April 2017

REPORT ON

ECOLOGICAL BASELINE AND IMPACT ASSESSMENT REPORT FOR THE PROPOSED REALIGNMENT OF THE MN73 ROAD NEAR POFADDER, NORTHERN CAPE PROVINCE

Report Number: 2015/013/10/05

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PURPOSE OF THIS DOCUMENT

Abengoa Solar (Pty) Ltd (herein further referred to as Abengoa) is proposing to establish a new solar facility (Paulputs Tower Facility) on Portion 4 of the Farm Scuitklip in the Northern Cape Province, South Africa. The study area is situated approximately 40km north-east of the town of Pofadder.

The proposed Paulputs project footprint will bisect the current MN73 road therefore a section of this road will need to be realigned in order to circumvent the project footprint.

The purpose of this report is to describe the receiving ecological environment and possible impacts and mitigations, of the proposed realignment of the MN73 road with reference to the receiving ecological environment, based on the studies conducted during August 2015 and April 2016.

This study will form part of the supporting documents for a basic assessment report for the proposed road realignment, to be conducted by Savannah Environmental Pty Ltd.

Executive Summary

Hudson Ecology (Pty) Ltd was commissioned by Savannah Environmental (Pty) Ltd to conduct an ecological specialist study of ecosystems associated with the proposed MN73 road realignment.

Based on species composition, physiognomy, moisture regime, rockiness, slope and soil properties, three main communities were recognised. The vegetation communities are described in this report and named according to dominant species and underlying substrate. The vegetation communities are named as follows:

- *Acacia mellifera – Aristida congesta* dune open shrubland;
- *Acacia mellifera – Parkinsonia africana* wash open shrubland; and
- *Stipagrostis ciliata – Aristida congesta* open grassland.

A list of plant species previously recorded in the quarter degree grid in which the study area is situated was obtained from the South African National Biodiversity Institute. Additional species that could occur in similar habitats, as determined from official database searches and reviewed literature, but not recorded in these grids are also listed. A total of 13 species of concern were determined to possibly be occurring in the study area. The species, listed as possibly occurring in the study area, were evaluated to determine the probability of occurrence in the study area based on habitat suitability. Of the species that are considered to occur within the area under investigation, there were five species that could occur in habitats that are available in the study area. According to IUCN two of these are listed as Vulnerable, one as Near Threatened and two as Declining. One of the vulnerable species, *Aloe dichotoma*, was recorded in the eastern portion of the study area and could occur anywhere within the hills in the study area, or in rocky areas in Bushmanland Arid Grassland.

The one Declining species, *Acacia erioloba*, also a protected tree, has a high probability of occurring in the study area, while *Hoodia gordonii* was recorded in the study area in a number of places.

Reptile diversity in the region is high with approximately 45 reptile species occurring in the area. Ten species were confirmed during the site surveys. No exotic herpetofauna species are expected to occur on the study site. Two of the species recorded, namely *Naja nivea* and *Cordylus polyzous,* are considered endemic to southern Africa.

Herpetofauna diversity is generally low in the study area as can be expected in arid areas but what can be noted is that evenness is high, indicating that there is a high similarity between the species occurring in the different vegetation communities. Most of the expected species in the area are common and widespread, with only the Black-necked spitting Cobra (*Naja nigricollis*) being classified as rare.

The study area is a fair distance from any permanent open water bodies (approximately 30km) and therefore, as expected amphibian diversity is low. Only seven species are expected to occur in the study area, and during the wet and dry season surveys no amphibian species were recorded.

Of the 67 mammal species expected to occur in the study area, according to historic recordings, only 16 were confirmed during both the site visits. Mammal diversity is low as can be expected in arid areas. Evenness is high, indicating that there is a high similarity between the species occurring in the different vegetation communities. A number of bat species are known to occur in the region. Bat species recorded in the area during the surveys are *Rhinolophus darlingi, Neoromicia capensis, Pipistrellus rueppelli* and *Tadarida aegyptiaca*.

Of the 21 faunal species of concern that may occur in the study area, 1 has no probability of occurrence, 5 have a low probability of occurrence, 9 have a medium probability of occurrence and 6 have a high probability of occurrence. Three of the species with a high probability of occurrence, the Black-necked spitting Cobra, Maccoa Duck and Lanner Falcon, were recorded during the study.

The ecological function of the study area can generally be described as moderate for the majority of the study area, although this does vary from low (in the transformed areas) to high in the more inaccessible or unutilisable areas. Areas in which overgrazing and clearing have taken place, as well as areas in which settlements have been established are considered as areas where ecological function is reduced.

Areas that have been severely disturbed such as where settlements occur are considered of low conservation importance. These areas are, however, quite small in relation to the overall study area (<30% of the study area).

Areas that have been disturbed by farming are considered of moderate conservation importance due to the fact that rehabilitation of these areas is possible. The natural areas are considered of very high conservation importance due to the presence of Red Data species in these areas and the intrinsic importance of these areas. In keeping with the Precautionary Principle, a higher conservation importance is assumed when in doubt.

According to the Khai-Ma Land Use Decision Support tool, the study area falls within an Ecological Support Area (ESA). The ESA is listed as a migration route, although the species utilising this migration route are not indicated. The migration route does seem to be counter-intuitive as it seems to start in the lowlands of the Gariep River, crosses over rocky mountainous areas only to return to the lowlands of the Gariep River lowlands again. Notwithstanding this the development will affect less than 30% of the width of the migration route and should have very little effect on species using this route.

Notwithstanding this, the ESAs are defined as "areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and / or in delivering ecosystem services that support socio-economic development, such as water provision, food mitigation or carbon sequestration." And it is stated that "The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas" It is also stated that "some" level of change in the biodiversity indicators for ESAs is allowed.

It must also be noted that the migration route indicated is part of a large system of migration routes and that the percentage of these migration routes that will be impacted will be negligible.

This impact assessment was conducted with the understanding that:

- The road will be 7m wide, with a road reserve of 20m;
- A corridor with a maximum width of 40m will be impacted upon during construction; and
- All possible mitigation methods advised will be adopted and implemented by the developer

The impact assessment determined that 8 main impacts are likely to occur due to the development, namely:

- Vegetation Clearing and subsequent loss of species of concern;
- Spillage of harmful or toxic substances;
- Disturbance of biodiversity due to vibration and noise;
- Habitat degradation and fauna impacts due to dust;
- Effects on local migrations;
- Increased prevalence of exotic invasive species; and
- Increased erosion.

Overall recommendations to mitigate the impacts, and comply with best practice, include:

- Compile an effective and efficient spillage containment plan in order to prevent spillage, leakage or release of harmful or toxic substances during transport or at areas where they are stored or used, and also to clean up any spills before they can be taken up by any possible natural receptors;
- Compile a vibration and noise management plan in order to minimise the disturbance of biodiversity due to vibration and noise;
- Compile and implement a dust suppression plan based on current best practices;
- The effect of roads on local migrations can be mitigated by the installation of culverts at regular intervals along the roads and the installation of drift fences towards the culverts , although these methods may not eliminate the mortalities among migrating animals, they should greatly reduce the number of animals killed on roads; and
- When possible, a low speed limit can be strictly enforced in order to reduce collisions with animals on the roads;

- A mitigation and monitoring plan should be put in place to monitor exotic and invasive species in order to report on progress and advise management of measure that need to be implemented, this monitoring should be conducted bi-annually; and
- A mitigation and monitoring plan should be put in place to monitor erosion in order to report on progress and advise management of measures that need to be implemented, this monitoring should be conducted bi-annually; and
- Identification and relocation of plant species (*Hoodia gordonii*) prior to ground clearing. Marking of protected tree species (*Boscia foetida*) to be conserved *in situ*.

These recommendations are not compulsory, but in order to mitigate the impacts they are strongly advised, if not implemented the unmitigated impact will have to be assumed, based on the Precautionary Principle (Comest, 2005).

In conclusion, with implementable mitigation measures and a functional monitoring – management – implementation – monitoring feedback loop in order to monitor and mitigate impacts, all probable ecological impacts can be managed to a low impact rating.

Short term impacts (vegetation clearing, dust and vibration and noise) are likely to have a short term increase in negative impacts on the site of the road realignment. The longer term impacts are however likely to be negligible in comparison with the current ecological status quo, due to the fact that these impacts already exist due to the existing road and its associated impacts. Overall the ecological impact is therefore likely to be very low and, from an ecological point of view, no fatal flaws can be discerned in this project. All impacts that may to occur in connection with this project are mitigable to an acceptable level.

From an ecological point of view, provided the mitigation measures here are implemented, there is no reason, in my opinion based on the information at hand that this project should not be approved.

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1 INTRODUCTION

Hudson Ecology (Pty) Ltd was commissioned by Savannah Environmental (Pty) Ltd to conduct an ecological specialist study of ecosystems associated with the proposed MN73 road realignment.

Abengoa Solar (Pty) Ltd (herein further referred to as Abengoa) is proposing to establish a new solar facility (Paulputs) on Portion 4 of the Farm Scuitklip 92 in the Northern Cape Province, South Africa. The study area is situated approximately 40km north-east of the town of Pofadder.

The proposed Paulputs project will consist of a CSP facility. The CSP facility and its associated infrastructure is likely to cover an area of approximately 900ha. For the purposes of this study a survey of the entire 1600ha study area was conducted. The associated infrastructure to operate the solar development is also taken into account in this Draft Ecological baseline and impact assessment Report.

The proposed Paulputs project footprint will bisect the current MN73 road therefore a section of this road will need to be realigned in order to circumvent the project footprint. The realignment of a section of the MN73 will only occur on Portion 4 of the Farm Scuitklip 92.

The purpose of this report is to describe the receiving ecological environment and possible impacts and mitigations, of the proposed realignment of the MN73 road with reference to the receiving ecological environment, based on the studies conducted during August 2015 and April 2016.

This study will form part of the supporting documents for a basic assessment report for the proposed road realignment, to be conducted by Savannah Environmental Pty Ltd.

2 LEGISLATIVE CONTEXT

This section provides a brief overview of both the national and international requirements that must be met by this report. It includes international conventions and agreements, as well as the IFC Standards and the Equator Principles.

2.1 National Environmental Management Act

This report has been prepared in terms the EIA Regulations 2014 (South Africa, 2014) promulgated under the National Environmental Management Act No. 107 of 1998 (NEMA) and is compliant with Regulation 982. Specialist reports and reports on specialised processes falls under the Act. Relevant clauses of the above regulation are quoted below and reflect the required information in the —Control sheet for specialist report provided in Appendix G.

Appointment of EAPs and specialists

12. (1) A proponent or applicant must appoint an EAP at own cost to manage the application.

(2) In addition to the appointment of an EAP, a specialist may be appointed, at the cost of the proponent or applicant, if the level of assessment is of a nature requiring the appointment of a specialist.

(3) The proponent or applicant must

(a) take all reasonable steps to verify whether the EAP and specialist complies with regulation 13(1)(a) and (b); and

(b) provide the EAP and specialist with access to all information at the disposal of the proponent or applicant regarding the application, whether or not such information is favourable to the application.

General requirements for EAPs and specialists

13. (1) An EAP and a specialist, appointed in terms of regulation 12(1) or 12(2), must-

(a) be independent;

(b) have expertise in conducting environmental impact assessments or undertaking specialist work as required, including knowledge of the Act, these Regulations and any guidelines that have relevance to the proposed activity;

(c) ensure compliance with these Regulations;

(d) perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the application;

(e) take into account, to the extent possible, the matters referred to in regulation 18 when preparing the application and any report, plan or document relating to the application; and

(f) disclose to the proponent or applicant, registered interested and affected parties and the competent authority all material information in the possession of the EAP and, where applicable, the specialist, that reasonably has or may have the potential of influencing-

(i) any decision to be taken with respect to the application by the competent authority in terms of these Regulations; or

(ii) the objectivity of any report, plan or document to be prepared by the EAP or specialist, in terms of these Regulations for submission to the competent authority; unless access to that information is protected by law, in which case it must be indicated that such protected information exists and is only provided to the competent authority.

(2) In the event where the EAP or specialist does not comply with subregulation (1)(a), the proponent or applicant must, prior to conducting public participation as contemplated in chapter 5 of these Regulations, appoint another EAP or specialist to externally review all work undertaken by the EAP or specialist, at the applicant's cost.

(3) An EAP or specialist appointed to externally review the work of an EAP or specialist as contemplated in subregulation (2), must comply with subregulation (1).

In terms of Appendix 6 of the Regulations (South Africa, 2014) the specialist impact assessment report must contain:

(a) details of-

(i) the specialist who prepared the report; and

(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;

(b) a declaration that the specialist is independent in a form as may be specified by the competent authority;

(c) an indication of the scope of, and the purpose for which, the report was prepared;

(d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;

(e) a description of the methodology adopted in preparing the report or carrying out the specialised process;

(f) the specific identified sensitivity of the site related to the activity and its associated structures and infrastructure;

(g) an identification of any areas to be avoided, including buffers;

(h) a map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;

(i) a description of any assumptions made and any uncertainties or gaps in knowledge;

(j) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives on the environment;

(k) any mitigation measures for inclusion in the EMPr;

(l) any conditions for inclusion in the environmental authorisation;

(m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;

(n) a reasoned opinion-

(i) as to whether the proposed activity or portions thereof should be authorised; and

(ii) if the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;

(o) a description of any consultation process that was undertaken during the course of preparing the specialist report; and

(p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto.

2.2 Further South African legislation considered in the compilation of this report

2.2.1 National Environmental Management Act, Act No. 107 of 1998 (NEMA)

NEMA requires, inter alia, that:

- Development must be socially, environmentally, and economically sustainable;
- Disturbance of ecosystems and loss of biological diversity are avoided, or, where they cannot be altogether avoided, are minimised and remedied; and
- A risk-averse and cautious approach is applied, which takes into account the limits of current knowledge about the consequences of decisions and actions.

NEMA states that —the environment is held in public trust for the people, the beneficial use of environmental resources must serve the public interest and the environment must be protected as the people‘s common heritage.

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2.2.2 National Forests Act (Act no 84 of 1998)

2.2.2.1 Protected trees

According to this Act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that no person may cut, damage, disturb, destroy or remove any protected tree, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a license granted by the Minister‘. The list of protected tree species are given in the list of protected tree species published in GN1161 (Republic of South Africa, 2015).

2.2.2.2 Forests

Prohibits the destruction of indigenous trees in any natural forest without a license.

2.2.3 National Environmental Management: Biodiversity Act (Act No 10 of 2004)

In terms of the Biodiversity Act, the developer has a responsibility for:

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).
- Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

2.2.4 Conservation of Agricultural Resources (Act No. 43 of 1983) as amended in 2001

Declared Weeds and Invaders in South Africa are categorised according to one of the following categories:

- Category 1 plants: are prohibited and must be controlled.
- Category 2 plants: (commercially used plants) may be grown in demarcated areas providing that there is a permit and that steps are taken to prevent their spread.
- Category 3 plants: (ornamentally used plants) may no longer be planted; existing plants may remain, as long as all reasonable steps are taken to prevent the spreading thereof, except within the floodline of watercourses and wetlands.

2.2.5 National Water Act

Wetlands, riparian zones, and watercourses are defined in the Water Act as a water resource and any activities that are contemplated that could affect the wetlands requires authorisation (Section 21 of the National Water Act of 1998). A "watercourse‖ in terms of the National Water Act (act 36 of 1998) means:

- River or spring;
- A natural channel in which water flows regularly or intermittently;
- A wetland, lake or dam into which, or from which, water flows; and

Any collection of water which the Minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks. A water use license (WUL) is required for any activities listed in terms of Section 21 of the Act.

2.3 Northern Cape Nature Conservation Act (Act No. 9 of 2009)

The aim of the Northern Cape Nature Conservation Act No 9 of 2009 is to:

- provide for the sustainable utilisation of wild animals, aquatic biota and plants;
- to provide for the implementation of the Convention on International Trade in Endangered Species of Wild Fauna and Flora;
- to provide for offences and penalties for contravention of the Act; to provide for the appointment of conservators to implement the provisions of the Act;
- to provide for the issuing of permits and other authorisations; and
- to provide for matters connected herewith.

2.4 Key authorities for the EIA application

The DENC will be the decision-making authority for the environmental authorisation process, which is being undertaken in terms of the NEMA.

2.5 International Conventions and Agreements

Relevant environmental and social international conventions and agreements to which South Africa is a party are presented in Table 1.

Table 1: Relevant international conventions to which South Africa is a party Convention Summary of objectives or relevant conditions South African Status

Convention	Summary of objectives or relevant conditions	South African Status
CITES Convention (1 July 1975)	CITES (the Convention on International Trade in Endangered Species of Wild Fauna and Flora) is an international agreement between governments. Its aim is to ensure that international trade in specimens of wild animals and plants does not threaten their survival.	Party to.
Convention on Biological Diversity (29 December 1993)	Develop strategies, plans or programs for conservation and sustainable use of biological diversity or adapt for this purpose existing strategies, plans or programs which shall reflect, inter alia, the measures set out in this Convention.	Party to.
Convention on Wetlands of International Importance (Ramsar) (21 December 1975)	To stem the progressive encroachment and loss of wetlands now and in the future.	Party to.
United Nations Convention to Combat Desertification (26 December 1996)	To combat desertification and mitigate the effects of drought through national action programs.	Party to.
Stockholm Convention on Persistent Organic Pollutants (POPs) (17 May 2004)	This convention seeks to ban the production and use of persistent organic chemicals but allow the use of some of these banned substances, such as DDT, for vector control.	Party to.

3 AIMS AND OBJECTIVES

The aim of this ecological specialist study was to provide a detailed description of the receiving ecological environment (including identified ecological patterns and processes), which may be impacted upon by the proposed realignment of the MN73 road, and

identify possible ecological issues associated with the ecology of the study area and surrounds. Issues identified will make specific reference to species of concern and habitats and will be investigated as to how significant the impacts will be, what mitigation can be applied to reduce the impact significance to an acceptable level and what cumulative and residual impacts will occur.

The objectives in this study can be summarised as follows:

- Description of the location of the proposed development;
- Description of the policy and legislative context applicable to the proposed development;
- Description of the Methodologies employed during the specialist study;
- Description of the receiving ecological environment;
- Description and assessment of the potential impacts identified during the ecological baseline and impact assessment phase study; and
- Recommendation of proposed mitigation measures to address the potential impacts.

4 SCOPE OF WORK

The scope of work for this project includes:

- Review of existing literature on biodiversity of the area;
- Review of previous work conducted for the project;
- A site investigation for the purposes of an ecological baseline and impact assessment study (conducted from the 4th to the 14th of August 2015 and from the 5th to the 13th of April 2016) as well as short site visit from the 30th of March to the 1st of April;
- Investigation of potential issues identified during the basic assessment;
- Compilation of an ecological baseline and impact assessment report comprising of the information described in the aims and objectives section above.

5 STUDY AREA

The area investigated for this study, covers approximately 587ha on portion 4 of the Farm Scuitklip 92. The area of interest which was considered is the 587ha area bordered by the R357 to the north and the existing MN73 to the east. The study area is to the north-east of the town of Pofadder, in Khai-Ma Municipal District of the Northern Cape (Figure 1). The site falls within the quarter degree grid 2819DC. No alternative route is currently being considered for the proposed MN73 realignment although data from the Paulputs Concentrated Solar Power facility (CSP) Environmental Impact Assessment was considered in the selection of this route.

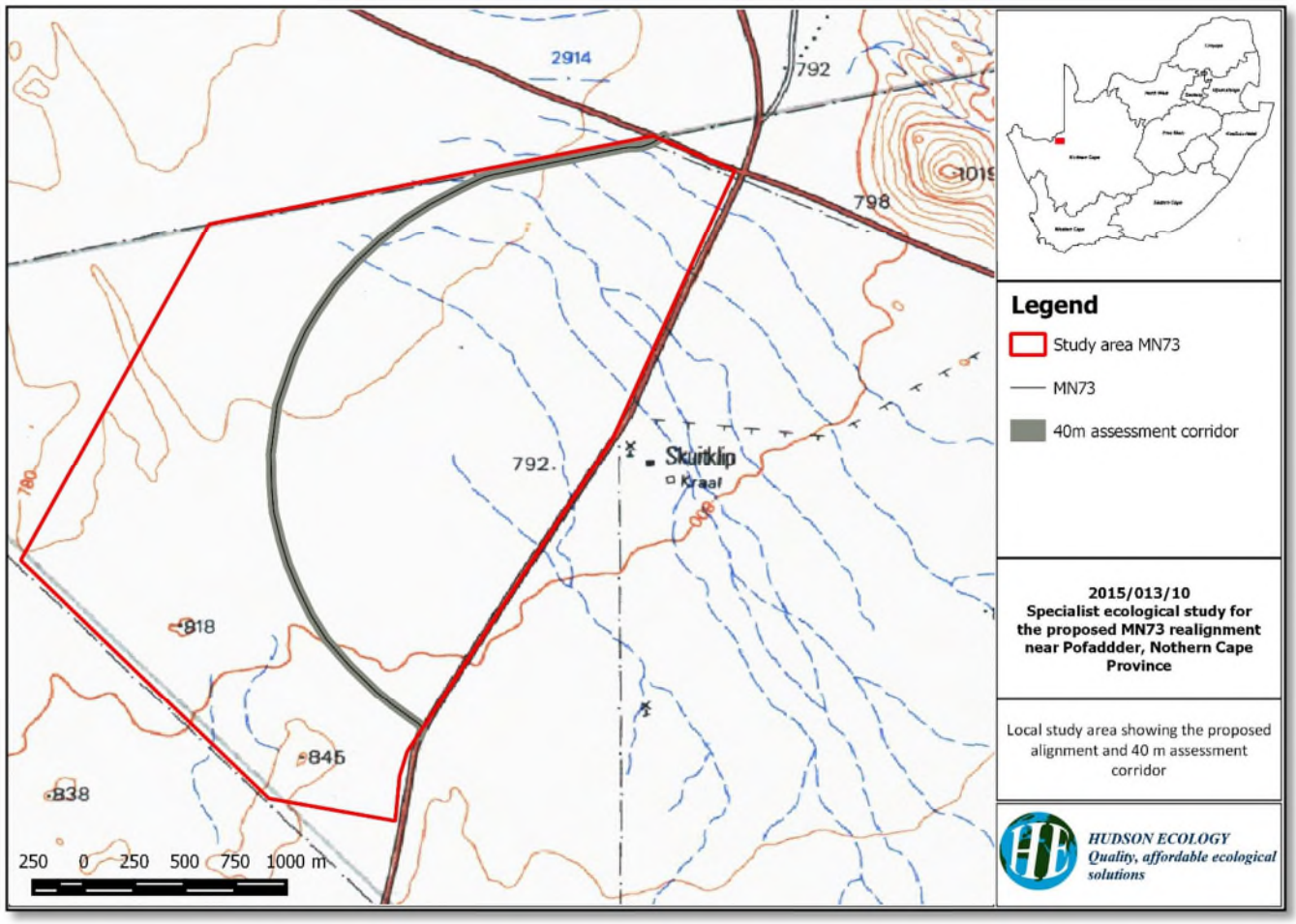

Figure 1: Locality of the study area

The study area is relatively isolated and is situated along a minor road that connects the N14 and the R357. The N14 connects Pofadder and Kakamas and the R358 connects Pofadder and Karasburg in Namibia.

6 METHODOLOGY

6.1 Desktop review of relevant documentation

A number of literature sources were reviewed for the purposes of this report. These include, *inter alia*, vegetation descriptions, field guides and atlases for the various flora and fauna taxa, and scientific articles in order to determine species lists for the area. Previous studies conducted in the area and scientific online literature.

6.2 Methodologies

The data from the original twelve study sites (Figure 2), which were selected within the study area (Figure 2) for the Paulputs CSP facility, were utilised. These sites were investigated during both the 2015 and 2016 surveys. In order to enable a characterization of the environment, as well as floral and faunal species that may be impacted by the proposed construction activities, faunal and floral groups were investigated. These species were then used in order to determine the possible magnitude of the impact of the proposed activities. The following taxa were investigated:

- Vegetation;
- Arthropoda;
- Mammals;

- Avifauna;
- Herpetofauna (Reptiles); and
- Amphibia.

All methods implemented during this investigation are based on accepted scientific investigative techniques and principles, and were performed to accepted standards and norms, whilst taking the limitations of this investigation into consideration. The Precautionary Principle (COMEST, 2005) was applied throughout the assessments.

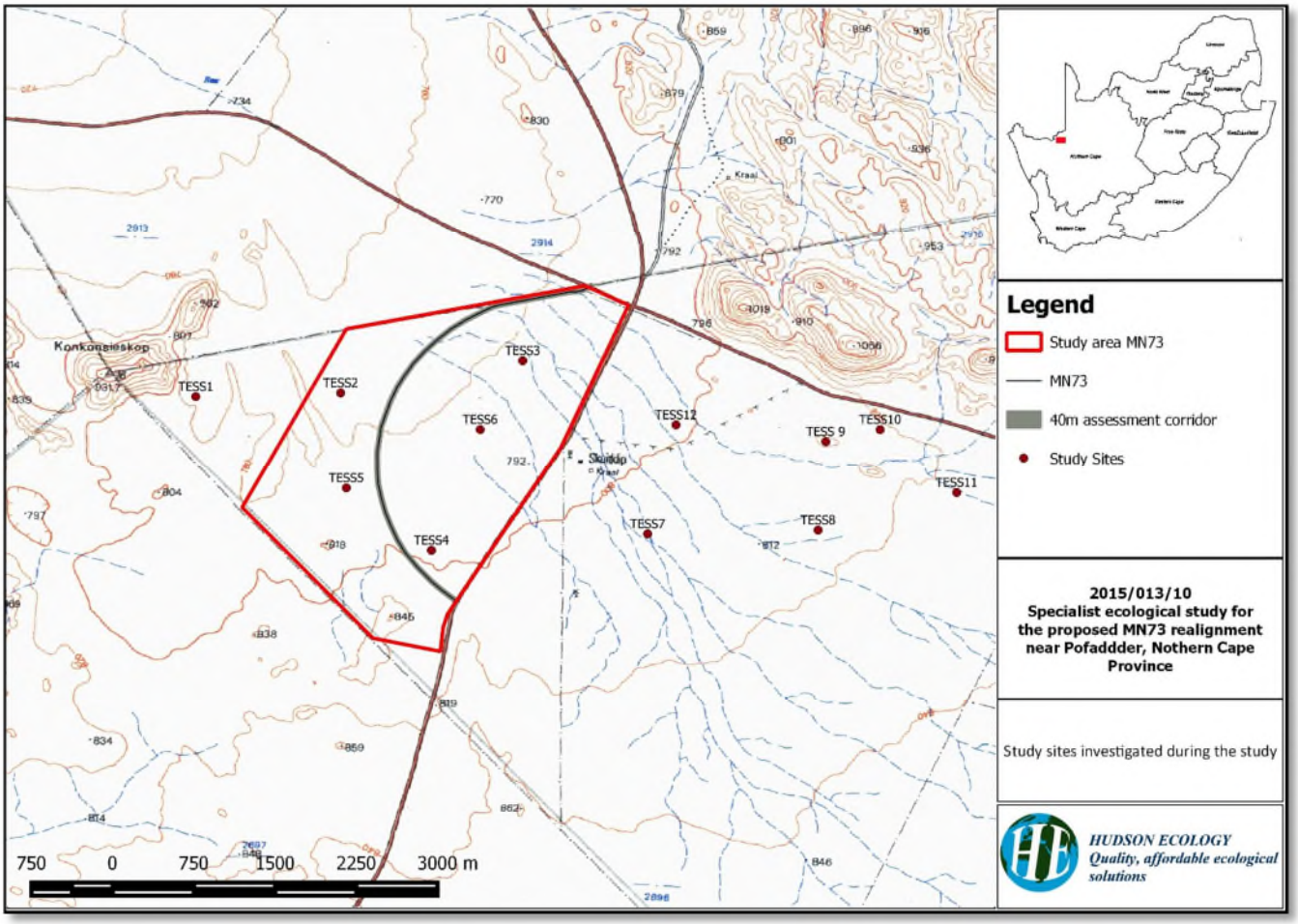

Figure 2: Terrestrial ecology study sites (TESS)

6.2.1 General Floristic Attributes

The vegetation assessment was based on a variation of the Braun-Blanquet method (Mueller-Dombois & Ellenberg, 1974; Westhoff & Van der Maarel, 1978) whereby vegetation is stratified, by means of aerial or satellite imagery with physiognomic characteristics as a first approximation. Stratification was further augmented by sites being selected to represent each of the areas that will be impacted by the current development footprint. Representative areas within these stratifications are then surveyed by means of line-point transects for grasses, sedges and forbs, as well as belt transects for shrubs and trees. Data obtained from these surveys are then subject to analysis to establish differences or similarities between observed units. Results and species lists provided should be interpreted with the above mentioned survey limitations in mind.

