!XHA BOOM WIND FARM GRID CONNECTION:

FAUNA & FLORA SPECIALIST BASIC ASSESSMENT REPORT

PRODUCED FOR SiVEST

ON BEHALF OF MAINSTREAM RENEWABLE POWER SOUTH AFRICA

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NEMA 2014 CHECKLIST

Section		*NEMA 2014 Regulations for Specialist Studies*	Position in report (pg.)	check
1	1	A specialist report prepared in terms of these Regulations must contain—		
	(a)	details of-		
		(i) the specialist who prepared the report; and	4-5	✓
		(ii) the expertise of that specialist to compile a specialist report including a curriculum vitae;		
	(b)	a declaration that the person 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;	6	✓
	(d)	a description of the methodology adopted in preparing the report or carrying out the specialised process;	8-10	✓
	(e)	a description of any assumptions made and any uncertainties or gaps in knowledge;	8	✓
	(f)	a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;	10-17	✓
	(g)	recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;	20-23	✓
	(h)	a description of any consultation process that was undertaken during the course of carrying out the specialist report;	See main EIA report	✓
	(i)	a summary and copies of any comments that were received during any consultation process; and	See main EIA report	✓
	(j)	any other information requested by the competent authority.		
	2	Where a proposed development and the geographical area within which it is located has been subjected to a pre-assessment using a spatial development tool, and the output of the pre-assessment in the form of a site specific development protocol has been adopted in the prescribed manner, the content of a specialist report may be determined by the adopted site specific development protocol applicable to the specific proposed development in the specific geographical area it is proposed in.	N/A	✓

PROFESSIONAL PROFILE OF CONSULTANT:

Simon Todd Consulting has extensive experience in the assessment of renewable energy developments, having provided ecological assessments for more than 80 different renewable energy developments. This includes a large number of developments in the immediate vicinity of the current site as well as in the broader Northern Cape Province. Simon Todd is a recognised ecological expert and is a past chairman of the Arid-Zone Ecology Forum and has 18 years' experience working throughout the country. Simon Todd is registered with the South African Council for Natural Scientific Professions (No. 400425/11).

Recent experience and relevant projects in the immediate vicinity of the current site include the following:

- Mainstream South Africa Dwarsrug Wind Energy Facility: Fauna & Flora Specialist Impact Assessment Report. Sivest 2014.
- Basic Assessment Process for the Proposed Construction of the Transnet 15km 50 kV Power Line from Eskom Helios Substation to the proposed new Transnet Helios Traction Feeder Substation. Nsovo Environmental Consulting. 2014.
- Loeriesfontein Wind Energy Facility – Substation & Grid Connection. Fauna & Flora Specialist Report for Basic Assessment. Specialist Report for Savannah Environmental. 2012.
- Proposed Re-Alignment of the Authorised Power Line for The Loeriesfontein 2 Wind Energy Facility.: Fauna & Flora Specialist Report for Basic Assessment. Savannah Environmental 2014.
- Mainstream Loeriesfontein 2 Wind Energy Facility: Fauna and Flora Preconstruction Walk-Through Report. Savannah Environmental 2014.
- Mainstream Khobab Wind Energy Facility: Fauna And Flora Preconstruction Walk-Through Report. Savannah Environmental 2014.

1 INTRODUCTION

As part of the proposed !Xha Boom Wind Farm, South Africa Mainstream Renewable Power Developments (Pty) Ltd (hereafter referred to as Mainstream) are proposing to construct a 33kV/132kV on-site substation, a 132kV Linking Substation and an associated 132kV power line north of Loeriesfontein in the Northern Cape Province. The purpose of the grid connection is to feed electricity generated by the proposed !Xha Boom Wind Farm (part of separate on-going EIA process) into the national grid at the Eskom Helios Substation. Mainstream have appointed SiVEST as the independent Environmental Assessment Practitioner (EAP) to undertake the required environmental authorisation process for the proposed development. SiVEST has appointed Simon Todd Consulting to provide a specialist terrestrial biodiversity study as part of the required Basic Assessment process for the grid connection and associated substations.

