation of sewage and water, including storm water, in pipelines with -

(i) an internal diameter of 0,36 metres or more; or

(ii) a peak throughput of 120 litres per second or more;

(l) the transmission and distribution of electricity above ground with a capacity of more than 33 kilovolts and less than 120 kilovolts;

(m) any purpose in the one in ten year flood line of a river or stream, or within 32 metres from the bank of a river or stream where the flood line is unknown, excluding purposes associated with existing residential use, but including -

(i) canals;

(ii) channels;

(iii) bridges;

(iv) dams; and

(v) weirs;

Activity 11 (Xi): The construction of infrastructure or structures covering 50 square metres or more where such construction occurs within a watercourse or within 32 metres of a watercourse, measured from the edge of a watercourse, excluding where such construction will occur behind the development setback line.

Under the **Environmental Impact Assessment Regulations Listing Notice 2 of 2010** (No. R.387) the following activities are likely to be triggered:

Activity 2. Any development activity, including associated structures and infrastructure, where the total area of the developed area is, or is intended to be, 20 hectares or more.

And, under **Environmental Impact Assessment Regulations Listing Notice 3** of 2010 (*R.546):*

Activity 12. The clearing of an area of 300 square meters or more of vegetation where 75% or more of the vegetation cover constitutes indigenous vegetation:

(b) Within critical biodiversity areas identified in bioregional plans

Activity 13. The clearing of an area of 1 hectares or more of vegetation where 75% or more of the vegetation cover constitutes indigenous vegetation:

(a) Within critical biodiversity areas and ecological support areas as identified in systematic biodiversity plans adopted by the compentent authority.

Activity 16 IV: The construction of infrastructure covering 10 square meters of more where such construction occurs within a watercourse of within 32 metres of a watercourse measured from the edge of the watercourse, excluding where such construction will occur behind the development setback line. Within:

It is important to note that the above thresholds and activities also apply to phased developments "*where any phase of the activity may be below a threshold but where a combination of the phases, including expansions or extensions, will exceed a specified threshold.*"

National Forests Act (No. 84 of 1998):

The National Forests Act provides for the protection of forests as well as specific tree species, quoting directly from the Act: "*no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a licence or exemption granted by the Minister to an applicant and subject to such period and conditions as may be stipulated*".

No nationally protected tree species were observed within the development footprint and given the open nature of the area and the limited extent of the development footprint, it can be confirmed with some certainty that no such species are likely to be affected by the development.

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

The Conservation of Agricultural Resources Act provides for the regulation of control over the utilisation of the natural agricultural resources in order to promote the conservation of soil,

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

Northern Cape Nature Conservation Act, No. 9 of 2009:

The Northern Cape Nature Conservation Act provides inter alia for the sustainable utilisation of wild animals, aquatic biota and plants as well as permitting and trade regulations regarding wild fauna and flora within the province. The Act also lists protected fauna and flora under 3 schedules ranging from Endangered (Schedule 1), Protected (schedule 2) to Common (schedule 3). The majority of mammals, reptiles and amphibians are listed under Schedule 2, except for listed species which are under Schedule 1. A permit is required for any activities which involve species listed under Schedule 1 or 2. Of relevance for the current development is the fact that several plant families and genera are listed in their entirety as protected, this includes, inter alia *Mesembryanthemaceae*, *Amaryllidaceae*, *Apocyanceae*, *Asphodeliaceae*, *Crassulaceae*, *Iridaceae* and *Euphorbia*. A permit obtainable from the DENC permit office in Kimberly would be required for the site clearing. A permit would also be required to destroy or translocate any nationally or provincially listed species from the site. A single integrated permit, which covers all of these permitting requirements as well as meets ToPS regulations, is used.

3 METHODOLOGY

3.1 DATA SOURCING AND REVIEW

The data sources consulted and used where necessary in the study includes the following:

Flora & Ecosystem

- Vegetation types for the area were extracted from the South African National Vegetation Map (Mucina and Rutherford 2006), while the conservation status of the affected vegetation types is from Mucina & Rutherford (2006) and the National List of Threatened Ecosystems (2011), as applicable.
- Information on plant and animal species recorded for the Quarter Degree Squares (QDS) 2818DD, 2819CC, 2918BB, 2919AA, 2918BD and 2919AC. was extracted from the SABIF/SIBIS database hosted by SANBI. This is a significantly larger extent than the Study Area and the list would therefore contain a lot more species than would actually

occur at the site, but represents a necessarily cautious approach as the specific study site and its vicinity have probably not been well sampled in the past.

- The IUCN conservation status (Table 1) of the species in the list was also extracted from the database and is based on the Threatened Species Programme, Red List of South African Plants (2012).
- Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011).
- Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES).

Fauna

- Lists of mammals, reptiles and amphibians which are likely to occur at the site were derived based on distribution records from the literature and various spatial databases.
- Literature consulted includes Branch (1988) and Alexander and Marais (2007) for reptiles, Du Preez and Carruthers (2009) for amphibians, Friedmann and Daly (2004) and Skinner and Chimimba (2005) for mammals.
- The list of reptiles for the site was augmented by generating a list of species recorded for the area from the SARCA website http://vmus.adu.org.za. The conservation status of reptiles is based on the list compiled by Branch & Bates for the *Atlas and Red List of the Reptiles of South Africa*, *Lesotho and Swaziland* (Bates et al. In Press)
- Bird data for the site was extracted from the SABAP 1 and SABAP 2 databases and Birdlife South Africa's Important Bird Areas was also consulted to ascertain if the site falls within the range of any range-restricted or globally threatened species as well as for descriptions of the IBAs.
- The faunal species lists provided are based on species which are known to occur in the broad geographical area, as well as a preliminary assessment of the availability and quality of suitable habitat at the site. For each species, the likelihood that it occurs at the site was rated according to the following scale:
    - **Low:** The available habitat does not appear to be suitable for the species and it is unlikely that the species occurs at the site.
    - **Medium:** The habitat is broadly suitable or marginal and the species may occur at the site.
    - **High:** There is an abundance of suitable habitat at the site and it is highly probable that the species occurs there.
    - **Confirmed:** Species that were directly or indirectly (scat, characteristic diggings, burrows etc.) observed at the site over the course of the site visits.

General

- The conservation status of each species is also listed, based on the IUCN Red List Categories and Criteria version 3.1 (2012) (See Table 1) and where species have not been

assessed under these criteria, the CITES status is reported where possible. These lists are adequate for mammals and amphibians, the majority of which have been assessed, however the majority of reptiles have not been assessed and therefore, it is not adequate to assess the potential impact of the development on reptiles, based on those with a listed conservation status alone. In order to address this shortcoming, the distribution of reptiles was also taken into account such that any narrow endemics or species with highly specialized habitat requirements occurring at the site were noted. This was particularly pertinent with regards to the Pella Water Board application, but the current study falls outside of the distribution of any narrow endemics and none are reported in this particular regard as a result.

Table 1. The IUCN Red List Categories for fauna and flora. Species which fall within the categories in red and orange below, are of conservation concern.

IUCN Red List Category
Critically Endangered (CR)
Endangered (EN)
Vulnerable (VU)
Near Threatened (NT)
Critically Rare
Rare
Declining
Data Deficient - Insufficient Information (DDD)
Data Deficient - Taxonomically Problematic (DDT)
Least Concern

3.2 SAMPLING LIMITATIONS AND ASSUMPTIONS

The site was visited on several separate occasions; including the 21st to 23rd of August 2012, the 3rd of December 2012 and 8th of March 2013. The pipeline and power line was investigated during the initial visit, the off-take pipeline during the second and the water treatment works during the third site visit. Although the various site visits provide some temporal variation in the sampling, it was relatively dry throughout the site visits and there was not a lot of difference in the state and composition of the vegetation. As a result, the plant species lists obtained for the site are representative of the perennial component and ephemeral species are not well represented. This is not seen a highly significant obstacle as there are no listed annuals in the area and the majority of listed species known from the area are likely to have been visible at the time of the site visits. Although no active small mammal or reptile trapping was conducted as part of the assessment, the lists of amphibians, reptiles and mammals for the site are based on those observed at the site as well as those likely to occur in the area based on their

distribution and habitat preferences. This represents a sufficiently conservative and cautious approach which takes account of the study limitations.

3.3 FIELD ASSESSMENT

During the site visits, the development footprint of each component was walked and a full plant species list for each site was drawn up. All individuals of listed and protected species were noted and their localities recorded with a GPS. Active searches for reptiles and amphibians were also conducted within habitats likely to harbor or be important for such species. The presence of sensitive habitats such as wetlands or pans and unique edaphic environments such as rocky outcrops or quartz patches were noted in the field if present and recorded on a GPS and mapped onto satellite imagery of the site. At the water treatment works a count of waterfowl and waders was also conducted in order to obtain an estimate of the number and composition of birds that are currently using the site.

3.4 SENSITIVITY MAPPING & ASSESSMENT

The ecological sensitivity of the site was assessed by integrating the information collected on-site with the available ecological and biodiversity information available in the literature and various spatial databases as described above. The ecological sensitivity of the different sites was rated according to the following scale:

- **Low –** Areas with a low sensitivity where there is likely to be a negligible impact on ecological processes and terrestrial biodiversity. This category is reserved specifically for areas where the natural vegetation has already been transformed, usually for intensive agricultural purposes such as cropping. Most types of development can proceed within these areas with little ecological impact. There were very few areas of low sensitivity within the development footprint as the area has generally been little impacted by transformation.
- **Medium**- Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impact such as erosion low. Development within these areas can proceed with relatively little ecological impact provided that appropriate mitigation measures are taken.
- **High –** Areas of natural or transformed land where a high impact is anticipated due to the high biodiversity value, sensitivity or important ecological role of the area. Development within these areas is highly undesirable and should only proceed with caution as it may not be possible to mitigate all impacts appropriately.
- **Very High –** Critical and unique habitats that serve as habitat for rare/endangered species or perform critical ecological roles. These areas are essentially no-go areas from a developmental perspective and should be avoided at all costs.

3.5 RELEVANT ASPECTS OF THE DEVELOPMENT

- The housing development is located on the outskirts of Aggeneys, between the two existing sections of the town and comprises an area of approximately 50 ha.
- The expansion of the water treatment works will occur immediately adjacent and to the south of the current treatment works and would comprise a number of treatment ponds covering about 6 ha.
- In terms of the substation and electrical infrastructure, Vedanta intends to either construct a 220 kv/ 66kv substation along the northern border of the N14 and a 66 kV/ 11 kV substation along the southern border of the N14. The two substations will be connected with two new 66 kV distribution lines. Alternatively, Vedanta intends to construct two 66 kV distribution lines from the existing Aggeneys substation to a new 66 kV/ 11 kV substation at the proposed mine.
- The offtake off of the proposed Orange River-Aggeneys pipeline will come off the pipeline opposite the mine and will cross the R27 at the current entrance to the Gamsberg.

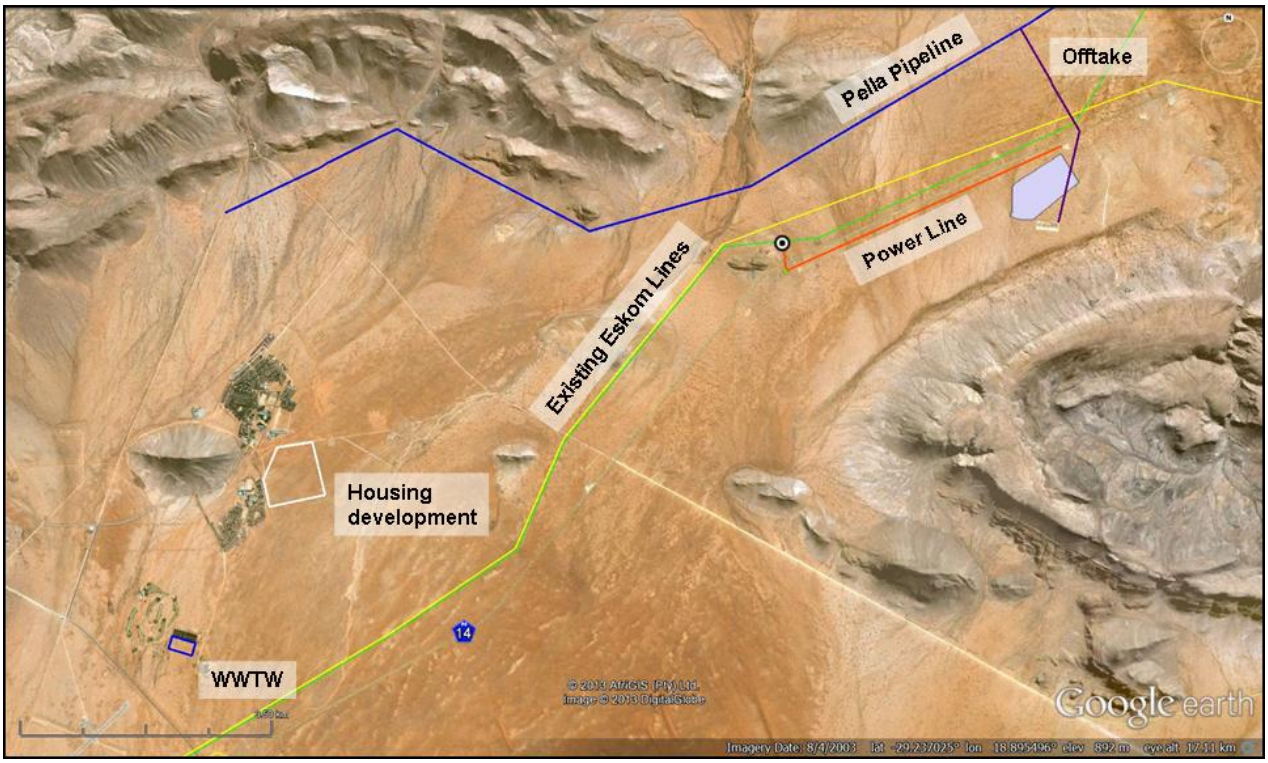

Figure 1. Satellite image depicting the location of the various development components being assessed in this study. (WWTW – Waste water treatment works)

4 DESCRIPTION OF THE AFFECTED ENVIRONMENT- BASELINE

4.1 BROAD-SCALE VEGETATION PATTERNS

The national vegetation map (Mucina & Rutherford 2006) for the Study Area is depicted below in *Figure 2*. Although there are a number of different vegetation types in the area, only two would be impacts by the development. The housing and waste water treatment works fall within the Bushmanland Sandy Grassland vegetation type, while the power line and water offtake fall within the Bushmanland Arid Grassland vegetation type.

Bushmanland Arid Grassland is an extensive vegetation type and is the second most extensive vegetation type in South Africa and occupies an area of 45478 km² and extends from the Study Area around Aggeneys in the east to Prieska in the west. It is associated largely with red-yellow apedal (without structure), freely drained soils, with a high base status and mostly less than 300mm deep. Due the arid nature of the unit which receives between 70 and 200 mm annual rainfall, it has not been significantly impacted by intensive agriculture and more than 99% of the original extent of the vegetation type is still intact. Mucina & Rutherford (2006) list 6 endemic species for the vegetation type which is a relatively low number given the extensive nature of the vegetation type.

Bushmanland Sandy Grassland occupies an area of 2282 km2 and occurs from around Aggeneys in the north along the Koa River valley in an easterly and southerly direction, with a smaller isolated extent near Prieska about 300km to the south east. Although no endemic flora species are listed for this vegetation unit, it is not very well known suggesting that there may be such species present. This vegetation unit is however the habitat of the Red Lark *Calendulauda burra* which is a Bushmanland Endemic listed as Vulnerable. Due to the homogenous sandy substrate these vegetation types do not exhibit a high degree of species turnover and the vast majority of species present are widespread. Along exposed ridges and open plains, there may be some areas of exposed calcrete or quartz outcrops which are home to edaphic specialists. Although some such areas have been identified within the broader study area, no such areas where identified within the current development footprint.

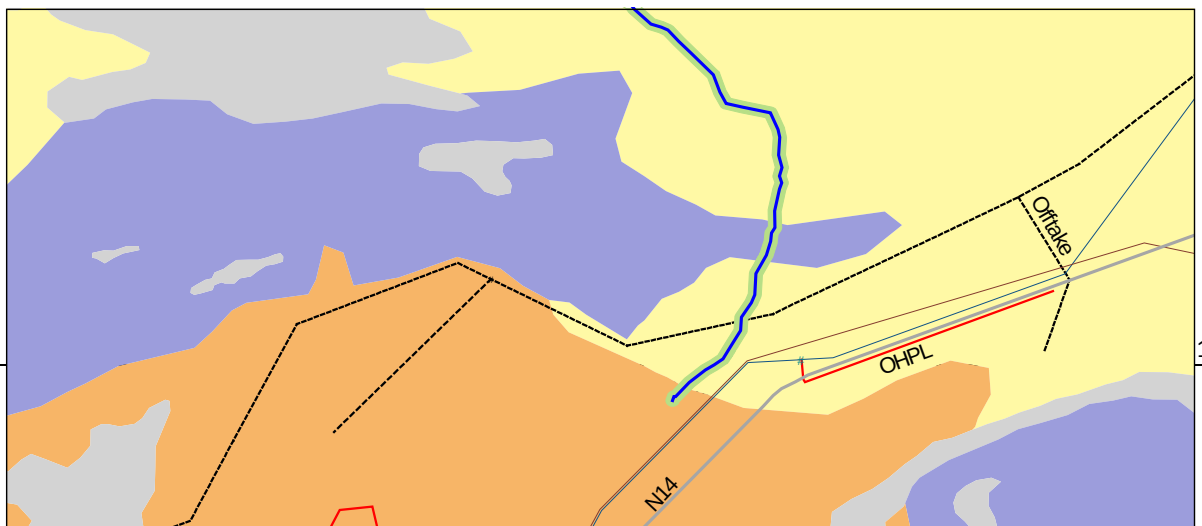

Figure 2. The national vegetation map (Mucina & Rutherford 2006) for the area around the proposed Gamsberg infrastructure. Rivers and wetlands delineated by the National Freshwater Ecosystem Priority Areas Assessment (Nel et al. 2011) are also depicted.