During the floral surveys conducted during the August 2015 survey, cognisance was taken of the following environmental attributes and general information:

- Biophysical environment (geology, topography, aspect, slope etc.);

- Regional vegetation;
- Current status of habitats;
- Red Data habitat suitability;
- Digital photographs; and
- GPS reference points.

Phytosociological data accumulated include the following:

- Plant species and growth forms;
- Dominant plant species;
- Cover abundance values; and
- Samples or digital images of unidentified plant species.

The desktop analysis of data was used to establish differences or similarities between vegetation communities, which were then described in terms of floristic species composition as well as driving environmental parameters. Results and species lists provided should be interpreted with the survey limitations, in Section 7 of this report, in mind.

6.2.2 Red Data Floral Assessment

- Compared data collected during the surveys and the IUCN Red Data plant species list and South African Threatened and Protected species (TOPS) list to compile a list of plant species of concern that may potentially occur within the study area and that were recorded in the study area.
- A survey of this kind (instantaneous sampling bout or “snapshot” investigations) poses limitations to the identification of Red Data plant species. Therefore, emphasis was placed on the identification of habitat that would be suitable for sustaining Red Data plant species, by associating available habitat to known habitat requirements of Red Data plant species.

6.2.3 Floristic Sensitivity Analysis

Floristic sensitivity analysis was determined by taking two factors into account namely ecological function and conservation importance. This sensitivity was quantified by subjectively assessing the ecological function and conservation importance of the vegetation. These were defined as follows:

Ecological Function:

- High ecological function: Sensitive ecosystems with either low inherent resistance or resilience towards disturbance factors or highly dynamic systems considered to be stable and important for the maintenance of ecosystems integrity (e.g. pristine grasslands, pristine wetlands and pristine ridges);
- Medium ecological function: Relatively important ecosystems at gradients of intermediate disturbances. An area may be considered of medium ecological function if it is directly adjacent to sensitive/pristine ecosystem; and
- Low ecological function: Degraded and highly disturbed systems with little or no ecological function.

Conservation Importance:

- High conservation importance: Ecosystems with high species richness usually provide suitable habitat for a number of threatened species. Usually termed ‘no-go’ areas and unsuitable for development, and should be protected;
- Medium conservation importance: Ecosystems with intermediate levels of species diversity without any threatened species. Low-density development may be allowed, provided the current species diversity is conserved; and
- Low conservation importance: Areas with little or no conservation potential and usually species poor (most species are usually exotic).

Sensitivity is a bit more complex as the sensitivity of an area is not only defined by the species occurring in the area but also by the development and possible impacts on the area as well as legislative constraints placed on the species. Sensitivity can best be defined as follows:

- Low sensitivity: Ecosystems that do not require much, if any, mitigation in order to comply with all legislative requirements and/or to conserve biodiversity and species in the area.
- Moderate sensitivity: Ecosystems that do require a moderate amount of mitigation in order to comply with all legislative requirements and/or to conserve biodiversity and species in the area.
- High sensitivity: Ecosystems that do require a large amount of mitigation in order to comply with all legislative requirements and/or to conserve biodiversity and species in the area.
- No-go areas: areas where the sensitivity of the area precludes activity due to the inability of mitigation measures to conserve biodiversity and species in the area or the preclusion of available mitigation measures by current legislation itself.

The Precautionary Principle (COMEST, 2005) was applied throughout this investigation (COMEST, 2005).

6.2.4 General Faunal Attributes

6.2.4.1 Reptilia

Suitable areas were identified and sampled using active search and capture methods. Searches were concentrated in rocky areas and disused ant hills were investigated for the presence of snakes. Snakes and other reptiles are identified visually and only captured if visual identification is hampered by swift-moving snakes or if the snake is obscured from view. Branch (1996) and Broadley (1971) were used as identification guides, where necessary.

6.2.4.2 Amphibia

Suitable areas for frogs were sampled by means of active search and capture and acoustic identification methods, especially at night when highest amphibian activity is expected. Areas were also netted for tadpoles and amphibian species identified by means of tadpoles. Du Preez and Carruthers (2009) was used to confirm identification where necessary.

6.2.4.3 Mammalia

Visual sightings and ecological indications were used to identify the small mammal inhabitants of the study area. Scats were also collected and used for identification of nocturnal small mammals. A number of reference sources *inter alia* Stuart and Stuart (2007) and Smithers (1983) were used for identification purposes.

6.2.5 Red Data Faunal Assessment

The following parameters were used to assess the Probability of Occurrence of each Red Data species:

- Habitat requirements (HR) – Most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics in the study area was evaluated;
- Habitat status (HS) – The status or ecological condition of available habitat in the area is assessed. Often a high level of habitat degradation prevalent in a specific habitat will negate the potential presence of Red Data species (this is especially evident in wetland habitats); and
- Habitat linkage (HL) – Movement between areas for breeding and feeding forms an essential part of the existence of many species. Connectivity of the study area to surrounding habitat and the adequacy of these linkages are evaluated for the ecological functioning of Red Data species within the study area.

Probability of occurrence is presented in four categories, namely:

- Low;
- Medium;
- High; and

- Recorded.

In order to assess the status of fauna species of concern in the study area, the following sources were used:

- IUCN Red List Categories and Criteria (IUCN, 2001);
- IUCN Red List of Threatened Species (IUCN, 2011); and
- South African Threatened and Protected species (TOPS) list (Republic of South Africa, 2004).

6.2.6 Statistical Analyses

6.2.6.1 Flora

Data, collected during the flora surveys, were analysed using the PC-Ord 5 multivariate analysis program. The data was analysed to confirm the vegetation units initially identified as well as to further divide the initial vegetation units into further plant communities based on species diversity data. TWINSPAN (Two Way INdicator SPecies ANalysis) was used to determine the dominant species in each of the vegetation units and a cluster analysis and non-metric multidimensional scaling was used to determine the similarities of the plant communities at each of the sites. The Shannon Diversity index was used to determine species diversity at each of the sites.

The Shannon index is one of several diversity indices used to measure diversity in categorical data. It is simply the information entropy of the distribution, treating species as symbols and their relative population sizes as the probability. The advantage of this index is that it takes into account the number of species and the evenness of the species. The index is increased either by having additional unique species, or by having greater species evenness.

$$H' = -\sum_{i=1}^{S}(p_i \ln p_i) - [(S-1)/2N]$$

Where:

i is the abundance of species.

S is the number of species, also referred to as species richness.

N is the total number of all individuals.

$\mathbf{p}_i$ is the relative abundance of each species, calculated as the proportion of individuals of a given species to the total number of individuals in the community.

6.2.6.2 Fauna

Data collect during the flora survey was analysed using the PC-Ord 5 multivariate analysis program. Pielou's Evenness was used to determine the numerical similarity between sites while the Shannon Diversity index for each of the plant communities was used to determine species diversity at each of the sites.

Species evenness is a measure of biodiversity which quantifies how equal the community is numerically. The evenness of a community can be represented by Pielou's evenness index:

$$J' = \frac{H'}{H'_{\max}}$$

Where H' is the number derived from the Shannon diversity index and H' max is the maximum value of H', equal to:

$$H_{\max} = -\sum_{i=1}^{S}\frac{1}{S}\ln\frac{1}{S} = \ln S.$$

E is constrained between 0 and 1. The less variation in communities between the species, the higher ***E*** is.

S is the total number of species.

6.3 Impact Assessment Methodology

6.3.1 Determination of Impacts

The Environmental Impact Assessment methodology that has been used in the evaluation of the overall effect of a proposed activity on the environment includes an assessment of the significant direct, indirect, and cumulative impacts. The significance of environmental impacts is to be assessed by means of the criteria of extent (scale), duration, magnitude (severity), probability (certainty) and direction (negative, neutral or positive).

The nature of the impact refers to the causes of the effect, what will be affected and how it will be affected.

Significance (S) - Rating of low, medium or high. Significance is determined through a synthesis of the characteristics described above where:

$$\boldsymbol{S = (E + D + M) \times P}$$

The significance weighting should influence the development project as per Table 2.

Table 2: Significance ratings of impacts and influence on the project

Significance	Influence on the project
Low significance (significance weighting: <30 points)	If the negative impacts have little real effects, it should not have an influence on the decision to proceed with the project. In such circumstances, there is a significant capacity of the environmental resources in the area to respond to change and withstand stress and they will be able to return to their pre-impacted state within the short-term.
Medium significance (significance weighting: 30 – 60 points)	If the impact is negative, it implies that the impact is real and sufficiently important to require mitigation and management measures before the proposed project can be approved. In such circumstances, there is a reduction in the capacity of the environmental resources in the area to withstand stress and to return to their pre-impacted state within the medium to long-term.
High significance (significance weighting: >60 points)	The environmental resources will be destroyed in the area leading to the collapse of the ecosystem pattern, process and functioning. The impact strongly influences the decision whether or not to proceed with the project. If mitigation cannot be effectively implemented, the proposed activity should be terminated.

The extent (E) of the impact indicates the spatial scale, of the impact in question, in relation to the development site. The rating scores of the extent of an impact are given in Table 3:

Table 3: Ratings for the extent (E) of impacts

Extent of impact	Rating Score
Development site only	1
Local (within 5km of development site)	2
Regional	3
National	4
Global	5

The duration (D) of the impact indicates the temporal scale, of the impact in question. The rating scores of the extent of an impact are given in Table 4:

Table 4: Ratings for the duration (D) of impacts

Duration	Rating Score
Very short term – up to 1 year	1
Short term – >1 – 5 years	2
Moderate term - >5 – 15 years	3
Long term – >15 years	4
Permanent	5

Magnitude (M) describes the severity of the impact in question. The ratings scores for the severity of an impact are given in Table 5:

Table 5: Ratings for the magnitude (M) of impacts

Magnitude	Rating Score
Small impact – the ecosystem pattern, process and functioning are not affected	0
Minor impact - a minor impact on the environment and processes will occur	2
Low impact - slight impact on ecosystem pattern, process and functioning	4
Moderate intensity – valued, important, sensitive or vulnerable systems or communities are negatively affected, but ecosystem pattern, process and functions can continue albeit in a slightly modified way	6
High intensity – environment affected to the extent that the ecosystem pattern, process and functions are altered and may even temporarily cease. Valued, important, sensitive or vulnerable systems or communities are substantially affected	8
Very high intensity – environment affected to the extent that the ecosystem pattern, process and functions are completely destroyed and may permanently cease	10

Probability (P) describes the probability or likelihood of the specific impact actually occurring, and is rated as shown in Table 6:

Table 6: Ratings for the duration (D) of impacts

Probability (P)	Rating Score
Very improbable – where the impact will not occur, either because of design or because of historic experience	1
Improbable – where the impact is unlikely to occur (some possibility), either because of design or historic experience	2
Probable - there is a distinct probability that the impact will occur (<50% chance of occurring)	3
Highly probable - most likely that the impact will occur (50 – 90% chance of occurring)	4
Definite – the impact will occur regardless of any prevention or mitigating measures (>90% chance of occurring).	5

6.3.2 Determination of cumulative impacts

The assessment of cumulative impacts is required in terms of Regulations 2 (c) and 3 (j) of Appendix 3 of the EIA Regulations 2014.

"Cumulative Impact", in relation to an activity, means the past, current and reasonably foreseeable future impact of an activity, considered together with the impact of activities associated with that activity that, in itself, may not be significant, but may become significant when added to existing and reasonably foreseeable impacts eventuating from similar or diverse activities.

The role of the cumulative assessment is to test if such impacts are relevant to the proposed project in the proposed location (i.e. whether the addition of the proposed project in the area will increase the impact). This section should address whether the proposed development will result in:

- Unacceptable risk
- Unacceptable loss
- Complete or wholescale changes to the environment or sense of place
- Unacceptable increase in impact

6.3.3 Determination of Mitigation Measures

A common approach to describing mitigation measures for critical impacts is to specify a range of targets with a predetermined acceptable range and an associated monitoring and evaluation plan. To ensure successful implementation, mitigation measures will be unambiguous statements of actions and requirements that are practical to execute. The following summarise the different approaches that will be used in prescribing and designing mitigation measures:

6.3.3.1 Avoidance

Mitigation by not carrying out the proposed action on the specific site, but rather on a more suitable site.

6.3.3.2 Minimization

Mitigation by scaling down the magnitude of a development, reorienting the layout of the project or employing technology to limit the undesirable environmental impact.

6.3.3.3 Rectification

Mitigation through the restoration of environments affected by the action.

6.3.3.4 Reduction

Mitigation by taking maintenance steps during the course of the action.

6.3.3.5 Offsetting

Mitigation by identification of an alternative site with similar attributes that can be protected in order to ensure a gain of biodiversity after all mitigation measures have been implemented.

7 ASSUMPTIONS AND LIMITATIONS

- Accuracy of the maps, ecosystems, routes and desktop assessments were made using Google earth and converting the .kml files to .shp files and are subject to the accuracy of Google Earth imagery with some loss of accuracy during the conversion process;
- GPS co-ordinates are accurate to within 10m and lines drawn on maps can only be assumed to be accurate to within a distance of 50m;
- Data obtained from published articles, reference books, field guides, official databases or any other official published or electronic sources are assumed to be correct and no review of such data was undertaken by Hudson Ecology Pty Ltd;
- Satellite imagery obtained was limited to imagery on Google Earth, thus the ability to accurately map vegetation communities was limited;
- Time and budget constraints do not allow for an intensive survey of the entire study area, and as with any survey of this kind, rare and cryptic species may be overlooked during the study; and

- Every possible precaution was taken to reduce the effect of the above-mentioned limitations on the data collected for this study.
- The fact that a species or Red Data species is not recorded during a survey cannot support the assumption that the species in question does not occur in the area, it can only indicate a decreased probability of the species occurring in the area. This is particularly pertinent if the species has been recently or historically recorded in the area;
- Ecological studies should be undertaken over a number of seasons in order to obtain long term ecological data. Studies are usually conducted in this way in order to eliminate the effects of unusual climatic conditions or other unusual conditions prevailing at the study area during the time of study;
- For the proposal, a dry season and a wet season were envisaged for the study these were planned for August 2015 and January/February 2016. However, on the 14th of January 2016, an email was received indicating that the EIA phase of the study was placed on hold and no further costs were to be incurred on the project. On the 29th of March 2016 an email was received indicating that the EIA phase of the project was to resume and that reports were required by the 14th of April 2016, thus excluding an appropriate summer season field survey. This being said, the fact that the summer (wet) season survey was late was ultimately beneficial due to the very late summer rains experienced in the area. From this perspective the survey was, in fact, well timed, despite being late.
- The results of this study are based on a literature review and dry and wet season field surveys, conducted in August 2015 and March – April 2016.

8 RESULTS

This section provides a discussion of the terrestrial ecology baseline environment and context in which the proposed project will take place.

8.1 Physical Setting

8.1.1 Topography

The study area is located on flat plains, gently sloping from the south to the north (Figure 3), with a slight depression in the central section. The highest point along the proposed alignment is 811masl while the lowest point is 777masl. A drainage line (wash) bisects the northern section of the study area from east to west, gradually narrowing towards the east (Figure 3).

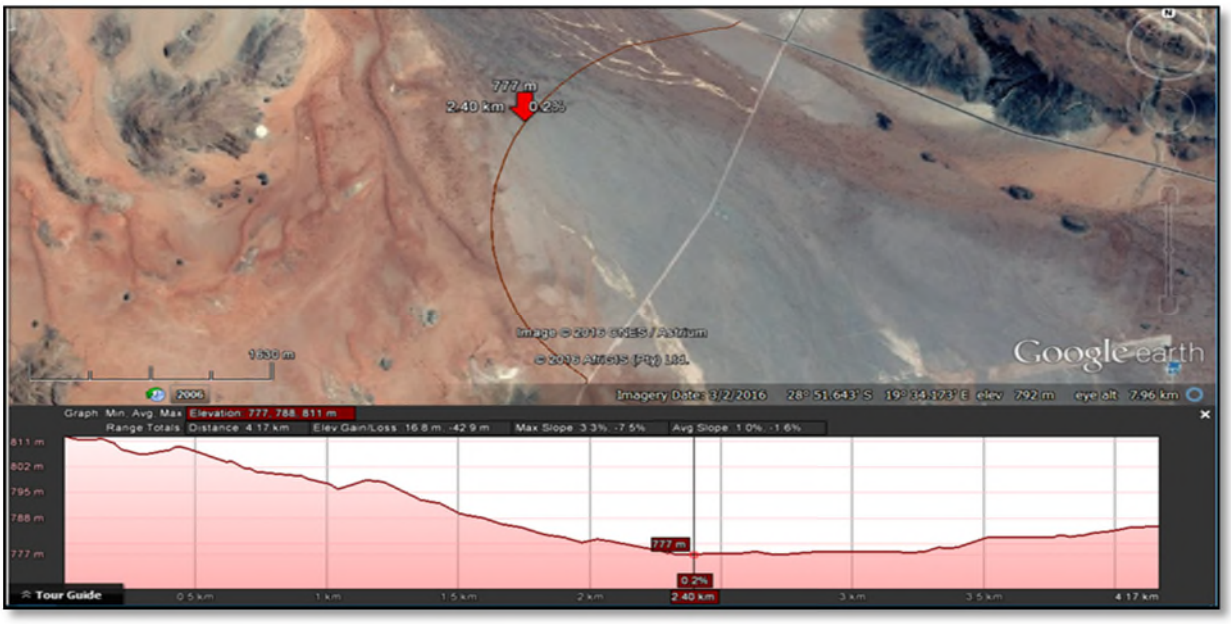

Figure 3: Gradient of the study area (reproduced from Google Earth)

8.1.2 Geology & Soils

Most of the area is covered by recent (Quaternary) alluvium and calcrete. Gneisses and metasediments of Mokolian age outcrop in the area. The soils of most of the area are red-yellow apedal soils, freely drained, with a high base status and <300 mm deep, with about one fifth of the area deeper than 300 mm, typical of Ag and Ae land types. (Mucina & Rutherford, 2006)

8.1.3 Climate

Rainfall occur largely in late summer/early autumn (major peak) and very variable from year to year. MAP ranges from about 70 mm in the west to 200 mm in the east. Mean maximum and minimum monthly temperatures for Kenhardt are 40.6°C and –3.7°C for January and July respectively. Corresponding values for Pofadder are 38.3°C and –0.6°C. Frost incidence ranges from around 10 frost days per year in the northwest to about 35 days in the east. Whirl winds (dust devils) are common on hot summer days. See also climate diagram for NKb 3 Bushmanland Arid Grassland. (Mucina & Rutherford, 2006)

8.1.4 Biome and Vegetation Types

The study area falls within the Karoo Biome (Rutherford & Westfall 1986). The most recent and detailed description of the vegetation of this region is part of a national map (Mucina & Rutherford, 2006). The study area also falls wholly within the Bushmanland Arid Grassland as shown in Figure 4.

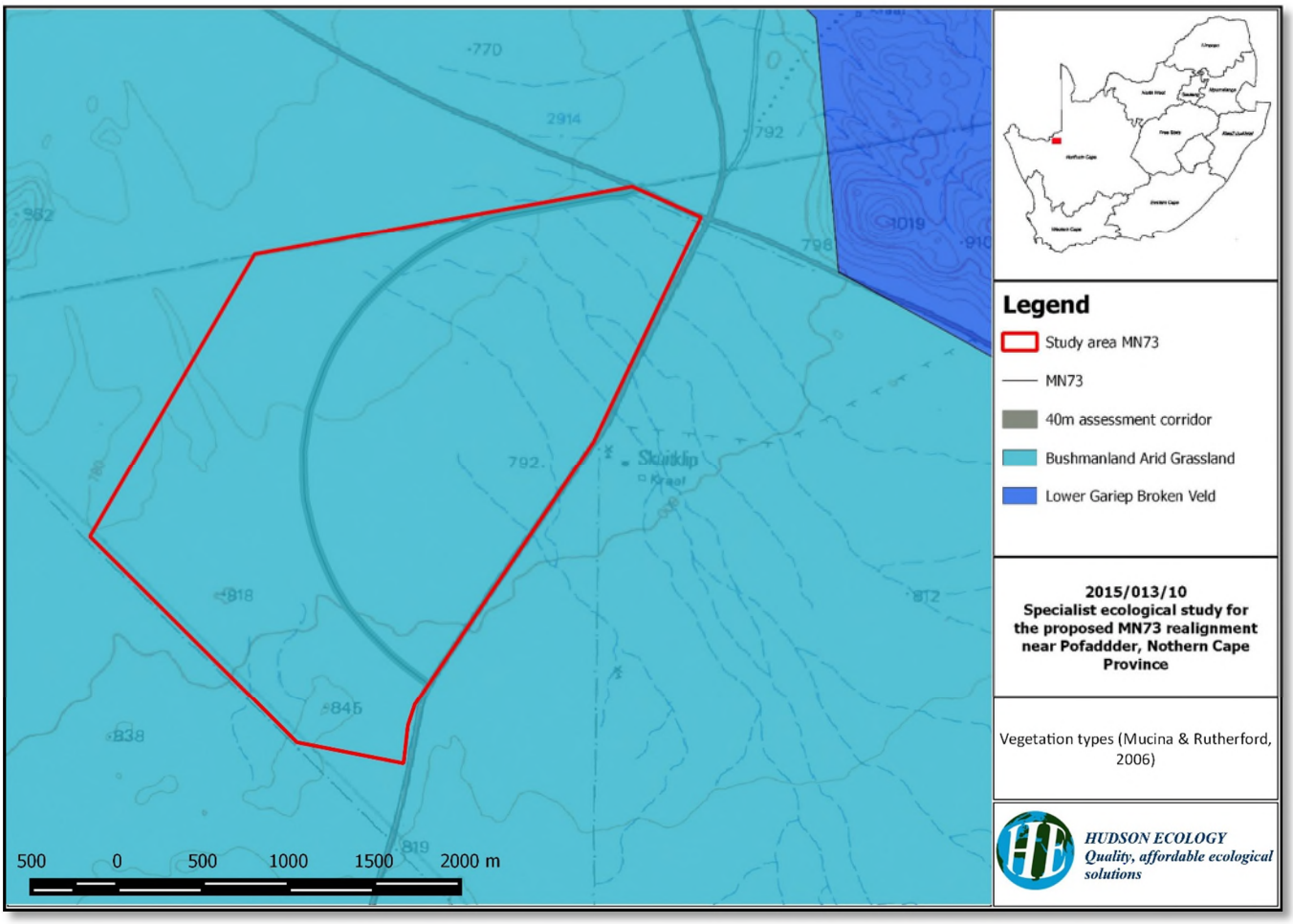

Figure 4: Vegetation types occurring in the study area (Mucina and Rutherford, 2006)

8.1.4.1 Bushmanland Arid Grassland

Synonyms: VT 29 Arid Karoo and Desert False Grassveld (36%), VT 32 Orange River Broken Veld (36%) (Acocks 1953). LR 51 Orange River Nama Karoo (51%) (Low & Rebelo 1996).

Distribution

Northern Cape Province: Spanning about one degree of latitude from around Aggeneys in the west to Prieska in the east. The southern border of the unit is formed by edges of the Bushmanland Basin while in the northwest this vegetation unit borders on desert vegetation (northwest of Aggeneys and Pofadder). The northern border (in the vicinity of Upington) and the eastern border (between Upington and Prieska) are formed with often intermingling units of Lower Gariep Broken Veld, Kalahari Karroid Shrubland and Gordonia Duneveld. Most of the western border is formed by the edge of the Namaqualand hills. Altitude varies mostly from 600–1 200 m (Mucina & Rutherford, 2006).

Vegetation & Landscape Features

Extensive to irregular plains on a slightly sloping plateau sparsely vegetated by grassland dominated by white grasses *(Stipagrostis* species) giving this vegetation type the character of semi-desert 'steppe'. In places, low shrubs of *Salsola* change the vegetation structure. In years of abundant rainfall rich displays of annual herbs can be expected (Mucina & Rutherford, 2006).

Important Taxa

Graminoids:

Aristida adscensionis (d), A. congesta (d), Enneapogon desvauxii (d), Eragrostis nindensis (d), Schmidtia kalahariensis (d), Stipagrostis ciliata (d), S. obtusa (d), Cenchrus ciliaris, Enneapogon scaber, Sporobolus nervosus, Stipagrostis brevifolia, S. uniplumis and Tragus berteronianus (Mucina & Rutherford, 2006).

Small Trees:

Acacia mellifera and Boscia foetida subsp. foetida (Mucina & Rutherford, 2006).

Tall Shrubs:

Lycium cinereum (d), Rhigozum trichotomum (d), Cadaba aphylla and Parkinsonia africana (Mucina & Rutherford, 2006).

Low Shrubs:

Aptosimum spinescens (d), Hermannia spinosa (d), Pentzia spinescens (d), Aptosimum elongatum, Barleria rigida, Berkheya annectens, Blepharis mitrata, Eriocephalus ambiguus, E. spinescens, Limeum aethiopicum, Lophiocarpus polystachyus, Monechma incanum, M. spartioides, Pentzia pinnatisecta, Polygala seminuda, Pteronia leucoclada, P. mucronata, P. sordida, Rosenia humilis, Senecio niveus, Sericocoma avolans, Solanum capense, Tetragonia arbuscula and Zygophyllum microphyllum (Mucina & Rutherford, 2006).