The purpose of the Terrestrial Biodiversity Basic Assessment Report is to describe and detail the ecological features of the proposed site; provide an assessment of the ecological sensitivity of the site and identify and assess the impacts associated with the development of the grid connection infrastructure. Impacts are assessed for the preconstruction, construction, operation, and decommissioning phases of the development. A variety of avoidance and mitigation measures associated with each identified impact are recommended to reduce the likely impact of the development, which should be included in the EMPr for the development. The full scope of study is detailed in Section 1.1 below.

1.1 SCOPE OF STUDY

The scope of the study includes the following activities:

- a description of the environment that may be affected by a specific activity and the manner in which the environment may be affected by the proposed project;
- a description and evaluation of environmental issues and potential impacts (including assessment of direct, indirect and cumulative impacts) that have been identified;
- a statement regarding the potential significance of the identified issues based on the evaluation of the issues/impacts;
- an indication of the methodology used in determining the significance of potential environmental impacts;
- an assessment of the significance of direct, indirect and cumulative impacts of the development;
- a description and comparative assessment of all alternatives including cumulative impacts;
- recommendations regarding practical mitigation measures for potentially significant impacts, for inclusion in the Environmental Management Programme (EMPr);

- an indication of the extent to which the issue could be addressed by the adoption of mitigation measures;
- a description of any assumptions uncertainties and gaps in knowledge; and
- an environmental impact statement which contains:
    - a summary of the key findings of the environmental impact assessment;
    - an assessment of the positive and negative implications of the proposed activity; and
    - a comparative assessment of the positive and negative implications of identified alternatives.

General Considerations for the study included the following:

- Disclose any gaps in information (and limitations in the study) or assumptions made.
- Identify recommendations for mitigation measures to minimize impacts.
- Outline additional management guidelines.
- Provide monitoring requirements, mitigation measures and recommendations in a table format as input into the EMPr for faunal or flora related issues.
- The assessment of the potential impacts of the development and the recommended mitigation measures provided have been separated into the following project phases:
    - Pre-construction
    - Construction
    - Operational
    - Decommissioning

1.2 RELEVANT ASPECTS OF THE DEVELOPMENT

At this stage, it is understood that the proposed development will include a 33kV/132kV on-site IPP substation (namely !Xha Boom Substation), as well as a 132kV Linking Substation and a 132kV power line. The aim of this development is to feed electricity generated by the proposed !Xha Boom Wind Farm (part of separate on-going EIA process) into the national grid.

The proposed development will include the following main activities:

- Construction of 1 x 33kV/132kV substation (referred to as the “proposed !Xha Boom Substation”)
- Construction of 1 x 132kV linking substation
- Construction of 1 x 132kV power line from the proposed !Xha Boom Substation, via the proposed Linking Substation to Helios substation, approximately 29km south-east of the proposed !Xha Boom Wind Farm.

The size of the proposed on-site substation site will be approximately 500m x 300m, while the Linking Substation site will be approximately 600m x 600m. A power line corridor of between 100m and 500m wide is being proposed to allow flexibility when determining the final route alignment. The proposed power line however only requires a 31m wide servitude and as such, this servitude would be positioned within the corridor.

It should be noted that two (2) alternative sites for the proposed on-site !Xha Boom Substation and the proposed Linking Substation are assessed during the Basic Assessment (BA), in conjunction with four (4) power line corridor alternatives.

The proposed power line will include a series of towers located approximately 170m to 250m apart. The type of towers being considered at this stage include self-supporting suspension monopole structures for relatively straight sections of the line and angle strain towers where the line bends to a significant degree. The steel monopole tower type is between 18 and 25m in height, depending on the terrain, but will ensure minimum overhead line clearances from buildings and surrounding infrastructure. An example of the type of line and typical footprint associated with the proposed power line can be seen low in Figure 1. The exact location of the towers will be determined during the final design stages of the power line.

The proposed !Xha Boom Wind Farm (part of a separate on-going EIA process) application site, proposed !Xha Boom Substation site and associated 132kV power line corridor route alternatives are shown in the locality map below (Figure 2).

Figure 1. A section of the 132kV grid connection for the Mainstream Khobab Wind Energy Facility, showing the type of infrastructure to be used and the associated footprint.