Table 3. The extent of the different vegetation types present within the broader Study Area, within the country as well as within the development footprint itself. All the vegetation types present are classified as Least Threatened.

Vegetation Type	Vegetation Type Total Extent (km²)	Vegetation Type Remaining Extent (%)	Extent in Study Area (ha)	Proportion in Study Area (%)
Aggeneys Gravel Vygieveld	62.22	99.1	5040.03	81.00
Bushmanland Arid Grassland	45478.96	99.4	87475.31	1.92
Bushmanland Inselberg Shrubland	637.52	99.8	15971.99	25.05
Bushmanland Sandy Grassland	2282.99	99.5	27604.83	12.09

4.2 FINE-SCALE VEGETATION PATTERNS

In this section the actual vegetation within the development footprints are described. The descriptions provided by Mucina and Rutherford (2006) are generic and do not necessarily reflect the vegetation patterns as observed on the ground. Therefore the characteristic and important species present within each of the different footprints are described below. Additional details on the plant communities present in the wider area are contained in the report for the Pella Water Board application and the reader is referred to that report as well for additional insight into the vegetation of the site.

Waste Water Treatment Works

The current waste water treatment works will be extended into the adjacent area to the south. The affected area is depicted below, and is previously disturbed with some parts having been ploughed in the past. Species observed within the development footprint include *Rhigozum trichotomum*, *Stipagrostis brevifolia*, *S.ciliata*, *S.obtusa*, *Zygophyllum retrofractum*, *Lycium pumilum*, *Hypertelis salsoloides*, *Salsola namibica*, *Salsola kali*, *Chascanum pumilum*, *Psilocaulon coriarium*, *Indigastrum argyraeum*, *Vernonia cinerascens*, *Galenia papulosa*, *Zygophyllum simplex*, *Mesembryanthemum crystallinum*. Alien species observed at the site include *Atriplex semibaccata*, *Atriplex inflata*, and *Prosopis glandulosa*. The diversity at the site is very low and the species listed above comprise the full list for the site. No species of conservation concern were observed within the development footprint and given the previous disturbance, it is not likely that any such species would be impacted. The major potential impact of the waste water treatment works would be on waterfowl and waders which are attracted to such features.

Figure 3. The expansion area for waste water treatment works and a section of the existing works.

Housing Development

The housing development area is an open sandy plain dominated by bushman grasses. Common species observed include *Stiagrostis brevifolia*, *S.obtusa*, *S.ciliata*, *S.anomala*, *S.namaquensis*, *Monechma incanum*, *Zygophyllum retrofractum*, *Parkinsonia africana*, *Derverra denudata*, *Hermannia affinis*, *Rhigozum trichotomum*, *Sisyndite spartea*, *Sutherlandia frutescens*, *Asparagus retrofractus*. No species of conservation concern were observed at the site and given the relatively limited extent of the site and the vegetation type present, it is unlikely that any such species occur within the development footprint. The vegetation is however in a good condition and apart from some disturbed areas near to the existing town, the vegetation is natural and intact with no aliens present.

Figure 4. Looking across the housing development area. The vegetation is dominated by *Stiagrostis brevifolia* and *S.obtusa*.

Power Line

The vegetation at the

substation where the power line will cross the N14 is similar to that at the housing development and is dominated by *Stipagrostis brevifolia* and *S.obtusa*, with occasional *Rhigozum trichotomum* and *Lycium pumilum*. No listed species were observed during the site visits, but some *Hoodia gordonii* plants do occur in this area and the final development footprint should be checked in the field prior to construction for such species, which can translocated outside the affected area. The vegetation to the north of the N14 is grazed and is in a reasonable condition. The area to the south of the N14 is not grazed and is in a better condition. The area affected by the switch yard and power line is not considered highly sensitive and there do not appear to be any highly sensitive plant communities along the route of the power line.

Figure 5. Looking from next to the existing Eskom substation towards the Gamsberg, where the power line will cross the N14.

Water Offtake Pipeline

The water offtake from the Pella-Aggeneys pipeline comes off the pipeline opposite the current mine entrance. The area is very flat and occurs on shallow red soils underlain by calcrete. The vegetation is dominated by *Stipagrostis brevifolia* with few other species present apart from occasional shrubs such as *Lycium pumilum*, *Rhigozum trichotomum* and *Zygophyllum retrofractum.* Some *Hoodia gordonii* plants occur in the area, particularly to the west of the N14 and depending on the exact alignment of the final pipeline route, some individuals of this species may be impacted. There are however no plant communities of conservation concern that have been observed within the pipeline route and the vegetation is considered to be of medium sensitivity.

Figure 6. Looking from the Pella-Aggeneys pipeline along the alignment of the proposed offtake pipeline. The vegetation is very homogenous and dominated by *Stipagrostis brevifolia*.

4.3 CRITICAL BIODIVERSITY AREAS & BROAD-SCALE PROCESSES

The site lies within the planning domain of the Namakwa Biodiversity Sector Plan (Desment & Marsh 2007). This biodiversity assessment identifies Critical Biodiversity Areas (CBAs) which represent biodiversity priority areas which should be maintained in a natural to near natural state. The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to maintain ecosystem functioning and meet national biodiversity objectives. As can be seen from the CBA map for the area, depicted below in *Figure 7*, the CBAs in the area are complex and reflect the landscape diversity in the area as well as the abundance of specific habitats of conservation significance. The waste water treatment works and the housing development fall outside of any CBA or Ecological Support Areas and given their proximity to the town, it is not likely that the development of these areas would create any broader scale issues. The pipeline and power line are both within an ecological support area. The total footprint of these elements is however low and would amount to less than 1 ha each and would not create a significant disruption of the landscape.

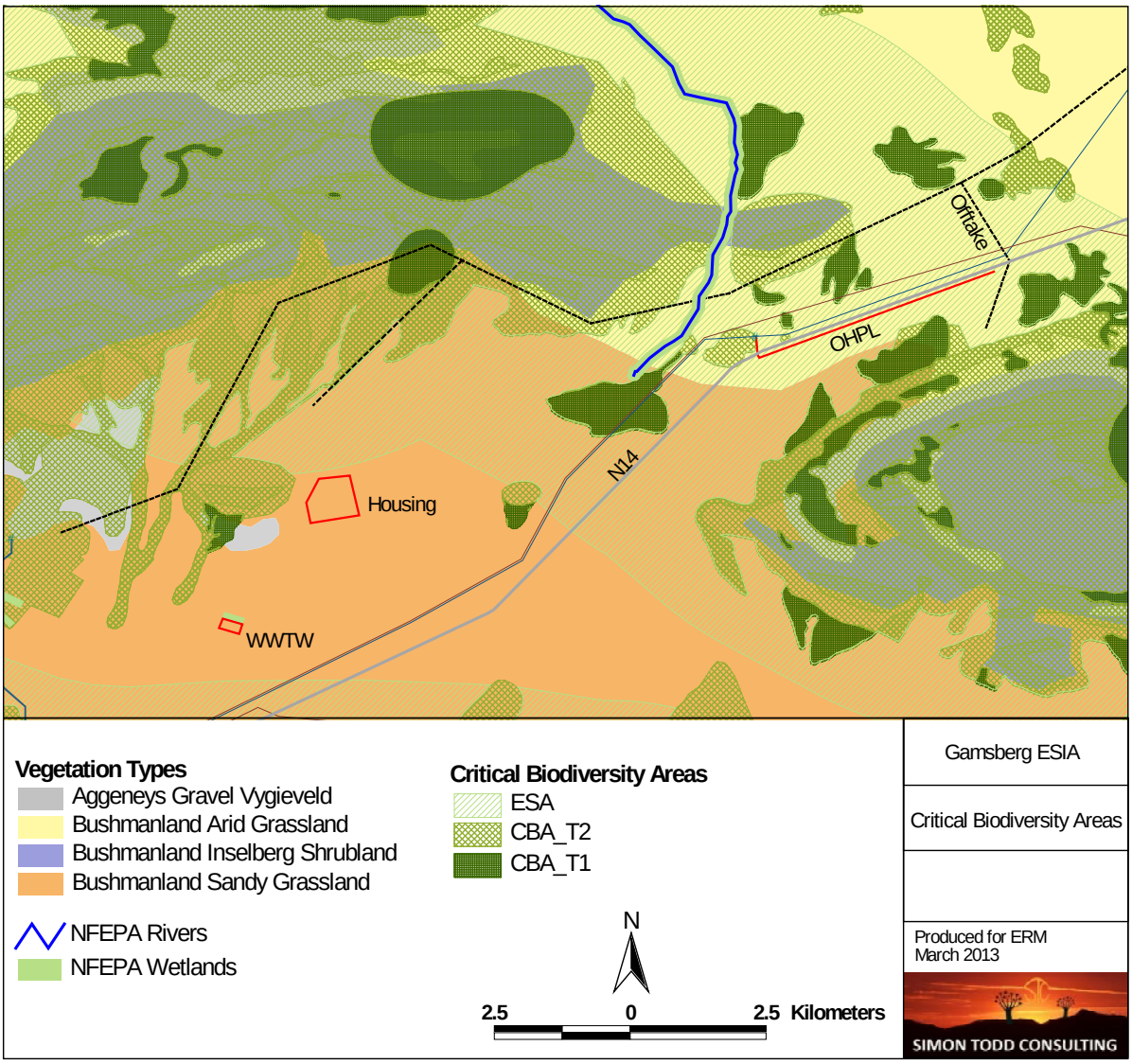

Figure 7. Critical Biodiversity Areas map for the study area. The CBA map is an extract of the CBA map for the Namakwa District as produced by Desment & Marsh (2007)

4.4 FAUNAL COMMUNITIES

The faunal communities are described fully in the Pella water board application and only the salient points as relevant to the current application are provided here.

Mammals

The site falls within the distribution range of as many as 48 terrestrial mammals and 8 bats, indicating the mammalian diversity at the site is potentially high. There are however only three listed species which may occur at the site; the Black-footed Cat *Felis nigripes* (Vulnerable), Leopard *Panthera pardus* (Near Threatened) and Angolan hairy bat *Cistugo seabrae* (Near

Threatened). The Black-footed Cat is likely to occur across the site at low density, but is widely distributed across the arid parts of the country and the long-term loss of habitat for this species would be minimal. The Leopard and the Angolan Hairy Bat are likely to be associated with the mountains and environment of the Orange River and are not likely to occur more widely across the site.

Mammal diversity within the affected areas is however likely to be low. The water treatment works site is highly disturbed and not likely to be attractive to many mammals. Some gerbil burrows, probably Hairy-footed Gerbil *Gerbillurus paeba* were observed at the site. Some burrows of yellow mongoose were also observed, but these animals would move elsewhere once construction begins. The habitat at the housing development site is less disturbed and likely to contain a greater variety of mammals. The substrate and vegetation is however homogenous which would limit the likely diversity of the site. Species observed to occur in this area include Cape Porcupine, Aardvark and South African Ground Squirrel. No listed fauna are likely to occur at either of these sites given their proximity to the existing town. The housing development would result in some habitat loss for fauna, but as this affected habitat is widely available in the area, this would not constitute a significant impact at the landscape scale. The power line infrastructure and water pipeline offtake are more remote and likely to have a more complete mammalian fauna. The extent of habitat loss resulting from these developments would however be minimal and it is not likely that any mammals would be significantly affected in the long-term by the development. The major impacts on mammals would be during the construction phase when a lot of noise and disturbance would be generated.

Reptiles are abundant in the area and include such species as the Bushmanland tent tortoise, *Psammobates tentorius verroxii* and Anchieta's Agama *Agama anchietae*. Diversity is however highest near the Orange River and within the habitats within the development footprint of the componenents being considered here, no specialized species were encountered.

Reptiles

The site lies in or near the distribution range of at least 60 reptile species (Appendix 3), comprising 1 tortoise, 25 snakes, 26 lizards and skinks, 12 geckos and 1 chameleon, indicating that the reptile diversity at the site is likely to be very high. A significant proportion of these are however associated with the Orange River and the adjacent mountains and not likely to occur within the footprint of the current developments. Furthermore, the habitat diversity within the affected areas is very low and is restricted to lowland sandy habitats and hence the reptile fauna is likely to be restricted to species associated with these habitats. Species observed in these areas include Ground Agama *Agama aculeata*, Spotted Desert Lizard *Meroles suborbitalis*, Plain Sand Lizard *Pedioplanis inornata* and Bushmanland Tent Tortoise *Psammobates tentorius verroxii.*

The impacts on reptiles are not likely to be highly significant when considered in the landscape context and the relatively minor habitat loss resulting from the infrastructure. Furthermore, development such as the housing development would create novel habitat that would be utilised by species adapted to homes and gardens such as some geckos and skinks.

Amphibians

The site lies within the distribution range of 10 amphibian species. However given the distance of the development sites to fresh water, the sites are not likely to be important for very many amphibians. It is likely that only species which are independent of water for breeding or which forage away from water occur at the sites. The water at the treatment works are too polluted for amphibians and it is highly unlikely that any amphibians use this area for breeding purposes. Given the likely low abundance of amphibians at the affected sites, the developments are not likely to have a significant impact on amphibians.

Avifauna

Although bird species richness at the site is quite low, the site lies within an important area for several listed species as well as many biome-restricted species. The area around Aggeneys, particularly those areas consisting of Bushmanland Sandy Grassland lie within an Important Bird Area (IBA) as defined by Birdlife South Africa. This IBA known as the Haramoep and Black Mountain Mine Nature Reserve IBA (Birdlife South Africa - Bird Area factsheet: SA 035), extends from south of the N14 near Aggeneys to the Orange River in the north and includes both red sand dunes associated with the Koa River valley as well as barren stony plains between Aggeneys and Orange River. According to the description provided by Birdlife South Africa for the IBA, this is one of the few sites protecting both the globally threatened Red Lark *Certhilauda burra*, which inhabits the red sand dunes, and the near-threatened Sclater's Lark *Spizocorys sclateri*, which occurs erratically on the barren stony plains.

Of the different components included in this study, the power line infrastructure poses the greatest risk to avifauna. Although the proximity of the line to the mine would deter some species from the vicinity, many collision-prone species fly at night and would probably still be vulnerable to collisions with the lines as they passed through the area. The entire length of the power line should be fitted with bird flight diverters to mitigate this potential impact. Power line infrastructure can also attract avifauna, but as there is already quite a large number of trees and power lines present in the immediate area, it is not likely that the new power line would attract much attention from species such as Sociable Weavers looking to build their large communal nests on the poles. In terms of other species, the proximity of the proposed power line to the mine and future mining activity would be likely to deter many of these species from using the majority of the new line, given that there are numerous alternatives in the area. Although the area is a key location for the Red Lark, it is not likely that the development would have a significant impact on the Red Lark as the red dune habitat preferred by this species does not occur within the development footprint

Figure 8. View of part the existing water treatment works at Aggeneys, showing some of the various waterfowl present and the structure of the ponds.

The waste water treatment works are also likely to have a significant influence an avifauna as they are likely to attract waders and waterfowl. Approximately 400 birds were counted at the current treatment works and the expansion of the works is likely to be accompanied by an increase in the number of birds using the treatment works. The utilisation of such artificial

features varies substantially over time depending on the availability and distribution of natural water sources in the surrounding landscape. The composition of waterfowl was dominated by the following species in descending order of abundance: Cape Teal *Anas capensis*, South African Shelduck *Tadorna cana*, Maccoa Duck *Oxyura maccoa*, Little Grebe *Tachybaptus ruficollis*, Egytian Goose *Alopochen aegyptiacus* and Cape Shoveler *Anas smithii*. These species accounted for more than 90% of the birds present and other less common species observed include Three-banded Plover *Charadrius tricollaris*, Black-winged Stilt *Himantopus himantopus* and Lesser Flamingo *Phoenicopterus minor*. Given the presence of the existing water treatment works at the site, the expansion would not create a novel impact in the area, but may increase the number of individuals using the site. As listed species vulnerable to collisions with power lines such as Flamingos are present, new and existing power lines in the vicinity of the water treatment works should be fitted with bird flight diverters to reduce the danger of collisions. Furthermore, if repeated collisions occur despite the diverters, then the alignment of the power lines should be adjusted to avoid the predominant flight path of the affected species. Ultimately the most effective mitigation would be to place cabling underground, but this would only be necessitated if monitoring reveals that collisions are still occurring despite the presence of warning devices. Since the birds present are accustomed to the maintenance activities at the works, the construction works for the expansion may deter some of the more shy species from the site, but many species are likely to tolerate the disturbance provided that they are not directly persecuted. An attribute of the current works which probably detracts from its value as a refuge for waterfowl is the lack of any areas where waterfowl can avoid terrestrial predators. This could take the form of low wooden platforms anchored in the water on which birds can roost at night.

4.5 SITE SENSITIVITY ASSESSMENT

The different development components covered in this assessment are all within areas of moderate sensitivity except for the waste water treatment works which is in an area of low sensitivity. There are no plant communities on conservation concern within the development footprints and faunal diversity is also likely to be low. No species of conservation concern were observed within the development footprint. It is however possible that some individuals of *Hoodia gordonii* might be affected by the development. The *Stipagrostis* grasslands that will be impacted are the dominant vegetation types in the landscape and the amount of habitat loss likely to result from all of the developments covered here combined is less than 100 ha, the majority of which would be caused by the housing development. The proposed sites are also all of very low slope, which would reduce the erosion potential. It is however important to recognize that the area is very arid and once disturbed the vegetation recovers very slowly and active rehabilitation can also be very difficult. As a result, it is important to ensure that the disturbance footprints are kept to a minimum and that no unnecessary vegetation clearing occurs during construction. The relatively low sensitivity of the assessed components is to a

large extent related to their location and any changes to their position would require a re-examination of their sensitivity and likely impacts.

5 IMPACT ASSESSMENT

5.1 ASSESSMENT & SIGNIFICANCE CRITERIA

The assessment criteria used in the assessment are described below and are drawn from the ESIA Regulations, published by the Department of Environmental Affairs and Tourism (April 1998) in terms of the Environmental Conservation Act No. 73 of 1989 as well as Brownlie (2005).

For each impact the following are described:

Nature of the impact. A description of positive or negative effect of the project on the affected environment, or *vice versa*. The description includes who or what would be affected, and how.