Succulent Shrubs:

Kleinia longiflora, Lycium bosciifolium, Salsola tuberculate and S. glabrescens (Mucina & Rutherford, 2006).

Herbs:

Acanthopsis hoffmannseggiana, Aizoon canariense, Amaranthus praetermissus, Chamaesyce inaequilatera, Dicoma capensis, Indigastrum argyraeum, Lotononis platycarpa, Sesamum capense, Tribulus pterophorus, T. terrestris and Vahlia capensis (Mucina & Rutherford, 2006).

Succulent Herbs:

Psilocaulon coriarium and Trianthema parvifolia.

Geophytic Herb:

Moraea venenata (Mucina & Rutherford, 2006).

Biogeographically Important Taxon (Bushmanland endemic)

Tridentea dwequensis (Mucina & Rutherford, 2006).

Endemic Taxa:

Dinteranthus pole-evansii, Larryleachia dinteri, L. marlothii, Ruschia kenhardtensis, Lotononis oligocephala and Nemesia maxii. (Mucina & Rutherford, 2006)

Conservation

Least threatened. Target 21%. Only small patches statutorily conserved in Augrabies Falls National Park and Goegab Nature Reserve. Very little of the area has been transformed. Erosion is very low (60%) and low (33%) (Mucina & Rutherford, 2006).

8.2 Flora Assessment

8.2.1 Vegetation Communities

Flora assessments were conducted during the dry season (August 2015) and during the wet season (March – April 2016). Based on species composition, physiognomy, moisture regime, rockiness, slope and soil properties, three main communities were recognised.

8.2.1.1 Statistical analyses of flora data

On the basis of the TWINSPAN, cluster analysis and Principle Components Analysis (PCA) results of the original 12 sample plots or releveés used to identify the different plant communities (Figure 5 and Figure 6).

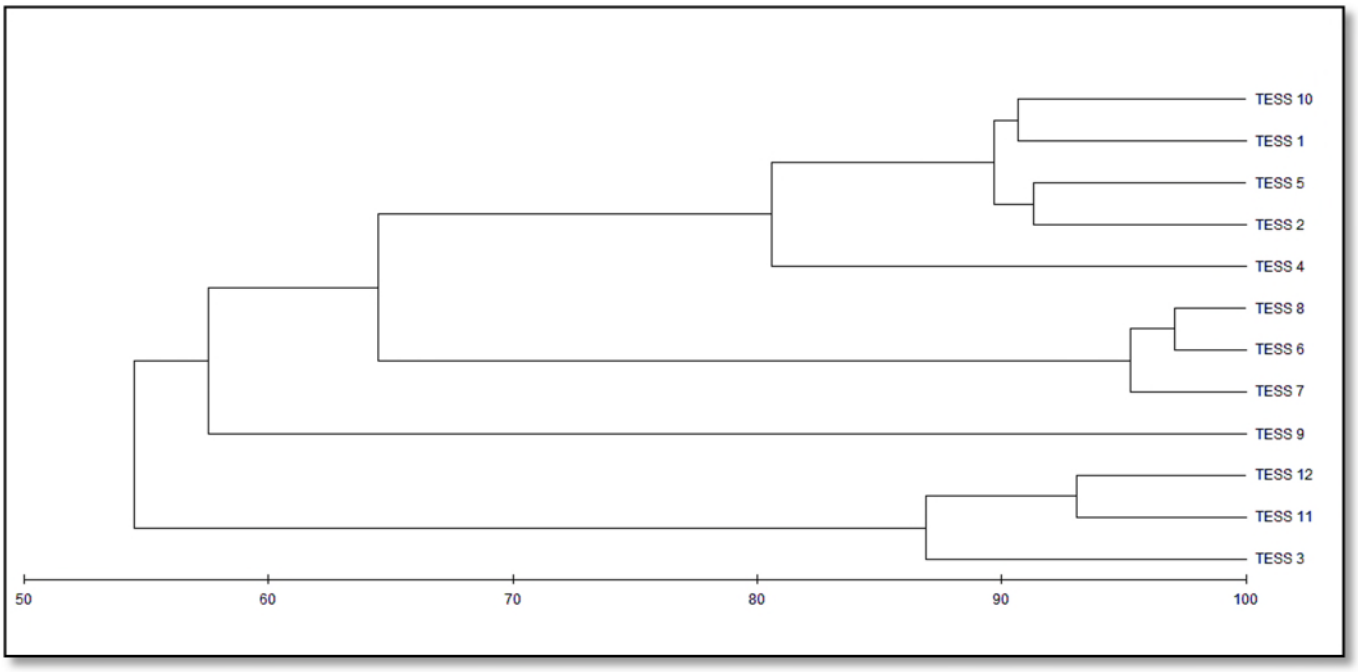

Figure 5: Dendrogram showing the similarities of the vegetation communities at the releveés.

A major division separates the releveés into grassland, riparian (wash) and dune communities (Figure 5). Releveés 3, 11 and 12 were classified as *Acacia mellifera – Parkinsonia africana* wash open shrubland, due to the dominance of these species and showed approximately a >85% similarity in species diversity (Figure 5). Releveés 6, 7 and 8 all occur on gravelly soil and show a high degree of similarity of approximately 95% (Figure 5) due to dominant vegetation and underlying substrate the plant community in which these releveés fall is classified as *Stipagrostis ciliata – Aristida congesta* open grassland. Releveés 1, 2, 4, 5 and 10 all occurred within the in the *Acacia mellifera – Aristida congesta* dune open shrubland and showed a > 90% similarity (Figure 5). Relive 9 was conducted on one of the rock hills and therefore shows an approximate similarity of only 55% with releveés 3, 11 and 12 and an approximate similarity of 58% with the remainder of the releveés (Figure 5). Although species recorded at this releveé are a subset of many of the other releveés, species diversity and abundances are very low leading to the low similarity to other releveés.

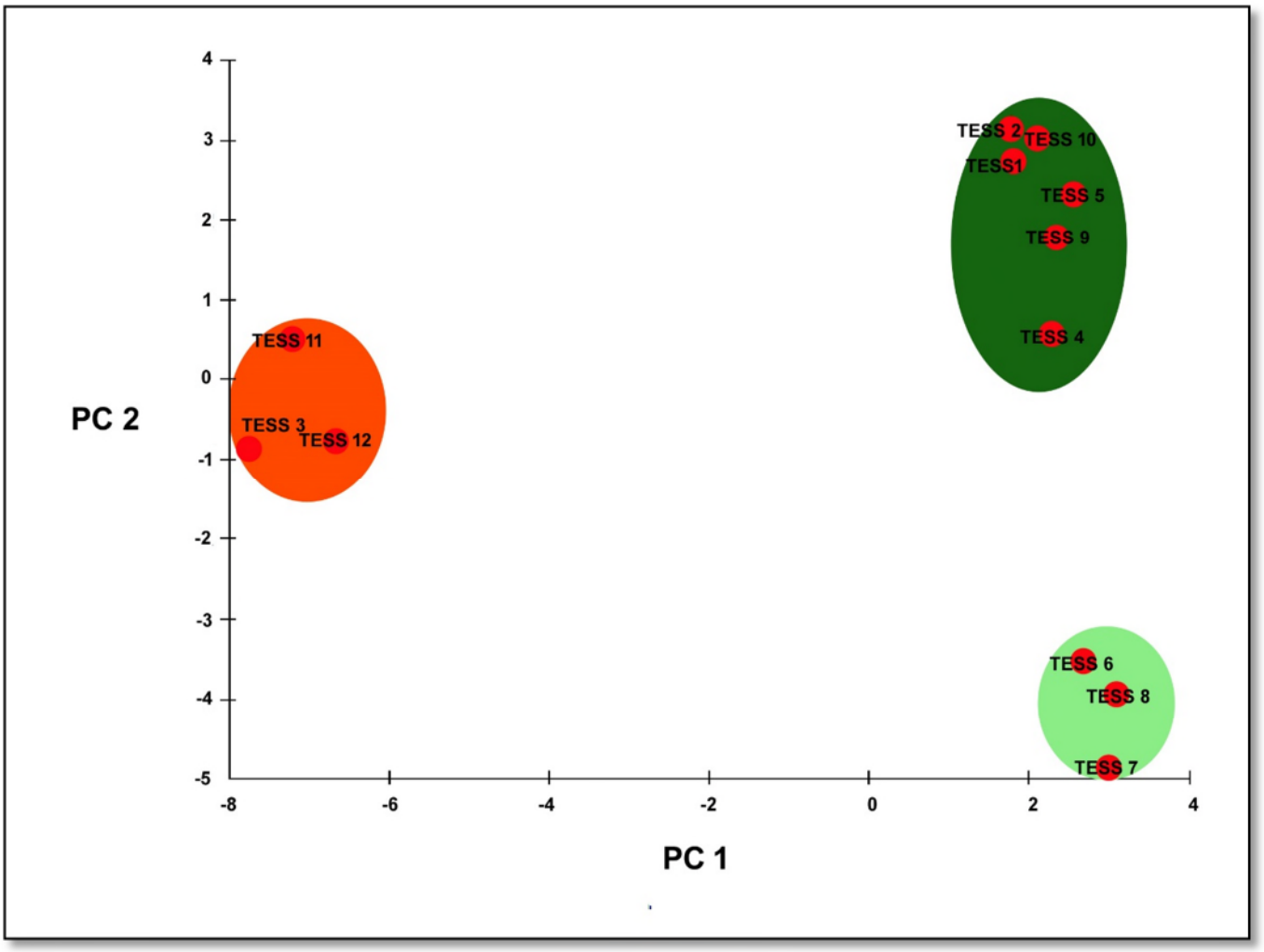

Figure 6: Principle Components Analysis of the releveés conducted during the study.

The vegetation communities are described in this report and named according to dominant species and underlying substrate. The vegetation communities are named as follows:

- Acacia mellifera – Aristida congesta dune open shrubland;
- Acacia mellifera – Parkinsonia africana wash open shrubland; and
- Stipagrostis ciliata – Aristida congesta open grassland.

These vegetation communities are shown in Figure 7 and the cover of each vegetation community is given in Table 7.

The total area of the study area was calculated to be 587ha. Table 7 gives the relative areas of each of the vegetation communities to the study area.

Table 7: Areas of vegetation communities within the study area

Vegetation Community	Area in ha	% of total study area	Length of realignment per vegetation unit	% of total realignment
Acacia mellifera – Aristida congesta dune open shrubland	286	48.72%	1838	45.13%
Acacia mellifera – Parkinsonia africana wash open shrubland	216	36.80%	1186	29.12%
Stipagrostis ciliata – Aristida congesta open grassland	85	14.48%	1049	25.75%
Total	**587**	**100.00%**	**4073**	**100.00%**

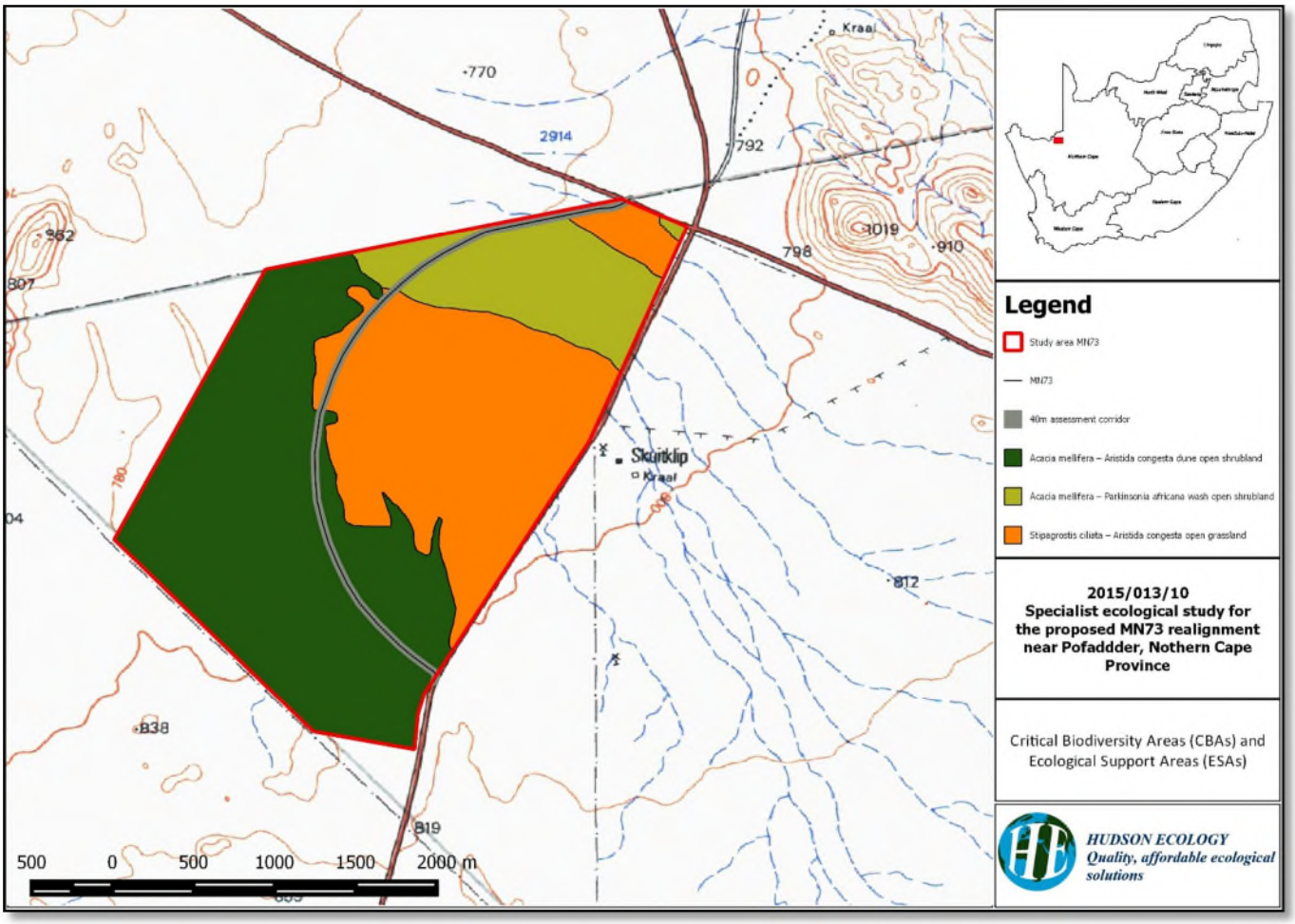

Figure 7: Study area showing vegetation communities

A list of plant species known to occur in the region are given in the first table of Appendix A, while recorded species are given in the second table in Appendix A.

8.2.1.2 Acacia mellifera – Aristida congesta dune open shrubland

This vegetation community is characterised by deposit dunes of deeper finer typical red sand with little or no calcrete deposits. This vegetation community is typically covered by sparse open grassland, with Stipagrostis ciliata and Aristida congesta being the dominant grass species. Other grass species occurring in this vegetation community include Stipagrostis obtusa, Aristida adscensionis, Fingerhuthia africana and Eragrostis lehmanniana, although these species occur in very modest abundance. Due to the deeper soils, as well as soil chemistry and an increased water retention potential, larger Acacia mellifera are dominant in this vegetation community, with scattered, drought resistant dwarf shrubs or small trees, e.g. Rhigozum

trichotomum and Boscia foetida (

Figure 8). This vegetation community also hosts a number of annual herb species in the wet season. Species of concern found to occur in this vegetation community are the protected species *Aloe dichotoma* and *Boscia foetida*. Due to the very sandy soil, protected species that prefer a more solid substrate, such as *Hoodia gordonii*, are absent.

Figure 8: Acacia mellifera – Aristida congesta dune open shrubland in the western part of the study area

Sensitivity aspects

- This vegetation community on the site has been moderately disturbed;
- Depending on the severity of the vegetation clearing , which has taken place, rehabilitation of this vegetation community could be relatively easily conducted, but in more severely degraded areas rehabilitation will be more difficult;
- Low - moderate species diversity;
- Floristic status of this variation is low - moderate;
- Suitability of the habitat for flora and fauna species of concern is high (*Aloe dichotoma* and *Boscia foetida* recorded);
- Ecological integrity of this community is High; and The Conservation importance of this community is moderate to high.

8.2.1.3 Acacia mellifera – Parkinsonia africana wash open shrubland

The drainage line within the plains of the study area are regarded as washes, as water will only flow after good rains, and soon dry up again. The increased water retention in the underlying substrate allows for the growth of larger individuals of the species *Acacia mellifera* and *Parkinsona africana*. These washes are wide and sandy, and blend into the landscape, merging with the adjacent grassland vegetation, but are nevertheless visible due to their microtopography and change in species composition (

Figure 9). The vegetation is often somewhat heterogeneous and infested with weeds, due to the disturbance of the periodic flooding.

Washes are of conservation concern and regarded as sensitive ecosystems, due to the ecosystem processes linked to provision and transport of water in the landscape.

Figure 9: Acacia mellifera – Parkinsonia africana wash open shrubland running from left to right in the central part of the photo

Sensitivity aspects

- This vegetation community on the site has been moderately to severely disturbed;
- Rehabilitation of this vegetation community will be difficult due to existing levels of degradation;
- Low indigenous species diversity;
- Floristic status of this variation is low;
- Suitability of the habitat for Red Data flora and fauna species is low – moderate although *Boscia foetida* was recorded;
- No floral Red Data species were recorded in this vegetation community;
- Ecological integrity of this community is low - moderate; and
- The Conservation importance of this community is low - moderate.

8.2.1.4 Stipagrostis ciliata – Aristida congesta open grassland

The flat sandy plains are covered with shallow sand with calcrete exposed locally. The open, sparse grassland is dominated by *Stipagrostis ciliata* and *Aristida congesta*. The shrubby *Rhigozum trichotomum* is prominent on the sandy localities while *Salsola aphylla* is more prominent where calcrete is exposed (

Figure 10). Other dominant grass species occurring in this vegetation community include *Stipagrostis obtusa, Aristida adscensionis* and, to a much lesser extent, *Fingerhuthia africana* and *Eragrostis lehmanniana.*

Figure 10: Stipagrostis ciliata – Aristida congesta open grassland

Sensitivity aspects

- This vegetation community on the site has been severely disturbed;
- Depending on the severity of degradation, rehabilitation of this vegetation community could be relatively easily conducted, in more severely degraded areas rehabilitation will be more difficult;
- Low - moderate species diversity;
- Floristic status of this variation is low - moderate;
- Suitability of the habitat for Red Data flora and fauna species is high (*Hoodia gordonii* recorded as well as isolated individuals of *Boscia foetida*);
- Ecological integrity of this community is low - moderate; and
- The Conservation importance of this community is moderate - high.

8.2.2 Flora species of concern

A list of plant species previously recorded in the quarter degree grid in which the study area is situated was obtained from the South African National Biodiversity Institute (0). Additional species that could occur in similar habitats, as determined from official database searches and reviewed literature, but not recorded in these grids are also listed. A total of 11 species were determined to possibly be occurring in the study area.

The species, listed as possibly occurring in the study area, were evaluated to determine the probability of occurrence in the study area based on habitat suitability. Of the species that are considered to occur within the area under investigation, there were five species that could occur in habitats that are available in the study area. According to IUCN (IUCN, 2013) two of these are listed as Vulnerable, one as Near Threatened and two as Declining. One of the vulnerable species, *Aloe dichotoma*, was recorded in the study area. All locations where this species was recorded is given in Figure 11. All individuals of this species were recorded outside of the footprint of the MN73 realignment and can therefore be avoided, and not affected by the development. The occurrence of this species can therefore not be seen as a fatal flaw.

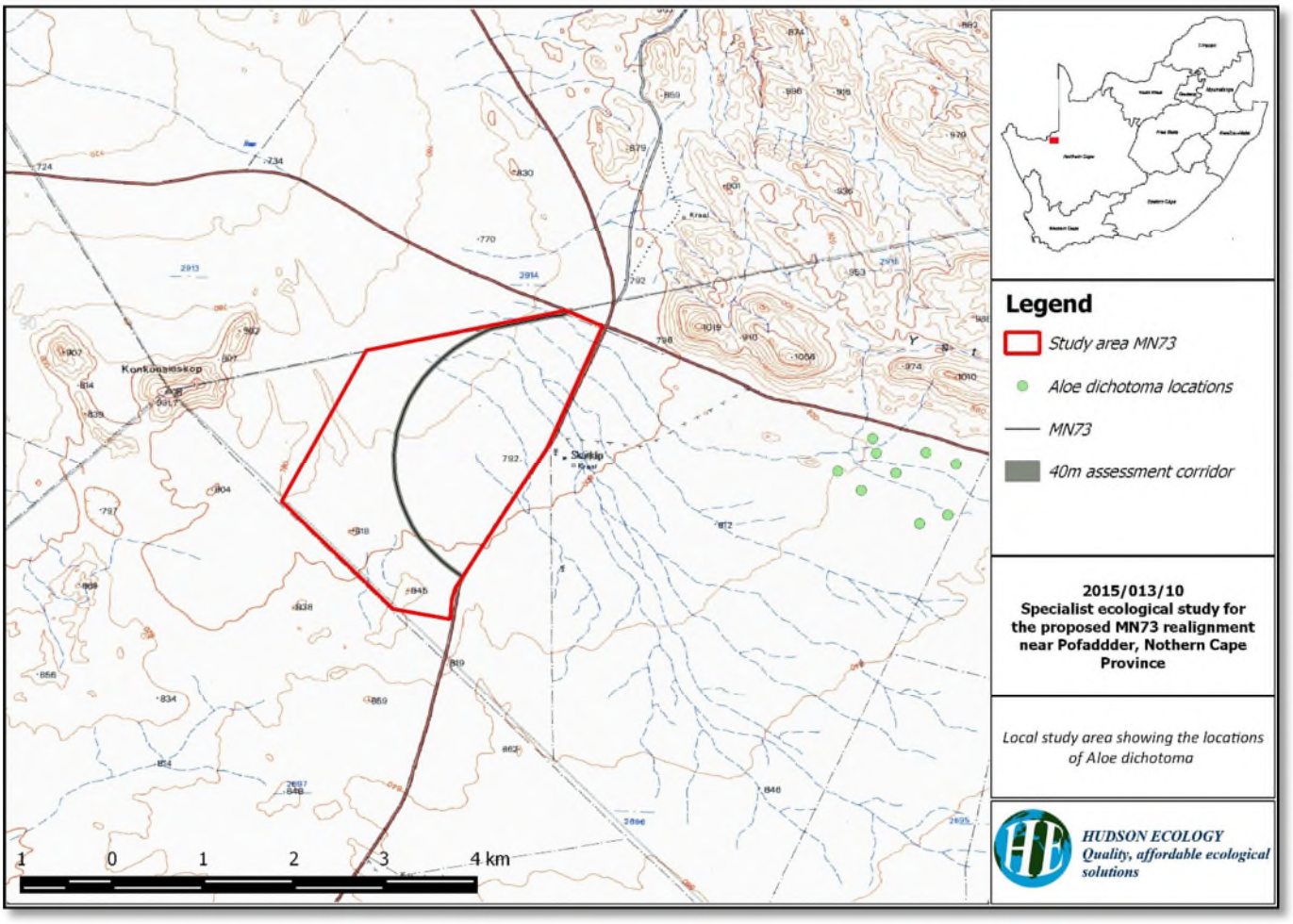

Figure 11: Locations of Aloe dichotoma recorded in the study area

Figure 12: Aloe dichotoma recorded in the study area (westernmost locality in Figure 14)

The other vulnerable species, *Lithops olivaea*, occurs only in white translucent quartzite patches. This habitat was not found in the study area during the ecological baseline and impact assessment study. The species has been recorded 30 km away, and has a wide distribution within the Gariep Centre of Floristic Endemism, there is thus a high probability of occurrence on site, if available habitat is present. The Near Threatened species, *Conophytum limpidum*, is found on inselbergs in Bushmanland in vertical crevices in rocks, generally preferring shaded situations. If it occurs in the study area, it is most likely to be found on the hills or rocky areas. The one Declining species, *Acacia erioloba*, also a protected tree, has a high probability of occurring in the study area, while *Hoodia gordonii* was recorded in the study area in a number of places (

Figure 13).

Figure 13: Hoodia gordonii recorded in the study area

The quantity and quality of floristic data for the study area is poor. There are few taxonomic collections and relatively little floristic information for the area (Van Wyk & Smith, 2001). There are over 400 succulent species listed as being endemic or near-endemics for the Gariep Centre of Endemism as well as a long list of non-succulents (Van Wyk & Smith, 2001). A number of these have been recorded in the region around the current study area, for example, *Aloe gariepensis, Crassula corallina subsp. macrorrhiza, Hoodia gordonii, Ruschia muricata* and *Sarcocaulon patersonii*. *Aloe gariepensis, Ruschia muricata* and *Maerua gilgii* are found in Bushmanland Arid Grassland, *Crassula corallina* subsp. *macrorrhiza* is found in Lower Gariep Broken Veld and *Sarcocaulon patersonii* is found in a variety of vegetation types, including Lower Gariep Broken Veld and Bushmanland Arid Grassland. Areas associated with calcareous soils and heavy metals are likely to have high numbers of species of restricted distribution. There is also a high probability that there are previously undescribed species from the site or surrounding areas. A list of flora species of concern, as well as their probability of occurrence and reasoning behind the probability of occurrence is given in Table 8.