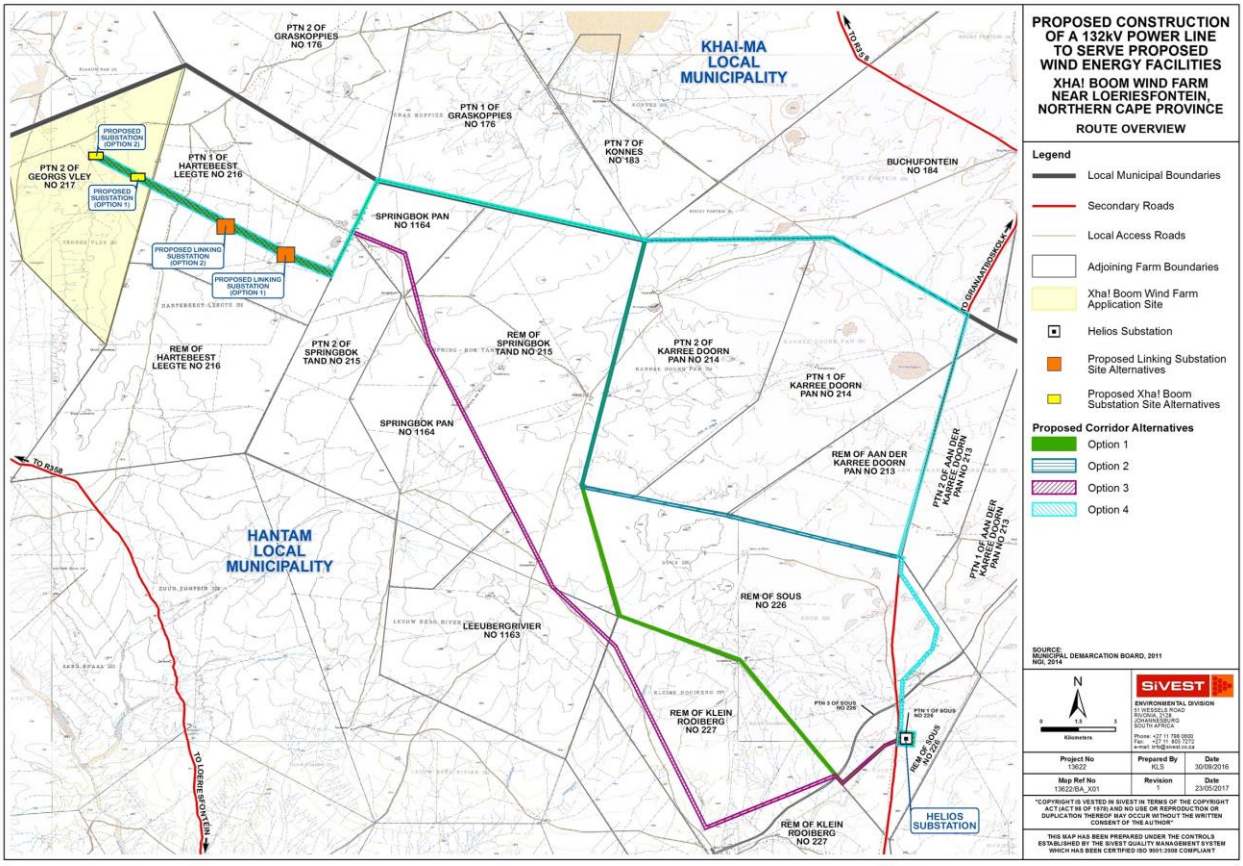

Figure 2. Layout of the !Xha Boom power line, linking substation and on-site !Xha Boom substation alternatives that are assessed in this study.

1.3 Assessment Approach and Philosophy

The assessment has been conducted according to the 2017 amended EIA Regulations as well as within the best-practice guidelines and principles for biodiversity assessment as outlined by Brownlie (2005) and De Villiers et al. (2005).