Extent of the impact. This includes assessing the spatial scale of the impact using the following scale:

- **On-site –** impacts that are limited to the site boundaries.
- **Local –** impacts that affect an area in a radius of 5 km around the site.
- **Regional –** impacts that affect regionally important environmental resources or are experienced at a regional scale as determined by administrative boundaries, habitat type/ecosystem.
- **National –** impacts that affect nationally important environmental resources or affect an area that is nationally important/ or have macro-economic consequences.
- **Transboundary/International –** impacts that affect internationally important resources such as areas protected by international conventions.

Duration of the impact. The lifespan of the impact is assessed as follows:

- **Temporary –** impacts are predicted to be of short duration and intermittent/occasional.
- **Short-term –** impacts that are predicted to last only for the duration of the construction period.
- **Long-term –** impacts that will continue for the life of the Project, but ceases when the Project stops operating.
- **Permanent –** impacts that cause a permanent change in the affected receptor or resource (eg. removal or destruction of ecological habitat) that endures substantially beyond the Project lifetime.

Certain impacts can also be *discontinuous or intermittent* (where the impact may only occur during specific climatic conditions or during a particular season of the year).

Intensity or magnitude of the impact. The intensity or severity of the impact would be indicated as either

- **Negligible** – the impact on the environment is not detectable.
- **Low** – the impact affects the environment in such a way that natural functions and processes are not affected.
- **Medium** – where the affected environment is altered but natural functions and processes continue, albeit in a modified way.
- **High** – where natural functions or processes are altered to the extent that it will temporarily or permanently cease.

Potential for impact on irreplaceable resources. This refers to the potential for an environmental resource to be replaced, should it be impacted. A resource could possibly be replaced by natural processes (e.g. by natural colonisation from surrounding areas), through artificial means (e.g. by reseeding disturbed areas or replanting rescued species) or by providing a substitute resource, in certain cases. In natural systems, providing substitute resources is usually not possible, but in social systems substitutes are often possible (e.g. by constructing new social facilities for those that are lost). Should it not be possible to replace a resource, the resource is essentially irreplaceable e.g. red data species that are restricted to a particular site or habitat of very limited extent.

Probability of occurrence. The likelihood of the impact actually occurring would be indicated as either Improbable (the possibility of the impact materialising is very low as a result of design or historic experience), Probable (there is a distinct possibility that the impact will occur), Highly probable (it is most likely that the impact will occur), or Definite (the impact will occur regardless of the implementation of any prevention measures).

Significance of the impact. Based on a synthesis of the information contained in the criteria above, the potential impact would then be described according to following significance criteria:

- **No significance**: the impacts do not influence the proposed development and/or environment in any way.
- **Low/Minor significance**: the impacts will have a minor influence on the proposed development and/or environment. These impacts require some attention to modification of the project design where possible, or alternative mitigation.
- **Moderate significance**: the impacts will have a moderate influence on the proposed development and/or environment. The impact can be ameliorated by a modification in the project design or implementation of effective mitigation measures.
- **High significance**: the impacts will have a major influence on the proposed development and/or environment and will result in the "no-go" option on the

development or portions of the development regardless of any mitigation measures that could be implemented. This level of significance must be well motivated.

The following table is used to determine significance based on the likelihood and magnitude of the assessed impact:

SIGNIFICANCE RATING				
	LIKELIHOOD	**Unlikely**	**Likely**	**Definite**
MAGNITUDE	Negligible	Negligible	Negligible	Minor
	Low	Negligible	Minor	Minor
	Medium	Minor	Moderate	Moderate
	High	Moderate	Major	Major

Table illustrating the different colour scales used to highlight significance ratings in the impact assessment tables.

Negative ratings	**Positive ratings**
Negligible	Negligible
Minor	Minor
Moderate	Moderate
Major	Major

Table of definitions of the different significance ratings and their implications for the development.

Significance Definitions	
Negligible significance	*An impact of negligible significance is where the magnitude is negligible, low or medium and the likelihood of the impact occurring is unlikely or likely.* An impact of negligible significance is where a resource or receptor will not be affected in any way by a particular activity, or the predicted effect is deemed to be imperceptible or is indistinguishable from natural background levels.
Minor significance	*An impact of minor significance is where the magnitude of the impact is low but the likelihood is high or where the magnitude is high but the likelihood of occurrence is unlikely or likely.* An impact of minor significance is one where an effect will be experienced, but the impact magnitude is sufficiently small and well within accepted standards,

	and/or the receptor is of low sensitivity/value.
Moderate significance	*An impact of moderate significance is where the magnitude is medium to high and the likelihood of the impact occurring is likely or definite.* An impact of moderate significance is one within accepted limits and standards. The emphasis for moderate impacts is on demonstrating that the impact has been reduced to a level that is as low as reasonably practicable (ALARP). This does not necessarily mean that "moderate" impacts have to be reduced to "minor" impacts, but that moderate impacts are being managed effectively and efficiently.
Major significance	*An impact of major significance is where the magnitude of the impact is medium to high and the likelihood of the impact occurring is also likely or definite.* An impact of major significance is one where an accepted limit or standard may be exceeded, or large magnitude impacts occur to highly valued/sensitive resource/receptors. A goal of the ESIA process is to get to a position where the Project does not have any major residual impacts, certainly not ones that would endure into the long term or extend over a large area. However, for some aspects there may be major residual impacts after all practicable mitigation options have been exhausted (i.e. ALARP has been applied). An example might be the visual impact of a development. It is then the function of regulators and stakeholders to weigh such negative factors against the positive factors, such as employment, in coming to a decision on the Project.

Confidence The level of confidence in predicting the impact can be described as:

- **low**, where there is little confidence in the prediction, due to inherent uncertainty about the likely response of the receiving ecosystem, or inadequate information;
- **medium**, where there is a moderate level of confidence in the prediction;
- or **high**, where the impact can be predicted with a high level of confidence.

Cumulative Impact

Consideration is given to the extent of any accumulative impact that may occur due to the proposed development. Such impacts are evaluated with an assessment of similar developments already in the environment. Such impacts will be either positive or negative, and will be graded as being of negligible, low, medium or high impact.

Mitigation

The objective of mitigation is to firstly avoid and minimise impacts where possible and where these cannot be completely avoided, to compensate for the negative impacts of the development on vegetation and animal habitats and to maximise re-vegetation and rehabilitation of disturbed areas. For each impact identified, appropriate mitigation measures to reduce or

otherwise avoid the potential impacts are suggested. All impacts are assessed without mitigation and with the mitigation measures as suggested appropriately implemented.

In order to ensure that impacts are avoided as far as possible and to implement effective mitigation at the site, the following mitigation hierarchy is used to prioritise mitigation actions:

- ***Avoidance***: Avoiding or reducing at source is essentially 'designing' the project so that a feature causing an impact is designed out (eg a waste stream is eliminated) or altered (eg reduced waste volume). Often called minimisation (most preferred)
- ***Reduction***: impact is reduced in magnitude and/or significance
- ***Abate on Site:*** This involves adding something to the basic design to abate the impact - pollution controls fall within this category. Often called 'end-of-pipe'.
- ***Rectification***: impact is mitigated after it has occurred e.g. rehabilitation of areas disturbed by construction
- ***Compensation***: providing a substitute resource for a resource that has been lost because of the project (e.g. "*conservation offsets*")
- ***No action (least preferred)***

5.2 IDENTIFICATION & NATURE OF IMPACTS

In this section the different impacts likely to result from the development are discussed and described for each of the development components. The impacts assessed differ slightly from those which were assessed for the Pella Water Board application, which can be ascribed to differences in the nature, context and extent of transformation associated with the different development components. Impacts on broad-scale processes have not been identified as being significant in the current context on account of the low extent ot transformation as in the case of the power line, or the proximity of the development to an existing impact as in the case of the housing development and water treatment works.

5.2.1 Waste Water Treatment Works

Given the degraded nature of the area identified for the expansion of the waste water treatment works, impacts on vegetation and terrestrial fauna are not likely to be significant and are assumed to be very low. The expansion of the works would however be highly likely to impact avifauna, negatively during the construction as birds using the existing works may be impacted and potentially positively thereafter if appropriate management and monitoring is applied.

5.2.2 Housing development

The housing development occupies a fairly extensive area compared to the other components of this study. As such impacts on terrestrial fauna, avifauna and flora can be expected and the

potential impact on each is assessed. The major avenue of impact from this component of the development would be the transformation and direct loss of habitat resulting from the construction of the housing development within an area of currently intact habitat.

5.2.3 Power Line

The power line infrastructure may impact vegetation within the development footprint and may also pose a long-term threat to avifauna. Impacts on terrestrial fauna are not likely to be significant given the low footprint of this component. Therefore, impacts on avifauna and flora are assessed with regards to the power line infrastructure.

5.2.4 Water Offtake Pipeline

After construction, the pipeline will be buried underground and impacts related to this component of the development would result from the disturbance created during the construction phase rather than the operation of the pipeline which can be expected to have a very low direct impact. Impacts from this component are likely to be largely restricted to fauna and flora.

5.3 ASSESSMENT OF IMPACTS

The major impacts identified above for each development component are assessed below, during the construction and operational phases of the project as well as before and after mitigation.

5.3.1 Waste water Treatment Works

Construction Phase Impacts

Impact 1: *Negative impact of construction activities on avifauna*

Impact Nature: Construction activities such as the operation of heavy machinery and the presence of construction personnel at the site will deter many bird species from using the existing water works and direct persecution such as poaching and hunting is also a risk.									
Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Probability*	*Significance*	*Confidence*
Without Mitigation	**Negative**	**Local**	**Short-term**	**Medium**	**Medium**	**Low**	**Probable**	**Moderate**	**High**
With Mitigation	**Negative**	**Local**	**Short-term**	**Low**	**High**	**Low**	**Probable**	**Minor**	**High**

Mitigation Description:

- Ensure that disturbance to the existing water treatment works area is kept to a minimum. This should include restricting access to this area by construction staff.
- There are currently no safe areas within the water treatment works which are not accessible from the mainland and which represent a safe area where waterfowl might find refuge, especially when they are moulting and cannot fly away. Therefore, a mitigation measure which should be applied to the new and existing water treatment works would be the supply of two or three floating platforms within each area, which are anchored away from the edges of the dams and which can be used as refuges by the waterfowl.
- No construction personnel should be allowed to purposely disturb the avifauna at the existing water treatment works.
- All construction staff should undergo an environmental induction course which includes clear instructions regarding the disturbance of avifauna at the site and that no birds may be hunted, trapped or otherwise disturbed.

Residual Impact: The noise and activity is likely to deter some species from the site, but as construction is transient, this would not be a long term impact and all species are likely to return after construction.

Cumulative Impact: During the construction phase the activity at the site will contribute towards disturbance of avifauna in the area. The construction phase will however be transient and no long-term cumulative impacts are likely to be generated by the construction activities themselves.

Operational Phase Impacts

Impact 1: *Negative impact of operational activities on avifauna*

Impact Nature: Operational activities such maintenance or uncontrolled access to the site may have a negative impact on avifauna.

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Probability*	*Significance*	*Confidence*
Without Mitigation	**Negative**	**Local**	**Short-term**	**Medium**	**High**	**Low**	**Probable**	**Moderate**	**High**
With Mitigation	**Negative**	**Local**	**Short-term**	**Low**	**High**	**Low**	**Probable**	**Minor**	**High**

Mitigation Description:

- Ensure that the site is fenced and that access to the fenced area is controlled with only maintenance staff allowed daily access.
- No hunting, trapping or other persecution of birds at the site should be allowed.
- There should be regular monitoring for bird mortality at the site to ensure that birds using the water works are not being negatively affected by toxins or low water quality at the works. This should include records of the identify and number of all dead birds found at the site as well as counts of the birds using the site.

Residual Impact: With sensitive management there are not likely to be significant residual impacts on avifauna.

Cumulative Impact: **N**o long-term cumulative impacts are likely to be generated by the presence of the facility if managed properly.

5.3.2 Housing Development

Construction Phase Impacts

Impact 1: *Impacts on vegetation and listed plant species*

Impact Nature: Site preparation and construction will result in a lot of disturbance and the loss of currently intact vegetation and potentially the loss of individuals of red-listed or protected plant species.									
Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Probability*	*Significance*	*Confidence*
Without Mitigation	**Negative**	**Local**	**Long-term**	**High**	**Low**	**Moderate**	**Definite**	**Moderate**	**High**
With Mitigation	**Negative**	**Local**	**Long-term**	**Medium**	**Low**	**Moderate -Low**	**Definite**	**Moderate**	**High**
Mitigation Description: • The final development area should be surveyed for species suitable for search and rescue, which should be translocated prior to the commencement of construction. • Where soil disturbance is required for the laying of service infrastructure, the topsoil should be put aside and replaced after the infrastructure has been installed. • Construction personnel should be restricted to the construction area and access to the surrounding area controlled and monitored.									
Residual Impact: The habitat loss resulting from the development is permanent and cannot be mitigated. The impact on any listed and protected plant species can be partly mitigated through search and rescue.									
Cumulative Impact: The development would contribute to cumulative habitat loss and degradation in the area. However, as the affected vegetation types are still largely intact, the impact would be largely local in nature.									

Impact 2: *Negative impact on fauna*

Impact Nature: Construction activities such as the operation of heavy machinery and the presence of construction personnel at the site will result in direct and indirect impacts on terrestrial fauna at the site.									
Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Probability*	*Significance*	*Confidence*
Without Mitigation	**Negative**	**Local**	**Short-term**	**High**	**Medium**	**Low**	**Probable**	**Moderate**	**High**
With Mitigation	**Negative**	**Local**	**Short-term**	**Medium**	**Medium**	**Low**	**Probable**	**Moderate**	**High**
Mitigation Description: • All construction staff should undergo an environmental induction from the ECO or other suitably qualified persons. • Any fauna directly threatened by the construction activities should be removed to a safe location by the ECO or other suitably qualified person.									

- The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander away from the construction area.
- No fires should be allowed on-site.
- No dogs should be allowed on-site.
- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
- All construction vehicles should adhere to a low speed limit to avoid collisions with susceptible species such as snakes and tortoises, as well as to minimize dust generation.
- All construction vehicles to remain on demarcated roads and access routes.

Residual Impact: Not all faunal impacts can be mitigated and there will be some residual impact resulting from noise, disturbance and mortality of species unable to flee the construction activities.

Cumulative Impact: The primary avenue for cumulative impact will be through cumulative habitat loss for fauna, which is not likely to be highly significant given the intact nature of the surrounding landscape and likely low faunal abundance in the affected area. Direct impacts on fauna during construction will be transient and will not generate significant long-term cumulative impact.

Impact 3: *Negative impact on avifauna*

Impact Nature: Construction activities such as the operation of heavy machinery and the presence of construction personnel at the site will deter many bird species from the area and disrupt the breeding of species breeding within the development area.

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Probability*	*Significance*	*Confidence*
Without Mitigation	**Negative**	**Local**	**Short-term**	**Medium**	**Low**	**Low**	**Probable**	**Moderate**	**High**
With Mitigation	**Negative**	**Local**	**Short-term**	**Low**	**Low**	**Low**	**Probable**	**Minor**	**High**

Mitigation Description:

- Access control to the surrounding intact areas should be controlled.
- Vehicles should remain on properly demarcated roads.
- No loose string and twine should be left lying around the site as it may get tangled around birds feet or blow off the site and tangle birds off site.

Residual Impact: The major residual impact would be the habitat loss resulting from the development, which cannot be mitigated.

Cumulative Impact: During the construction phase the activity at the site will contribute towards disturbance of avifauna in the area. The construction phase will however be transient and no long-term cumulative impacts are likely to be generated by the construction activities themselves.

Operational Phase Impacts

Impact 1: *Impacts on vegetation and listed plant species*

Impact Nature: The presence of the housing development may generate some impact such as alien plant invasion risk and the gathering of plants by residents could impact the areas surrounding the new housing development									
Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Probability*	*Significance*	*Confidence*
Without Mitigation	**Negative**	**Local**	**Long-term**	**Medium -Low**	**High**	**Low**	**Probable**	**Minor**	**High**
With Mitigation	**Negative**	**Local**	**Long-term**	**Low**	**High**	**Low**	**Improbable**	**Minor**	**High**
Mitigation Description: • If any management and clearing of natural vegetation adjacent to the new housing development is required, this should be done by hand. No herbicides should be used to control vegetation. • For greening purposes, only indigenous species should be used. These should also preferably be of water-wise types which do require large amounts of water to maintain within this arid landscape. • No alien or indigenous species should be allowed to invade the natural vegetation from the housing development area and regular monitoring for and clearing of such such species should occur.									
Residual Impact: The presence of the housing development constitutes a residual impact that cannot be mitigated. That aside, the residual impacts from the daily activities of the housing development should be low.									
Cumulative Impact: The housing development would contribute towards cumulative habitat loss in the area, but the contribution would be low given the extensive nature of the affected vegetation type.									

Impact 2: *Negative impact on fauna*

Impact Nature: The presence of the housing development could impact fauna in the surrounding area.									
Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Probability*	*Significance*	*Confidence*
Without Mitigation	**Negative**	**Local**	**Long-term**	**Medium -Low**	**Low**	**Low**	**Improbable**	**Minor**	**High**
With Mitigation	**Negative**	**Local**	**Long-term**	**Low**	**Low**	**Low**	**Improbable**	**Minor**	**High**
Mitigation Description: • The housing development is within a natural environment and is likely to attract species such as porcupines and mongoose to the gardens as they green up. Residents should be educated as to the role of these species in the ecosystem and encouraged to leave them alone and appreciate their presence rather than persecute them. • Litter bins should be freely available in the area and regular clean-ups of the surrounding natural veld should be conducted.									

• No fires should be allowed in the veld • No dogs should be allowed to wander the veld off a leash.
Residual Impact: The development would result in permanent habitat loss for some species which cannot be mitigated. The extent of habitat loss would however be relatively low and is not significant at the landscape scale.
Cumulative Impact: The presence of the facility will contribute to cumulative habitat loss and disturbance in the area. The contribution would however be small.