Table 8: Red Data floral species possibly occurring in the area

Family	Taxon	Status	Habitat	Likelihood of occurrence in the study area
FABACEAE	*Acacia erioloba*	Declining	Savanna, semi-desert and desert areas, deep sandy soils and along drainage line in very arid areas, sometimes in rocky outcrops.	HIGH
ASPHODALACEAE	*Aloe dichotoma subsp. dichotoma*	VU	North-facing rocky slopes (particularly dolomite) in the south of its range. Lower Gariep Broken Veld and rocky areas in Bushmanland Arid Grassland	RECORDED
CAPPARACEAE	*Boscia foetida*	Protected	Savanna, semi-desert and desert areas, deep sandy soils and along drainage line in very arid areas, sometimes in rocky outcrops	RECORDED
APIACEAE	*Anginon jaarsveldii*	EN	Pofadder. Groot Pellaberg. Dry rocky area, xerophytic plants. Aggeneys Gravel Vygieveld.	LOW, nearest locality is 50 km away
ASPHODALACEAE	*Bulbine striata*	Critically rare	Groot Pellaberg, this species appears to be endemic to the mountains north of Pella. Quartz pebbles and rocks in well-drained soil	LOW, nearest locality is 50 km away

Family	Taxon	Status	Habitat	Likelihood of occurrence in the study area
			on the upper and middle slopes at the base of sheer rock faces.	
FABACEAE	*Caesalpinia bracteata*	VU	This species is only known from below the Augrabies Falls near the Orange River and Klein Pella on granite. Blouputs Karroid Thornveld.	LOW, nearest locality is 20 km away
MESEMBRYANTHEMACEAE	*Conophytum achabense*	VU	Namiesberge, near Poffader. Western end of the Namiesberge on an elevated quartz vlakte. Bushmanland Inselberg Shrubland.	LOW, nearest locality is 60 km away
MESEMBRYANTHEMACEAE	*Conophytum limpidum*	NT	Inselbergs in Bushmanland. Particularily dense on the Namiesberg. Vertical crevices generally prefering shaded situations. Lower Gariep Broken Veld	HIGH
EBENACEAE	*Euclea pseudebenus*	LC	Euclea pseudebenus is found in harsh, stony and sandy desert and semi-desert areas, usually in lowlying areas along watercourses, or fairly nearby.	LOW, nearest lrecorded locality is approximately 40km from the site
MESEMBRYANTHEMACEAE	*Conophytum ratum*	VU	Ghaamsberg, South West of Pofadder. Spongy quartz soil.	LOW, nearest locality is 70 km away
APOCYNACEAE	*Hoodia gordonii*	Declining	Wide variety of arid habitats	RECORDED
MESEMBRYANTHEMACEAE	*Lithops dinteri subsp. frederici*	VU	Only known from a small area near Pella (near Pofadder) in Northern Cape. Eastern Gariep Plains Desert	LOW, nearest locality is 50 km away
MESEMBRYANTHEMACEAE	*Lithops dorotheae*	EN	Just N of Pofadder / Pella vicinity, Pella mountains between Pella and Pofadder. Grows on fine grained, sheared, feldspathic quartzite. False Succulent Karoo Veld or Orange River Broken Veld (Eastern Gariep Rocky Desert)	LOW, known distribution is to the west
MESEMBRYANTHEMACEAE	*Lithops olivacea*	VU	Aggenys to Pofadder. Habitat specialist - grows on white translucent quartzite in Arid Karoo Veld (Aggeneys Gravel Vygieveld).	MEDIUM

* Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001), as evaluated by the Threatened Species Programme of the South African National Biodiversity Institute in Pretoria. *IUCN (3.1) Categories: VU = Vulnerable, EN = Endangered, CR = Critically Endangered, NT = Near Threatened.

8.3 Fauna Assessment

The faunal assessment was conducted in the dry season during the month of August 2015 and in the wet season during April 2016.

8.3.1 Recorded Faunal Species

8.3.1.1 Herpetofauna

Reptile diversity in the area is high with approximately 45 reptile species (0) occurring in the area and reptile endemism is especially high in the region with 19 species (42%) being endemic. Ten species were confirmed during the wet and dry season site surveys (Table 9). Although the number of species does not seem high, herpetofauna are by nature shy animals and the fact that almost 25% of the species known to occur in the area were recorded indicates quite high species richness in the area. No exotic herpetofauna species are expected to occur on the study site. Two of the species recorded, namely *Naja nivea* and *Cordylus polyzous,* are considered endemic to southern Africa.

Table 9: Reptile species recorded during the August 2015 and April 2016 surveys

Order	Suborder	Family	Subfamily	Biological Name	Common Name	Status
Squamata	Serpentes (Ophidia)	COLUBRIDAE	Boadontinae	*Lamprophis fuliginosus*	Brown House Snake	
			Psammophinae	*Psammophis notostictus*	Karoo Whip Snake	
		ELAPIDAE	Najinae	*Naja nivea*	Cape Cobra	E

Order	Suborder	Family	Subfamily	Biological Name	Common Name	Status
				Naja nigricollis	Black-necked Spitting Cobra	Rare
			Viperinae	*Bitis arietans*	Puff Adder	
				Bitis caudalis	Horned Adder	
	Sauria (Lacertillia)	SCINCIDAE	Lygosomatiinae	*Mabuya striata*	Striped Skink	
				Mabuya variegata	Variegated Skink	
		AGAMIDAE		*Agama aculeata*	Ground Agama	
		CORDYLIDAE	Cordylinae	*Cordylus polyzous*	Karoo Girdled Lizard	E

Most of the expected species in the area (Table 9) are common and widespread, with only the Black-necked spitting Cobra (Naja nigricollis) being classified as rare. Species of concern are discussed further in section 6.2.5.

Figure 14: Karoo Girdled lizard, Cordylus polyzous, recorded during the study

The results of the statistical analysis of the herpetofauna occurring in the three vegetation communities are given in Figure 15. From this figure it can be seen that diversity is generally low as can be expected in arid areas. What can be noted is that evenness is high, an indication that there is a high similarity between the species occurring in the different vegetation communities. The *Acacia mellifera – Parkinsonia africana* wash vegetation community showed the highest diversity. This can be as a result of water retention causing a greater diversity of vegetation attracting a higher diversity of prey items for herpetofauna.

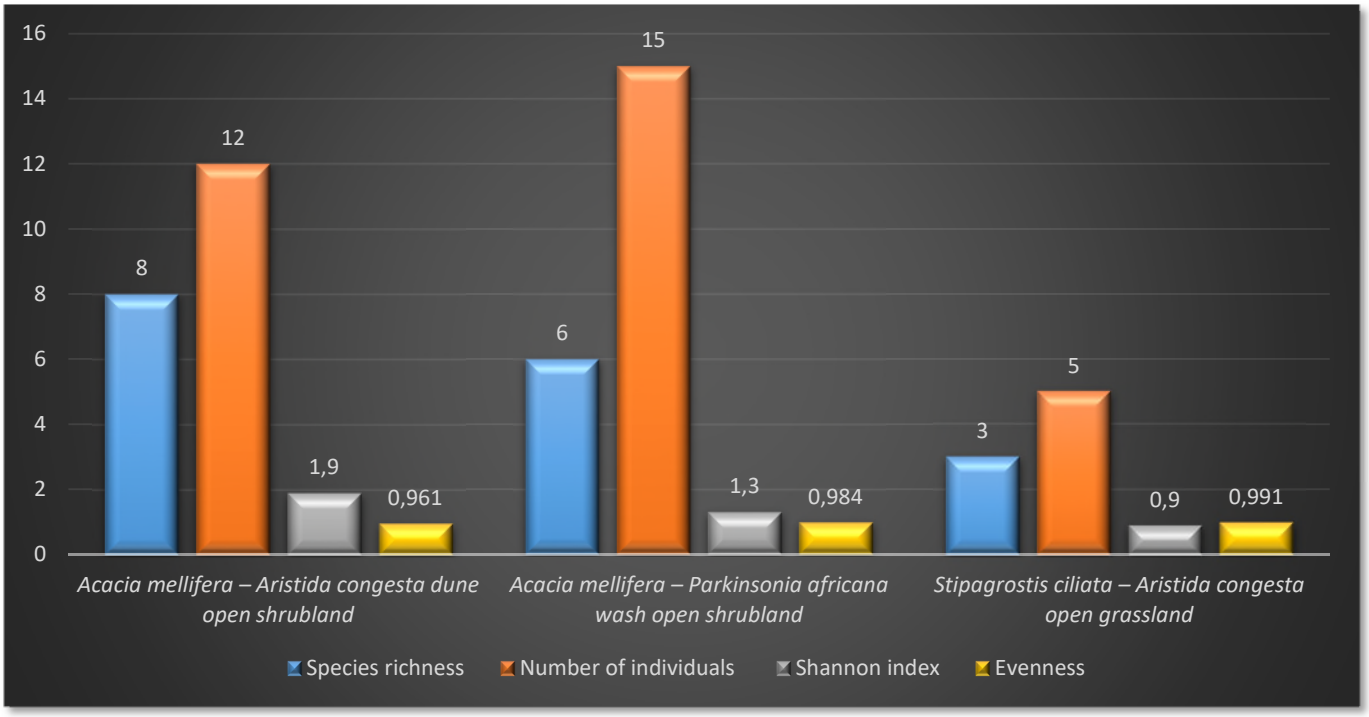

Figure 15: Herpetofauna species diversity between vegetation communities

Most of the expected species in the area (Table 9) are common and widespread, with only the Black-necked spitting Cobra (Naja nigricollis) being classified as rare. Species of concern are discussed further in section 8.3.3.

8.3.1.2 Amphibia

The study area is a fair distance from any permanent open water bodies and therefore, as expected amphibian diversity is low. Only seven species are expected to occur in the study area (0), and during the wet and dry season surveys no amphibian species were recorded. Due to the dry conditions, distance from any open water bodies and distance from the Orange River, the lack of amphibian species in the study area was expected. The study site area falls outside the natural range of giant bullfrogs, desert rain frog and the Karoo caco, and these species should not occur on the study site. Due to the fact that no amphibian species were recorded on site, no statistical analyses were conducted.

8.3.1.3 Mammalia

Of the 67 mammal species expected to occur in the study area, according to historic recordings (0), only 16 were confirmed during both the site visits (Table 10). A number of species may contribute to the low species diversity and abundance recorded in the mammal population, these include overgrazing and local extinctions due to anthropogenic impacts.

Table 10: Mammal species recorded during the study

Family	Biological Name	Common Name
MACROSCELIDIDAE (Sengis/Elephant Shrews)	*Elephantulus rupestris*	Western Rock Sengi
SORICIDAE (Shrews)	*Crocidura cyanea*	Reddish-grey Musk Shrew
LEPORIDAE (Hares and Rabbits)	*Lepus saxatillis*	Scrub Hare
BATHYERGIDAE (Rodent Moles / Mole Rats)	*Cryptomys hottentotus*	Common (African) Mole-rat
HYSTRICIDAE (Porcupine)	*Hystrix africaeaustralis*	Cape Porcupine
MURIDAE (Rats and Mice)	*Saccostomus campestris*	Pouched Mouse
MURIDAE (Rats and Mice)	*Michaelamys namaquensis*	Namaqua Rock Mouse

Family	Biological Name	Common Name
MURIDAE (Rats and Mice)	*Rhabdomys pumilio*	Four-striped Grass Mouse
MURIDAE (Rats and Mice)	*Mastomys natalensis*	Natal Multimammate Mouse
CANIDAE	*Otocyon megalotis*	Bat Eared Fox
HERPESTIDAE	*Galerella pulverulenta*	Small Grey Mongoose
HERPESTIDAE	*Suricata suricatta*	Suricate (Meerkat)
ORYCTEROPODIDAE	*Orycteropus afer*	Aardvark
PROCAVIIDAE	*Procavia capensis*	Rock Dassie (Hyrax)
RUMINANTIA	*Raphicerus campestris*	Steenbok
RUMINANTIA	*Sylvicapra grimmia*	Common Duiker

Mammals reliant on wetland and arboreal habitats were a priori omitted from the list of occurrences since these habitat-types are absent from the study site. As such a species richness of 56 species in an area with average habitat diversity and a low carrying capacity is high.

All 16 species recorded are robust and widespread, mostly with the proviso that suitable habitat and sufficient space to maintain home ranges / territories are available. Given no or lowkey persecution, all species are capable of maintaining their presences in remote areas such as the site and surrounding properties. The nearby roads are obviously a main source of fatalities – several carcasses were recorded during transit to and from the study area.

The results of the statistical analysis of the mammalia occurring in the three vegetation communities are given in Figure 16. From this figure it can be seen that diversity is low as can be expected in arid areas. Evenness is high, indicating that there is a high similarity between the species occurring in the different vegetation communities. The A*cacia mellifera - Aristida congesta* dune open shrubland community showed the highest diversity, although the variation is so little that it cannot be seen as definitive of a significant variation in species diversity.

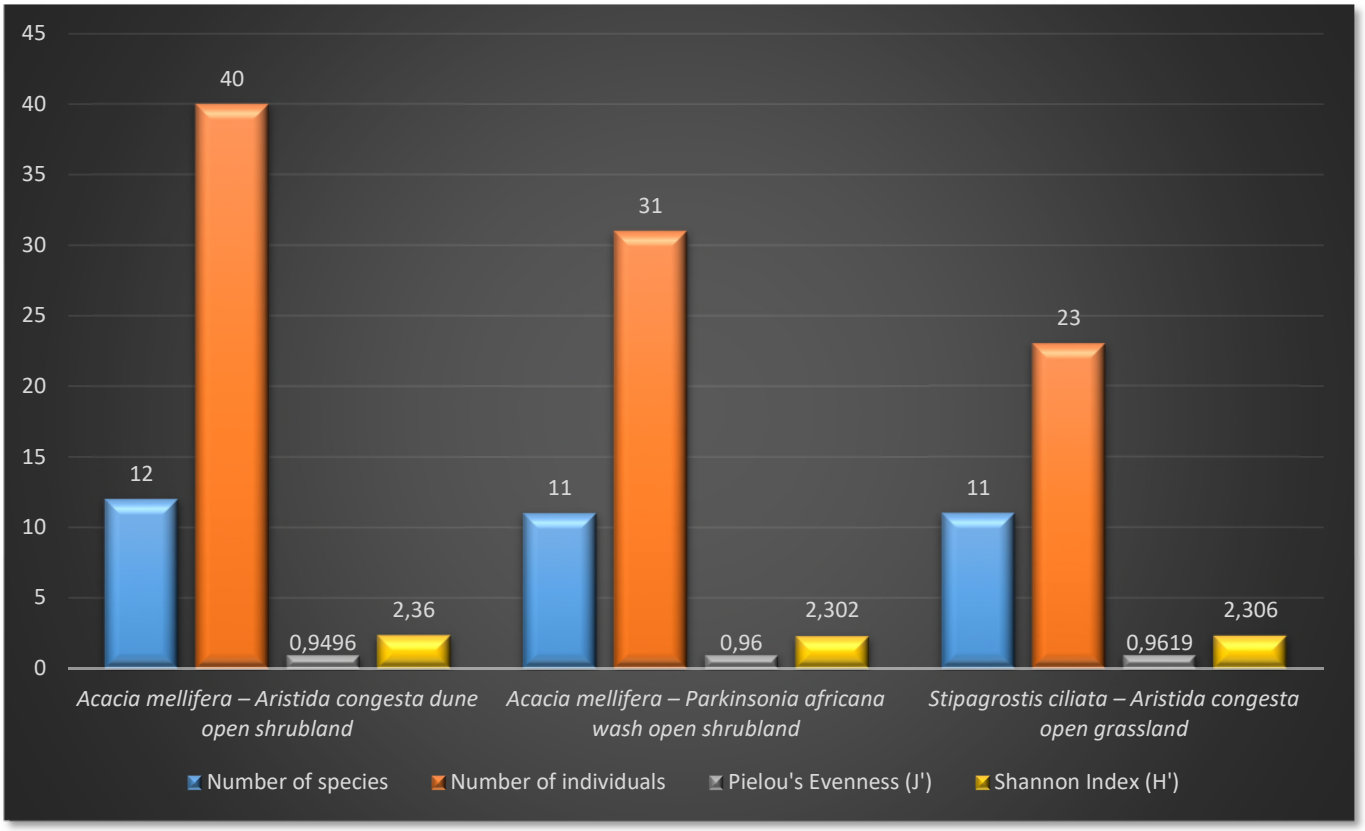

Figure 16: Mammalia species diversity between vegetation communities

8.3.2 Avifauna

During the surveys a total of 29 species were recorded and a total of 1341 individual birds were recorded. The species recorded are given in Table 11. Only one species of conservation importance was recorded during the study namely, the Maccoa Duck (*Oxyura maccoa*). The Maccoa Duck was recorded to the south of the study area, flying towards the evaporation ponds at the Kaxu facility.

Table 11: Species and abundances of avifauna recorded during the study

Species	Species Biological Name	Total number of individuals recorded
South African Shelduck	*Tadorna cana*	35
Maccoa Duck	*Oxyura maccoa*	5
Lanner Falcon	*Falco biarmicus*	4
Namaqua Sandgrouse	*Pterocles namaqua*	54
Rock Dove	*Columba livia*	33
Speckled Pigeon	*Columba guinea*	25
Cape Turtle Dove	*Streptopelia capicola*	17
Laughing Dove	*Streptopelia senegalensis*	25
Namaqua Dove	*Oena capensis*	14
Red-faced Mousebird	*Urocolius indicus*	78

Species	Species Biological Name	Total number of individuals recorded
Red-capped Lark	*Calandrella cinerea*	21
Sabota Lark	*Calendulauda sabota*	16
Spike-heeled Lark	*Chersomanes albofasciata*	149
Pied crow	*Corvus albus*	40
Familiar Chat	*Cercomela familiaris*	27
Ant-eating Chat	*Myrmecocichla formicivora*	19
Karoo Scrub Robin	*Erythropygia coryphoeus*	10
Chestnut-vented Tit-Babbler	*Sylvia subcaerulea*	5
Zitting Cisticola	*Cisticola juncidis*	12
African Pied Wagtail	*Motacilla aguimp*	27
Bokmakierie	*Telophorus zeylonus*	9
Cape Sparrow	*Passer melanurus*	187
Southern Grey-headed Sparrow	*Passer diffusus*	142
White-browed Sparrow-Weaver	*Plocepasser mahali*	121
Sociable Weaver	*Philetairus socius*	221
Yellow Canary	*Crithagra flaviventris*	31
Barn Swallow	*Hirundo rustica*	14

8.3.3 Red Data Faunal Species

Table 12 describes the habitat requirements and probability of occurrence of fauna species of concern identified as likely to occur in the study area.

Table 12: Red Data fauna species that may occur in the study area

Common name	Taxon	Habitat	Status	Likelihood of occurrence
Black rhinoceros	*Diceros bicornis bicornis*	Wide variety of habitats, but currently only occurs in game reserves.	CR	**NONE**, only occurs in game reserves
Hartmann's mountain zebra	*Equus zebra hartmannae*	Rocky barren areas, ecotones between mountains and plains / flats, grazer	EN	**LOW,** only occurs in game reserves.
Angolan Wing-gland Bat	*Cistugo seabrai*	Nama-Karoo, gleaning insectivore, roosts unrecorded, but probably in crevices in rocks. Occurs in areas with less than 100 mm rainfall.	VU	**MEDIUM**, previously recorded in neighbouring grid, on edge but within geographical distribution, no roosting habitat available on site.
Honey badger	*Mellivora capensis*	Wide variety of habitats. Probably only in natural habitats.	NT	**MEDIUM**, overall geographical distribution includes this area, habitat is suitable.
Darling's horseshoe bat	*Rhinolophus darlingii*	Savanna, rossting in caves and sub-terranean habitats	NT	**MEDIUM**, recorded in nearby grid, on edge of

Common name	Taxon	Habitat	Status	Likelihood of occurrence
				distribution; suitable habitat may occur on site.
Dent's horseshoe bat	*Rhinolophus denti*	Savanna, nama-Karoo, succulent Karoo, and distribution follows rivers. Caves and subterranean habitats. Aerial insectivore.	NT	**LOW**, on edge of distribution; suitable habitat may occur on site or may be vagrant from Orange River valley.
Littledale's whistling rat	*Parotomys littledalei*	Desert, Karoo. Sandy or gravel open plains. Tends to excavate burrow beneath a shrub, but will also contruct stick nest at the base of a shrub. Herbivorous, favouring leaves of Zygophullum and Mesembryanthemaceae.	NT	**HIGH**, site is in core of distribution range. Habitat suitable on site.
Dassie Rat	*Petromus typicus*	Rocky barren areas on rocky outcrops and koppies. Flat rock crevices. Eats soft vegetable matter, including leaves of shrubs and flowers of many Asteraceae.	NT	**HIGH**, site is in core of distribution range. Habitat suitable on site.
Reddish-grey musk shrew	*Crocidura cyanea*	Wide variety of habitats. Nocturnal, terrestrial.	DD	**MEDIUM**, previously recorded in nearby grid and geographical distribution includes this area.
Lesser red musk shrew	*Crocidura hirta*	Wide range of habitats from moist savanna and wetlands to Kalahari thornveld. Terrestrial, nocturnal.	DD	**LOW**, overall distribution includes this area, but low reporting rate in arid part of country.
Rock dormouse	*Graphiurus platyops*	Rocky terrain, also been found in camelthorn trees. Eats insects and seeds. Nocturnal.	DD	**MEDIUM**, not previously recorded in this area, but habitat suitable and within overall geographical distribution.
Bushveld Gerbil	*Tatera leucogaster*	Terrestrial, sandy soils. Excavates burrows in sandy soils, usually at the base of small shrubs, but also in the open. Granivorous, insectivorous and herbivorous.	DD	**MEDIUM**, recorded in nearby grid, on edge of distribution; suitable habitat may occur on site.
Bushveld Elephant-shrew	*Elephantulus intufi*	Savanna, grassland, shrubland. Sandy soils with sparse grass cover. Requires cover of low bushes. Eats insects, primarily ants, but also catches grasshoppers.	DD	**MEDIUM**, recorded in nearby grid, on edge of distribution; suitable habitat may occur on site.
Giant Bullfrog	*Pyxicephalus adspersus*	Widely distributed in southern Africa, mainly at higher elevations. Inhabits a variety of vegetation types where it breeds in seasonal, shallow, grassy pans in flat, open areas; also utilises non-permanent vleis and shallow water on margins of waterholes and dams. Prefer sandy substrates although they sometimes inhabit clay soils.	NT	**LOW,** just outside known distribution range.
Black-necked spitting cobra	*Naja nigricollis woodi*	Favours rocky terrain and dry rocky watercourses.	RARE	**HIGH,** overall geographical distribution includes this area; suitability of habitat on site appears favourable.
Maccoa Duck	*Oxyura maccoa*	Maccoa Duck's breeding habitat is shallow fresh waters, and it is also found in brackish and saline lakes in winter. Rarer than previously believed, it was uplisted from a species of Least Concern to Near Threatened status in the 2007 IUCN Red List	NT	**RECORDED** at Xaxu evaporation ponds

Common name	Taxon	Habitat	Status	Likelihood of occurrence
Secretarybird	*Sagittarius serpentarius*	This species is uncommon to locally fairly common, favouring open grasslands with scattered trees and shrubs. Although considered resident, it is not sedentary, with highly nomadic movements across their large home range (up to 230km2).	NT	
Lanner Falcon	*Falco biarmicus*	This species has a fairly high tolerance regarding habitat requirements, being found across southern Africa in most habitat types excluding forest. The Lanner Falcon is generally a cliff nester and its distribution is closely associated with mountainous areas. However, and especially in the Karoo, the increasing number of power line towers has offered alternative nesting opportunities for this species	NT	**HIGH,** overall geographical distribution includes this area; suitability of habitat on site appears favourable.
Sclater's Lark	*Spizocorys sclateri*	This species is endemic to South Africa and Southern Namibia, where its distribution is confined to the Nama Karoo biome - concentrated in the Northern Cape, slightly to the south of the study area. Although this species has been reported to move substantially, it appears to move within in its core Bushmanland distribution. This species was not detected during the site visits, but is notoriously nomadic responding to rainfall events. Its preferred habitat is sparsely vegetated quartz gravel or stony plains, sometimes with some scattered grass tufts or scrubby bushes, on shales or clay. It is therefore not expected that this species occurs within the study area	NT	**MEDIUM,** not previously recorded in this area, but habitat suitable and within overall geographical distribution**.**
Kori Bustard	*Ardeotis kori*	This species is considered uncommon to locally common, favouring open savannah woodland, dwarf shrubland and occasionally grassland. Although a sedentary resident, this species is locally nomadic in response to rainfall and the subsequent flush of small invertebrates. The species has declined in South Africa due to habitat loss through transformation, collision with overhead power lines and poisoning. This species has the potential to occur within or pass through the study area due to the availability of suitable foraging habitat and the species' nomadic movements.	VU	**HIGH,** overall geographical distribution includes this area; suitability of habitat on site appears favourable.
Ludwig's Bustard	*Neotis ludwigii*	This species is a sparse to locally common near endemic nomad, favouring semi-arid dwarf shrubland, arid woodland and the arid western edge of the grassland biome. This species is highly susceptible to collisions with overhead power lines and telephone wires, with this single human-induced mortality factor considered the most important threat to this species. A study of 150 km of power line transects across the country revealed approximately 600 carcasses comprising mainly of this species (± 45% of carcasses). This species has the potential to occur within or pass through the study area due to the availability of suitable foraging habitat and the species highly nomadic movements	VU	**MEDIUM,** not previously recorded in this area, but habitat suitable and within overall geographical distribution.
Martial Eagle	*Polemaetus bellicosus*	This species is widespread, although generally uncommon in South Africa, tolerating a wide range of habitat types, including open grassland, scrub and woodland. This species requires exceptionally large home ranges (in excess of 130 km2), making use of large trees and electricity pylons to provide nest sites – which are often a limiting factor concerning this species.	VU	**HIGH,** overall geographical distribution includes this area; suitability of habitat on site appears favourable.

Of the 21 faunal species of concern that may occur in the study area, 1 has no probability of occurrence, 5 have a low probability of occurrence, 9 have a medium probability of occurrence and 6 have a high probability of occurrence. Three of the species with a high probability of occurrence, the Black-necked spitting Cobra, Maccoa Duck and Lanner Falcon, were recorded during the study.

8.4 Ecological Integrity

The ecological function of the study area can generally be described as moderate for the majority of the study area, although this does vary from low (in the highly transformed areas) to high in the more inaccessible or unutilisable areas. Areas in which overgrazing and clearing have taken place, as well as areas in which settlements have been established are considered as areas where ecological function is reduced. Areas of high ecological integrity are areas that have been minimally impacted. These areas can be considered as areas of high sensitivity and development in these areas should be limited, while areas of moderate and low ecological are areas where a greater amount of disturbance has already occurred and, in order to conserve areas of high ecological integrity, should be preferable for development. The ecological function of the study area is indicated in Figure 17.