In terms of NEMA, this assessment demonstrates how the proponent intends to comply with the principles contained in Section 2 of NEMA, which amongst other things, indicates that environmental management should:

- (In order of priority) aim to: avoid, minimize or remedy disturbance of ecosystems and loss of biodiversity;
- Avoid degradation of the environment;
- Avoid jeopardising ecosystem integrity;
- Pursue the best practicable environmental option by means of integrated environmental management;

- Protect the environment as the people's common heritage;
- Control and minimize environmental damage; and
- Pay specific attention to management and planning procedures pertaining to sensitive, vulnerable, highly dynamic or stressed ecosystems.

These principles serve as guidelines for all decision-making matters that may affect the environment. As such, it is incumbent upon the proponent to show (through the EIA process) how proposed activities would comply with these principles and thereby contribute towards the achievement of sustainable development as defined in terms of NEMA.

Furthermore, in terms of best practice guidelines as outlined by Brownlie (2005) and De Villiers et al. (2005), a precautionary and risk-averse approach should be adopted for projects which may result in substantial detrimental impacts on biodiversity and ecosystems, especially the irreversible loss of habitat and ecological functioning in threatened ecosystems or designated sensitive areas: i.e. Critical Biodiversity Areas (CBAs) (as identified by systematic conservation plans, Biodiversity Sector Plans or Bioregional Plans) and Freshwater Ecosystem Priority Areas.

In order to adhere to the above principles and best-practice guidelines, the following approach forms the basis for the study approach and assessment philosophy:

- The study includes data searches, desktop studies, site walkovers / field survey of the property and baseline data collection, describing:
- A description of the broad ecological characteristics of the site and its surrounds in terms of any mapped spatial components of ecological processes and/or patchiness, patch size, relative isolation of patches, connectivity, corridors, disturbance regimes, ecotones, buffering, viability, etc.

In terms of **pattern**, the following will be identified or described:

Community and ecosystem level

- The main vegetation type, its aerial extent and interaction with neighboring types, soils or topography;
- Threatened or vulnerable ecosystems (*cf. SA vegetation map/National Spatial Biodiversity Assessment, fine-scale systematic conservation plans, etc*).

Species level

- Species of Conservation Concern (SCC) (giving location if possible using GPS)
- The viability of an estimated population size of the SCC species that are present (including the degree of confidence in prediction based on availability of information and specialist knowledge, i.e. High=70-100% confident, Medium 40-70% confident, low 0-40% confident)
- The likelihood of other RDB species, or species of conservation concern, occurring in the vicinity (include degree of confidence).

Fauna

- Describe and assess the terrestrial fauna present in the area that will be affected by the proposed development.
- Conduct a faunal assessment that can be integrated into the ecological study.
- Describe the existing impacts of current land use as they affect the fauna.
- Clarify species of special concern (SSC) and that are known to be:
    - endemic to the region;
    - that are considered to be of conservational concern;
    - that are in commercial trade (CITES listed species); or
    - are of cultural significance.
- Provide monitoring requirements as input into the EMPr for faunal related issues.

Other pattern issues

- Any significant landscape features or rare or important vegetation associations such as seasonal wetlands, alluvium, seeps, quartz patches or salt marshes in the vicinity.
- The extent of alien plant cover of the site, and whether the infestation is the result of prior soil disturbance such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than infestation of undisturbed sites).
- The condition of the site in terms of current or previous land uses.

In terms of **process**, the following will be identified and/or described:

- The key ecological “drivers” of ecosystems on the site and in the vicinity, such as fire.
- Any mapped spatial component of an ecological process that may occur at the site or in its vicinity (i.e. *corridors* such as watercourses, upland-lowland gradients, migration routes, coastal linkages or inland-trending dunes, and *vegetation boundaries* such as edaphic interfaces, upland-lowland interfaces or biome boundaries).
- Any possible changes in key processes, e.g. increased fire frequency or drainage/artificial recharge of aquatic systems.
- Furthermore, any further studies that may be required during or after the EIA process will be outlined.
- All relevant legislation, permits and standards that would apply to the development will be identified.
- The opportunities and constraints for development will be described and shown graphically on an aerial photograph, satellite image or map delineated at an appropriate level of spatial accuracy.