Impact 3: *Negative impact on avifauna*

Impact Nature: The presence of the housing development will result in a shift in bird species composition within the affected areas from arid plains species such as larks to garden birds.									
Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Probability*	*Significance*	*Confidence*
Without Mitigation	**Negative**	**Local**	**Long-term**	**Medium**	**Low**	**Low**	**Probable**	**Minor**	**High**
With Mitigation	**Negative**	**Local**	**Long-term**	**Low**	**Low**	**Low**	**Probable**	**Minor**	**High**
Mitigation Description: • Residents of the area should be discouraged from keeping cats which are known to have a high impact on avifauna. • No feral cats should be tolerated at the site and should any appear they should be removed to the SPCA.									
Residual Impact: The housing development constitutes long term habitat loss for some species which cannot be mitigated. The extent of habitat loss is however low and would not create a significant impact on any species.									
Cumulative Impact: The development will contribute to cumulative habitat loss for avifauna in the area. However, this is likely to be a very minor contribution and is not likely to be significant for any species after mitigation.									

5.3.3 Power Line

Construction Phase Impacts

Impact 1: *Impacts on vegetation and listed plant species*

Impact Nature: Site preparation and construction will result in a lot of disturbance and the loss of currently intact vegetation and possibly the loss of individuals of red-listed and protected plant species.									
Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Probability*	*Significance*	*Confidence*
Without Mitigation	**Negative**	**Local**	**Medium-term**	**Medium**	**Medium**	**Low**	**Definite**	**Moderate**	**High**
With	**Negative**	**Local**	**Medium**	**Low**	**Medium**	**Low**	**Likely**	**Minor**	**High**

Mitigation			**-term**						

Mitigation Description:

- The final development area should be surveyed for species suitable for search and rescue, which should be translocated prior to the commencement of construction.
- Once construction activities have been completed the disturbed areas should be leveled to correspond to local slope conditions and any rubble and other building materials and litter removed from the site.
- If any excavation is required, the topsoil should be put aside and replaced after the infrastructure has been installed.
- A permanent access road should not be established beneath the power line.

Residual Impact: There will be very little residual impact after mitigation.

Cumulative Impact: Cumulative impacts resulting from the power line infrastructure on the terrestrial environment will be very low.

Impact 2: Negative impact on avifauna

Impact Nature: Construction activities such as the operation of heavy machinery and the presence of construction personnel at the site will deter many bird species from the area and disrupt the breeding of sensitive species or those breeding near the development area.

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Probability*	*Significance*	*Confidence*
Without Mitigation	**Negative**	**Local**	**Short-term**	**Medium**	**High**	**Low**	**Probable**	**Moderate**	**High**
With Mitigation	**Negative**	**Local**	**Short-term**	**Low**	**High**	**Low**	**Probable**	**Minor**	**High**

Mitigation Description:

- Ensure that all new lines are marked with bird flight diverters along their entire length.
- All new power line infrastructure should be bird-friendly in configuration and adequately insulated (Lehman et al. 2007). These activities should be supervised by someone with experience in this field.
- The nest sites of any raptors observed breeding at the site should be avoided and buffered during construction.

Residual Impact: Not all avifaunal impacts can be mitigated and many birds especially larger species such as raptors and bustards are likely to avoid the affected areas during construction.

Cumulative Impact: During the construction phase the activity at the site will contribute towards disturbance of avifauna in the area. The construction phase will however be transient and no long-term cumulative impacts are likely to be generated by the construction activities themselves.

Operational Phase Impacts

Impact 1: Impacts on vegetation and listed plant species

Impact Nature: Maintenance or repair activities could impact intact vegetation and individuals of listed or protected plant species.

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Probability*	*Significance*	*Confidence*
Without Mitigation	**Negative**	**Local**	**Long-term**	**Low**	**High**	**Low**	**Probable**	**Minor**	**High**
With Mitigation	**Negative**	**Local**	**Long-term**	**Low**	**High**	**Low**	**Improbable**	**Minor**	**High**

Mitigation Description:

- Any maintenance activities required should maintain the low footprint of the powerline and disturbance along the power line route kept to a minimum.
- It should not be necessary to control the vegetation underneath the power given the low stature of the vegetation.

Residual Impact: After mitigation the residual impact of the power line on flora would be negligible.

Cumulative Impact: Cumulative impacts would be very low on account of the small footprint of the power line infrastructure.

Impact 3: *Negative impact on avifauna*

Impact Nature: The presence of the overhead power lines will pose a risk of collisions and electrocution for susceptible bird species.

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Probability*	*Significance*	*Confidence*
Without Mitigation	**Negative**	**Regional**	**Long-term**	**Medium**	**Medium**	**Medium**	**Probable**	**Moderate**	**High**
With Mitigation	**Negative**	**Local**	**Long-term**	**Low**	**High**	**Low**	**Probable**	**Minor**	**High**

Mitigation Description:

- Ensure that any maintenance on the transmission infrastructure of the site retains the bird-friendly design features.
- Any electrocution and collision events that occur should be recorded, including the species affected and the date. If repeated collisions occur within the same area, then further mitigation and avoidance measures may need to be implemented.

Residual Impact: Despite mitigation measures, some collisions with the overhead lines may still occur as the bird flight diverters are not 100% effective.

Cumulative Impact: **A**fter mitigation, cumulative impacts related to collisions with the power line is likely to be very low.

5.3.4 Water Offtake Pipeline

Construction Phase Impacts

Impact 1: *Impacts on vegetation and listed plant species*

Impact Nature: Site preparation and construction will result in a lot of disturbance and the loss of currently intact vegetation and possibly the loss of individuals of red-listed and protected plant species.									
Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Probability*	*Significance*	*Confidence*
Without Mitigation	**Negative**	**Local**	**Long-term**	**High**	**Medium**	**Moderate**	**Definite**	**Moderate**	**High**
With Mitigation	**Negative**	**Local**	**Medium-term**	**Medium**	**Medium**	**Low**	**Highly Probable**	**Minor**	**High**
Mitigation Description: • The final development area should be surveyed for species suitable for search and rescue, which should be translocated prior to the commencement of construction. • Once construction activities have been completed the disturbed areas should be leveled to correspond to local slope conditions and any rubble and other building materials and litter removed from the site. • The topsoil should be put aside and replaced after the pipeline has been installed. • In order to minimize the disturbed area and the risk to fauna, it is also recommended that the construction of the pipeline proceeds in a staged manner with different sections of the pipeline being completed in stages so that a large trench is not present along large sections of the pipeline for an extended period of time.									
Residual Impact: The disturbed area is not likely to fully recover and some residual impact will occur as a result.									
Cumulative Impact: The development would contribute towards cumulative habitat loss and degradation in the area. However, the extent of disturbance is quite low and as the affected vegetation types are still largely intact, the impact would be largely local in nature and some recovery of the vegetation within disturbed areas is likely to occur. Cumulative impacts would therefore be low.									

Impact 2: *Negative impact on fauna*

Impact Nature: Construction activities such as the operation of heavy machinery and the presence of construction personnel at the site will result in direct and indirect impacts on terrestrial fauna near the pipeline route.									
Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Probability*	*Significance*	*Confidence*
Without Mitigation	**Negative**	**Local**	**Short-term**	**Medium**	**High**	**Low**	**Probable**	**Moderate**	**High**
With Mitigation	**Negative**	**Local**	**Short-term**	**Low**	**High**	**Low**	**Probable**	**Minor**	**High**

Mitigation Description:

- All construction staff should undergo an environmental induction from the ECO or other suitably qualified persons.
- Any fauna directly threatened by the construction activities should be removed to a safe location by the ECO or other suitably qualified person.
- The collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander away from the construction area.
- No fires should be allowed on-site.
- No dogs should be allowed on-site.
- All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill.
- All construction vehicles should adhere to a low speed limit to avoid collisions with susceptible species such as snakes and tortoises, as well as to minimize dust generation.
- All construction vehicles to remain on demarcated roads and access routes.

Residual Impact: Not all faunal impacts can be mitigated and there will be some residual impact resulting from noise, disturbance and mortality of species unable to flee the construction activities.

Cumulative Impact: Direct impacts on fauna during construction will be transient and will not generate significant long-term cumulative impact.

Operational Phase Impacts

Impact 1: *Impacts on vegetation and listed plant species*

Impact Nature: Maintenance or repair activities could impact intact vegetation and individuals of listed or protected plant species.

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Probability*	*Significance*	*Confidence*
Without Mitigation	**Negative**	**Local**	**Long-term**	**Medium -Low**	**Low**	**Low**	**Probable**	**Minor**	**High**
With Mitigation	**Negative**	**Local**	**Long-term**	**Low**	**Low**	**Low**	**Improbable**	**Minor**	**High**

Mitigation Description:

- Any maintenance activities required should maintain the low footprint of the pipeline and disturbance of intact vegetation adjacent to the pipeline route should be avoided as much as possible.
- There should be regular monitoring for alien species along the disturbance footprint of the pipeline with associated clearing.

Residual Impact: After mitigation the residual impact of the pipeline would be low and would be restricted to a minor extent of habitat loss.

Cumulative Impact: Service roads and the disturbed area associated with the pipeline would contribute towards cumulative habitat loss in the area, but the contribution would be very small and would decline over time as the disturbed area becomes naturally revegetated.

Impact 2: *Negative impact on fauna*

Impact Nature: The operation of the pipeline could impact fauna if disturbance levels are high or if access control to the area is compromised.

Impact	*Nature*	*Extent*	*Duration*	*Intensity*	*Reversibility*	*Impact on Irreplaceable Resources*	*Probability*	*Significance*	*Confidence*
Without Mitigation	**Negative**	**Local**	**Long-term**	**Low**	**High**	**Low**	**Probable**	**Minor**	**High**
With Mitigation	**Negative**	**Local**	**Long-term**	**Low**	**High**	**Low**	**Probable**	**Minor**	**High**

Mitigation Description:

- Noise and disturbance along the pipeline route should be kept to a minimum during operation.
- No uncontrolled access to the area should be allowed.
- There is a tendency for small mammals such as ground squirrels to dig their burrows along the pipeline on account of the fact that soil has been loosened and the hard-pan broken. Such faunal activity along the pipeline does not compromise the functioning or safety of the pipeline and should be tolerated.

Residual Impact: Residual impact would be very low and no significant residual impacts are anticipated.

Cumulative Impact: A small amount of habitat loss is likely to result from the pipeline, however this is likely to be a very minor contribution and is not likely to be significant for any species after mitigation.

5.4 SUMMARY ASSESSMENT

A summary assessment of the likely impacts of the various development components is provided below in Table 4. The construction phase impacts of the housing development on fauna and flora cannot be mitigated on account of the permanent loss of habitat which results from the development. During the operational phase all impacts are of minor significance after mitigation and there are no long-term moderate or high impacts. The major feature of the elements considered in this assessment is their relatively small extent. The housing development is the only development that would result in a significant extent of long-term habitat loss. The proximity of the housing development to the existing town serves to reduce the overall ecological impact of the development, especially with regards to the potential implications for broad-scale ecological processes.

Table 4. Summary assessment of the pre- and post-mitigation impacts associated with the construction and operation phases of the project, under the two development alternatives.

Element/Impact	Construction		Operation	
	Pre-mitigation	Post-mitigation	Pre-mitigation	Post-mitigation
Waste Water Treatment Works				
Avifauna impacts	Moderate	Minor	Moderate	Minor
Housing development				
Impact on vegetation	Moderate	Moderate	Minor	Minor
Impact on fauna	Moderate	Moderate	Minor	Minor
Impact on avifauna	Moderate	Minor	Minor	Minor
Power Line				
Impact on vegetation	Moderate	Minor	Minor	Minor
Impact on Avifauna	Moderate	Minor	Minor	Minor
Water Offtake Pipeline				
Impact on vegetation	Moderate	Minor	Minor	Minor
Impact on fauna	Moderate	Minor	Minor	Minor

5.5 CUMULATIVE IMPACTS

Cumulative impacts arise from the combined presence of several similar developments within an area which affect ecological processes operating at broader scales or which each have a small impact which becomes significant when combined. In context, the development components considered in this assessment are small in extent and in severity compared to the actual mining infrastructure and their contribution to cumulative impact would be relatively small in context of the whole development. In terms of the implications of this study for the potential implementation of offsets, the total extent of habitat loss resulting from the development components considered can be assumed to amount to 100 ha of moderate sensitivity habitat. No irreplaceable or high conservation value communities have been impacted and the habitat

loss would be offset through the conservation of an appropriate extent of similar *Stipagrostis* shrubland in the vicinity.

6 CONCLUSION & RECOMMENDATIONS

Although there is a variety of highly sensitive ecological receptors in the Aggeneys area, the current development components are restricted to areas of moderate to low sensitivity. A further characteristic is the low extent of habitat loss and ecological interference resulting from the development components. The housing development is the only development feature likely to result in significant long-term habitat loss.

The major impacts associated with the development are likely to occur during the construction phase of the development, with operational phase impacts generally being very low on account of the low disturbance levels likely to be generated at this time. Many of the construction phase impacts cannot be fully mitigated as they are unavoidable consequences of the development. Important mitigation recommendations associated with the development would include ensuring that the disturbance footprint is kept to a minimum, translocating sensitive species prior to construction; topsoil stockpiling and redistributing after construction; and ensuing compliance to the recommended mitigation measures by any contractors used on the project.

Provided that the mitigation measures as suggested can be implemented, then the overall impact of the development components would be of low overall significance and it is not likely that the development would result in an overall net loss of biodiversity or long-term degradation of the receiving environment.

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8 ANNEX 1. LIST OF PLANTS

List of plant species observed during the field assessments, as well as a list of species recorded in the area based on previous studies with the current IUCN status according to the Red List of South African Plants. The full list and the conservation status are derived from the SANBI SIBIS database, records accessed December 2012.

Family	Species	IUCN	Present	Family	Species	IUCN	Present
Acanthaceae	*Acanthopsis hoffmannseggiana*	LC	1	*Acanthaceae*	*Barleria lancifolia subsp. lancifolia*	LC	
Acanthaceae	*Barleria lichtensteiniana*	LC	1	*Acanthaceae*	*Barleria rigida*	LC	1
Acanthaceae	*Blepharis capensis*	LC		*Acanthaceae*	*Blepharis mitrata*	LC	1
Acanthaceae	*Justicia guerkeana*	LC		*Acanthaceae*	*Justicia thymifolia*	LC	1
Acanthaceae	*Monechma divaricatum*	LC		*Acanthaceae*	*Monechma genistifolium subsp. australe*	LC	
Acanthaceae	*Monechma incanum*	LC	1	*Acanthaceae*	*Monechma mollissimum*	LC	
Acanthaceae	*Monechma saxatile*	Rare		*Acanthaceae*	*Monechma spartioides*	LC	1
Acanthaceae	*Petalidium setosum*	LC	1	*Aizoaceae*	*Aizoon asbestinum*	LC	1
Aizoaceae	*Aizoon canariense*	LC		*Aizoaceae*	*Galenia africana*	LC	
Aizoaceae	*Galenia crystallina var. crystallina*	LC		*Aizoaceae*	*Galenia fruticosa*	LC	1
Aizoaceae	*Galenia papulosa*	LC	1	*Aizoaceae*	*Galenia sarcophylla*	LC	
Aizoaceae	*Tetragonia acanthocarpa*	LC		*Aizoaceae*	*Tetragonia arbuscula*	LC	1
Aizoaceae	*Tetragonia reduplicata*	LC		*Aizoaceae*	*Trianthema parvifolia var. parvifolia*	LC	
Aizoaceae	*Trianthema parvifolia var. rubens*	LC		*Amaranthaceae*	*Amaranthus capensis subsp. capensis*	LC	
Amaranthaceae	*Amaranthus praetermissus*	LC		*Amaranthaceae*	*Amaranthus thunbergii*	LC	
Amaranthaceae	*Calicorema capitata*	LC	1	*Amaranthaceae*	*Hermbstaedtia glauca*	LC	1
Amaranthaceae	*Leucosphaera bainesii*	LC	1	*Amaranthaceae*	*Sericocoma avolans*	LC	1
Amaranthaceae	*Sericocoma pungens*	LC		*Amaryllidaceae*	*Brunsvigia bosmaniae*	LC	
Amaryllidaceae	*Brunsvigia comptonii*	LC		*Amaryllidaceae*	*Brunsvigia herrei*	VU	
Amaryllidaceae	*Brunsvigia namaquana*	DDT		*Amaryllidaceae*	*Crinum bulbispermum*	Declining	
Amaryllidaceae	*Haemanthus coccineus*	LC		*Amaryllidaceae*	*Hessea speciosa*	LC	
Amaryllidaceae	*Hessea stenosiphon*	Rare		*Anacardiaceae*	*Ozoroa dispar*	LC	
Anacardiaceae	*Searsia burchellii*	LC	1	*Anacardiaceae*	*Searsia populifolia*	LC	
Apiaceae	*Anginon jaarsveldii*	EN		*Apiaceae*	*Deverra denudata*	LC	1
Apocynaceae	*Cryptolepis decidua*	LC	1	*Apocynaceae*	*Ectadium virgatum*	NT	
Apocynaceae	*Gomphocarpus filiformis*	LC		*Apocynaceae*	*Hoodia alstonii*	LC	
Apocynaceae	*Hoodia gordonii*	DDD	1	*Apocynaceae*	*Huernia clavigera*	LC	
Apocynaceae	*Microloma incanum*	LC	1	*Apocynaceae*	*Microloma sagittatum*	LC	
Apocynaceae	*Pachypodium namaquanum*	LC		*Apocynaceae*	*Pergularia daemia subsp. garipensis*	LC	
Apocynaceae	*Sarcostemma pearsonii*	LC		*Apocynaceae*	*Sarcostemma viminale subsp. thunbergii*	LC	
Apocynaceae	*Sarcostemma viminale subsp. viminale*	LC	1	*Apocynaceae*	*Stapelia similis*	LC	
Asparagaceae	*Asparagus asparagoides*	LC		*Asparagaceae*	*Asparagus capensis*	LC	1
Asparagaceae	*Asparagus ovatus*	LC		*Asparagaceae*	*Asparagus retrofractus*	LC	1
Asphodelaceae	*Aloe claviflora*	LC	1	*Asphodelaceae*	*Aloe dabenorisana*	Rare	