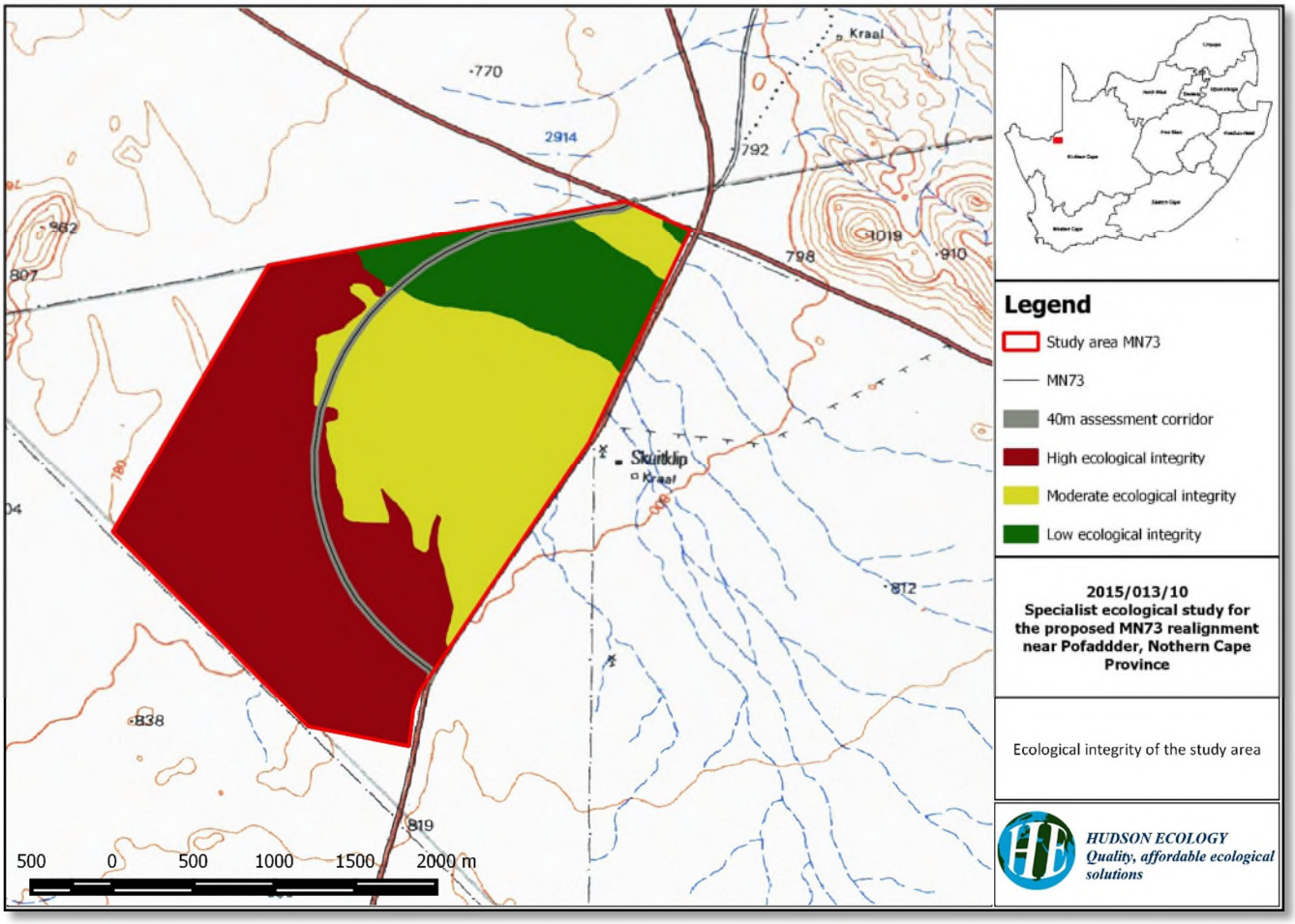

Figure 17: Ecological integrity within the study area

8.5 Conservation Importance

Areas of high conservation importance can be considered as areas of high sensitivity, due to the fact that they are proven to host species of conservation and development in these areas should be limited and impacts well mitigated, while areas of moderate and low ecological are areas where a greater amount of disturbance has already occurred and species of concern are less likely to be present and, in order to conserve areas of high conservation importance, should be preferable for development. Areas that have been severely disturbed such as settlements are considered of low conservation importance, in the study area the edge effect of the famer's homestead has an effect on small parts of the study area as well as roads that are as a result of human settlement. These areas are, however, quite small in relation to the overall study area (>2% of the study area). Areas that have been disturbed by farming are considered of moderate conservation importance due to the fact that rehabilitation of these areas

is possible, the impacts of farming in this area is mostly overgrazing as well as denudation of some areas around watering holes and roads. Another impact of farming is the introduction of exotic species. Feed imported during droughts contains seed or parts of exotic species that make their way into the natural systems where they germinate and spread. This is particularly evident in the drainage line to the north of the study area. The natural areas are considered of very high conservation importance due to the presence of Red Data species in these areas and the intrinsic importance of these areas. In keeping with the Precautionary Principle (COMEST, 2005), we need to assume a higher conservation importance when in doubt.

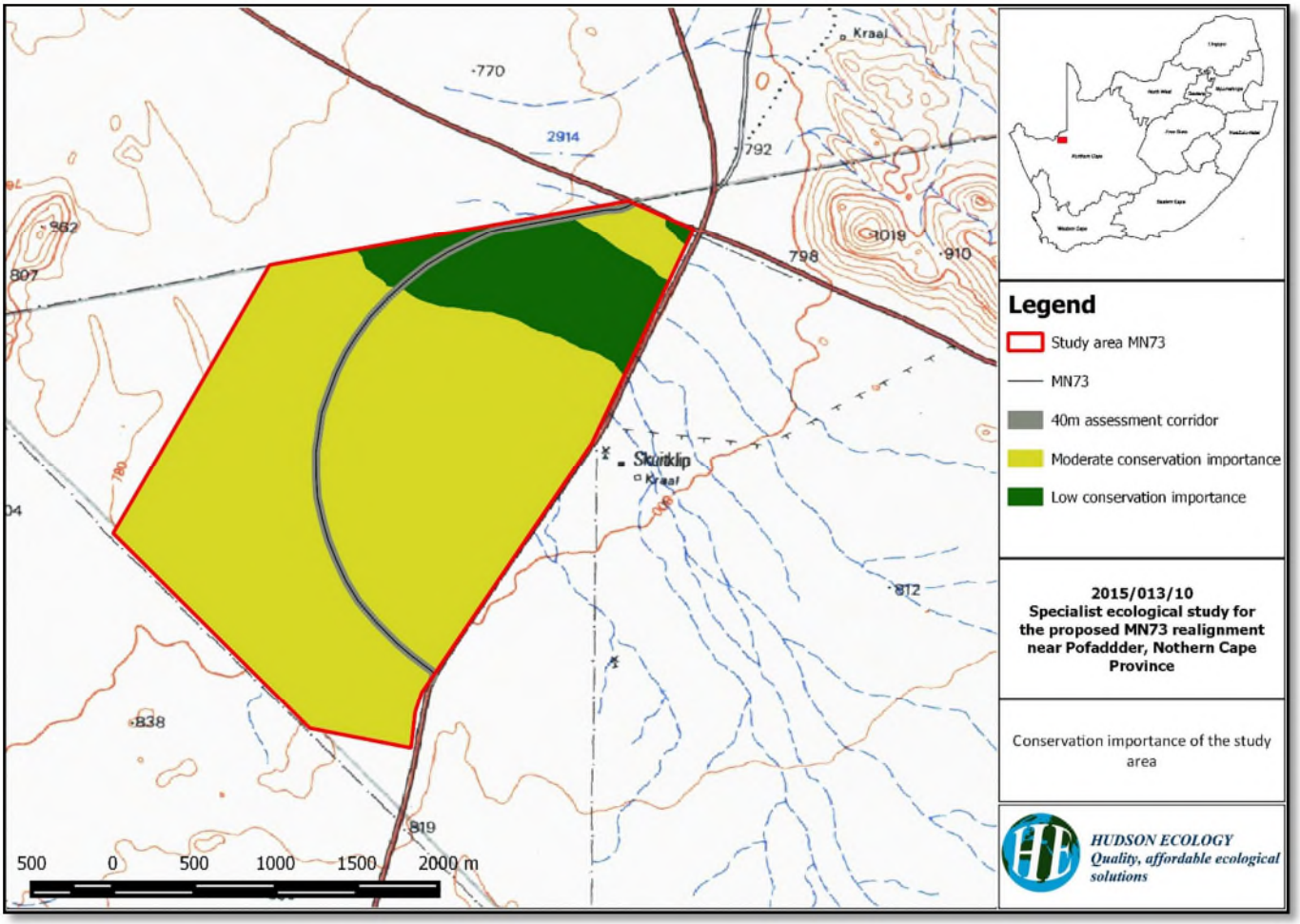

Figure 18: Conservation importance within the study area

8.6 Critical Biodiversity Areas and Ecological Support Areas

Critical Biodiversity Areas (CBAs) are terrestrial and aquatic features in the landscape that are critical for retaining biodiversity and supporting continued ecosystem functioning and services. These form the key output of a systematic conservation assessment and are the biodiversity sectors inputs into multisectoral planning and decision making tools.

The identification and mapping of CBAs form part of the biodiversity assessment of the Northern Cape Province which will be used to inform the development of the Provincial Biodiversity Sector plans, bioregional plans, and also be used to inform Spatial Development Frameworks (SDFs), Environmental Management Frameworks (EMFs), Strategic Environmental Assessments (SEAs) and in the Environmental Impact Assessment (EIA) process in the Province.

Simply put the purpose of the CBA is to indicate spatially the location of critical or important areas for biodiversity in the landscape. The CBA, through the underlying land management objectives that define the CBA, prescribes the desired ecological state in which the Province would like to keep this biodiversity. Therefore, the desired ecological state or land management objective determines which land-use activities are compatible with each CBA category based on the perceived impact of each activity on biodiversity pattern and process.

According to the guidelines for bioregional plans, three basic CBA categories can be identified based on three high-level and management objectives (Table 13).

Table 13: Definitions and framework for linking CBAs to land-use planning and decision-making guidelines based on a set of high-level land biodiversity management objectives

CBA category	Land Management Objective
Critical Biodiversity Areas (CBAs) Definition: CBAs are areas of the landscape that need to be maintained in a natural or near-natural state in order to ensure the continued existence and functioning of species and ecosystems and the delivery of ecosystem services. In other words, if these areas are not maintained in a natural or near-natural state then biodiversity conservation targets cannon be met. Maintaining an area in a natural state can include a variety of biodiversity-compatible land uses and resource uses.	
Protected Areas (PA) & CBA 1	**Natural landscapes:** Ecosystems and species fully intact and undisturbed. » These are areas with high irreplaceability or low flexibility in terms of meeting biodiversity pattern targets. If the biodiversity features targeted in these areas are lost then targets will not be met. » These are landscapes that are at or past their limits of acceptable change.
CBA 2	**Near-natural landscapes:** » Ecosystems and species largely intact and undisturbed. » Areas with intermediate irreplaceability or some flexibility in terms of area required to meet biodiversity targets. There are options for loss of some components of biodiversity in these landscapes without compromising the ability to achieve targets. » These are landscapes that are approaching but have not passed their limits of acceptable change.
Ecological Support Areas (ESAs) Definition: ESAs are areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and / or in delivering ecosystem services that support socio-economic development, such as water provision, food mitigation or carbon sequestration. The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas.	
ESA	**ESA Functional landscapes:** » Ecosystem moderately to significantly disturbed but still able to maintain basic functionality. » Individual species or other biodiversity indicators may be severely disturbed or reduced. » These are areas with low irreplaceability with respect to biodiversity pattern targets only.
ONA (Other Natural Areas) and Transformed	**Production landscapes:** Manage land to optimize sustainable utilization of natural resources.

The high-level land management objectives (natural, near-natural and functional) can be further unpacked using the three ecosystem integrity indicators namely; ecosystem composition, structure and function. Composition relates to biodiversity pattern, whereas structure and function relate to ecological process and services Table 14).

Table 14: Land management Objectives

Land management objective	Land Management Objective Biodiversity Indicators			
	Component of Biodiversity	Biodiversity Pattern	Ecological Services and Processes	
	Indicator category	Composition	Structure	Functioning

	Specific Indicators	• Habitat types; • Species; • Populations; • Meta-populations; • Alien Plants	• Transformation • Fragmentation	• Fire; • Grazing regimes; • Biogeochemical processes; • Hydrological functioning; • Soil formation and erosion; • Biotic processes
	CBA Category	Limit of Acceptable Change (LAC): Permitted amount or degree of change in biodiversity indicator.		
Natural	PA / CA	None	None	None
	CBA1	None	None	None
Near Natural	CBA2	Some	Some	None
Functional	ESA1	Significant	Some	none
	ESA2	Significant	Some	Some
	ONA	Significant	Significant	Some
	Transformed	Significant	Significant	Significant

According to the Khai-Ma Land Use Decision Support tool, the study area falls with an Ecological Support Area (ESA) (Figure 19). The ESA is listed as a migration route, although the species utilising this migration route are not indicated. The migration route does seem to be counter-intuitive as it seems to start in the lowlands of the Gariep River, crosses over rocky mountainous areas only to return to the lowlands of the Gariep River lowlands again. Notwithstanding this the development area will affect less than 30% of the width of the migration route and should have very little effect on species using this route.

Notwithstanding this the ESAs are defined as “areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and/or in delivering ecosystem services that support socio-economic development, such as water provision, food mitigation or carbon sequestration.” And it is stated that “The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas” It is also stated that “some” level of change in the biodiversity indicators for ESAs is allowed.

CBA 2 areas are areas of near-natural landscapes, and “ecosystems and species largely intact and undisturbed. Areas with intermediate irreplaceability or some flexibility in terms of area required to meet biodiversity targets. There are options for loss of some components of biodiversity in these landscapes without compromising the ability to achieve targets. These are landscapes that are approaching but have not passed their limits of acceptable change”. The fact that the development borders of a CBA 2 area, should have no bearing on the ability to achieve targets.

It must also be noted that the migration route is part of a large system of migration routes and that the percentage of these migration routes that will impacted upon will be negligible. According to the SANBI guidelines set for ESAs and CBAs, ESAs do not exclude development and “significant” change is allowed for biodiversity patterns and some change is allowed for biodiversity processes, due to development, in ESAs. The fact that the development is situated within an ESA can therefore not be seen as a fatal flaw.

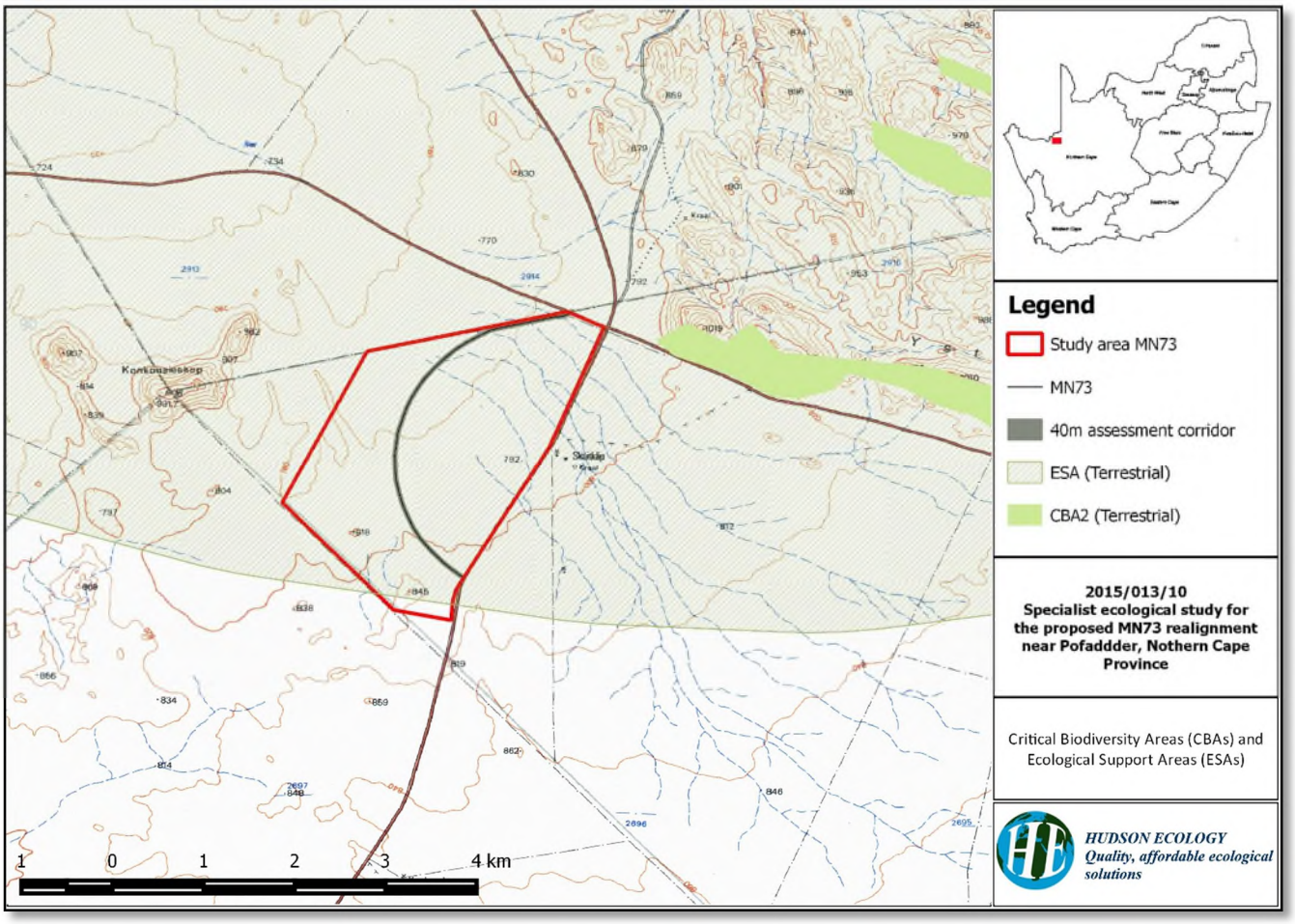

Figure 19: Critical Biodiversity areas and Ecological Support areas as per the LUDS

9 ECOLOGICAL IMPACT ASSESSMENT

9.1 Impact Assessment

This impact assessment takes into account the impacts of the realignment of the MN73 road, by means of the construction of a 4.073km detour around the proposed Paulputs CSP facility. The proposed route is shown in Figure 20

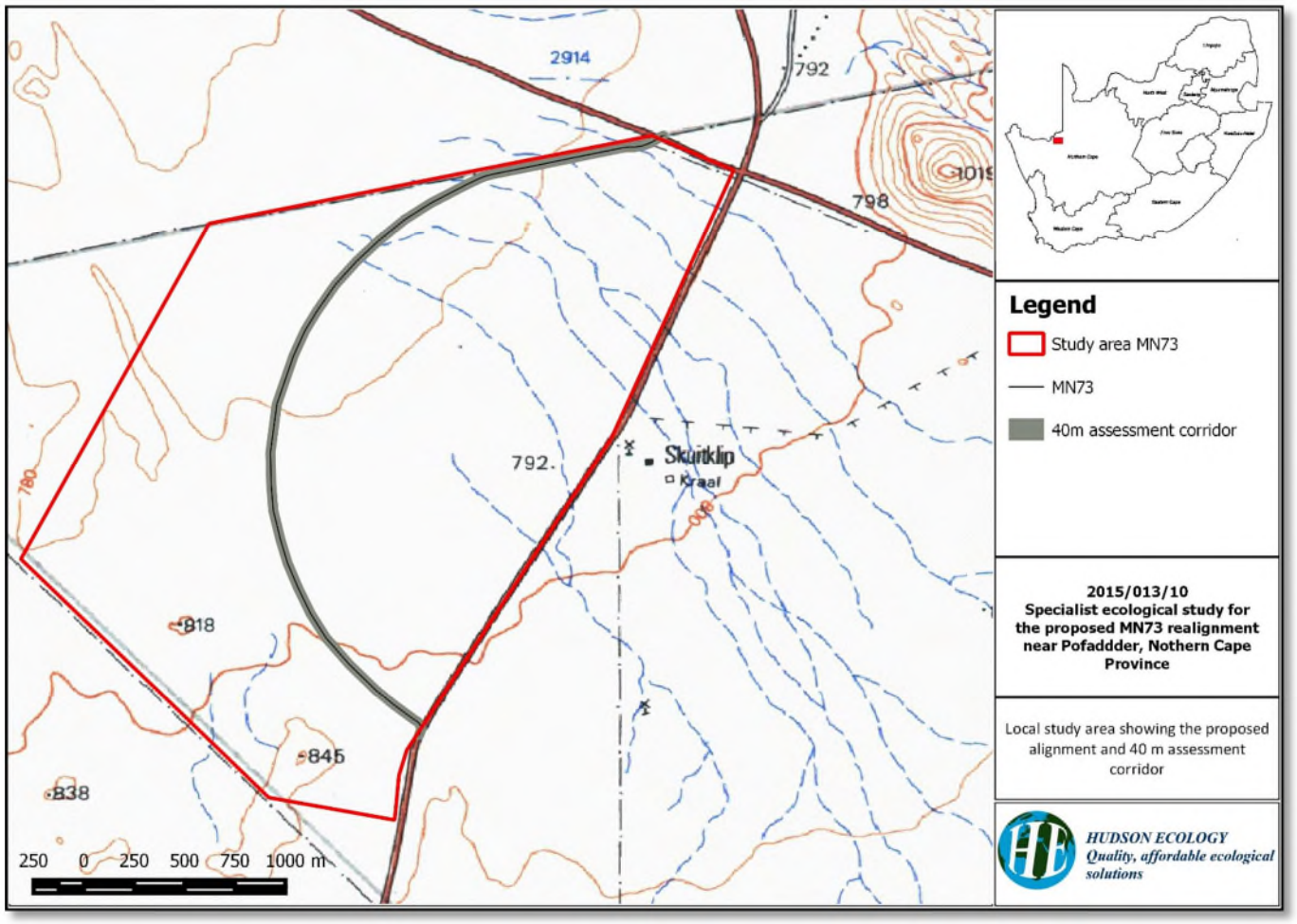

Figure 20: Proposed project infrastructure

This impact assessment was conducted with the understanding that:

- The pipeline alignment will follow the alignment given in Figure 20;
- The road will be 7m wide, with a road reserve of 20m
- A corridor with a maximum width of 40m will be impacted upon during construction; and
- All possible mitigation methods advised will be adopted and implemented by the developer.

9.2 Sensitivity Index

In order to determine the habitat sensitivity of a vegetation community (habitat type/land use), the following factors were taken into account:

- Proximity to formally protected area
- Proximity to a CBA
- Proximity to an ESA
- Ecological integrity
- Conservation importance

- Probability of occurrence of species of concern
- Protection Status
- Level of Degradation
- Rehabilitation Index

Each of these factors were determined using the indices outlined in Table 15.

Table 15: Factors and indices for the sensitivity analysis

Factor	Factor value	Factor Index
Proximity to formally protected area (Prox)	<5km	5
	5-20km	4
	20-40km	3
	40-60km	2
	60-100km	1
	>100km	0
Proximity to CBA (CBA)	<5km	5
	5-20km	4
	20-40km	3
	40-60km	2
	60-100km	1
	>100km	0
Proximity to ESA (ESA)	<5km	5
	5-20km	4
	20-40km	3
	40-60km	2
	60-100km	1
	>100km	0
Ecological integrity (EI)	High	5
	Moderate	3
	Low	1
Conservation importance (CI)	High	5
	Moderate	3
	Low	1
Probability of occurrence of SoC (SoC)	Recorded	5
	High	4
	Moderate	3
	Low	2
	Very Low	1
	Negligible	0
Protection Status (PS)	High	5

	Moderate	3
	Low	1
Level of Degradation (LD)	Very High	4
	High	3
	Moderate	2
	Low	1
	Very Low	0
Rehabilitation Index (RI)	Low	5
	Moderate	3
	High	1

The sensitivity index (SI) for each of the vegetation communities was calculated using the formula:

$$SI = \frac{(Prox + CBA + ESA + EI + CI + SoC + PS + RI - LD)}{(4)}$$

Using this formula a sensitivity index (SI) of between 1 and 10 for each of the vegetation communities was determined. The sensitivity index gives an indication of the sensitivity of the vegetation as shown in Table 16.

Table 16: Sensitivity determined by Sensitivity Index (SI)

Sensitivity (SI)	Sensitivity
1 - 2.5	Negligible
2.6 - 5	Low
5.1 - 7.5	Moderate
7.6 - 10	High

Using this sensitivity index we obtained the results with regards to the sensitivity of the land uses, these results are given in Table 17 below and shown in Figure 21.

Table 17: Sensitivity of vegetation communities in the study area

Vegetation Community	Proximity to formally protected area	Proximity to CBA	Proximity to ESA	Ecological integrity	Conservation importance	Probability of Occurrence of SoC	Protection Status	Level of Degradation	Rehabilitation Index	Sensitivity Index	Sensitivity
Acacia mellifera – Aristida congesta dune open shrubland	5	4	5	5	3	5	1	1	3	7.5	Moderate
Acacia mellifera – Parkinsonia africana wash open shrubland	5	4	5	1	1	2	1	2	3	5.0	Low
Stipagrostis ciliata – Aristida congesta open grassland	5	4	5	3	3	5	1	3	3	6.5	Moderate

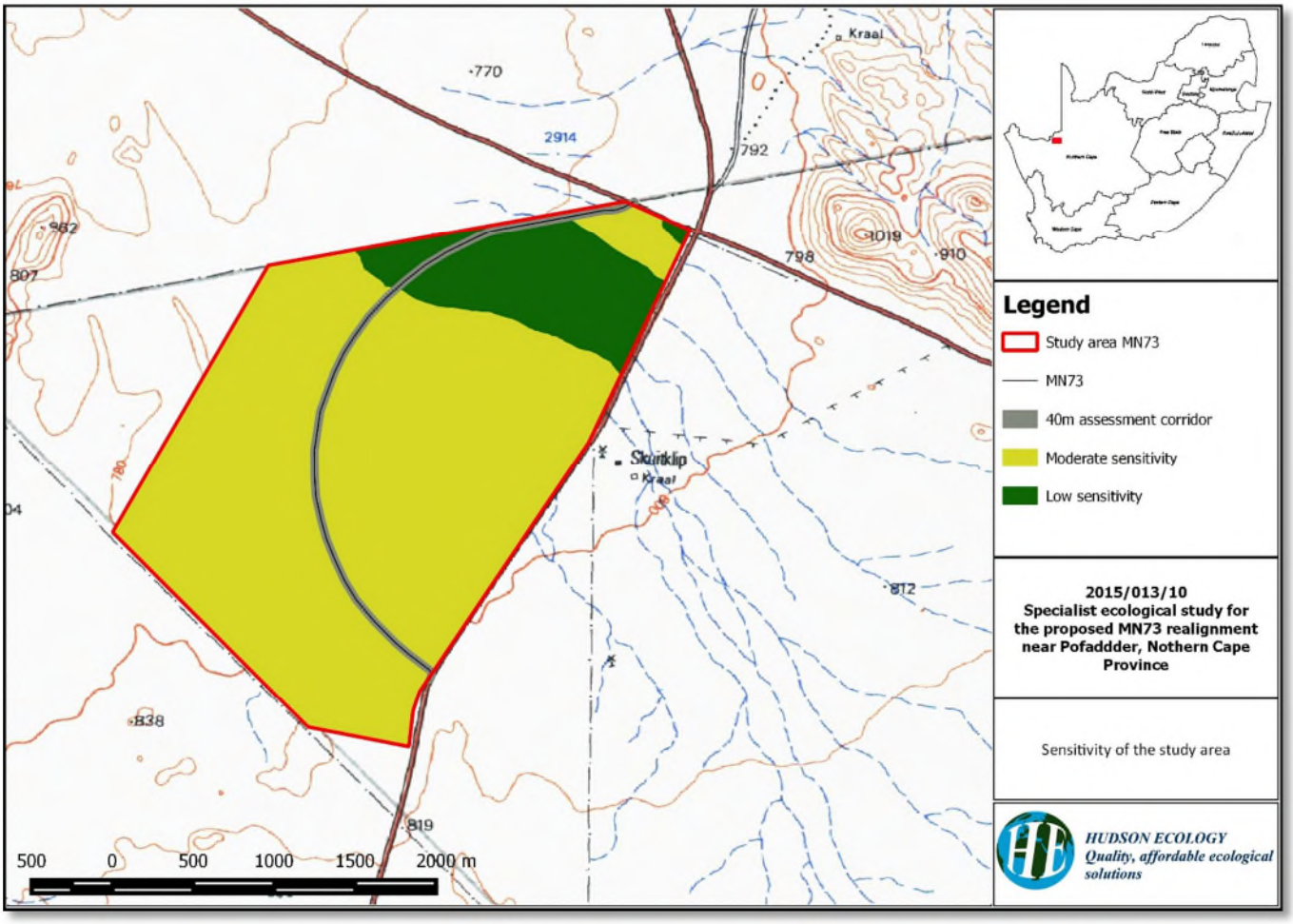

Figure 21: Sensitivity map of the study area

Impacts and mitigations are discussed in the tables below:

9.2.1 Construction Phase

Impact 1: Vegetation Clearing and loss of species of concern				
Vegetation clearing is likely to be the greatest impact on the vegetation communities affected by the proposed road realignment. All three vegetation communities are likely to be affected to some degree, with the *Acacia mellifera – Aristida congesta* open shrubland vegetation community being the vegetation community with the most vegetation cleared. Ecological integrity and -conservation importance of the areas that will be affected by this impact are low to moderate, however species of concern (such as *Hoodia gordonii* and *Boscia foetida)* may be impacted upon. *Boscia foetida* have been identified within the assessment corridor, while *Hoodia gordonii* have not been identified. However, *Hoodia gordonii* is not a large conspicuous species and the likelihood that isolated species or colonies occurring in the area can be high.				
	Without Mitigation		With Mitigation	
Extent (E)	1	Site Only	1	Site Only
Duration (D)	5	Permanent	5	Permanent
Magnitude (M)	4	Low	2	Minor

Probability (P)	4	Highly Probable	4	Highly Probable
Significance (S = [E+D+M]xP)	40	Moderate	28	Low
Status (Positive, negative or neutral)	Negative		Negative	
Reversibility	Low		Low	
Irreplaceable loss of resources	Yes		Yes	
Mitigability	Yes		Yes	

Mitigation measures:

Vegetation clearing is inevitable and unavoidable. Mitigation of this impact can, however, be implemented by keeping the area cleared to a minimum and careful removal and replanting of plants and trees of conservation importance. Seed collection, propagation and re-planting of saplings to make up for lost species should also be considered. Areas of high conservation importance and/or ecological integrity should be avoided, if possible, or kept to a minimum and any species of concern relocated, or demarcated to prevent destruction, before the ground clearing begins. Ground clearing should take place at the beginning of winter in order to minimise impacts on young of burrowing animals and nesting birds. The impact of vegetation clearing is likely to be a permanent impact, but through careful planning, monitoring, enforcement of the EMP and rehabilitation, the impact can be greatly reduced. Topsoil should be stockpiled for revegetation once construction is completed. Search and rescue of species of concern should take place before ground clearing.