Asphodelaceae	*Aloe dichotoma*	VU	1
Asphodelaceae	*Bulbine ophiophylla*	LC	
Asphodelaceae	*Bulbine striata*	Critically Rare	
Asphodelaceae	*Trachyandra divaricata*	LC	
Asphodelaceae	*Trachyandra laxa var. laxa*	LC	
Asteraceae	*Amellus epaleaceus*	LC	
Asteraceae	*Arctotis hirsuta*	LC	
Asteraceae	*Arctotis venusta*	LC	
Asteraceae	*Berkheya fruticosa*	LC	
Asteraceae	*Berkheya spinosissima subsp. spinosissima*	LC	1
Asteraceae	*Chrysocoma microphylla*	LC	
Asteraceae	*Cineraria canescens var. canescens*	LC	
Asteraceae	*Didelta carnosa var. carnosa*	LC	
Asteraceae	*Dimorphotheca sinuata*	LC	
Asteraceae	*Eriocephalus merxmuelleri*	LC	1
Asteraceae	*Eriocephalus scariosus*	LC	
Asteraceae	*Euryops subcarnosus subsp. vulgaris*	LC	
Asteraceae	*Felicia muricata subsp. cinerascens*	LC	
Asteraceae	*Felicia namaquana*	LC	
Asteraceae	*Gazania lichtensteinii*	LC	1
Asteraceae	*Geigeria vigintisquamea*	LC	
Asteraceae	*Gymnodiscus linearifolia*	LC	
Asteraceae	*Helichrysum herniarioides*	LC	
Asteraceae	*Helichrysum obtusum*	LC	
Asteraceae	*Helichrysum pumilio subsp. fleckii*	LC	
Asteraceae	*Hirpicium alienatum*	LC	1
Asteraceae	*Hirpicium integrifolium*	LC	
Asteraceae	*Kleinia cephalophora*	LC	
Asteraceae	*Leysera tenella*	LC	1
Asteraceae	*Lopholaena cneorifolia*	LC	
Asteraceae	*Nidorella resedifolia subsp. resedifolia*	LC	
Asteraceae	*Osteospermum armatum*	LC	
Asteraceae	*Osteospermum muricatum subsp. muricatum*	LC	
Asteraceae	*Othonna abrotanifolia*	LC	
Asteraceae	*Othonna furcata*	LC	
Asteraceae	*Othonna sedifolia*	LC	
Asteraceae	*Pegolettia retrofracta*	LC	
Asteraceae	*Pentzia argentea*	LC	
Asteraceae	*Pentzia pinnatisecta*	LC	
Asphodelaceae	*Aloe variegata*	LC	1
Asphodelaceae	*Bulbine praemorsa*	LC	
Asphodelaceae	*Haworthia venosa subsp. tessellata*	LC	
Asphodelaceae	*Trachyandra jacquiniana*	LC	
Aspleniaceae	*Asplenium cordatum*	LC	
Asteraceae	*Amphiglossa tomentosa*	LC	
Asteraceae	*Arctotis leiocarpa*	LC	
Asteraceae	*Berkheya canescens*	LC	
Asteraceae	*Berkheya spinosissima subsp. namaensis var. namaensis*	LC	
Asteraceae	*Chrysocoma longifolia*	LC	1
Asteraceae	*Chrysocoma sparsifolia*	LC	
Asteraceae	*Dicoma capensis*	LC	1
Asteraceae	*Dimorphotheca polyptera*	LC	
Asteraceae	*Doellia cafra*	LC	
Asteraceae	*Eriocephalus microphyllus var. pubescens*	LC	
Asteraceae	*Eriocephalus spinescens*	LC	
Asteraceae	*Felicia hirsuta*	LC	
Asteraceae	*Felicia muricata subsp. muricata*	LC	
Asteraceae	*Foveolina dichotoma*	LC	
Asteraceae	*Geigeria pectidea*	LC	
Asteraceae	*Gorteria corymbosa*	LC	
Asteraceae	*Helichrysum gariepinum*	LC	
Asteraceae	*Helichrysum micropoides*	LC	
Asteraceae	*Helichrysum pulchellum*	LC	
Asteraceae	*Helichrysum zeyheri*	LC	
Asteraceae	*Hirpicium echinus*	LC	
Asteraceae	*Ifloga molluginoides*	LC	
Asteraceae	*Kleinia longiflora*	LC	1
Asteraceae	*Litogyne gariepina*	LC	1
Asteraceae	*Myxopappus acutilobus*	LC	1
Asteraceae	*Oncosiphon piluliferum*	LC	
Asteraceae	*Osteospermum karrooicum*	LC	
Asteraceae	*Osteospermum pinnatum var. pinnatum*	LC	
Asteraceae	*Othonna arbuscula*	LC	
Asteraceae	*Othonna quercifolia*	LC	
Asteraceae	*Pegolettia oxyodonta*	LC	
Asteraceae	*Pentatrichia petrosa*	LC	1
Asteraceae	*Pentzia lanata*	LC	
Asteraceae	*Pentzia spinescens*	LC	

Asteraceae	*Pteronia glabrata*	LC	
Asteraceae	*Pteronia lucilioides*	LC	
Asteraceae	*Pteronia scariosa*	LC	
Asteraceae	*Rosenia humilis*	LC	
Asteraceae	*Senecio eenii*	LC	
Asteraceae	*Senecio niveus*	LC	
Asteraceae	*Senecio piptocoma*	LC	
Asteraceae	*Senecio sisymbriifolius*	LC	
Asteraceae	*Tripteris sinuata var. linearis*	LC	
Asteraceae	*Ursinia nana subsp. nana*	LC	
Asteraceae	*Vernonia cinerascens*	LC	
Bignoniaceae	*Rhigozum trichotomum*	LC	1
Boraginaceae	*Ehretia rigida subsp. rigida*	LC	1
Boraginaceae	*Heliotropium tubulosum*	LC	
Brassicaceae	*Heliophila carnosa*	LC	1
Brassicaceae	*Heliophila deserticola var. deserticola*	LC	
Brassicaceae	*Heliophila lactea*	LC	
Brassicaceae	*Lepidium trifurcum*	LC	
Campanulaceae	*Wahlenbergia annularis*	LC	
Campanulaceae	*Wahlenbergia meyeri*	LC	
Capparaceae	*Boscia foetida subsp. foetida*	LC	1
Capparaceae	*Cleome foliosa var. lutea*	LC	1
Capparaceae	*Cleome paxii*	LC	
Caryophyllaceae	*Dianthus namaensis var. dinteri*	LC	
Chenopodiaceae	*Salsola aphylla*	LC	1
Chenopodiaceae	*Salsola columnaris*	LC	
Chenopodiaceae	*Salsola tuberculata*	LC	1
Colchicaceae	*Ornithoglossum undulatum*	LC	
Colchicaceae	*Ornithoglossum vulgare*	LC	
Crassulaceae	*Adromischus diabolicus*	Rare	
Crassulaceae	*Adromischus trigynus*	LC	
Crassulaceae	*Crassula brevifolia subsp. brevifolia*	LC	
Crassulaceae	*Crassula corallina subsp. macrorrhiza*	LC	1
Crassulaceae	*Crassula deltoidea*	LC	1
Crassulaceae	*Crassula exilis subsp. sedifolia*	LC	
Crassulaceae	*Crassula macowaniana*	LC	
Crassulaceae	*Crassula sericea var. hottentotta*	LC	
Crassulaceae	*Crassula sericea var. velutina*	Rare	
Asteraceae	*Pteronia glauca*	LC	
Asteraceae	*Pteronia mucronata*	LC	1
Asteraceae	*Pteronia unguiculata*	LC	
Asteraceae	*Senecio bulbinifolius*	LC	
Asteraceae	*Senecio flavus*	LC	
Asteraceae	*Senecio pinguifolius*	LC	
Asteraceae	*Senecio sarcoides*	LC	
Asteraceae	*Tripteris microcarpa subsp. microcarpa*	LC	
Asteraceae	*Tripteris sinuata var. sinuata*	LC	1
Asteraceae	*Ursinia speciosa*	LC	
Asteraceae	*Vernonia obionifolia subsp. obionifolia*	LC	
Boraginaceae	*Codon royenii*	LC	1
Boraginaceae	*Heliotropium ciliatum*	LC	
Boraginaceae	*Trichodesma africanum*	LC	1
Brassicaceae	*Heliophila crithmifolia*	LC	
Brassicaceae	*Heliophila deserticola var. micrantha*	LC	
Brassicaceae	*Heliophila trifurca*	LC	
Burseraceae	*Commiphora gracilifrondosa*	LC	1
Campanulaceae	*Wahlenbergia divergens*	DDT	
Campanulaceae	*Wahlenbergia prostrata*	LC	
Capparaceae	*Cleome angustifolia subsp. diandra*	LC	
Capparaceae	*Cleome oxyphylla var. oxyphylla*	LC	
Caryophyllaceae	*Dianthus micropetalus*	LC	
Celastraceae	*Gymnosporia heterophylla*	LC	1
Chenopodiaceae	*Salsola barbata*	LC	
Chenopodiaceae	*Salsola kalaharica*	LC	1
Colchicaceae	*Ornithoglossum dinteri*	LC	
Colchicaceae	*Ornithoglossum viride*	LC	
Convolvulaceae	*Convolvulus sagittatus*	LC	
Crassulaceae	*Adromischus nanus*	LC	
Crassulaceae	*Cotyledon orbiculata var. orbiculata*	LC	
Crassulaceae	*Crassula campestris*	LC	
Crassulaceae	*Crassula cotyledonis*	LC	
Crassulaceae	*Crassula exilis subsp. exilis*	Rare	
Crassulaceae	*Crassula garibina subsp. garibina*	LC	
Crassulaceae	*Crassula muscosa var. muscosa*	LC	
Crassulaceae	*Crassula sericea var. sericea*	LC	
Crassulaceae	*Crassula subaphylla var. subaphylla*	LC	

Crassulaceae	*Crassula tabularis*	LC	
Crassulaceae	*Crassula tomentosa var. glabrifolia*	LC	
Crassulaceae	*Tylecodon reticulatus subsp. reticulatus*	LC	
Crassulaceae	*Tylecodon sulphureus var. armianus*	Rare	
Cucurbitaceae	*Coccinia rehmannii*	LC	
Cucurbitaceae	*Cucumis rigidus*	LC	
Cucurbitaceae	*Trochomeria debilis*	LC	
Cyperaceae	*Cyperus marginatus*	LC	
Cyperaceae	*Scirpoides dioecus*	LC	1
Ebenaceae	*Diospyros ramulosa*	LC	
Ebenaceae	*Euclea undulata*	LC	
Eriospermaceae	*Eriospermum ernstii*	Rare	
Euphorbiaceae	*Euphorbia braunsii*	LC	1
Euphorbiaceae	*Euphorbia gariepina subsp. gariepina*	LC	1
Euphorbiaceae	*Euphorbia gummifera*	LC	
Euphorbiaceae	*Euphorbia mauritanica var. mauritanica*	LC	1
Euphorbiaceae	*Euphorbia spinea*	LC	1
Euphorbiaceae	*Jatropha orangeana*	LC	
Fabaceae	*Acacia mellifera subsp. detinens*	LC	1
Fabaceae	*Bauhinia bowkeri*	NT	
Fabaceae	*Indigastrum argyraeum*	LC	
Fabaceae	*Indigofera heterotricha*	LC	
Fabaceae	*Indigofera pechuelii*	LC	
Fabaceae	*Indigofera sessilifolia*	LC	
Fabaceae	*Lebeckia spinescens*	LC	
Fabaceae	*Lessertia incana*	LC	
Fabaceae	*Lotononis parviflora*	LC	
Fabaceae	*Melolobium adenodes*	LC	
Fabaceae	*Melolobium microphyllum*	LC	1
Fabaceae	*Parkinsonia africana*	LC	1
Fabaceae	*Requienia sphaerosperma*	LC	
Fabaceae	*Tephrosia dregeana var. dregeana*	LC	
Geraniaceae	*Monsonia umbellata*	LC	
Geraniaceae	*Pelargonium crithmifolium*	LC	
Geraniaceae	*Pelargonium xerophyton*	LC	
Geraniaceae	*Sarcocaulon crassicaule*	LC	
Gisekiaceae	*Gisekia pharnacioides var. pharnacioides*	LC	
Hyacinthaceae	*Albuca setosa*	LC	
Hyacinthaceae	*Bowiea volubilis subsp.*	LC	
Crassulaceae	*Crassula tenuipedicellata*	LC	
Crassulaceae	*Tylecodon reticulatus subsp. phyllopodium*	LC	
Crassulaceae	*Tylecodon rubrovenosus*	LC	
Crassulaceae	*Tylecodon sulphureus var. sulphureus*	LC	
Cucurbitaceae	*Cucumis africanus*	LC	
Cucurbitaceae	*Kedrostis capensis*	LC	
Cyperaceae	*Cyperus laevigatus*	LC	
Cyperaceae	*Isolepis hemiuncialis*	LC	
Ebenaceae	*Diospyros acocksii*	LC	
Ebenaceae	*Euclea pseudebenus*	LC	1
Eriospermaceae	*Eriospermum bakerianum subsp. bakerianum*	LC	
Eriospermaceae	*Eriospermum pusillum*	Rare	
Euphorbiaceae	*Euphorbia dregeana*	LC	1
Euphorbiaceae	*Euphorbia gregaria*	LC	1
Euphorbiaceae	*Euphorbia inaequilatera var. inaequilatera*	LC	
Euphorbiaceae	*Euphorbia phylloclada*	LC	
Euphorbiaceae	*Euphorbia virosa subsp. virosa*	LC	
Fabaceae	*Acacia erioloba*	Declining	1
Fabaceae	*Adenolobus garipensis*	LC	1
Fabaceae	*Crotalaria virgultalis*	LC	
Fabaceae	*Indigastrum argyroides*	LC	
Fabaceae	*Indigofera meyeriana*	LC	
Fabaceae	*Indigofera pungens*	LC	
Fabaceae	*Indigofera sordida*	LC	
Fabaceae	*Lessertia depressa*	LC	
Fabaceae	*Lotononis fruticoides*	LC	
Fabaceae	*Lotononis rabenaviana*	LC	
Fabaceae	*Melolobium candicans*	LC	
Fabaceae	*Microcharis disjuncta var. disjuncta*	LC	
Fabaceae	*Pomaria lactea*	LC	
Fabaceae	*Rhynchosia totta var. totta*	LC	
Geraniaceae	*Monsonia parvifolia*	LC	
Geraniaceae	*Pelargonium carnosum subsp. carnosum*	LC	
Geraniaceae	*Pelargonium spinosum*	LC	
Geraniaceae	*Sarcocaulon ciliatum*	LC	
Gisekiaceae	*Gisekia africana var. africana*	LC	
Hyacinthaceae	*Albuca namaquensis*	LC	
Hyacinthaceae	*Albuca spiralis*	LC	
Hyacinthaceae	*Dipcadi ciliare*	LC	

	gariepensis		
Hyacinthaceae	*Drimia intricata*	LC	
Hyacinthaceae	*Lachenalia undulata*	LC	
Hyacinthaceae	*Massonia bifolia*	LC	
Hyacinthaceae	*Ornithogalum pruinosum*	LC	
Hyacinthaceae	*Ornithogalum subcoriaceum*	LC	
Iridaceae	*Ferraria variabilis*	LC	
Iridaceae	*Gladiolus saccatus*	LC	
Iridaceae	*Lapeirousia littoralis subsp. littoralis*	LC	
Iridaceae	*Moraea unguiculata*	LC	
Juncaceae	*Juncus rigidus*	LC	
Lamiaceae	*Salvia garipensis*	LC	
Lamiaceae	*Stachys linearis*	LC	
Loasaceae	*Kissenia capensis*	LC	1
Loranthaceae	*Septulina glauca*	LC	1
Malvaceae	*Abutilon pycnodon*	LC	1
Malvaceae	*Hermannia affinis*	LC	
Malvaceae	*Hermannia burchellii*	LC	
Malvaceae	*Hermannia comosa*	LC	
Malvaceae	*Hermannia cuneifolia*	LC	1
Malvaceae	*Hermannia gariepina*	LC	
Malvaceae	*Hermannia leucantha*	LC	
Malvaceae	*Hermannia minutiflora*	LC	
Malvaceae	*Hermannia spinosa*	LC	1
Malvaceae	*Hermannia tomentosa*	LC	1
Malvaceae	*Hibiscus engleri*	LC	
Meliaceae	*Nymania capensis*	LC	1
Menispermaceae	*Antizoma miersiana*	LC	1
Mesembryanthemaceae	*Antimima nordenstamii*	Rare	
Mesembryanthemaceae	*Antimima vanzylii*	LC	
Mesembryanthemaceae	*Aridaria noctiflora subsp. straminea*	LC	1
Mesembryanthemaceae	*Brownanthus arenosus*	LC	1
Mesembryanthemaceae	*Brownanthus schenckii*	LC	
Mesembryanthemaceae	*Cephalophyllum parvibracteatum*	LC	
Mesembryanthemaceae	*Cheiridopsis denticulata*	LC	
Mesembryanthemaceae	*Conophytum achabense*	VU	
Mesembryanthemaceae	*Conophytum calculus subsp. vanzylii*	LC	
Mesembryanthemaceae	*Conophytum fulleri*	LC	
Mesembryanthemaceae	*Conophytum longum*	LC	
Mesembryanthemaceae	*Conophytum praesectum*	LC	
Mesembryanthemaceae	*Conophytum subfenestratum*	LC	
Hyacinthaceae	*Lachenalia polypodantha*	Rare	
Hyacinthaceae	*Ledebouria undulata*	LC	1
Hyacinthaceae	*Ornithogalum glandulosum*	LC	
Hyacinthaceae	*Ornithogalum suaveolens*	LC	
Hypoxidaceae	*Spiloxene scullyi*	LC	
Iridaceae	*Gladiolus orchidiflorus*	LC	
Iridaceae	*Hesperantha rupicola*	LC	
Iridaceae	*Lapeirousia plicata subsp. plicata*	LC	
Iridaceae	*Tritonia karooica*	LC	
Lamiaceae	*Acrotome pallescens*	LC	
Lamiaceae	*Stachys flavescens*	LC	
Lamiaceae	*Stachys rugosa*	LC	
Lophiocarpaceae	*Lophiocarpus polystachyus*	LC	
Loranthaceae	*Tapinanthus oleifolius*	LC	
Malvaceae	*Hermannia abrotanoides*	LC	
Malvaceae	*Hermannia bicolor*	LC	
Malvaceae	*Hermannia cernua*	LC	
Malvaceae	*Hermannia confusa*	LC	
Malvaceae	*Hermannia disermifolia*	LC	
Malvaceae	*Hermannia grandiflora*	LC	
Malvaceae	*Hermannia macra*	LC	
Malvaceae	*Hermannia modesta*	LC	
Malvaceae	*Hermannia stricta*	LC	1
Malvaceae	*Hibiscus elliottiae*	LC	
Malvaceae	*Radyera urens*	LC	
Melianthaceae	*Melianthus comosus*	LC	
Mesembryanthemaceae	*Amphibolia rupis-arcuatae*	LC	
Mesembryanthemaceae	*Antimima tuberculosa*	LC	
Mesembryanthemaceae	*Arenifera stylosa*	LC	
Mesembryanthemaceae	*Aspazoma amplectens*	LC	
Mesembryanthemaceae	*Brownanthus nucifer*	LC	
Mesembryanthemaceae	*Cephalophyllum fulleri*	Rare	
Mesembryanthemaceae	*Cephalophyllum staminodiosum*	Rare	1
Mesembryanthemaceae	*Conicosia elongata*	LC	
Mesembryanthemaceae	*Conophytum burgeri*	EN	
Mesembryanthemaceae	*Conophytum ectypum subsp. ectypum*	LC	
Mesembryanthemaceae	*Conophytum limpidum*	NT	
Mesembryanthemaceae	*Conophytum maughanii subsp. maughanii*	LC	
Mesembryanthemaceae	*Conophytum ratum*	VU	
Mesembryanthemaceae	*Dinteranthus puberulus*	LC	

Mesembryanthemaceae	*Dorotheanthus bellidiformis subsp. hestermalensis*	LC	
Mesembryanthemaceae	*Drosanthemum diversifolium*	LC	
Mesembryanthemaceae	*Drosanthemum hispidum*	LC	
Mesembryanthemaceae	*Drosanthemum luederitzii*	LC	
Mesembryanthemaceae	*Ebracteola fulleri*	LC	
Mesembryanthemaceae	*Hereroa pallens*	LC	
Mesembryanthemaceae	*Ihlenfeldtia vanzylii*	LC	
Mesembryanthemaceae	*Lithops dinteri subsp. frederici*	VU	
Mesembryanthemaceae	*Lithops olivacea*	VU	1
Mesembryanthemaceae	*Mesembryanthemum crystallinum*	LC	1
Mesembryanthemaceae	*Mesembryanthemum inachabense*	LC	
Mesembryanthemaceae	*Phyllobolus lignescens*	LC	
Mesembryanthemaceae	*Prenia tetragona*	LC	
Mesembryanthemaceae	*Psilocaulon coriarium*	LC	1
Mesembryanthemaceae	*Ruschia centrocapsula*	LC	
Mesembryanthemaceae	*Ruschia divaricata*	LC	
Mesembryanthemaceae	*Ruschia robusta*	LC	
Mesembryanthemaceae	*Schwantesia marlothii*	LC	
Mesembryanthemaceae	*Schwantesia triebneri*	LC	
Mesembryanthemaceae	*Titanopsis calcarea*	LC	1
Mesembryanthemaceae	*Trichodiadema obliquum*	DDT	
Molluginaceae	*Hypertelis salsoloides var. salsoloides*	LC	1
Molluginaceae	*Limeum dinteri*	LC	
Molluginaceae	*Limeum aethiopicum*	LC	1
Molluginaceae	*Pharnaceum croceum*	LC	
Molluginaceae	*Suessenguthiella scleranthoides*	LC	
Moraceae	*Ficus cordata subsp. cordata*	LC	
Neuradaceae	*Grielum humifusum var. humifusum*	LC	1
Nyctaginaceae	*Phaeoptilum spinosum*	LC	1
Oxalidaceae	*Oxalis annae*	LC	
Passifloraceae	*Adenia repanda*	LC	
Pedaliaceae	*Rogeria longiflora*	LC	1
Poaceae	*Aristida adscensionis*	LC	
Poaceae	*Aristida congesta subsp. congesta*	LC	1
Poaceae	*Brachiaria glomerata*	LC	
Poaceae	*Cynodon dactylon*	LC	
Poaceae	*Digitaria eriantha*	LC	
Poaceae	*Ehrharta pusilla*	LC	
Mesembryanthemaceae	*Drosanthemum albens*	LC	
Mesembryanthemaceae	*Drosanthemum godmaniae*	DDT	
Mesembryanthemaceae	*Drosanthemum karrooense*	LC	
Mesembryanthemaceae	*Drosanthemum schoenlandianum*	LC	1
Mesembryanthemaceae	*Hereroa hesperantha*	LC	
Mesembryanthemaceae	*Ihlenfeldtia excavata*	LC	
Mesembryanthemaceae	*Lapidaria margaretae*	LC	
Mesembryanthemaceae	*Lithops julii subsp. fulleri*	LC	1
Mesembryanthemaceae	*Malephora lutea*	LC	
Mesembryanthemaceae	*Mesembryanthemum guerichianum*	LC	
Mesembryanthemaceae	*Phyllobolus latipetalus*	LC	
Mesembryanthemaceae	*Phyllobolus nitidus*	LC	
Mesembryanthemaceae	*Psilocaulon articulatum*	LC	
Mesembryanthemaceae	*Psilocaulon subnodosum*	LC	
Mesembryanthemaceae	*Ruschia cradockensis subsp. triticiformis*	LC	
Mesembryanthemaceae	*Ruschia muricata*	LC	
Mesembryanthemaceae	*Ruschia spinosa*	LC	
Mesembryanthemaceae	*Schwantesia ruedebuschii*	LC	
Mesembryanthemaceae	*Stomatium fulleri*	LC	
Mesembryanthemaceae	*Trichodiadema littlewoodii*	LC	
Mesembryanthemaceae	*Trichodiadema setuliferum*	LC	
Molluginaceae	*Limeum arenicolum*	LC	
Molluginaceae	*Limeum myosotis var. myosotis*	LC	
Molluginaceae	*Mollugo cerviana var. cerviana*	LC	
Molluginaceae	*Pharnaceum viride*	LC	
Montiniaceae	*Montinia caryophyllacea*	LC	1
Moraceae	*Ficus ilicina*	LC	
Neuradaceae	*Grielum sinuatum*	LC	
Orobanchaceae	*Hyobanche rubra*	LC	
Oxalidaceae	*Oxalis pes-caprae var. pes-caprae*	LC	
Pedaliaceae	*Sesamum capense*	LC	
Plumbaginaceae	*Dyerophytum africanum*	LC	1
Poaceae	*Aristida congesta subsp. barbicollis*	LC	
Poaceae	*Aristida engleri var. engleri*	LC	
Poaceae	*Cenchrus ciliaris*	LC	
Poaceae	*Danthoniopsis ramosa*	LC	
Poaceae	*Ehrharta calycina*	LC	
Poaceae	*Eleusine coracana subsp. africana*	LC	

Poaceae	*Enneapogon cenchroides*	LC	
Poaceae	*Enneapogon scaber*	LC	1
Poaceae	*Eragrostis homomalla*	LC	
Poaceae	*Eragrostis procumbens*	LC	
Poaceae	*Eragrostis trichophora*	LC	
Poaceae	*Leucophrys mesocoma*	LC	
Poaceae	*Oropetium capense*	LC	1
Poaceae	*Phragmites australis*	LC	
Poaceae	*Schmidtia kalahariensis*	LC	1
Poaceae	*Sporobolus nervosus*	LC	1
Poaceae	*Stipagrostis brevifolia*	LC	1
Poaceae	*Stipagrostis hochstetteriana var. hochstetteriana*	LC	
Poaceae	*Stipagrostis namaquensis*	LC	1
Poaceae	*Stipagrostis uniplumis var. uniplumis*	LC	
Poaceae	*Tricholaena capensis subsp. capensis*	LC	1
Polygalaceae	*Polygala leptophylla var. armata*	LC	1
Portulacaceae	*Anacampseros baeseckei*	LC	
Portulacaceae	*Avonia albissima*	LC	1
Portulacaceae	*Avonia papyracea subsp. namaensis*	LC	
Portulacaceae	*Avonia quinaria subsp. alstonii*	LC	
Portulacaceae	*Avonia recurvata subsp. recurvata*	LC	
Portulacaceae	*Ceraria namaquensis*	LC	1
Pteridaceae	*Cheilanthes deltoidea*	LC	
Rubiaceae	*Anthospermum spathulatum subsp. spathulatum*	LC	
Rubiaceae	*Kohautia caespitosa subsp. brachyloba*	LC	
Rubiaceae	*Nenax cinerea*	LC	
Santalaceae	*Thesium lineatum*	LC	1
Scrophulariaceae	*Antherothamnus pearsonii*	LC	1
Scrophulariaceae	*Aptosimum marlothii*	LC	1
Scrophulariaceae	*Aptosimum procumbens*	LC	
Scrophulariaceae	*Diascia engleri*	LC	
Scrophulariaceae	*Jamesbrittenia glutinosa*	LC	
Scrophulariaceae	*Jamesbrittenia ramosissima*	LC	1
Scrophulariaceae	*Manulea nervosa*	LC	
Scrophulariaceae	*Nemesia maxii*	LC	
Scrophulariaceae	*Selago albida*	LC	
Scrophulariaceae	*Zaluzianskya diandra*	LC	
Solanaceae	*Lycium oxycarpum*	LC	1
Poaceae	*Enneapogon desvauxii*	LC	1
Poaceae	*Eragrostis brizantha*	LC	
Poaceae	*Eragrostis nindensis*	LC	
Poaceae	*Eragrostis rotifer*	LC	
Poaceae	*Karroochloa schismoides*	LC	
Poaceae	*Melinis repens subsp. grandiflora*	LC	
Poaceae	*Panicum arbusculum*	LC	
Poaceae	*Schismus barbatus*	LC	
Poaceae	*Schmidtia pappophoroides*	LC	
Poaceae	*Stipagrostis anomala*	LC	1
Poaceae	*Stipagrostis ciliata var. capensis*	LC	1
Poaceae	*Stipagrostis hochstetteriana var. secalina*	LC	
Poaceae	*Stipagrostis obtusa*	LC	1
Poaceae	*Tragus berteronianus*	LC	
Poaceae	*Triraphis ramosissima*	LC	
Polygalaceae	*Polygala seminuda*	LC	
Portulacaceae	*Anacampseros filamentosa subsp. namaquensis*	LC	1
Portulacaceae	*Avonia herreana*	VU	
Portulacaceae	*Avonia papyracea subsp. papyracea*	LC	
Portulacaceae	*Avonia recurvata subsp. minuta*	DDD	
Portulacaceae	*Ceraria fruticulosa*	LC	
Portulacaceae	*Portulaca kermesina*	LC	1
Rhamnaceae	*Ziziphus mucronata*	LC	1
Rubiaceae	*Gaillonia crocyllis*	LC	1
Rubiaceae	*Kohautia cynanchica*	LC	
Santalaceae	*Thesium hystricoides*	LC	
Sapindaceae	*Pappea capensis*	LC	1
Scrophulariaceae	*Aptosimum junceum*	LC	1
Scrophulariaceae	*Aptosimum albomarginatum*	LC	1
Scrophulariaceae	*Aptosimum spinescens*	LC	1
Scrophulariaceae	*Jamesbrittenia aridicola*	LC	
Scrophulariaceae	*Jamesbrittenia maxii*	LC	1
Scrophulariaceae	*Manulea gariepina*	LC	
Scrophulariaceae	*Nemesia fleckii*	LC	
Scrophulariaceae	*Peliostomum leucorrhizum*	LC	1
Scrophulariaceae	*Zaluzianskya affinis*	LC	
Scrophulariaceae	*Zaluzianskya sanorum*	LC	
Solanaceae	*Solanum capense*	LC	

Solanaceae	*Solanum tomentosum var. tomentosum*	LC		*Tamaricaceae*	*Tamarix usneoides*	LC	1
Tecophilaeaceae	*Cyanella lutea*	LC		*Urticaceae*	*Forsskaolea candida*	LC	1
Verbenaceae	*Chascanum garipense*	LC	1	*Verbenaceae*	*Chascanum pumilum*	LC	
Viscaceae	*Viscum rotundifolium*	LC		*Zygophyllaceae*	*Augea capensis*	LC	
Zygophyllaceae	*Sisyndite spartea*	LC	1	*Zygophyllaceae*	*Tribulus cristatus*	LC	
Zygophyllaceae	*Tribulus pterophorus*	LC		*Zygophyllaceae*	*Tribulus terrestris*	LC	1
Zygophyllaceae	*Tribulus zeyheri subsp. zeyheri*	LC		*Zygophyllaceae*	*Zygophyllum dregeanum*	LC	1
Zygophyllaceae	*Zygophyllum flexuosum*	LC		*Zygophyllaceae*	*Zygophyllum foetidum*	LC	
Zygophyllaceae	*Zygophyllum microcarpum*	LC		*Zygophyllaceae*	*Zygophyllum pubescens*	LC	1
Zygophyllaceae	*Zygophyllum retrofractum*	LC	1	*Zygophyllaceae*	*Zygophyllum simplex*	LC	1

9 ANNEX 2. LIST OF MAMMALS

List of mammals which are likely to occur in the broad vicinity of the Gamsberg ESIA study area. Habitat notes and distribution records are based on Skinner & Chimimba (2005), while conservation status is from the IUCN Red Lists 2012.

Scientific Name	Common Name	Status	Habitat	Likelihood
Macroscledidea (Elephant Shrews):				
Macroscelides proboscideus	Round-eared Elephant Shrew	LC	Species of open country, with preference for shrub bush and sparse grass cover, also occur on hard gravel plains with sparse boulders for shelter, and on loose sandy soil provided there is some bush cover	High
Elephantulus rupestris	Western Rock Elephant Shrew	LC	Rocky koppies, rocky outcrops or piles of boulders where these offer sufficient holes and crannies for refuge.	High
Tubulentata:				
Orycteropus afer	Aardvark	LC	Wide habitat tolerance, being found in open woodland, scrub and grassland, especially associated with sandy soil	Confirmed
Hyracoidea (Hyraxes)				
Procavia capensis	Rock Hyrax	LC	Outcrops of rocks, especially granite formations and dolomite intrusions in the Karoo. Also erosion gullies	Confirmed
Lagomorpha (Hares and Rabbits):				
Pronolagus rupestris	Smith's Red Rock Rabbit	LC	Confined to areas of krantzes, rocky hillsides, boulder-strewn koppies and rocky ravines	High
Lepus capensis	Cape Hare	LC	Dry, open regions, with palatable bush and grass	High
Rodentia (Rodents):				
Hystrix africaeaustralis	Cape Porcupine	LC	Catholic in habitat requirements.	Confirmed
Petromus typicus	Dassie Rat	LC	Mountainous regions and inselbergs, where they are confined to rocky outcrops and live in crevices or piles of boulders	High
Xerus inauris	South African Ground Squirrel	LC	Open terrain with a sparse bush cover and a hard substrate	Confirmed
Graphiurus platyops	Rock Dormouse	LC	Rocky terrain, under the exfoliation on granite bosses, and in piles of boulders	High
Rhabdomys pumilio	Four-striped Grass Mouse	LC	Essentially a grassland species, occurs in wide variety of habitats where there is good grass cover.	High
Thallomys paedulcus	Acacia Tree Rat	LC	Associated with stands of Acacia woodland	Low
Thallomys nigricauda	Black-tailed Tree Rat	LC	Associated with stands of Acacia woodland	Low
Aethomys namaquensis	Namaqua Rock Mouse	LC	Catholic in their habitat requirements, but where there are rocky koppies, outcrops or boulder-strewn hillsides they use these preferentially	Confirmed
Parotomys brantsii	Brants' Whistling Rat	LC	Associated with a dry sandy substrate in more arid parts of the Nama-karoo and Succulent Karoo. Species selects areas of low percentage of plant cover and areas with	High

Scientific Name	Common Name	Status	Habitat	Likelihood
			deep sands.	
Parotomys littledalei	Littledale's Whistling Rat	LC	Riverine associations or associated with Lycium bushes or Psilocaulon absimile	High
Desmodillus auricularis	Cape Short-tailed Gerbil	LC	Tend to occur on hard ground, unlike other gerbil species, with some cover of grass or karroid bush	High
Gerbillurus paeba	Hairy-footed Gerbil	LC	Gerbils associated with Nama and Succulent Karoo preferring sandy soil or sandy alluvium with a grass, scrub or light woodland cover	High
Gerbillurus tytonis	Dune Hairy-footed Gerbil	LC	Hot dry areas on shifting red sand dunes	Moderate
Gerbilliscus leucogaster	Bushveld Gerbil	LC	Predominantly associated with light sandy soils or sandy alluvium	Moderate
Gerbilliscus brantsii	Higheld Gerbil	LC	Sandy soils or sandy alluvium with some cover of grass, scrub or open woodland	Moderate
Saccostomus campestris	Pouched Mouse	LC	Catholic habitat requirements, commoner in areas where there is a sandy substrate.	High
Malacothrix typica	Gerbil Mouse	LC	Found predominantly in Nama and Succulent Karoo biomes, in areas with a mean annual rainfall of 150-500 mm.	High
Petromyscus collinus	Pygmy Rock Mouse	LC	Arid areas on rocky outcrops or koppies with a high rock cover	High
Primates:				
Papio ursinus	Chacma Baboon	LC	Can exploit fynbos, montane grasslands, riverine courses in deserts, and simply need water and access to refuges.	Confirmed
Cercopithecus mitis	Vervet Monkey	LC	Most abundant in and near riparian vegetation of savannahs	Low
Eulipotyphla (Shrews):				
Crocidura cyanea	Reddish-Grey Musk Shrew	LC	Occurs in relatively dry terrain, with a mean annual rainfall of less than 500 mm. Occur in karroid scrub and in fynbos often in association with rocks.	High
Carnivora:				
Proteles cristata	Aardwolf	LC	Common in the 100-600mm rainfall range of country, Nama-Karoo, Succulent Karoo Grassland and Savanna biomes	Confirmed
Caracal caracal	Caracal	LC	Caracals tolerate arid regions, occur in semi-desert and karroid conditions	High
Felis silvestris	African Wild Cat	LC	Wide habitat tolerance.	High
Panthera pardus	Leopard	NT	Wide habitat tolerance, associated with areas of rocky koppies and hills, mountain ranges and forest	High
Felis nigripes	Black-footed cat	VU	Associated with arid country with MAR 100-500 mm, particularly areas with open habitat that provides some cover in the form of tall stands of grass or scrub.	High