Cumulative impacts: The significance of cumulative impacts are considered to be of low significance. Due to the fact that the Project will serve as the realignment of an existing road, there are unlikely to be increased cumulative impacts.

Residual impacts:

Localised loss of vegetation

Impact 2: Spillage of harmful or toxic substances

Harmful or toxic substances that may affect the biota of the area if they were to enter the system include: diesel, hypoid oil, motor oil, polluted water used during the construction of the road and chemicals transported to and from site. Habitats affected are mainly those with moderate ecological integrity and moderate conservation importance. The spillage of harmful or toxic substances may impact on the fauna and flora of the area in a number of ways. Direct pathways include ingestion of the substances by fauna species resulting in toxicity in that individual, uptake of toxic chemicals by the roots plants which may lead to toxicity in the plants and the chemicals entering the plant or animals system due to contact (through the skin, leaves or stems). Indirect pathways include the ingestion of contaminated plants or animals by other herbivorous or predatory species. The predation of contaminated animals by both other animals and humans is a common occurrence during chemical contamination due to these animals being sluggish, and less likely to escape predation, due to chemical toxicity.

Impacts on high ecological integrity and -conservation importance areas are low to moderate, however species of concern (such as *Hoodia gordonii* and *Boscia foetida*) may be impacted upon.

	Without Mitigation		With Mitigation	
Extent (E)	2	Local	1	Site Only
Duration (D)	4	Long term (>15 years)	1	Very short (0 - 1 years)

Magnitude (M)	8	High	4	Low
Probability (P)	4	Highly Probable	1	Very Improbable
Significance (S = [E+D+M]xP)	56	Moderate	6	Low
Status (Positive, negative or neutral)	Negative		Negative	
Reversibility	Low		High	
Irreplaceable loss of resources	Yes		No	
Mitigability	Yes		Yes	
Mitigation measures:				
Mitigation: The spillage of harmful or toxic substances can be mitigated by the implementation of best practice management measures for the storage and handling of all hazardous substances as well as through the implementation of a sound emergency spillage containment plan, which can be implemented as soon as a spill of harmful or toxic substances occurs.				
Cumulative impacts:				
Residual impacts: Localised loss of species				

Impact 3: Disturbance of biodiversity due to vibration and noise				
Vibration and noise will have a significant effect mainly on fauna species in the immediate vicinity of the development, due to the heavy machinery utilised. Vibration can affect a number of subterranean fauna taxa, such as burrowing mammals, reptiles and arthropods. Vibration affects these animals by causing the collapsing of burrows, and causing these animals to leave the area due to the vibration. Noise will also affect a wide range of taxa including avifauna, mammals, reptiles, amphibians and arthropods. Avifauna, especially songbirds, and amphibians may find it difficult to find mates in areas of increased noise. Mammals, reptiles and arthropods may find increased noise disturbing and therefore move away from the area. Areas of high conservation importance and/or ecological integrity should be avoided.				
	Without Mitigation		With Mitigation	
Extent (E)	2	Local	1	Site Only
Duration (D)	2	Short (2 - 5 years)	2	Short (2 - 5 years)
Magnitude (M)	6	Moderate	4	Low
Probability (P)	5	Definite	4	Highly Probable
Significance (S = [E+D+M]xP)	50	Moderate	28	Low
Status (Positive, negative or neutral)	Negative		Negative	
Reversibility	Low		Moderate	
Irreplaceable loss of resources	Yes		Yes	
Mitigability	Yes		Yes	
Mitigation measures:				

Vibration and noise from heavy machinery can be kept to a minimum by reducing the movement of heavy vehicles to a minimum necessary for construction. Placing the vehicle yard as close to the construction area as possible will also reduce the scale of impact of vibration.

Residual impacts:

Localised loss of species

Impacts 4: Habitat degradation and fauna impacts due to dust

Increased dust will occur in all areas where vegetation is cleared. Dust will be caused by excavation, and construction. Dust in the area will be greatly increased due to the dry weather conditions and the nature of the soil in the area. Dust settling on plant material can reduce the amount of light reaching the chlorophyll in the leaves, thereby reducing photosynthesis, which in turn reduces plant productivity, growth and recruitment.

	Without Mitigation		With Mitigation	
Extent (E)	2	Local	1	Site Only
Duration (D)	2	Short (2 - 5 years)	2	Short (2 - 5 years)
Magnitude (M)	6	Moderate	6	Moderate
Probability (P)	5	Definite	2	Improbable
Significance (S = [E+D+M]xP)	50	Moderate	18	Low
Status (Positive, negative or neutral)	Negative		Negative	
Reversibility	Low		Moderate	
Irreplaceable loss of resources	Yes		Yes	
Mitigability	Yes		Yes	

Mitigation measures:

Mitigation: The following methods can be used to prevent conditions conducive to dust generation and suppress dust should it occur:
• Dust suppression on roads by water bowsers or the use of other appropriate dust suppressants, if no water is available;
• Exposed excavations, disturbed ground surfaces, and unpaved traffic areas can be maintained in a moist condition;
• During non-working hours in the construction phase, the site can be left in a condition that will prevent dust from being generated. At the end of each work day, disturbed areas can be wetted down and security fencing can be installed and or inspected to prevent access and additional disturbance;
• Provide temporary cover and daily maintenance for soil stockpiles and keep active surfaces moist;• Construction activities should be conducted using methods that minimize dust generation. Best Management Practices (BMPs) can also be followed to help minimise and control dust emissions at the site, during construction of the road.

Cumulative impacts: The significance of cumulative impacts are considered to be of low significance, short in duration and confined to the site only.

Residual impacts:

None

Impact 5: Effects on local migrations				
Local migrations of fauna in the area may be affected by linear infrastructure, due to these areas forming a barrier to migrating animals or reducing the chance of an animal surviving its migration due to collisions with vehicles on roads. Desert animals are particularly migratory due to variations in food and water availability, and species of concern may be affected by this impact. This impact is likely to be low due to the greatly reduced wildlife in the area due to previous disturbances in the area causing a greatly reduced species. Furthermore, many of the roads are already in use. The study area is recognised as an ESA due to being a migratory route, this requires further monitoring during construction, with regards to types of species using the migration route and the effects on these species.				
	Without Mitigation		With Mitigation	
Extent (E)	2	Local	1	Site Only
Duration (D)	5	Permanent	5	Permanent
Magnitude (M)	6	Moderate	4	Low
Probability (P)	4	Highly probable	2	Improbable
Significance (S = [E+D+M]xP)	52	Moderate	20	Low
Status (Positive, negative or neutral)	Negative		Negative	
Reversibility	Low		Moderate	
Irreplaceable loss of resources	Yes		Yes	
Mitigability	Yes		Yes	
Mitigation measures:				
Impacts on local migrations can be mitigated by: • The effect of roads on local migrations can be mitigated by the installation of culverts at regular intervals along the roads and the installation of drift fences towards the culverts, although these methods may not eliminate the mortalities among migrating animals, they should greatly reduce the number of animals killed on roads; and • A low speed limit can be strictly enforced in order to reduce collisions with animals on the roads during construction phase.				
Cumulative impacts: The significance of cumulative impacts are considered to be of low significance, permanent in duration and confined to the site only.				
Residual impacts: None				

Impact 6: Increased prevalence of exotic invasive species

The fact that the area will be cleared, for the construction of the road and adjacent reserve, creates niches that can be colonised by exotic and/or invasive species. This is compounded by the fact that trucks and other heavy machinery often act as vectors for seeds of these species. Desert and semi-desert areas are very susceptible to invasion by exotic species due to the slow growth rate of indigenous vegetation due to low rainfall and this impact needs to be monitored and mitigated. Areas of high conservation importance and/or ecological integrity should be avoided. Invasive species currently present in the study area are: *Opuntia ficus-indica, Argemone mexicana, Datura stramonium, Agave americana, Prosopis glandulosa.*				
	Without Mitigation		With Mitigation	
Extent (E)	2	Local	1	Site Only
Duration (D)	5	Permanent	5	Permanent
Magnitude (M)	6	Moderate	4	Low
Probability (P)	5	Definite	2	Improbable
Significance (S = [E+D+M]xP)	65	High	20	Low
Status (Positive, negative or neutral)	Negative		Negative	
Reversibility	Low		Moderate	
Irreplaceable loss of resources	Yes		Yes	
Mitigability	Yes		Yes	
Mitigation measures:				
Mitigation: An exotic/invasive species monitoring and management plan should be put in place to manage exotic and invasive species.				
Residual impacts: None				

Impact 7: Increased soil erosion				
Increased erosion can eventually lead to the loss of vegetation and habitats for fauna species. Soils in the area are prone to erosion in areas where vegetation is cleared, this is further compounded by the fact that precipitation in the area occurs through heavy rainfall events in the form of thundershowers in summer. Furthermore large areas will be cleared before construction leaving these areas prone to erosion				
	Without Mitigation		With Mitigation	
Extent (E)	2	Local	1	Site Only
Duration (D)	5	Permanent	5	Permanent
Magnitude (M)	6	Moderate	4	Low
Probability (P)	5	Definite	2	Improbable
Significance (S = [E+D+M]xP)	65	High	20	Low
Status (Positive, negative or neutral)	Negative		Negative	
Reversibility	Low		Moderate	
Irreplaceable loss of resources	Yes		Yes	

Mitigability	Yes	Yes
Mitigation measures:		
This impact can be mitigated by: • An erosion monitoring and mitigation plan being put in place to help with the early detection of erosion and advising management on problem areas and remediation plans; and • The management of stormwater to prevent large volumes of high energy water flowing along or off the road..		
Residual impacts: None		

9.2.2 Operational Phase

The road will be maintained by the Northern Cape Department of Roads and Public Works (NC DR&PW). . Due to the fact that the section of road constructed will be replacing an existing road, with associated impacts, it is unlikely that any additional impacts will be resultant. The only possible impacts associated with the road during the operational phase may be due to road maintenance, and these will need to be addressed by the relevant agency before such maintenance is implemented. Therefore, the fact that the existing impacts from the road that will be decommissioned will be carried over to the realignment makes the operational impacts of the road a moot academic argument.

9.3 Cumulative impacts

Due to the fact that there are already three existing solar facilities in the area, as well as the fact there are more planned, the cumulative impacts are likely to be of a higher order of magnitude than the significance ratings given in the impact assessment section. It must however be noted that none of the other solar facilities are tower facilities and therefore impacts unique to tower facilities are unlikely to have a higher cumulative impact. We cannot comment on the impacts, mitigation plans and their effectiveness, of other projects, therefore we cannot determine what the mitigated impacts would be and thus the cumulative impacts given here are based on all other projects' unmitigated impacts cumulated with this project's mitigated impacts.

Cumulative impacts are given in the impact assessment tables below:

Impact 1: Vegetation Clearing				
Vegetation clearing is likely to be the greatest impact on the vegetation communities affected by the proposed development and activities. Habitats affected area mainly those with moderate ecological integrity and moderate conservation importance. High, moderate and low ecological integrity and -conservation importance of the areas that will be impacted by this impact are low to moderate, however species of concern (such as *Hoodia gordonii* and *Boscia foetida*) may be impacted upon.				
	Overall impact of the proposed project considered in isolation (with mitigation)		Cumulative Impact of the project and other projects in the area	
Extent (E)	2	Local	2	Local
Duration (D)	5	Permanent	5	Permanent
Magnitude (M)	4	Low	4	Low
Probability (P)	2	Improbable	3	Probable

Significance (S = [E+D+M]xP)	22	Low	33	Moderate
Status (Positive, negative or neutral)	Negative		Negative	
Reversibility	Low		Moderate	
Irreplaceable loss of resources	Yes		Yes	
Mitigability	Yes		Yes	
Confidence in findings: High				
Mitigation: Provided that all similar projects are held to the same standards of mitigation this impact can be further mitigated in its entirety across all projects. This could reduce the overall probability and magnitude of this impact in the region				

Impact 2: Spillage of harmful or toxic substances				
Harmful or toxic substances that may affect the biota of the area if they were to enter the system include: diesel, hypoid oil, motor oil, polluted water used during the operations and chemicals transported to and from site and used in the operations. Habitats affected area mainly those with moderate ecological integrity and moderate conservation importance. The spillage of harmful or toxic substances may impact on the fauna and flora of the area in a number of ways. Direct pathways include ingestion of the substances by fauna species resulting in toxicity in that individual, uptake of toxic chemicals by the roots plants which may lead to toxicity in the plants and the chemicals entering the plant or animals system due to contact (through the skin, leaves or stems). Indirect pathways include the ingestion of contaminated plants or animals by other herbivorous or predatory species. The predation of contaminated animals by both other animals and humans is a common occurrence during chemical contamination due to these animals being sluggish, and less likely to escape predation, due to chemical toxicity. High, moderate and low ecological integrity and -conservation importance areas may be impacted by this impact are low to moderate, however species of concern (such as *Hoodia gordonii* and Boscia *foetida*) may be impacted upon.				
	Overall impact of the proposed project considered in isolation (with mitigation)		Cumulative Impact of the project and other projects in the area	
Extent (E)	1	Site Only	2	Local
Duration (D)	1	0 - 1 years	4	>15 years
Magnitude (M)	4	Low	6	Moderate
Probability (P)	1	Very Improbable	3	Probable
Significance (S = [E+D+M]xP)	6	Low	36	Moderate
Status (Positive, negative or neutral)	Negative		Negative	
Reversibility	Low		Moderate	
Irreplaceable loss of resources	Yes		Yes	
Mitigability	Yes		Yes	
Confidence in findings: High				

Mitigation: Provided that all similar projects are held to the same standards of mitigation this impact can be further mitigated in its entirety across all projects. This could reduce the overall probability and magnitude of this impact in the region

Impact 3: Disturbance of biodiversity due to vibration and noise

Vibration and noise will have a significant effect mainly on fauna species in the immediate vicinity of the development, due to the heavy machinery utilised. Vibration can affect a number of subterranean fauna taxa, such as burrowing mammals, reptiles and arthropods. Vibration affects these animals by causing the collapsing of burrows, and causing these animals to leave the area due to the vibration. Noise will also affect a wide range of taxa including avifauna, mammals, reptiles, amphibians and arthropods. Avifauna, especially songbirds, and amphibians may find it difficult to find mates in areas of increased noise, mammals, reptiles and arthropods may find increased noise disturbing and therefore move away from the area. Areas of high conservation importance and/or ecological integrity should be avoided.

	Overall impact of the proposed project considered in isolation (with mitigation)		Cumulative Impact of the project and other projects in the area	
Extent (E)	1	Site Only	3	Regional
Duration (D)	2	2 - 5 years	3	5 - 15 years
Magnitude (M)	4	Low	6	Moderate
Probability (P)	4	Highly Probable	4	Highly Probable
Significance (S = [E+D+M]xP)	28	Low	48	Moderate
Status (Positive, negative or neutral)	Negative		Negative	
Reversibility	Moderate		Low	
Irreplaceable loss of resources	Yes		Yes	
Mitigability	Yes		Yes	

Confidence in findings: High

Mitigation: Provided that all similar projects are held to the same standards of mitigation this impact can be further mitigated in its entirety across all projects. This could reduce the overall probability and magnitude of this impact in the region

Impacts 4: Habitat degradation due to dust

Increased dust will occur in all areas where vegetation is cleared. Dust in the area will be greatly increased due to the dry weather conditions and the nature of the soil in the area. Dust settling on plant material can reduce the amount of light reaching the chlorophyll in the leaves, thereby reducing photosynthesis, which in turn reduces plant productivity, growth and recruitment.

	Overall impact of the proposed project considered in isolation (with mitigation)		Cumulative Impact of the project and other projects in the area	
Extent (E)	1	Site Only	3	Regional
Duration (D)	2	2 - 5 years	3	5 - 15 years
Magnitude (M)	6	Moderate	6	Moderate
Probability (P)	2	Improbable	3	Probable
Significance (S = [E+D+M]xP)	18	Low	36	Moderate
Status (Positive, negative or neutral)	Negative		Negative	
Reversibility	Moderate		Low	
Irreplaceable loss of resources	Yes		Yes	
Mitigability	Yes		Yes	
Confidence in findings: High				
Mitigation: Provided that all similar projects are held to the same standards of mitigation this impact can be further mitigated in its entirety across all projects. This could reduce the overall probability and magnitude of this impact in the region				

Impact 5: Effects on local migrations				
Local migrations of fauna in the area may be affected by linear infrastructure, fences and buildings, due to these areas forming a barrier to migrating animals or reducing the chance of an animal surviving its migration due to collisions with vehicles on roads. Desert animals are particularly migratory due to variations in food and water availability, and species of concern may be affected by this impact. This impact is likely to be low due to the greatly reduced wildlife in the area due to previous disturbances in the area causing a greatly reduced species. Furthermore, many of the roads are already in use. The study area is recognised as an ESA due to being a migratory route, this requires further investigation.				
	Overall impact of the proposed project considered in isolation (with mitigation)		Cumulative Impact of the project and other projects in the area	
Extent (E)	1	Site Only	3	Regional
Duration (D)	5	Permanent	5	Permanent
Magnitude (M)	4	Low	6	Moderate
Probability (P)	2	Improbable	3	Probable
Significance (S = [E+D+M]xP)	20	Low	42	Moderate
Status (Positive, negative or neutral)	Negative		Negative	
Reversibility	Moderate		Low	
Irreplaceable loss of resources	Yes		Yes	

Mitigability	Yes	Yes
Confidence in findings: High		
Mitigation: Provided that all similar projects are held to the same standards of mitigation this impact can be further mitigated in its entirety across all projects. This could reduce the overall probability and magnitude of this impact in the region		

Impact 6: Increased prevalence of exotic invasive species				
The fact that the area will be cleared for construction creates niches that can be colonised by exotic and/or invasive species. This is compounded by the fact that trucks and other heavy machinery often act as vectors for seeds of these species. Desert and semi-desert areas are very susceptible to invasion by exotic species due to the slow growth rate of indigenous vegetation due to low rainfall and this impact needs to monitored and mitigated. Areas of high conservation importance and/or ecological integrity should be avoided.				
	Overall impact of the proposed project considered in isolation (with mitigation)		Cumulative Impact of the project and other projects in the area	
Extent (E)	1	Site Only	3	Regional
Duration (D)	5	Permanent	5	Permanent
Magnitude (M)	4	Low	8	High
Probability (P)	2	Improbable	5	Highly Probable
Significance (S = [E+D+M]xP)	20	Low	80	High
Status (Positive, negative or neutral)	Negative		Negative	
Reversibility	Moderate		Low	
Irreplaceable loss of resources	Yes		Yes	
Mitigability	Yes		Yes	
Confidence in findings: High				
Mitigation: Provided that all similar projects are held to the same standards of mitigation this impact can be further mitigated in its entirety across all projects. This could reduce the overall probability and magnitude of this impact in the region				

Impact 7: Increased erosion

Increased erosion can eventually lead to the loss of vegetation and habitats for fauna species. Soils in the area are prone to erosion in areas where vegetation is cleared, this is further compounded by the fact that precipitation in the area occurs through heavy rainfall events in in the form of thundershowers in summer. Furthermore large areas will be cleared before construction leaving these areas prone to erosion. Increased erosion can eventually lead to the loss of vegetation and habitats for further species. Soils in the area are prone to erosion in areas where vegetation is cleared, this is further compounded by the fact that precipitation in the area occurs through heavy rainfall events in in the form of thundershowers in summer. Furthermore large areas will be cleared before construction leaving these areas prone to erosion.				
	Overall impact of the proposed project considered in isolation (with mitigation)		Cumulative Impact of the project and other projects in the area	
Extent (E)	1	Site Only	3	Regional
Duration (D)	5	Permanent	5	Permanent
Magnitude (M)	4	Low	6	Moderate
Probability (P)	2	Improbable	4	Highly Probable
Significance (S = [E+D+M]xP)	20	Low	56	Moderate
Status (Positive, negative or neutral)	Negative		Negative	
Reversibility	Moderate		Low	
Irreplaceable loss of resources	Yes		Yes	
Mitigability	Yes		Yes	
Confidence in findings: High				
Mitigation: Provided that all similar projects are held to the same standards of mitigation this impact can be further mitigated in its entirety across all projects. This could reduce the overall probability and magnitude of this impact in the region				

9.3.1 Cumulative Impact Statement

The cumulative impacts of roads, taking into account the developments in the area are likely to be considerable if not mitigated. Due to increased traffic, construction and operational noise in the affected area, the cumulative impact of dust, vibration and noise can be considered as moderate. Vegetation clearing, construction of roads and increased traffic will cause a moderate to high cumulative impact by the increase in exotic species and a moderate impact caused by increased soil erosion in the area.

10 DISCUSSION AND CONCLUSIONS

Based on species composition, physiognomy, moisture regime, rockiness, slope and soil properties, three main communities were recognised. The vegetation communities are described in this report and named according to dominant species and underlying substrate. The vegetation communities are named as follows:

- *Acacia mellifera – Aristida congesta* dune open shrubland;
- *Acacia mellifera – Parkinsonia africana* wash open shrubland; and
- *Stipagrostis ciliata – Aristida congesta* open grassland.

A list of plant species previously recorded in the quarter degree grid in which the study area is situated was obtained from the South African National Biodiversity Institute. Additional species that could occur in similar habitats, as determined from official

database searches and reviewed literature, but not recorded in these grids are also listed. A total of 13 species of concern were determined to possibly be occurring in the study area. The species, listed as possibly occurring in the study area, were evaluated to determine the probability of occurrence in the study area based on habitat suitability. Of the species that are considered to occur within the area under investigation, there were five species that could occur in habitats that are available in the study area. According to IUCN two of these are listed as Vulnerable, one as Near Threatened and two as Declining. One of the vulnerable species, *Aloe dichotoma*, was recorded in the eastern portion of the study area and could occur anywhere within the hills in the study area, or in rocky areas in Bushmanland Arid Grassland.

The one Declining species, *Acacia erioloba*, also a protected tree, has a high probability of occurring in the study area, while *Hoodia gordonii* was recorded in the study area in a number of places.

Reptile diversity in the region is high with approximately 45 reptile species occurring in the area. Ten species were confirmed during the site surveys. No exotic herpetofauna species are expected to occur on the study site. Two of the species recorded, namely *Naja nivea* and *Cordylus polyzous,* are considered endemic to southern Africa.

Herpetofauna diversity is generally low in the study area as can be expected in arid areas but what can be noted is that evenness is high, indicating that there is a high similarity between the species occurring in the different vegetation communities. Most of the expected species in the area are common and widespread, with only the Black-necked spitting Cobra (*Naja nigricollis*) being classified as rare.

The study area is a fair distance from any permanent open water bodies (approximately 30km) and therefore, as expected amphibian diversity is low. Only seven species are expected to occur in the study area, and during the wet and dry season surveys no amphibian species were recorded.

Of the 67 mammal species expected to occur in the study area, according to historic recordings, only 16 were confirmed during both the site visits. Mammal diversity is low as can be expected in arid areas. Evenness is high, indicating that there is a high similarity between the species occurring in the different vegetation communities. A number of bat species are known to occur in the region. Bat species recorded in the area during the surveys are *Rhinolophus darlingi, Neoromicia capensis, Pipistrellus rueppelli* and *Tadarida aegyptiaca*.

Of the 21 faunal species of concern that may occur in the study area, 1 has no probability of occurrence, 5 have a low probability of occurrence, 9 have a medium probability of occurrence and 6 have a high probability of occurrence. Three of the species with a high probability of occurrence, the Black-necked spitting Cobra, Maccoa Duck and Lanner Falcon, were recorded during the study.

The ecological function of the study area can generally be described as moderate for the majority of the study area, although this does vary from low (in the highly transformed areas) to high in the more inaccessible or unutilisable areas. Areas in which overgrazing and clearing have taken place, as well as areas in which settlements have been established are considered as areas where ecological function is reduced.

Areas that have been severely disturbed such as where settlements occur are considered of low conservation importance. These areas are, however, quite small in relation to the overall study area (<30% of the study area). Areas that have been disturbed by farming are considered of moderate conservation importance due to the fact that rehabilitation of these areas is possible. A grass mix of *Aristida congesta, Stipagrostis ciliata, Stipagrostis obtusa, Aristida adscensionis* and *Eragrostis lehmanniana* can be used. If shrubs or small trees are needed for soil retention of to increase biodiversity features, *Acacia mellifera* can be used, *Boscia foetida* can also be used but it must be noted that these are slow growing thus are seldom used in rehabilitation.

The natural areas are considered of very high conservation importance due to the presence of Red Data species in these areas and the intrinsic importance of these areas. In keeping with the Precautionary Principle, a higher conservation importance is assumed when in doubt.

According to the Khai-Ma Land Use Decision Support tool, the study area falls within an Ecological Support Area (ESA). The ESA is listed as a migration route, although the species utilising this migration route are not indicated. The migration route does seem to be counter-intuitive as it seems to start in the lowlands of the Gariep River, crosses over rocky mountainous areas only to return to the lowlands of the Gariep River lowlands again. Notwithstanding this the development will affect less than 30% of the width of the migration route and should have very little effect on species using this route.

Notwithstanding this, the ESAs are defined as “areas that are not essential for meeting biodiversity representation targets/thresholds but which nevertheless play an important role in supporting the ecological functioning of critical biodiversity areas and / or in delivering ecosystem services that support socio-economic development, such as water provision, food

mitigation or carbon sequestration." And it is stated that "The degree of restriction on land use and resource use in these areas may be lower than that recommended for critical biodiversity areas" It is also stated that "some" level of change in the biodiversity indicators for ESAs is allowed.

It must also be noted that the migration route indicated is part of a large system of migration routes and that the percentage of these migration routes that will be impacted will be negligible.

This impact assessment was conducted with the understanding that:

- The road will be 7m wide, with a road reserve of 20m;
- A corridor with a maximum width of 40m will be impacted upon during construction; and
- All possible mitigation methods advised will be adopted and implemented by the developer

The impact assessment determined that 8 main impacts are likely to occur due to the development, namely:

- Vegetation Clearing and subsequent loss of species of concern;
- Spillage of harmful or toxic substances;
- Disturbance of biodiversity due to vibration and noise;
- Habitat degradation and fauna impacts due to dust;
- Effects on local migrations;
- Increased prevalence of exotic invasive species; and
- Increased erosion.

Overall recommendations to mitigate the impacts, and comply with best practice, include:

- Compile an effective and efficient spillage containment plan in order to prevent spillage, leakage or release of harmful or toxic substances during transport or at areas where they are stored or used, and also to clean up any spills before they can be taken up by any possible natural receptors;
- Compile a vibration and noise management plan in order to minimise the disturbance of biodiversity due to vibration and noise;
- Compile and implement a dust suppression plan based on current best practices;
- The effect of roads on local migrations can be mitigated by the installation of culverts at regular intervals along the roads and the installation of drift fences towards the culverts , although these methods may not eliminate the mortalities among migrating animals, they should greatly reduce the number of animals killed on roads; and
- When possible, a low speed limit can be strictly enforced in order to reduce collisions with animals on the roads;
- A mitigation and monitoring plan should be put in place to monitor exotic and invasive species in order to report on progress and advise management of measure that need to be implemented, this monitoring should be conducted bi-annually; and
- A mitigation and monitoring plan should be put in place to monitor erosion in order to report on progress and advise management of measures that need to be implemented, this monitoring should be conducted bi-annually; and
- Identification and relocation of plant species (*Hoodia gordonii*) prior to ground clearing. Marking of protected tree species (*Boscia foetida*) to be conserved *in situ*.

These recommendations are not compulsory, but in order to mitigate the impacts they are strongly advised, if not implemented the unmitigated impact will have to be assumed, based on the Precautionary Principle (Comest, 2005).

In conclusion, with implementable mitigation measures and a functional monitoring – management – implementation – monitoring feedback loop in order to monitor and mitigate impacts, all probable ecological impacts can be managed to a low impact rating.

Short term impacts (vegetation clearing, dust and vibration and noise) are likely to have a short term increase in negative impacts on the site of the road realignment. The longer term impacts are however likely to be negligible in comparison with the current

ecological status quo, due to the fact that these impacts already exist due to the existing road and its associated impacts. Overall the ecological impact is therefore likely to be very low and, from an ecological point of view, no fatal flaws can be discerned in this project. All impacts that may to occur in connection with this project are mitigable to an acceptable level.

From an ecological point of view, provided the mitigation measures here are implemented, there is no reason, in my opinion based on the information at hand that this project should not be approved.

11 ENVIRONMENTAL MANAGEMENT PLAN INPUTS

The following Objectives are required to be included in the draft EMP for the project:

11.1 Construction Phase

OBJECTIVE 1: Identification and relocation of plant and tree species prior to ground clearing. Marking of protected tree species to be conserved *in situ.*

Project component/s	Ground clearing for road realignment.
Potential Impact	The impact would include the local extinction of a number of individuals of the protected species *Hoodia gordonii* and *Boscia foetida*
Activity/risk source	Omitting individuals of protected species while marking trees and plants for removal or *in situ* conservation. Ground clearing beginning before the objective is complete. Unqualified personnel utilised for the activity, only a SACNASP registered ecologist or botanist should be considered to conduct this activity.
Mitigation: Target/Objective	Non-destruction of at least 90% of protected species occurring in the area identified for ground clearing.

Mitigation: Action/control	Responsibility	Timeframe
• Identification of flora species of concern. • Marking of species to be relocated and conserved *in situ*. • Identification of suitable relocation sites for each species. • Removal and relocation of species of concern to be relocated. • Marking of species to be conserved *in situ*. • Monitoring during ground clearing to assess conservation of species and relocation of any individuals that may have been overlooked. • Ground clearing should be kept to a minimum. • Topsoil should be collected during ground clearing and kept for revegetation purposes.	Environmental Manager Appointed ecologist or horticulturist	Identification marking and relocation to be completed before ground clearing starts. Monitoring to occur continuously until ground clearing is completed.

Performance Indicator	Number of species and individuals identified Number of individuals successfully relocated Number of species successfully maintained in situ after ground clearing is completed. Number of species collected during ground clearing minimal. 90% or more species of concern protected *in situ* and/or by relocation.
Monitoring	Report including the locations of all species of concern to be completed before ground clearing starts Number of species relocated to be recorded on a daily basis during relocation and cross checked with initial report Number of species marked for in situ conservation to be recorded daily Number of trees to be conserved in situ to be checked cross checked against the trees marked for in situ conservation after ground clearing is completed Final relocation report to be compiled and submitted to the relevant authorities

OBJECTIVE 2: Compile an effective and efficient spillage containment plan in order to prevent spillage, leakage or release of harmful or toxic substances during transport or at areas where they are stored or used, and also to clean up any spills before they can be taken up by any possible natural receptors.

Project component/s	Any component that involves the use, transport or storage of hazardous materials. This includes materials used in construction and transport vehicles such as oil, fuel hypoid oil, hydraulic fluid etc.
Potential Impact	The spillage of harmful or toxic substances may impact on the fauna and flora of the area in a number of ways. Direct pathways include ingestion of the substances by fauna species resulting in toxicity in that individual, uptake of toxic chemicals by the roots plants which may lead to toxicity in the plants and the chemicals entering the plant or animals system due to contact (through the skin, leaves or stems). Indirect pathways include the ingestion of contaminated plants or animals by other herbivorous or predatory species. The predation of contaminated animals by both other animals and humans is a common occurrence during chemical contamination due to these animals being sluggish, and less likely to escape predation, due to chemical toxicity
Activity/risk source	Failure to effectively implement a hazardous substance containment plan
Mitigation: Target/Objective	No hazardous substances must enter the potential receiving ecological systems.

Mitigation: Action/control	Responsibility	Timeframe
• Excessive soil contamination by fuel or oil spills, for example, from construction vehicles, will be collected to be treated at a pre-determined and dedicated location, or will be treated in situ using	Environmental Manager Plant manager Contractors	The hazardous substances management plan should be in place before any construction begins and the management plan should be

bioremediation, in accordance with Abengoa's existing procedures and legal requirements. • Vehicles will be maintained regularly and kept in a good working order. • No oils or fuels from vehicles, machinery or generators should be allowed to enter ecosystems, in the case of accidental spills, immediate clean-up action must be initiated to prevent further spread. • Standard operating procedures for the transport of potentially dangerous substances need to be put in place and followed.		continuous throughout the life of the project.

Performance Indicator	No hazardous chemicals are to be allowed to enter the receiving ecosystems.
Monitoring	All spills must be recorded Remedial actions taken and results of the remedial actions need to be recorded All recorded incidents need to be included in an incident register to be included in a monthly report

OBJECTIVE 3: Compile a vibration and noise management plan in order to minimise the disturbance of biodiversity due to vibration and noise.

Project component/s	Any component that involves the use and transport of heavy vehicles and construction vehicles
Potential Impact	Vibration and noise will have a significant effect mainly on fauna species in the immediate vicinity of the development, due to the heavy machinery utilised. Vibration can affect a number of subterranean fauna taxa, such as burrowing mammals, reptiles and arthropods. Vibration affects these animals by causing the collapsing of burrows, and causing these animals to leave the area due to the vibration. Noise will also affect a wide range of taxa including avifauna, mammals, reptiles, amphibians and arthropods. Avifauna, especially songbirds, and amphibians may find it difficult to find mates in areas of increased noise, mammals, reptiles and arthropods may find increased noise disturbing and therefore move away from the area.
Activity/risk source	Failure to effectively implement a noise and vibration management plan
Mitigation: Target/Objective	Vibration and noise from heavy machinery can be kept to a minimum, especially during periods when indigenous species area active.

Mitigation: Action/control	Responsibility	Timeframe
• Vibration and noise from heavy machinery can be kept to a minimum by reducing the movement of heavy vehicles to a minimum necessary. • Placing the vehicle yard as close to the construction area as possible will also reduce the spatial scale of impact of vibration. • Changing the rerouting of the M73 to the east of the infrastructure instead of through areas of greater biodiversity importance to the west of the infrastructure will reduce this impact.	Environmental Manager Plant manager Contractors	The vibration and noise reduction measures should be in place before any construction begins and the management plan should be continuous throughout the life of the project.

Performance Indicator	Vibration and noise should be kept to a minimum and limited to diurnal periods and also minimised in higher biodiversity areas.
Monitoring	Measures and success of measures implemented in order to reduce vibrations and noise need to be reported on monthly. Any incidents of contravention of the measures resulting in excessive noise, noise during the wrong time of the day or noise in the wrong areas need to be recorded and reported on monthly.

OBJECTIVE 4: Habitat degradation due to dust

Project component/s	Any component that involves the use and transport of heavy vehicles on dirt roads, ground clearing, excavation and construction
Potential Impact	Dust settling on plant material can reduce the amount of light reaching the chlorophyll in the leaves, thereby reducing photosynthesis, which in turn reduces plant productivity, growth and recruitment. Furthermore excessive dust can affect the respiratory systems of fauna species and affect visibility of predatory species thus affecting their hunting abilities and also that of prey species thus affecting their ability to evade predators.
Activity/risk source	Failure to effectively implement an effective dust suppression plan Availability of water Availability of bowsers Breakdown of bowsers

Mitigation: Target/Objective	Dust from cleared areas, dirt roads, construction areas and excavation areas should be kept to a minimum.

Mitigation: Action/control	Responsibility	Timeframe
The following methods can be used to prevent conditions conducive to dust generation and suppress dust should it occur: • Dust suppression on roads by water bowsers or other forms of dust suppressants; • Adjacent paved areas and roads used for construction traffic can be maintained free of tracked soil or fill materials. At minimum, paved traffic areas, can be cleaned on a daily basis by wet sweeping and/or washing. More frequent cleaning can be provided as necessary. Adjacent paved areas and roads can be left clean at the end of each day; • Exposed excavations, disturbed ground surfaces, and unpaved traffic areas can be maintained in a moist condition; • During non-working hours, the site can be left in a condition that will prevent dust from being generated. At the end of each work day, disturbed areas can be wetted down and security fencing can be installed and or inspected to prevent access and additional disturbance; • Provide temporary cover and daily maintenance for soil stockpiles and keep active surfaces moist; and Construction activities should be conducted using methods that minimize dust generation. The following Best Management Practices (BMPs) can also be followed to help minimize and control dust emissions at the site to the greatest extent possible: • All onsite traffic can be restricted to specific designated roads. Off-road travel can only be authorized on a case-by-case basis. Traffic speed can also be restricted to an appropriate level on all designated roads. All designated roads can be considered as high potential dust source areas, and as such, can be a priority for dust controls utilizing water and/or gravel; and	Environmental Manager Plant manager Contractors	The dust suppression measures should be in place before any construction begins and the management plan should be continuous throughout the life of the project.

• This plan can be in effect during all hours of operation at the site. During non-working hours, there can be no activities generating dust. Therefore, dust control actions can be restricted to hours of operation only. However, as a best management practice, if high winds are evident at the close of a business day (or immediately prior to a weekend, holiday, etc.), site personnel should evaluate vulnerable areas and implement controls, as appropriate, to minimize off-hours emissions.		

Performance Indicator	Dust generation should be kept to a minimum and limited to diurnal periods. An acceptable level of dust is 50 µg/m3 as recorded by standard air quality methods.
Monitoring	Measures and success of measures implemented in order to dust generation need to be reported on monthly. Any incidents of contravention of the measures resulting in excessive dust need to be recorded and reported on monthly.

OBJECTIVE 5: Minimise effects on local migrations

Project component/s	Any linear infrastructure, roads, fencing and buildings may negatively affect fauna species ability to conduct local migrations after food water or shelter
Potential Impact	Local migrations of fauna in the area may be affected by linear infrastructure, fences and buildings, due to these areas forming a barrier to migrating animals or reducing the chance of an animal surviving its migration due to collisions with vehicles on roads. Desert animals are particularly migratory due to variations in food and water availability, and species of concern may be affected by this impact.
Activity/risk source	Failure to effectively implement a plan to reduce the impacts of these structures
Mitigation: Target/Objective	Minimum impact of migrating fauna. No fatalities caused by linear infrastructure roads and other infrastructure and fencing.

Mitigation: Action/control	Responsibility	Timeframe

The following methods can be used to prevent impacts on local migrations: • The construction area can be isolated by means of a chain link fence in order to prevent animals on local migrations entering the area and being killed; • The effect of roads on local migrations can be mitigated by the installation of culverts at regular intervals along the roads and the installation of drift fences towards the culverts , although these methods may not eliminate the mortalities among migrating animals, they should greatly reduce the number of animals killed on roads; and • A low speed limit can be strictly enforced in order to reduce collisions with animals on the roads during construction.	Environmental Manager Plant manager Contractors	The migration assistance measures should be in place during construction and the management plan should be continuous throughout the life of the project.

Performance Indicator	Effects on local migrations and migrating animal mortalities needs kept to a minimum. Preferably zero incidents.
Monitoring	Any incidents involving the impediment of local migration or animal mortalities on roads or against fences need to be recorded and reported on monthly.

OBJECTIVE 6: Manage prevalence of exotic invasive species

Project component/s	Vegetation clearing of any kind, transport of – and by heavy vehicles
Potential Impact	The fact that the area will be cleared for construction creates niches that can be colonised by exotic and/or invasive species. This is compounded by the fact that trucks and other heavy machinery often act as vectors for seeds of these species. Desert and semi-desert areas are very susceptible to invasion by exotic species due to the slow growth rate of indigenous vegetation due to low rainfall and this impact needs to monitored and mitigated.
Activity/risk source	Failure to effectively implement a plan to reduce the increase in prevalence of exotic species
Mitigation: Target/Objective	Keep exotic species on site to a minimum, preferably zero.

Mitigation: Action/control	Responsibility	Timeframe
The following methods can be used to reduce the prevalence of exotic and invasive species: • Monitoring of exotic and invasive species should be conducted regularly during construction; • A plan must be developed and implemented in order to eradicate exotic and invasive species within the property; and • A monitoring plan should be put in place to monitor exotic and invasive species in order to report on progress and advise management of measure that need to be implemented.	ECO Appointed consultant	The exotic and invasive species control plan should be in place before construction and the management plan should be continuous throughout the life of the project.

Performance Indicator	All exotic species within the site eradicated or, at a minimum controlled and no increase measured.
Monitoring	A monitoring plan should be put in place to monitor exotic and invasive species in order to report on progress and advise management of measure that need to be implemented, this monitoring should be conducted bi-annually.

OBJECTIVE 7: Manage erosion

Project component/s	Vegetation clearing of any kind unpaved roads any surface water runoff
Potential Impact	Increased erosion can eventually lead to the loss of vegetation and habitats for fauna species. Soils in the area are prone to erosion in areas where vegetation is cleared, this is further compounded by the fact that precipitation in the area occurs through heavy rainfall events in in the form of thundershowers in summer. Furthermore large areas will be cleared before construction leaving these areas prone to erosion. Increased erosion can eventually lead to the loss of vegetation and habitats for further species. Soils in the area are prone to erosion in areas where vegetation is cleared, this is further compounded by the fact that precipitation in the area occurs through heavy rainfall events in in the form of thundershowers in summer. Furthermore large areas will be cleared before construction leaving these areas prone to erosion.
Activity/risk source	Failure to effectively implement a plan to reduce erosion

Mitigation: Target/Objective	Keep erosion and soil loss on site to a minimum, preferably zero.

Mitigation: Action/control	Responsibility	Timeframe
Develop an erosion control map including: • Drainage patterns or approximate slopes after major grading activities. • Indicate the direction of flow for all runoff from the site. • Areas where soil disturbance will occur (shade or use border) including parking on or storing items on grass as disturbance. • Show the location of all structural controls, either planned or in place, on the map. This includes concrete washout areas, fueling areas, soil stockpiles, stabilised construction entrances, etc • Locations where stabilization practices are expected to occur. • Locations of off-site material, waste, borrow, fill, or equipment storage areas. If the staging yard is not on the site, a separate map for the yard is required. • Surface waters or riverbeds either adjacent or in close proximity to the project area. • Locations where storm water discharges from the site directly to a surface water body, river or riverbed. • Determine methods for the reduction of runoff water energy.	Environmental Manager Plant manager Appointed consultant	The erosion measures should be in place before construction and the measures should be continuous throughout the life of the project.

• Determine the location for collection areas, conduits, energy dissipation pools, gabions and culverts. • Determine Erosion and Sediment Control • Determine how disturbed areas will be restored. This includes vegetation, paved, gravelled or mulched areas. This needs to be determined by a rehabilitation ecologist who will assess the disturbance as when, how and with what species the area needs to be rehabilitated. The erosion control map does not mitigate erosion but indicates high risk areas, where erosion control measures need to be implemented in order to manage erosion.		

Performance Indicator	Erosion within the site kept to a minimum or completely eliminated
Monitoring	A monitoring plan should be put in place to monitor erosion in order to report on progress and advise management of measures that need to be implemented, this monitoring should be conducted bi-annually.

11.2 Operational Phase

Due to the fact that the ownership and responsibilities of the road will be handed over to the relevant roads agency after completion. The road agency will need to set up a management plan for the road, and due to the fact that we have no mandate from the roads agency to develop inputs into an EMPR.

12 LIST OF ACRONYMS AND ABBREVIATIONS

CSP	Concentrated Solar Power
DEA	Department of Environmental Affairs
DSR	Draft Scoping Report
DWS	Department of Water and Sanitation
EIA	Environmental Impact Assessment
EMP	Environmental Management Programme
GN	General Notice
ha	Hectares

I&APs	Interested and affected parties
km	Kilometre
m	metres
masl	metres above sea level
NEMA	National Environmental Management Act, 1998 (Act 107 of 1998)

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APPENDIX A

Plant species recorded as occurring in the 2819DC QDS

Family	Species	Threat status	SA Endemic	Lifecycle	Growth forms
ACANTHACEAE	*Acanthopsis disperma Nees*	LC	No	Annual (occ. perennial)	Herb
ACANTHACEAE	*Barleria lancifolia T.Anderson subsp. lancifolia*	LC	No	Perennial	Dwarf shrub
ACANTHACEAE	*Blepharis pruinosa Engl.*		No	Perennial	Dwarf shrub
AIZOACEAE	*Aizoon canariense L.*	LC	No	Perennial	Herb
AIZOACEAE	*Galenia africana L.*	LC	No	Perennial	Shrub
AIZOACEAE	*Galenia fruticosa (L.f.) Sond.*	LC	No	Perennial	Dwarf shrub
AIZOACEAE	*Galenia sarcophylla Fenzl*	LC	No	Perennial	Dwarf shrub
AIZOACEAE	*Galenia secunda (L.f.) Sond.*	LC	No	Perennial	Dwarf shrub
AIZOACEAE	*Trianthema parvifolia E.Mey. ex Sond. var. parvifolia*	LC	No	Annual	Herb
AMARANTHACEAE	*Sericocoma avolans Fenzl*	LC	No	Perennial	Dwarf shrub
ANACARDIACEAE	*Searsia burchellii (Sond. ex Engl.) Moffett*	LC	No	Perennial	Shrub
ANACARDIACEAE	*Searsia populifolia (E.Mey. ex Sond.) Moffett*	LC	No	Perennial	Shrub
APOCYNACEAE	*Microloma sagittatum (L.) R.Br.*	LC	No	Perennial	Climber
ASTERACEAE	*Dicoma capensis Less.*	LC	No	Perennial	Herb
ASTERACEAE	*Eriocephalus pauperrimus Merxm. & Eberle*	LC	No	Perennial	Shrub
ASTERACEAE	*Euryops dregeanus Sch.Bip.*	LC	No	Perennial	Dwarf shrub
ASTERACEAE	*Geigeria filifolia Mattf.*	LC	No	Annual (occ. perennial)	Herb
ASTERACEAE	*Geigeria vigintisquamea O.Hoffm.*	LC	No	Annual	Herb
ASTERACEAE	*Helichrysum herniarioides DC.*	LC	No	Annual	Herb

Family	Species	Threat status	SA Endemic	Lifecycle	Growth forms
ASTERACEAE	*Ifloga molluginoides (DC.) Hilliard*	LC	No	Annual	Herb
ASTERACEAE	*Osteospermum rigidum Aiton var. rigidum*	LC	No	Perennial	Shrub
ASTERACEAE	*Senecio niveus (Thunb.) Willd.*	LC	No	Perennial	Dwarf shrub
ASTERACEAE	*Senecio sisymbriifolius DC.*	LC	No	Annual	Herb
CAMPANULACEAE	*Wahlenbergia psammophila Schltr.*	LC	No	Annual	Herb
CAPPARACEAE	*Cleome oxyphylla Burch. var. oxyphylla*	LC	No	Perennial	Herb
CAPPARACEAE	*Maerua gilgii Schinz*	LC	No	Perennial	Shrub
EBENACEAE	*Diospyros acocksii (De Winter) De Winter*	LC	No	Perennial	Shrub
EUPHORBIACEAE	*Euphorbia virosa Willd.*		No	[No lifecycle defined]	[No lifeform defined]
FABACEAE	*Indigastrum argyroides (E.Mey.) Schrire*	LC	No	Annual	Herb
LAMIACEAE	*Stachys burchelliana Launert*	LC	No	Annual	Shrub
LOPHIOCARPACEAE	*Lophiocarpus polystachyus Turcz.*	LC	No	Perennial	Dwarf shrub
MALVACEAE	*Hermannia minutiflora Engl.*	LC	No	Perennial	Dwarf shrub
MALVACEAE	*Hermannia stricta (E.Mey. ex Turcz.) Harv.*	LC	No	Perennial	Dwarf shrub
MESEMBRYANTHEMACEAE	*Mesembryanthemum crystallinum L.*	LC	No	Annual	Succulent
MESEMBRYANTHEMACEAE	*Psilocaulon articulatum (Thunb.) N.E.Br.*	LC	No	Perennial (occ. annual)	Succulent
MESEMBRYANTHEMACEAE	*Psilocaulon coriarium (Burch. ex N.E.Br.) N.E.Br.*	LC	No	Perennial (occ. annual)	Shrub

Family	Species	Threat status	SA Endemic	Lifecycle	Growth forms
MESEMBRYANTHEMACEAE	*Psilocaulon subnodosum (A.Berger) N.E.Br.*	LC	No	Perennial (occ. annual)	Succulent
MOLLUGINACEAE	*Pharnaceum brevicaule (DC.) Bartl.*	LC	No	Perennial	Herb
MOLLUGINACEAE	*Suessenguthiella scleranthoides (Sond.) Friedrich*	LC	No	Annual	Herb
NEURADACEAE	*Grielum humifusum Thunb. var. parviflorum Harv.*	LC	No	Annual	Herb
PORTULACACEAE	*Anacampseros filamentosa (Haw.) Sims subsp. tomentosa (A.Berger) Gerbaulet*	LC	No	Perennial	Herb
PORTULACACEAE	*Avonia albissima (Marloth) G.D.Rowley*	LC	No	Perennial	Herb
RUBIACEAE	*Kohautia cynanchica DC.*	LC	No	Annual (occ. perennial)	Herb
SANTALACEAE	*Thesium lineatum L.f.*	LC	No	Perennial	Dwarf shrub
SAPINDACEAE	*Pappea capensis Eckl. & Zeyh.*	LC	No	Perennial	Shrub
SCROPHULARIACEAE	*Aptosimum procumbens (Lehm.) Steud.*	LC	No	Perennial	Herb
SCROPHULARIACEAE	*Jamesbrittenia aridicola Hilliard*	LC	No	Annual	Herb
SCROPHULARIACEAE	*Manulea schaeferi Pilg.*	LC	No	Annual	Herb
SCROPHULARIACEAE	*Selago divaricata L.f.*	LC	No	Perennial	Dwarf shrub
VISCACEAE	*Viscum capense L.f.*	LC	No	Perennial	Parasite
ZYGOPHYLLACEAE	*Augea capensis Thunb.*	LC	No	Perennial	Dwarf shrub
ZYGOPHYLLACEAE	*Sisyndite spartea E.Mey. ex Sond.*	LC	No	Perennial	Shrub
ZYGOPHYLLACEAE	*Zygophyllum dregeanum Sond.*	LC	No	Perennial	Dwarf shrub
CACTACEAE	*Opuntia ficus-indica L.*	Exotic	No	Perrenial	Succulent
PAPAVERACEAE	*Argemone mexicana L.*	Exotic	No	Annual	Herb

Family	Species	Threat status	SA Endemic	Lifecycle	Growth forms
SOLANACEAE	Datura stramonium L.	Exotic	No	Annual	Herb
ASPARAGACEAE	Agave americana L.	Exotic	No	Perrenial	Succulent
FABACEAE	Prosopis glandulosa Torr.	Exotic	No	Perrenial	Tree