Scientific Name	Common Name	Status	Habitat	Likelihood
Genetta genetta	Small-spotted genet	LC	Occur in open arid associations	High
Suricata suricatta	Meerkat	LC	Open arid country where substrate is hard and stony. Occur in Nama and Succulent Karoo but also fynbos	Confirmed
Cynictis penicillata	Yellow Mongoose	LC	Semi-arid country on a sandy substrate	Confirmed
Herpestes pulverulentus	Cape Grey Mongoose	LC	Wide habitat tolerance	High
Atilax paludinosus	Marsh Mongoose	LC	Associated with well-watered terrain, living in close association with rivers, streams, marshes, etc.	High
Vulpes chama	Cape Fox	LC	Associated with open country, open grassland, grassland with scattered thickets and coastal or semi-desert scrub	High
Canis mesomelas	Black-backed Jackal	LC	Wide habitat tolerance, more common in drier areas.	High
Otocyon megalotis	Bat-eared Fox	LC	Open country with mean annual rainfall of 100-600 mm	High
Aonyx capensis	African Clawless Otter	LC	Predominantly aquatic and do not occur far from permanenet water	Confirmed
Ictonyx striatus	Striped Polecat	LC	Widely distributed throughout the sub-region	High
Rumanantia (Antelope):				
Tragelaphus strepsiceros	Greater Kudu	LC	Broken, rocky terrain with a cover of woodland and a nearby water supply.	Confirmed
Oryx gazella	Gemsbok	LC	Open arid country	High
Sylvicapra grimmia	Common Duiker	LC	Presence of bushes is essential	High
Antidorcas marsupialis	Springbok	LC	Arid regions and open grassland.	Confirmed
Raphicerus campestris	Steenbok	LC	Inhabits open country,	Confirmed
Oreotragus oreotragus	Klipspringer	LC	Closely confined to rocky habitat.	High
Chiroptera (Bats)				
Sauromys petrophilus	Flat-headed free-tailed bat	LC	Rocky areas and the availability of narrow rock fissures essential requirements	High
Tadarida aegyptiaca	Egyptian Free-tailed Bat	LC	In arid areas. often associated with water sources	High
Nycteris thebaica	Egyptian Slit-faced Bat	LC	Wide habitat tolerance	High
Cistugo seabrae	Angolan hairy bat	NT	From areas with annual rainfall of less than 100 mm, usually near open water	High
Eptesicus hottentotus	Long-talied serotine bat	LC	Wide habitat tolerance	High
Rhinolophus clivosus	Geoffroy's horsehoe bat	LC	Wide habitat tolerance but Roost in caves	Low
Rhinolophus capensis	Cape horseshoe bat	LC	Many records from coastal caves	Low
Rhinolophus darlingi	Darling's Horsehoe Bat	LC	Savanna woodland species but requires caves	High

10 ANNEX 3. LIST OF REPTILES

List of reptiles which are likely to occur in the broad vicinity of the Gamsberg ESIA study area, as well as those observed in the area by SARCA. Habitat notes and distribution records are based on Branch (1988) and Alexander and Marais (2007), while conservation status is from the Branch & Bates (In Prep).

Scientific Name	Common Name	Distribution	Status	Habitat	Likelihood	SARCA
Tortoises and Terrapins:						
Psammobates tentorius verroxii	Bushmanland Tent Tortoise	Endemic	Not Assessed	Varied: usually arid karroid areas or rocky sandveld	Confirmed	SARCA
Snakes:						
Rhinotyphlops lalandei	Delalande's Beaked Blind Snake	Endemic	LC	Varied: semi-desert, coastal bush, fynbos & savannah	Low	
Rhinotyphlops schinzi	Schinz's Beaked Blind Snake	Endemic	LC	Semi-deseet and arid savanna	High	
Leptotyphlops occidentalis	Western Thread Snake	Endemic	LC	Nambib Desert and Karoo scrub	High	
Lamprophis capensis	Brown House Snake	Widespread	LC	Common in highveld grassland & arid karroid regions, but found everywhere & tolerant of urban sprawl	High	
Lamprophis guttatus	Spotted Rock Snake	Endemic	LC	Inland mnts of Cape & Cape fold mnts, extending into S.Namibia	High	SARCA
Lamprophis fiskii	Fisk's House Snake	Endemic	LC	Karroid sandy veld, but few specimens from widely scattered localities	Low	
Pseudaspis cana	Mole Snake	Widespread	LC	Sandy scrubland in SW Cape, highveld grassland & mountainous & desert regions	High	
Prosymna frontalis	South-western Shovel-Snout	Widespread	LC	Rocky areas in arid regions	High	
Prosymna bivittata	Two-striped Shovel-snout		LC	Acacia sanannah entering sandveld	High	SARCA
Dipsina multimaculata	Dwarf Beaked Snake	Endemic	LC	Rocky, sandy areas. Cape karroid areas.	High	SARCA
Psammophylax rhombeatus	Spotted Or Rhombic Skaapsteker	Widespread	LC	Highland grassveld & fynbos, entering karroid areas	Low	
Psammophis notostictus	Karoo Sand or Whip Snake	Widespread	LC	Arid scrubland & karroid regions	High	SARCA
Psammophis trinasalis	Kalahari Sand Snake	Widespread	LC	Mainly Kalahari thornveld but may also occur in savanna and grassland	Low	
Psammophis namibensis	Namib Sand Snake	Endemic	LC	Namib desert and karoo vegetation	Low	
Dasypeltis scabra	Common/Rhombic Egg Eater	Widespread	LC	Absent only from true desert & closed-canopy forest	High	
Telescopus beetzii	Namib Tiger Snake	Endemic	LC	Rocky, arid regions	High	
Telescopus semiannulatus polystictus	Eastern Tiger Snake	Widespread	LC	Desert to Karoo, savanna and forest	High	
Aspidelaps lubricus	Coral Shield Cobra	Widespread	LC	Karroid & sandveld regions, entering dry valley plains in S and E Cape	High	SARCA
Naja nivea	Cape Cobra	Widespread	LC	Arid karroid regions, particularly along river courses, entering well drained open areas along the southern coast	High	SARCA
Naja nigricollis woodi	Black Spitting Cobra	Endemic	LC	Namibia to Citrusdal in karroid	High	

Scientific Name	Common Name	Distribution	Status	Habitat	Likelihood	SARCA
				scrub		
Bitis arietans	Puff Adder	Widespread	LC	Absent only from desert & mnt tops	High	
Bitis cornuta	Many-horned Adder	Endemic	LC	Mountainous regions, rocky outcrops. gravel plains and mountain fynbos	High	
Bitis xeropaga	Desert Mountain Adder	Endemic	LC	Mountain slopes and sparsely vegetated rocky hillsides	Low	SARCA
Bitis caudalis	Horned Adder	Widespread	LC	Sandy regions, throughout Karoo	High	SARCA
Lizard and Skinks:						
Acontias gracilicauda namaquensis	Thin-tailed Legless Skink	Endemic	LC	Valley bushveld, grassland entering sandy regions	Low	
Acontias lineatus	Striped Legless Skink	Endemic	LC	Sandy, arid soils	High	
Mabuya capensis	Cape Skink	Widespread	LC	Very varied: arid karroid veld, moist coastal bush, montane grassland, etc	High	
Mabuya occidentalis	Western Three-Striped Skink	Widespread	LC	Arid Savanna karroid veld and desert	High	SARCA
Mabuya spilogaster	Kalahari Tree Skink	Widespread	LC	Arid Savannah	High	
Mabuya sulcata	Western Rock Skink	Widespread	LC	Karroid areas	Confirmed	SARCA
Mabuya variegata	Variegated Skink	Widespread	LC	Extremely varied; desert, karroid veld, montane grassland, savanna, coastal bush & valley bushveld	High	SARCA
Meroles knoxii	Knox's Desert Lizard	Endemic	LC	Coastal dunes and succulent karroid veld		SARCA
Meroles suborbitalis	Spotted Desert Lizard	Endemic	LC	Varied, arid savanna to desert	Confirmed	SARCA
Nucras tessellata	Western Sandveld Lizard		LC	Rocky ground in arid savanna and karroid veld	High	
Pedioplanis laticeps	Cape Sand Lizard	Endemic	LC	Coastal dunes and succulent karroid veld	Low	
Pedioplanis lineoocellata	Spotted Sand Lizard	Endemic	LC	Very varied: karroid veld, valley bushveld & arid & mesic savannah	High	SARCA
Pedioplanis namaquensis	Namaqua Sand Lizard	Widespread	LC	Karroid veld	High	SARCA
Pedioplanis pulchella	Common Sand Lizard	Widespread	LC	Widespread in the Fynbos, Succulent and Nama Karoo	High	SARCA
Pedioplanis inornata	Plain Sand Lizard	Endemic	LC	Bedrock flats in semi-desert	Confirmed	SARCA
Cordylosaurus subtessellatus	Dwarf Plated Lizerd	Endemic	LC	Sandy areas among rocks	Moderate	
Gerrhosaurus typicus	Namaqua Plated Lizard	Endemic	LC	Karroid succulent veld	Low	
Cordylus cataphractus	Armadillo Girdled Lizard	Endemic	LC	Rock outcrops and mountain ranges	High	
Cordylus peersi	Peers Girdled Lizard	Narrow Endemic	LC	Rocky outcrops in succulent karroid veld	Low	
Cordylus polyzonus	Karoo Girdled Lizard	Endemic	LC	Karroid regions, coastal renosterveld and succulent karoo	High	SARCA
Platysaurus broadleyi	Broadley's Flat Lizard	Narrow Endemic	LC	Rocky, arid sanannah, between augrabies and Pella	High	SARCA
Varanus niloticus	Water Monitor	Widespread	LC	Rivers pans and major lakes	High	
Agama aculeata	Ground Agama	Widespread	LC	Semi desert and savanna	Confirmed	SARCA
Agama anchietae	Anchieta's Agama	Widespread	LC	Semi desert and arid savanna	Confirmed	
Agama atra	Southern Rock Agama	Endemic	LC	Semi-desert to fynbos, from sea level to mountain tops	High	SARCA

Scientific Name	Common Name	Distribution	Status	Habitat	Likelihood	SARCA
Chameleons:						
Chamaeleo namaquensis	Namaqua Chameleon	Widespread	LC	Sandy regions (incl coastal dunes) with scrub vegetation	High	
Geckos:						
Chondrodactylus angulifer	Common Giant Ground Gecko	Endemic	LC	Gravel plains, interdune spaces & sandy flats	High	SARCA
Goggia lineata	Striped Leaf-Toed Gecko	Endemic	LC	Coastal fynbos, succulent & transitional karroid veld, montane grassland	High	
Lygodactylus bradfieldi	Bradfield's Dwarf Gecko	Widespread	LC	Arid savannah and succulent desert	High	
Chondrodactylus bibronii	Bibron's Tubercled Gecko	Endemic	LC	Rocky outcrops, cliffs and large trees	High	SARCA
Pachydactyus haackei	Haacke's Thick-toed Gecko	Endemic	LC	Large rock outcrops in the Lower Orange River Valley	High	
Pachydactylus rugosus	Rough Thick-toed Gecko	Endemic	LC	Semi-desert and succulent karroid veld	High	
Ptenopus garrulus maculatus	Spotted Barking Gecko	Endemic	LC	Desert and semi-desert on various soil types, preferring flat stable sandy soils with sparse vegetation cover	High	SARCA
Chondrodactylus turneri	Turner's Gecko	Widespread	LC	Semi-desert and arid savannah		SARCA
Pachydactylus goodi	Good's Gecko	Endemic	LC	Richersveld and vicinity of Aggeneys in rocky hills		SARCA
Pachydactylus latirostris	Quartz Gecko	Widespread	LC	Bushmanland and Nama karoo of the Northern Cape		SARCA
Pachydactylus montanus	Namaqua Mountain Gecko	Endemic	LC	Lower Orange River valley and Richtersveld		SARCA
Pachydactylus purcelli	Purcell's Gecko	Widespread	LC	Rocky outcrops in the Succulent and western Nama karoo		SARCA

11 ANNEX 4. LIST OF AMPHIBIANS

List of amphibians which are likely to occur in the broad vicinity of the Gamsberg ESIA study area. Habitat notes and distribution records are based on Du Preez and Carruthers (2009), while conservation status is from the IUCN Red Lists 2012.

Scientific Name	Common Name	Status	Habitat	Distribution	Likelihood
Amietophrynus gutturalis	Guttural Toad	Not Threatened	Around open pools, dams, vleis and other semi-permanent or permenent water	Widespread	Low
Amietophrynus rangeri	Raucous Toad	Not Threatened	Rivers and stream in grassland and fynbos	Endemic	High
Vandijkophrynus gariepensis	Karoo Toad	Not Threatened	Karoo Scrub	Widespread	High
Vandijkophrynus robinsoni	Paradise Toad	Not Threatened	Natural springs and waterholes in the arid areas of the Richtersveld	Endemic	High
Phrynomantis annectens	Marbled Rubber Frog	Not Threatened	Arid environments, closely associated with inselbergs and rocky areas	Widespread	High
Xenopus laevis	Common Platanna	Not Threatened	Any more or less permanent water	Widespread	High
Amietia angolensis	Common River Frog	Not Threatened	Banks of slow-flowing streams or permanent bodies of water	Widespread	High
Strongylopus springbokensis	Namaqua Stream Frog	Vulnerable	Mountainous areas of Namaqualand associated with seeps and springs	Endemic	Low
Tomopterna delalandii	Cape Sand Frog	Not Threatened	Lowlands in fynbos and Succulent Karoo	Endemic	High
Tomopterna tandyi	Tandy's Sand Frog	Not Threatened	Nama karoo grassland and savanna	Widespread	High

12 ANNEX 5. LIST OF BIRDS

List of birds which are likely to occur in the broad area around the proposed Gamsberg ESIA study area. The list is derived from the SABAP 2 dataset for the Quarter Degree Squares 2818 and 2819.

Rank	Common Name	Scientific Name	Status	Total Reports	Total Cards	Reporting Rate (%)
1	Cape Sparrow	*Passer melanurus*		61	67	91
2	African Red-eyed Bulbul	*Pycnonotus nigricans*		12	14	85.7
2	Pied Crow	*Corvus albus*		56	67	83.6
3	Anteating Chat	*Myrmecocichla formicivora*		48	67	71.6
4	Spike-heeled Lark	*Chersomanes albofasciata*		47	67	70.1
5	Karoo Chat	*Cercomela schlegelii*		46	67	68.7
7	Cape Bunting	*Emberiza capensis*		45	67	67.2
6	Mountain Wheatear	*Oenanthe monticola*		45	67	67.2
9	Common Fiscal	*Lanius collaris*		40	67	59.7
8	Rufous-eared Warbler	*Malcorus pectoralis*		40	67	59.7
10	White-throated Canary	*Crithagra albogularis*		40	67	59.7
11	Pale-winged Starling	*Onychognathus nabouroup*		39	67	58.2
12	Bokmakierie Bokmakierie	*Telophorus zeylonus*		37	67	55.2
13	Dusky Sunbird	*Cinnyris fuscus*		34	67	50.7
14	Speckled Pigeon	*Columba guinea*		30	67	44.8
16	Namaqua Sandgrouse	*Pterocles namaqua*		29	67	43.3
15	Southern Pale Chanting Goshawk	*Melierax canorus*		29	67	43.3
17	Rock Martin	*Hirundo fuligula*		27	67	40.3
18	Familiar Chat	*Cercomela familiaris*		26	67	38.8
19	Tractrac Chat	*Cercomela tractrac*		26	67	38.8
20	Yellow Canary	*Crithagra flaviventris*		26	67	38.8
21	Capped Wheatear	*Oenanthe pileata*		25	67	37.3
22	Acacia Pied Barbet	*Tricholaema leucomelas*		23	67	34.3
23	Grey-backed Cisticola	*Cisticola subruficapilla*		23	67	34.3
24	Karoo Long-billed Lark	*Certhilauda subcoronata*		23	67	34.3
25	Chat Flycatcher	*Bradornis infuscatus*		20	67	29.9
23	African Darter	*Anhinga rufa*		4	14	28.6
28	Lark-like Bunting	*Emberiza impetuani*		19	67	28.4
29	Ludwig's Bustard	*Neotis ludwigii*	VU	19	67	28.4
26	Red Lark	*Calendulauda burra*	VU	19	67	28.4
27	Scaly-feathered Finch	*Sporopipes squamifrons*		19	67	28.4
31	Grey Tit	*Parus afer*		18	67	26.9
30	Grey-backed Sparrowlark	*Eremopterix verticalis*		18	67	26.9
32	Rock Kestrel	*Falco rupicolus*		18	67	26.9
33	Large-billed Lark	*Galerida magnirostris*		17	67	25.4
34	Sociable Weaver	*Philetairus socius*		17	67	25.4
35	Karoo Korhaan	*Eupodotis vigorsii*		16	67	23.9
36	Laughing Dove	*Streptopelia senegalensis*		16	67	23.9
38	Cape Turtle-Dove	*Streptopelia capicola*		15	67	22.4
37	Karoo Scrub-Robin	*Cercotrichas coryphoeus*		15	67	22.4
39	White-backed Mousebird	*Colius colius*		15	67	22.4
37	African Fish-Eagle	*Haliaeetus vocifer*		3	14	21.4
34	Grey Heron	*Ardea cinerea*		3	14	21.4
36	Hamerkop Hamerkop	*Scopus umbretta*		3	14	21.4
35	Little Egret	*Egretta garzetta*		3	14	21.4
41	Malachite Kingfisher	*Alcedo cristata*		3	14	21.4