	TESS 1	TESS 2	TESS 3	TESS 4	TESS 5	TESS 6	TESS 7	TESS 8	TESS 9	TESS 10	TESS 11	TESS 12
Galenia fruticosa	X	X	X	X	X	X			X	X	X	X
Galenia sarcophylla						X	X			X		
Lophiocarpus polystachyus	X	X	X	X	X	X			X	X		X
Thesium lineatum	X	X	X	X	X			X	X	X		X
Schmidtia kalahariensis			X									X
Stipagrostis ciliata	X	X	X	X	X	X	X	X	X	X	X	X
Aristida congesta	X	X	X	X	X	X	X	X	X	X	X	X
Aristida adscensionis			X	X		X	X					
Stipagrostis obtusa			X	X		X	X					
Eragrostis lehmanniana				X			X	X				
Acanthopsis disperma			X								X	X
Barleria lancifolia			X								X	X
Blepharis pruinosa			X									
Trianthema parvifolia						X				X		
Dicoma capensis			X								X	X
Euryops dregeanus	X		X					X			X	X
Geigeria filifolia	X										X	X
Geigeria vigintisquamea			X	X		X						X
Osteospermum rigidum			X							X	X	X
Senecio niveus		X	X	X		X						
Senecio sisymbriifolius		X	X	X		X						X
Indigastrum argyroides			X								X	X
Stachys burchelliana			X							X	X	X
Hermannia minutiflora		X	X	X		X				X	X	X
Psilocaulon articulatum		X				X	X					
Psilocaulon coriarium		X				X		X				X
Grielum humifusum			X							X	X	X
Kohautia cynanchica			X							X	X	X
Aptosimum procumbens			X							X	X	X
Manulea schaeferi												
Selago divaricata	X	X		X		X	X			X	X	X

Viscum capense										X	X	
Albuca setosa			X									X
Sisyndite spartea			X			X	X	X		X	X	X
Rhigozum trichotomum			X	X		X	X	X				X
Hoodia gordonii			X			X	X	X				
Searsia burchellii	X	X		X	X						X	
Searsia populifolia	X	X	X	X	X					X	X	X
Parkinsonia africana			X					X		X	X	X
Maerua gilgii		X	X	X	X	X	X	X	X	X	X	X
Boscia foetida	X	X	X	X	X	X	X	X	X	X	X	X
Acacia mellifera	X	X	X	X	X				X	X	X	X
Aloe dichotoma	X									X	X	

APPENDIX B

Reptile species occurring in the region of the study area

Order	Suborder	Family	Subfamily	Biological Name	Common Name	Endemism
Chelonii	Pleurodira	Testudinae		*Psamobates tentorius*	Tent Tortoise	E
		Pelomedusidae		*Pelomedusa subrufa*	Marsh or Helmeted Terrapin	
Squamata	Serpentes (Ophidia)	Tryphlopidae		*Typhlops schinzi*	Beaked Blind Snake	E
		Leptotyphlopidae		*Leptotyphlops occidentalis*	Western Thread Snake	E
		Colubridae	Boadontinae	*Lamprophis fuliginosus*	Brown House Snake	
				Pseudoaspis cana	Mole Snake	
				Prosymna frontalis	South-western Shovel-snout	
			Psammophinae	*Dipsina multimaculata*	Dwarf Beaked Snake	E
				Psammophis notostictus	karoo Sand or Whip Snake	
				Psammophis leightoni	Cape, Namib and Fork-marked Sand Snake	
			Atractaspidinae	*Xenocalamus bicolor*	Bicoloured Quill-snouted Snake	
				Dasypeltis scabra	Common or Rhombic Egg Eater	
				Telescopus semiannulatus	Eastern Tiger Snake	
				Telescopus beetzii	Namib Tiger Snake	E
		Elapidae	Najinae	*Aspidelaps lubricus*	Coral Snake	
				Naja nivea	Cape Cobra	E

Order	Suborder	Family	Subfamily	Biological Name	Common Name	Endemism
				Naja nigricollis	Black-necked Spitting Cobra	
			Viperinae	*Bitis arietans*	Puff Adder	
				Bitis cornuta	Many-horned Adder	E
				Bitis caudalis	Horned Adder	
	Sauria (Lacertillia)	Scincidae	Acontiinae	*Acontias lineatus*	Striped Legless Skink	E
			Lygosomatiinae	*Mabuya occidentalis*	Western Three-striped Skink	
				Mabuya striata	Striped Skink	
				Mabuya sulcata	Western Rock Skink	
				Mabuya variegata	Variegated Skink	
		Lacertidae		*Meroles suborbitalis*	Spotted Desert Lizard	E
				Nucras tessellata	Striped Sandveld Lizard	
				Pedioplanis laticeps	Cape Sand Lizard	E
				Pedioplanis lineoocellata	Spotted Sand Lizard	E
				Pedioplanis namaquensis	Namaqua Sand Lizard	
				Pedioplanis undata	Western Sand Lizard	
		Cordylidae	Gerrhosaurinae	*Angolosaurus skoogi*	Desert Plated Lizard	
			Cordylinae	*Cordylus polyzous*	Karoo Girdled Lizard	E

Order	Suborder	Family	Subfamily	Biological Name	Common Name	Endemism
			Cordylinae	*Platysaurus capensis*	Cape Flat Lizard	E
		Agamidae		*Agama aculeata*	Ground Agama	
				Agama anchietae	Anchieta's Agama	
				Agama atra	Southern Rock Agama	E
		Chamaeleonidae		*Chamaeleo namaquesis*	Namaqua Chamaeleon	
		Gekkonidae		*Chrondrodactylus angulifer*	Giant Ground Gecko	E
				Colopus wahlbergii	Kalahari Ground Gecko	E
				Lygodactylus bernardi	Bernard's Dwarf Gecko	
				Pachydactylus laevigatus	Button-scaled Gecko	
				Pachydactylus rugosus	Rough-scaled Gecko	E
				Pachydactylus serval	Western Spotted Gecko	E
				Ptenopus garrulus	Common Barking Gecko	E

APPENDIX C

Amphibian species occurring in the region of the study area

FAMILY	SPECIES		Endemic Status	Revised Status	Recorded
BUFONIDAE	*Vandijkophrynus gariepensis*	Karoo Toad	2	NL	
MICROHYLIDAE	*Phrynomantis annectens*	Marbled rubber frog	1	NL	
PIPIDAE	*Xenopus laevis*	Common Platanna	0	NL	
PETROPEDETIDAE	*Cacosternum boettgeri*	Boettger's Caco	1	NL	
PYXICEPHALIDAE	*Pyxicephalus adspersus*	Giant Bullfrog	0	NT	
PYXICEPHALIDAE	*Tomopterna tandyi*	Tandy's Sand Frog	0	NL	
PYXICEPHALIDAE	*Amietia angolensis*	Common River Frog			

Species list for the region spanning South Africa, Lesotho and Swaziland. Endemic status:

0 indicates no endemism to southern Africa

1 indicates endemism to southern Africa;

2 indicates endemism to the region (South Africa, Lesotho and Swaziland).

The relevant IUCN status categories are:

Critically Endangered (CR)

Endangered (EN)

Vulnerable (VU)

Near Threatened (NT)

Data Deficient (DD)

Least Concern (LC)

All species without a category are shown as Not Listed (NL)

Shaded species indicate species known to occur within the study area

APPENDIX D

Mammal species occurring in the region of the study area

Family	Subfamily	Biological Name	Common Name
MACROSCELIDIDAE (Sengis/Elephant Shrews)		*Macroscelides proboscideus*	Round-eared Sengi
		Elephantulus rupestris	Western Rock Sengi
		Elephantulus intufi	Bushveld Sengi
SORICIDAE (Shrews)		*Crocidura cyanea*	Reddish-grey Musk Shrew
NYCTERIDAE (Slit-faced Bats)		*Nycteris thebiaca*	Egyptian Slit-faced Bat
RHINOLOPHIDAE (Horseshoe Bats)		*Rhinolophus clivosus*	Geoffrey's Horseshoe Bat
		Rhinolophus darlingi	Darling's Horseshoe Bat
		Rhinolophus denti	Dent's Horseshoe Bat
VESPERTILIONIDAE (Vesper Bats)	VESPERTILIONINAE	*Cistugo seabrai*	Angolan Hairy Bat
		Neoromicia capensis	Cape Serotine Bat
		Pipistrellus rueppelli	Ruppell's Pipistrelle
MOLOSSIDAE (Free-tailed Bats)		*Sauromys petrophyilus*	Flat-headed Free-tailed Bat
		Tadarida aegyptiaca	Egyptian Free-tailed Bat
CERCOPITHECIDAE (Baboons and Monkeys)		*Papio cynocephalus ursinus*	Savanna Baboon
		Cercopithecus pygerythrus	Vervet Monkey
MANIDAE (Pangolins)		*Manis temminckii*	Ground Pangolin
LEPORIDAE (Hares and Rabbits)		*Lepus capensis*	Cape Hare
		Lepus saxatillis	Scrub Hare
		Pronolagus saundersiae	Hewitt's Red Rock Rabbit
		Pronolagus rupestris	Smith's Red Rock Rabbit

Family	Subfamily	Biological Name	Common Name
SCIURIDAE (Squirrels)		*Xerus inauris*	Southern African Ground Squirrel
MYOXIDAE (Dormice)		*Graphiurus ocularis*	Spectacled Dormouse
PEDETIDAE (Springhares)		*Pedetes capensis*	Springhare
BATHYERGIDAE (Rodent Moles / Mole Rats)		*Cryptomys hottentotus*	Common (African) Mole-rat
HYSTRICIDAE (Porcupine)		*Hystrix africaeaustralis*	Cape Porcupine
PETROMURIDAE (Dassie Rat)		*Petromus typicus*	Dassie Rat
MURIDAE (Rats and Mice)		*Saccostomus campestris*	Pouched Mouse
		Malacothrix typica	Gerbil Mouse
	GERBILLINAE	*Desmodillus auricularis*	Cape Short-tailed Gerbil
		Gerbillurus paeba	Hairy-footed Gerbil
		Gerbillurus vallinus	Brush-tailed Hairy-footed Gerbil
		Tatera leucogaster	Bushveld Gerbil
		Tatera brantsii	Highveld Gerbil
		Michaelamys namaquensis	Namaqua Rock Mouse
		Rhabdomys pumilio	Four-striped Grass Mouse
		Mus minutoides	Pygmy Mouse
		Mus musculus	House Mouse
		Thallomys paedulcus	Acacia Rat
		Thallomys nigricaudatus	Black-tailed Tree Rat
		Mastomys natalensis	Natal Multimammate Mouse

Family	Subfamily	Biological Name	Common Name
		Mastomys coucha	Southern Multimammate Mouse
		Parotomys brantsii	Brants's Whistling Rat
		Parotomys littledalei	Littledale's Whistling Rat
		Petromyscus collinus	Pygmy Rock Mouse
		Petromyscus monticularis	Brukkaros Pygmy Rock Mouse
CANIDAE		*Vulpes chama*	Cape Fox
		Otocyon megalotis	Bat Eared Fox
		Canis mesomelas	Black-backed Jackal
MUSTELIDAE		*Mellivora capensis*	Honey Badger
		Ictonyx striatus	Striped Polecat
HERPESTIDAE		*Galerella pulverulenta*	Small Grey Mongoose
		Cynictis penicillata	Yellow Mongoose
		Suricata suricatta	Suricate (Meerkat)
VIVERRIDAE		*Genetta genetta*	Small Spotted Genet
HYAENIDAE		*Parahyaena brunnea*	Brown hyaena
PROTELIDAE		*Proteles cristatus*	Aardwolf
FELIDAE		*Felis silvestris lybica*	African Wild Cat
		Felis nigripes	Small Spotted Cat
		Caracal caracal	Caracal
ORYCTEROPODIDAE		*Orycteropus afer*	Aardvark

Family	Subfamily	Biological Name	Common Name
PROCAVIIDAE		*Procavia capensis*	Rock Dassie (Hyrax)
RHINOCEROTIDAE		*Diceros bicornis*	Hook-lipped (Black) Rhinoceros
BOVIDAE		*Tragelaphus strepsiceros*	Greater Kudu
RUMINANTIA		*Antidorcas marsupialis*	Springbok
		Oreotragus oreotragus	Klipspringer
		Raphicerus campestris	Steenbok
		Sylvicapra grimmia	Common Duiker

APPENDIX E

Avifauna species historically recorded in the region

Full Name	*Scientific Name*	RD (Regional, Global)	S	E
Little Grebe	*Tachybaptus ruficollis*			
Black-headed Heron	*Ardea melanocephala*			
Goliath Heron	*Ardea goliath*			
Grey Heron	*Ardea cinerea*			
Little Egret	*Egretta garzetta*			
Black Stork	*Ciconia nigra*	VU, LC		
White Stork	*Ciconia ciconia*			
Hamerkop	*Scopus umbretta*			
Egyptian Goose	*Alopochen aegyptiaca*			
Spur-winged Goose	*Plectropterus gambensis*			
South African Shelduck	*Tadorna cana*			
Maccoa Duck	*Oxyura maccoa*	NT, NT		
White-backed Duck	*Thalassornis leuconotus*			
Southern Pochard	*Netta erythrophthalma*			
African Black Duck	*Anas sparsa*			
Yellow-billed Duck	*Anas undulata*			
Cape Shoveler	*Anas smithii*			
Cape Teal	*Anas capensis*			
Red-billed Teal	*Anas erythrorhyncha*			
Black-chested Snake Eagle	*Circaetus pectoralis*			
Martial Eagle	*Polemaetus bellicosus*	EN, VU		
Verreauxs' Eagle	*Aquila verreauxii*	VU, LC		
Booted Eagle	*Hieraaetus pennatus*			
European Honey Buzzard	*Pernis apivorus*			
Jackal Buzzard	*Buteo rufofuscus*			(*)
Common (Steppe) Buzzard	*Buteo buteo*			
Pale Chanting Goshawk	*Melierax canorus*			
Black-shouldered Kite	*Elanus caeruleus*			
Yellow-billed Kite	*Milvus aegyptius*			
Gabar Goshawk	*Melierax gabar*			
Lanner Falcon	*Falco biarmicus*	VU, LC		
Peregrine Falcon	*Falco peregrinus*			
Red-necked Falcon	*Falco chicquera*			
Greater Kestrel	*Falco rupicoloides*			
Rock Kestrel	*Falco rupicolus*			
Helmeted Guineafowl	*Numida meleagris*			
Common Ostrich	*Struthio camelus*			
Common Quail	*Coturnix coturnix*			

Full Name	*Scientific Name*	RD (Regional, Global)	S	E
Red-knobbed coot	*Fulica cristata*			
Secretarybird	*Sagittarius serpentarius*	VU, VU		
Kori Bustard	*Ardeotis kori*	NT, NT		
Ludwig's Bustard	*Neotis ludwigii*	EN, EN		
Karoo Korhaan	*Eupodotis vigorsii*	NT, LC		
Northern Black Korhaan	*Afrotis afraoides*			
Red-crested Korhaan	*Lophotis ruficrista*			
Southern Black Korhaan	*Afrotis afra*	VU, VU		*
Pied Avocet	*Recurvirostra avosetta*			
Black-winged Stilt	*Himantopus himantopus*			
Common Ringed Plover	*Charadrius hiaticula*			
Kittlitz's Plover	*Charadrius pecuarius*			
Three-banded Plover	*Charadrius tricollaris*			
Crowned Lapwing	*Vanellus coronatus*			
Blacksmith Lapwing	*Vanellus armatus*			
Ruff	*Philomachus pugnax*			
Curlew Sandpiper	*Calidris ferruginea*			
Little Stint	*Calidris minuta*			
Common Sandpiper	*Actitis hypoleucos*			
Wood Sandpiper	*Tringa glareola*			
Common Greenshank	*Tringa nebularia*			
Marsh Sandpiper	*Tringa stagnatilis*			
Burchell's Courser	*Cursorius rufus*	VU, LC		
Double-banded Courser	*Rhinoptilus africanus*			
Spotted Thick-knee	*Burhinus capensis*			
White-winged Tern	*Chlidonias leucopterus*			
Double-banded Sandgrouse	*Pterocles bicinctus*			
Namaqua Sandgrouse	*Pterocles namaqua*			
Rock Dove	*Columba livia*			
Speckled Pigeon	*Columba guinea*			
Cape Turtle Dove	*Streptopelia capicola*			
Laughing Dove	*Streptopelia senegalensis*			
Namaqua Dove	*Oena capensis*			
Rosy-faced Lovebird	*Agapornis roseicollis*			
Diederik Cuckoo	*Chrysococcyx caprius*			
Spotted Eagle-Owl	*Bubo africanus*			
Western Barn Owl	*Tyto alba*			
Rufous-cheeked Nightjar	*Caprimulgus rufigena*			

Full Name	*Scientific Name*	RD (Regional, Global)	S	E
Alpine Swift	*Tachymarptis melba*			
Common Swift	*Apus apus*			
Böhm's Spinetail	*Neafrapus boehmi*			
African Palm Swift	*Cypsiurus parvus*			
Little Swift	*Apus affinis*			
Red-faced Mousebird	*Urocolius indicus*			
White-backed Mousebird	*Colius colius*			
European Bee-eater	*Merops apiaster*			
Swallow-tailed Bee-eater	*Merops hirundineus*			
African Hoopoe	*Upupa africana*			
Common Scimitarbill	*Rhinopomastus cyanomelas*			
Cardinal Woodpecker	*Dendropicos fuscescens*			
Golden-tailed Woodpecker	*Campethera abingoni*			
Fawn-coloured Lark	*Calendulauda africanoides*			
Large-billed Lark	*Galerida magnirostris*			(*)
Red-capped Lark	*Calandrella cinerea*			
Sabota Lark	*Calendulauda sabota*			
Karoo Long-billed Lark	*Certhilauda subcoronata*			
Sclater's Lark	*Spizocorys sclateri*	NT, NT		(*)
Stark's Lark	*Spizocorys starki*			
Black-eared Sparrow-lark	*Eremopterix australis*			(*)
Chestnut-backed Sparrow-lark	*Eremopterix leucotis*			
Grey-backed Sparrow-lark	*Eremopterix verticalis*			
Spike-heeled Lark	*Chersomanes albofasciata*			
Barn Swallow	*Hirundo rustica*			
White-throated Swallow	*Hirundo albigularis*			
Brown-throated Martin	*Riparia paludicola*			
Rock Martin	*Hirundo fuligula*			
Fork-tailed Drongo	*Dicrurus adsimilis*			
Cape Crow	*Corvus capensis*			
Pied crow	*Corvus albus*			
Ashy Tit	*Parus cinerascens*			
African Red-eyed Bulbul	*Pycnonotus nigricans*			
Karoo Thrush	*Turdus smithi*			(*)
Short-toed Rock Thrush	*Monticola brevipes*			
Familiar Chat	*Cercomela familiaris*			
Karoo Chat	*Cercomela schlegelii*			
Sickle-winged Chat	*Cercomela sinuata*			(*)

Full Name	*Scientific Name*	RD (Regional, Global)	S	E
Tractrac Chat	*Cercomela tractrac*			
Mountain Wheatear	*Oenanthe monticola*			
Capped Wheatear	*Oenanthe pileata*			
Ant-eating Chat	*Myrmecocichla formicivora*			
Karoo Scrub Robin	*Erythropygia coryphoeus*			
Willow Warbler	*Phylloscopus trochilus*			
Burnt-necked Eremomela	*Eremomela usticollis*			
Green-capped Eremomela	*Eremomela scotops*			
Karoo Eremomela	*Eremomela gregalis*			(*)
Yellow-bellied Eremomela	*Eremomela icteropygialis*			
Cape Penduline-Tit	*Anthoscopus minutus*			
Long-billed crombec	*Sylvietta rufescens*			
Fairy Flycatcher	*Stenostira scita*			(*)
Chestnut-vented Tit-Babbler	*Sylvia subcaerulea*			
Layard's Tit-Babbler	*Sylvia layardi*			(*)
Zitting Cisticola	*Cisticola juncidis*			
Grey-backed Cisticola	*Cisticola subruficapilla*			
Black-chested Prinia	*Prinia flavicans*			
Namaqua Warbler	*Phragmacia substriata*			(*)
Rufous-eared Warbler	*Malcorus pectoralis*			
Spotted flycatcher	*Muscicapa striata*			
Chat Flycatcher	*Bradornis infuscatus*			
Cape White-eye	*Zosterops virens*			(*)
Orange River White-eye	*Zosterops pallidus*			
Pririt Batis	*Batis pririt*			
African Pied Wagtail	*Motacilla aguimp*			
Cape Wagtail	*Motacilla capensis*			
Long-billed Pipit	*Anthus similis*			
African Pipit	*Anthus cinnamomeus*			
Southern (Common) Fiscal	*Lanius collaris*			
Lesser Grey Shrike	*Lanius minor*			
Red-backed Shrike	*Lanius collurio*			
Bokmakierie	*Telophorus zeylonus*			
Brubru	*Nilaus afer*			
Pale-winged Starling	*Onychognathus nabouroup*			
Wattled Starling	*Creatophora cinerea*			
Dusky Sunbird	*Cinnyris fuscus*			

Full Name	*Scientific Name*	RD (Regional, Global)	S	E
Southern Double-collared Sunbird	*Cinnyris chalybeus*			(*)
Cape Sparrow	*Passer melanurus*			
House Sparrow	*Passer domesticus*		I	
Southern Grey-headed Sparrow	*Passer diffusus*			
White-browed Sparrow-Weaver	*Plocepasser mahali*			
Sociable Weaver	*Philetairus socius*			
Southern Masked Weaver	*Ploceus velatus*			
Southern Red Bishop	*Euplectes orix*			
Red-billed Quelea	*Quelea quelea*			
Pin-tailed Whydah	*Vidua macroura*			
Red-billed Firefinch	*Lagonosticta senegala*			
Grey Waxbill	*Estrilda perreini*			
Red-headed Finch	*Amadina erythrocephala*			
Scaly-feathered Finch	*Sporopipes squamifrons*			
Black-throated Canary	*Crithagra atrogularis*			
Yellow Canary	*Crithagra flaviventris*			
Black-headed Canary	*Serinus alario*			(*)
Cape Bunting	*Emberiza capensis*			
Lark-like Bunting	*Emberiza impetuani*			
White-throated Canary	*Crithagra albogularis*			

Red Data (RD); Regional*, Global

CR = Critically Endangered
EN = Endangered
VU = Vulnerable
NT = Near Threatened
LC = Least Concern
EX = Extinct (regionally)

DD= Data Deficient
NR= Not Recognised by BirdLife International

NA = Not Assessed
§ = Refer to footnote

Status in South Africa (S)

V = vagrant
I = introduced

Endemism in south Africa (E)

Endemism in South Africa (E) (not southern Africa as in field guides)

* = endemic
SLS = endemic to South Africa, Lesotho and Swaziland
(*) = near endemic (i.e. ~70% or more of population in RSA)

B* = breeding endemic
BSLS = breeding South Africa, Lesotho and Swaziland endemic

W* = winter endemic

APPENDIX F

Details of Specialist

Appointment of specialist

Hudson Ecology Pty Ltd was commissioned by Savannah Environmental (Pty) Ltd to provide specialist consulting services for the Environmental Impact Assessment for the proposed Solar Thermal Plant near Pofadder in the Northern Cape. The consulting services comprise an assessment of potential impacts on the flora, fauna, vegetation and ecology in the study area by the proposed project.

Details of specialist

Adrian HUdson
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Cell: 082 344 2758
Email: adrian@hudsonecology.co.za

Summary of expertise

Adrian Hudson is the owner, director and senior ecologist Hudson Ecology Pty Ltd. In this role, he provides assessments which encompass all aspects of terrestrial and wetland ecological studies including (but not limited to) baseline ecological assessments, ecological impact assessments and biodiversity management plans. He also has considerable experience in conservation, and conducted studies in veld management, stocking rates (wildlife and domestic) for a number of companies and organisations. Projects, unless otherwise requested by the client, are conducted according to the IFC Performance standard 6 criteria and Adrian Hudson is, therefore, au fait with the requirements and criteria of the Standard. Adrian has reviewed a number of projects throughout Africa for IFC Performance Standard 6 compliance, including Hassai Gold Mine in Sudan and Konkola North Copper mine in Zambia.

Adrian Hudson is a qualified ecologist and ornithologist who holds a Master's of Science degree in Ecology from the North West University and is currently completing his PhD in Ecology at the same institution. Adrian is currently still closely associated with the university as a supervisor for Honours and Master's degree students, lecturing of short courses at the university and co-authoring of scientific articles with faculty members of the university. Adrian is a member of the Zoological Society of Southern Africa and the International Society of Conservation Biology. Adrian is also a member of the Department of Environmental Affairs and Tourism (South African Government Department) roster of experts on ecology and desertification and a reviewer for a number of internationally accredited scientific journals. He is also accredited with authorship of a number of articles published in scientific journals.

Before founding Hudson Ecology Pty Ltd. in September 2014, Adrian worked for 18 years for a diverse range of organizations, including Natal Parks Board, North West University, United Nations Environmental Program /Global Environment Facility, ECOSUN cc and Golder Associates Africa Pty Ltd. In these roles, Adrian was responsible for anti- poaching, lecturing, research and consulting respectively. Thus far Adrian has worked as a consulting ecologist on more than 90 projects in 20 countries, including projects in Angola, South Africa, Lesotho, Swaziland, Namibia, Botswana, Mozambique, Zambia, Tanzania, Central African Republic, Democratic Republic of Congo, Sudan, Guinea, Guinea-Bissau, Uzbekistan and Liberia.

Independence

Hudson Ecology Pty Ltd and its Directors have no connection with Abengoa. Hudson Ecology Pty Ltd is not a subsidiary, legally or financially, of the proponent. Remuneration for services by the proponent in relation to this project is not linked to approval by decision-making authorities responsible for authorising this proposed project and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project. Adrian Hudson is an independent consultant to Savannah Environmental (Pty) Ltd 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 this specialist performing such work.

The percentage work received directly or indirectly from the proponent in the last twelve months is approximately 0% of turnover.

Scope and purpose of report

The scope and purpose of the report are reflected in the Terms of reference section of this report

Conditions relating to this report

This report as well as the information contained therein remains the property of Hudson Ecology Pty Ltd until such time as Hudson Ecology Pty Ltd has been remunerated in full for the report and preceding field investigation. As such, until payment is received this report may not be used for insertion in orther reports, placed in the public domain or be passed on to- or reproduced for any third party.

The findings, results, observations, conclusions and recommendations given in this report are based on the author's best scientific and professional knowledge as well as available information. Hudson Ecology Pty Ltd and its staff reserve the right to modify aspects of the report, including the recommendations, if and when new information may become available from ongoing research or further work in this field, or pertaining to this investigation.

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APPENDIX G

CONTROL SHEET FOR SPECIALIST REPORT

The table below lists the specific requirements for specialist studies, according to the 2014 EIA Regulations (South Africa, 2014)

Activity	Yes	No	Comment
Details of: i the person who prepared the report; and	√		
ii the expertise of that person to carry out the specialist study or specialised process	√		
	√		
ii. the expertise of that person to carry out the specialist study or specialised process	√		
A declaration that the person is independent in a form as may be specified by the competent authority	√		
An indication of the scope of, and the purpose for which, the report was prepared	√		
A description of the methodology adopted in preparing the report or carrying out the specialised process	√		
A description of any assumptions made and any uncertainties or gaps in knowledge	√		
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	√		
Recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority	√		
A description of any consultation process that was undertaken during the course of carrying out the study		√	n/a
A summary and copies of any comments that were received during any consultation process		√	n/a
Any other information requested by the competent authority		√	n/a

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