40	Pied Kingfisher	*Ceryle rudis*	3	14	21.4
44	Southern Red Bishop	*Euplectes orix*	3	14	21.4
41	Jackal Buzzard	*Buteo rufofuscus*	14	67	20.9
40	Karoo Prinia	*Prinia maculosa*	14	67	20.9
42	Namaqua Dove	*Oena capensis*	14	67	20.9
45	Greater Kestrel	*Falco rupicoloides*	13	67	19.4
43	Karoo Lark	*Calendulauda albescens*	13	67	19.4
44	Stark's Lark	*Spizocorys starki*	13	67	19.4
46	Black-headed Canary	*Serinus alario*	12	67	17.9
47	Verreaux's Eagle	*Aquila verreauxii*	12	67	17.9
49	Karoo Eremomela	*Eremomela gregalis*	11	67	16.4
50	Malachite Sunbird	*Nectarinia famosa*	11	67	16.4
50	African Palm-Swift	*Cypsiurus parvus*	2	14	14.3
54	African Reed-Warbler	*Acrocephalus baeticatus*	2	14	14.3
46	Double-banded Sandgrouse	*Pterocles bicinctus*	2	14	14.3
45	Helmeted Guineafowl	*Numida meleagris*	2	14	14.3
51	Cape Crow	*Corvus capensis*	9	67	13.4
53	Layard's Tit-Babbler	*Parisoma layardi*	9	67	13.4
52	Long-billed Crombec	*Sylvietta rufescens*	9	67	13.4
54	Red-capped Lark	*Calandrella cinerea*	8	67	11.9
58	Double-banded Courser	*Rhinoptilus africanus*	7	67	10.4
57	South African Shelduck	*Tadorna cana*	7	67	10.4
56	Southern Double-collared Sunbird	*Cinnyris chalybeus*	7	67	10.4
60	Black-chested Prinia	*Prinia flavicans*	6	67	9
61	Cape Weaver	*Ploceus capensis*	6	67	9
62	Common Ostrich	*Struthio camelus*	6	67	9
59	Sickle-winged Chat	*Cercomela sinuata*	6	67	9
64	Barn Swallow	*Hirundo rustica*	5	67	7.5
65	Cape Bulbul	*Pycnonotus capensis*	5	67	7.5
67	Cape Glossy Starling	*Lamprotornis nitens*	5	67	7.5
63	Fawn-coloured Lark	*Calendulauda africanoides*	5	67	7.5
68	Karoo Thrush	*Turdus smithi*	5	67	7.5
70	Little Swift	*Apus affinis*	5	67	7.5
66	Long-billed Pipit	*Anthus similis*	5	67	7.5
69	Orange River White-eye	*Zosterops pallidus*	5	67	7.5
99	African Pied Wagtail	*Motacilla aguimp*	1	14	7.1
100	African Pipit	*Anthus cinnamomeus*	1	14	7.1
68	African Spoonbill	*Platalea alba*	1	14	7.1
73	Black-shouldered Kite	*Elanus caeruleus*	1	14	7.1
75	Cape Spurfowl	*Pternistis capensis*	1	14	7.1
95	Chestnut-vented Tit-Babbler	*Parisoma subcaeruleum*	1	14	7.1
79	Giant Kingfisher	*Megaceryle maximus*	1	14	7.1
89	Lesser Swamp-Warbler	*Acrocephalus gracilirostris*	1	14	7.1
94	Namaqua Warbler	*Phragmacia substriata*	1	14	7.1
77	Rosy-faced Lovebird	*Agapornis roseicollis*	1	14	7.1
84	Short-toed Rock-Thrush	*Monticola brevipes*	1	14	7.1
106	Southern Grey-headed Sparrow	*Passer diffusus*	1	14	7.1
69	Spur-winged Goose	*Plectropterus gambensis*	1	14	7.1
64	White-breasted Cormorant	*Phalacrocorax carbo*	1	14	7.1
80	White-fronted Bee-eater	*Merops bullockoides*	1	14	7.1
92	Zitting Cisticola	*Cisticola juncidis*	1	14	7.1
83	Alpine Swift	*Tachymarptis melba*	4	67	6

72	Black-eared Sparrowlark	*Eremopterix australis*		4	67	6
80	Blacksmith Lapwing	*Vanellus armatus*		4	67	6
74	Cape Wagtail	*Motacilla capensis*		4	67	6
75	House Sparrow	*Passer domesticus*		4	67	6
78	Martial Eagle	*Polemaetus bellicosus*	VU	4	67	6
81	Red-eyed Dove	*Streptopelia semitorquata*		4	67	6
77	Red-headed Finch	*Amadina erythrocephala*		4	67	6
71	Sabota Lark	*Calendulauda sabota*		4	67	6
76	Southern Masked-Weaver	*Ploceus velatus*		4	67	6
82	Spotted Eagle-Owl	*Bubo africanus*		4	67	6
79	Three-banded Plover	*Charadrius tricollaris*		4	67	6
73	Yellow-bellied Eremomela	*Eremomela icteropygialis*		4	67	6
84	African Hoopoe	*Upupa africana*		3	67	4.5
91	Burchell's Courser	*Cursorius rufus*		3	67	4.5
87	Cape Clapper Lark	*Mirafra apiata*		3	67	4.5
88	Egyptian Goose	*Alopochen aegyptiacus*		3	67	4.5
93	European Bee-eater	*Merops apiaster*		3	67	4.5
85	Fairy Flycatcher	*Stenostira scita*		3	67	4.5
89	Lanner Falcon	*Falco biarmicus*	NT	3	67	4.5
90	Pygmy Falcon	*Polihierax semitorquatus*		3	67	4.5
92	Red-faced Mousebird	*Urocolius indicus*		3	67	4.5
86	White-browed Sparrow-Weaver	*Plocepasser mahali*		3	67	4.5
99	Black-chested Snake-Eagle	*Circaetus pectoralis*		2	67	3
98	Booted Eagle	*Aquila pennatus*		2	67	3
94	Brown-throated Martin	*Riparia paludicola*		2	67	3
97	Hadeda Ibis	*Bostrychia hagedash*		2	67	3
96	Northern Black Korhaan	*Afrotis afraoides*		2	67	3
95	Pririt Batis	*Batis pririt*		2	67	3
100	Spotted Thick-knee	*Burhinus capensis*		2	67	3
118	African Sacred Ibis	*Threskiornis aethiopicus*		1	67	1.5
116	Black-headed Heron	*Ardea melanocephala*		1	67	1.5
109	Black-throated Canary	*Crithagra atrogularis*		1	67	1.5
123	Black-winged Stilt	*Himantopus himantopus*		1	67	1.5
102	Cape Penduline-Tit	*Anthoscopus minutus*		1	67	1.5
103	Cape Robin-Chat	*Cossypha caffra*		1	67	1.5
119	Cape Teal	*Anas capensis*		1	67	1.5
111	Cape White-eye	*Zosterops virens*		1	67	1.5
107	Common Waxbill	*Estrilda astrild*		1	67	1.5
121	Crowned Lapwing	*Vanellus coronatus*		1	67	1.5
112	Eastern Long-billed Lark	*Certhilauda semitorquata*		1	67	1.5
117	Goliath Heron	*Ardea goliath*		1	67	1.5
101	Ground Woodpecker	*Geocolaptes olivaceus*		1	67	1.5
113	Little Grebe	*Tachybaptus ruficollis*		1	67	1.5
120	Maccoa Duck	*Oxyura maccoa*		1	67	1.5
122	Pied Avocet	*Recurvirostra avosetta*		1	67	1.5
108	Pin-tailed Whydah	*Vidua macroura*		1	67	1.5
106	Red-billed Quelea	*Quelea quelea*		1	67	1.5
114	Reed Cormorant	*Phalacrocorax africanus*		1	67	1.5
110	Rock Dove	*Columba livia*		1	67	1.5
104	Spotted Flycatcher	*Muscicapa striata*		1	67	1.5
125	Swallow-tailed Bee-eater	*Merops hirundineus*		1	67	1.5

SHORT CV OF CONSULTANT:

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SUMMARY OF EXPERTISE:

SIMON TODD

- Profession: Ecological Consultant
- Specialisation: Plant & Animal Ecology
- Years of Experience: 15 Years

Skills & Primary Competencies

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

Tertiary Education:

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

Employment History

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

General Experience & Expertise

- Conducted a large number of fauna and flora specialist assessments distributed widely across South Africa. Projects have ranged in extent from <50 ha to more then 50 000 ha.

- Extensive experience in the field and exceptional level of technical expertise, particularly with regards to GIS capabilities which is essential with regards to producing high-quality sensitivity maps for use in the design of final project layouts.
- Strong research background which has proved invaluable when working on several ecologically sensitive and potentially controversial sites containing some of the most threatened fauna in South Africa.
- Published numerous research reports as well as two book chapters and a large number of papers in leading scientific journals dealing primarily with human impacts on the vegetation and ecology of South Africa.
- Maintain several long-term vegetation monitoring projects distributed across Namaqualand and the karoo.
- Guest lecturer at two universities and have also served as an external examiner.
- Reviewed papers for more than 10 international ecological journals.
- Past chairman and current committee member of the Arid Zone Ecological Forum.
- SACNASP registered as a Professional Natural Scientist, (Ecology) No. 400425/11.

A selection of recent work is as follows:

Specialist Assessments:

Pella Water Board- Infrastrucure Upgrade. Fauna and Flora Specialist Report for Basic Assessment. Environmental Resources Management (ERM), 2013.

ESKOM 300MW Kleinsee Wind Energy Facility. Fauna Specialist Report For Impact Assessment. Savannah Environmental. 2012.

Karoshoek Solar Valley Development, Near Upington: Fauna & Flora Specialist Impact Assessment Report. Savannah Environmental. 2012.

Project Blue Wind and Solar Energy Facility, Near Kliensee. Fauna Specialist Report For Impact Assessment. Savannah Environmental. 2012.

O'Kiep 3 PV Solar Energy Facility on a Site In O'kiep Near Springbok, Northern Cape Province. Fauna & Flora Specialist Report for Basic Assessment. Savannah Environmental 2012.

Photovoltaic Solar Energy Facility on Voëlklip, South of Springbok. Fauna & Flora Specialist Report for Basic Assessment. Savannah Environmental 2012.

Namaqua Photovoltaic Solar Energy Facility on a Site North of Kamieskroon. Fauna & Flora Specialist Report for Basic Assessment. Savannah Environmental 2012.

Rare Earth Separation Plant Near Vredendal, Western Cape Province. Fauna & Flora Specialist Report for Basic Assessment. Savannah Environmental 2012.

Inca Graafwater Photovoltaic Solar Energy Facility, Graafwater, Western Cape Province. Faunal Ecology Specialist Report for Impact Assessment. Savannah Environmental 2012.

Aberdeen Solar Facility. Fauna & Flora Specialist Report for Basic Assessment. Specialist Report for Savannah Environmental. 2012.

Venetia Solar Facility. Fauna & Flora Specialist Report for Basic Assessment. Specialist Report for Savannah Environmental. 2012.

Southern Cross Solar Energy Facility: Southern Farm 425. Fauna & Flora Specialist Report for Basic Assessment. Specialist Report for Savannah Environmental. 2012.

Tutwa Solar Energy Facility: Portion 4 of Narries 7. Fauna & Flora Specialist Report for Basic Assessment. Specialist Report for Savannah Environmental. 2012.

Karoshoek Grid Integration Infrastructure. Fauna & Flora Specialist Report For Basic Assessment. Specialist Report for Savannah Environmental. 2012.

Valleydora Photovolataic Solar Power Plant, Free State. Fauna & Flora Specialist Report. CSIR, 2012.

Reddersburg Solar Facility - Fauna & Flora Specialist Assessment. CSIR, 2012.

Melkvlei Photovolataic Solar Power Plant. Fauna & Flora Specialist Report for Basic Assessment. Specialist report for ERM. 2012.

Ruinte Photovolataic Solar Power Plant. Fauna & Flora Specialist Report for Basic Assessment. Specialist report for ERM. 2012.

Genoegsaam Solar Park. Fauna & Flora Specialist Report for Basic Assessment. Specialist report for ERM. 2012.

Genoegsaam Solar Park. Fauna & Flora Specialist EIA Report. Specialist report for ERM. 2012.

Graspan Solar Facility. Fauna & Flora Specialist Report for Impact Assessment. Specialist report for ERM. 2012.

Olyven Kolk Solar Power Plant, Northern Cape: Botanical and Faunal Specialist Assessment. Specialist Report for Environmental Resources Management (ERM). 2011.

Klawer Wind Farm: Ecological and Biodiversity Assessment: Terrestrial Vertebrate Fauna & Botanical Specialist Study. Specialist Report for Environmental Resources Management. 2011.

Lambert's Bay Wind Farm: Ecological and Biodiversity Assessment: Terrestrial Vertebrate Fauna & Botanical Specialist Study. Specialist Report for Environmental Resources Management. 2011.

Richtersveld Wind Farm: Ecological and Biodiversity Assessment: Terrestrial Vertebrate Fauna & Botanical Specialist Study. Specialist Report for Environmental Resources Management (ERM). 2011.

Roggeveld Wind Farm: Ecological and Biodiversity Assessment: Terrestrial Vertebrate Fauna & Botanical Specialist Study. Specialist Report for Environmental Resources Management (ERM). 2011.

Witberg Wind Farm: Ecological and Biodiversity Assessment: Terrestrial Vertebrate Fauna & Botanical Specialist Study. Specialist Report for Environmental Resources Management (ERM). 2011.

Skuitdrift Solar Facility. Fauna & Flora Specialist Report for Basic Assessment. Specialist Report for Cape EAPrac. 2012.

Khoi-Sun Solar Facility. Fauna & Flora Specialist Scoping Report. Specialist Report for Cape EAPrac. 2012.

Boesmanland Solar Farm. Fauna & Flora Specialist Scoping Study. Specialist Report for Cape EAPrac. 2012.

Bitterfontein Solar Plant - Fauna & Flora Specialist Assessment. Specialist Report for Cape EAPrac. 2012.

Beaufort West Solar Facility, Erf 7388 - Fauna & Flora Specialist Assessment. Specialist Report for Cape EAPrac. 2012.

Improvements to the Ou Kaapse Weg / Silvermine Road Intersection. Specialist Faunal Study For Basic Assessment. Khula Environmental Consultants, 2012.

Upgrading of Tourism Facilities at Goegap Nature Reserve. Specialist Ecological Assesment. Van Zyl Environmental Consultants. 2012.

The Proposed Commercial Concentrated Solar Power Tower Facility and Concentrated Photovoltaic Facility at Van Roois Vley Near Upington. Specialist Vegetation Assessment for EIA. WSP Environmental 2012.

Plant Sweeps on Portion 2 of the Farm Demaneng 546, Kuruman District, Northern Cape Province for SA Manganese. 2011.

Research Reports & Peer Reviewed Publications:

Todd, S.W. 2010. Vegetation and Plant Communities Associated with the Tillite and Dolerite Renosterveld Types of the Avontuur Conservation Area, Nieuwoudtville, South Africa. DRYNET.

Todd, S.W., Milton, S.J., Dean, W.R.J. Carrick, P.J. & Meyer, A. 2009. Ecological best Practice Guidelines for the Namakwa District. The Botanical Society of South Africa.

Todd, S.W. 2009. Field-Based Assessment of Degradation in the Namakwa District. Final Report. Mapping Degradation in the Arid Subregions of the BIOTA South Transect. SANBI.

Todd, S.W. 2009. A fence-line in time demonstrates grazing-induced vegetation shifts and dynamics in the semi-arid Succulent Karoo. *Ecological Applications*, 19: 1897–1908.

Todd, S.W. 2007. Characterisation of Riparian Ecosystems. D14 of The WADE Project. Floodwater Recharge of Alluvial Aquifers in Dryland Environments. *GOCE-CT-2003-506680- WADE.* Sixth Framework Programme Priority 1.1.6.3 Global Change and Ecosystems.

Todd, S.W. 2006. Gradients in vegetation cover, structure and species richness of Nama-Karoo shrublands in relation to distance from livestock watering points. *Journal of Applied Ecology* 43: 293-304.

Benito, G., Rohde, R., Seely, M., Külls, C., Dahan, O., Enzel, Y., **Todd, S**. Botero, B., Morin, E., Grodek, T., Roberts, C. 2010. Management of Alluvial Aquifers in Two Southern African Ephemeral Rivers: Implications for IWRM. *Water Resources Management*, 24:641–667.

Hahn, B.D., Richardson, F.D., Hoffman, M.T., Roberts, R., **Todd, S.W.** and Carrick, P.J. 2005. A simulation model of long-term climate, livestock and vegetation interactions on communal rangelands in the semi-arid Succulent Karoo, Namaqualand, South Africa. *Ecological Modelling* 183, 211–230.

Malgas, R.R., Potts, A.J., Oettlé, N.M., Koelle, B., **Todd, S.W.**, Verboom G.A. & Hoffman M.T.. 2010. Distribution, quantitative morphological variation and preliminary molecular analysis of different growth forms of wild rooibos (*Aspalathus linearis*) in the northern Cederberg and on the Bokkeveld Plateau. *South African Journal of Botany*, 76, 72-81.

Mills, A., Fey, M., Donaldson, J.D., **Todd, S.W**. & Theron, L.J. 2009. Soil infiltrability as a driver of plant cover and species richness in the semi-arid Karoo, South Africa. *Plant and Soil* 320: 321–332.

Rahlao, J.S., Hoffman M.T., **Todd, S.W**. & McGrath, K. 2008. Long-term vegetation change in the Succulent Karoo, South Africa following 67 years of rest from grazing. *Journal of Arid Environments*, 72, 808-819.

Hoffman, M.T. & **Todd, S.W.** 2010. Using Fixed-Point Photography, Field Surveys, And Gis To Monitor Environmental Change: An Example From Riemvasmaak, South Africa. Chapter In *Repeat Photography: Methods And Applications In The Natural Sciences.* R.H. Webb, Editor. Island Press.