1.4 LIMITATIONS & ASSUMPTIONS

The current study is based on a number of site visits as well as an associated desktop study. Although it was not very wet at the time of the site visits, conditions were nevertheless suitable for the assessment and there no significant limitations associated with the timing of the field assessment. The presence of some fauna is difficult to verify in the field as these may be shy or rare and their potential presence at the site must be evaluated based on the literature and available databases. In many cases, these databases are not intended for fine-scale use and the reliability and adequacy of these data sources relies heavily on the extent to which the area has been sampled in the past. Many remote areas have not been well sampled with the result that the species lists derived for the area do not always adequately reflect the actual fauna and flora present at the site. This is acknowledged as a limitation of the study, however it is substantially reduced by the fact that the consultant has sampled the adjacent properties on multiple occasions across different seasons. In order to further reduce this limitation, and ensure a conservative approach, the species lists derived for the site from the literature were obtained from an area significantly larger than the study site.

2 METHODOLOGY

2.1 DATA SOURCING AND REVIEW

Data sources from the literature consulted and used where necessary in the study includes the following:

Vegetation:

- Vegetation types and their conservation status were extracted from the South African National Vegetation Map (Mucina and Rutherford 2006) as well as the National List of Threatened Ecosystems (2011), where relevant.
- Information on plant and animal species recorded for Quarter Degree Squares (QDS) 3019AC, AB, AD and BC was extracted from the SABIF/SIBIS database hosted by SANBI. This is a considerably larger area than the study area, but this is necessary to ensure a conservative approach as well as counter the fact that the site itself has not been well sampled in the past.
- The IUCN conservation status (Figure 3) of the species in the list was also extracted from the database and is based on the Threatened Species Programme, Red List of South African Plants (2014).
- Freshwater and wetland information was extracted from the National Freshwater Ecosystem Priority Areas assessment, NFEPA (Nel et al. 2011).

- Important catchments and protected areas expansion areas were extracted from the National Protected Areas Expansion Strategy 2008 (NPAES).

Fauna

- Lists of mammals, reptiles and amphibians which are likely to occur at the site were derived based on distribution records from the literature and the ADU databases http://vmus.adu.org.za.
- Literature consulted includes Branch (1988) and Alexander and Marais (2007) for reptiles, Du Preez and Carruthers (2009) for amphibians, Friedmann and Daly (2004) and Skinner and Chimimba (2005) for mammals.
- The faunal species lists provided are based on species which are known to occur in the broad geographical area, as well as a preliminary assessment of the availability and quality of suitable habitat at the site.
- The conservation status of each species is also listed, based on the IUCN Red List Categories and Criteria 2017 (See Figure 3) and where species have not been assessed under these criteria, the CITES status is reported where possible.

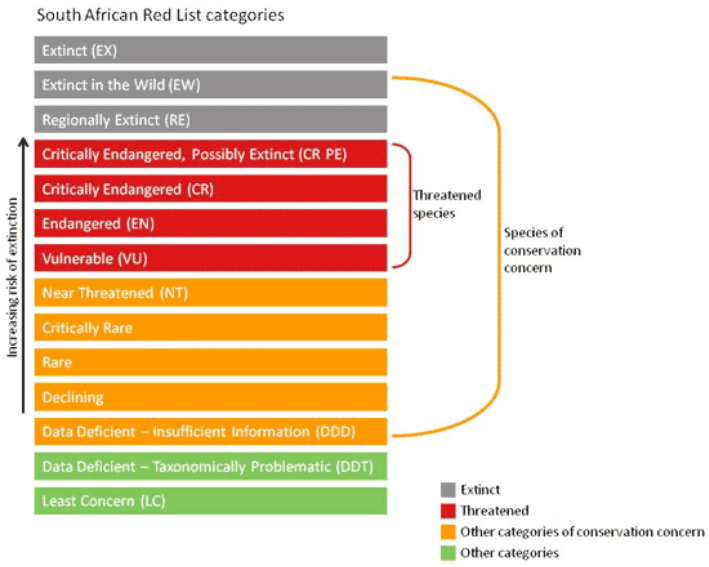

Figure 3.Schematic representation of the South African Red List categories. Taken from http://redlist.sanbi.org/redcat.php

2.2 SITE VISIT

The main site visit took place on the 11-13th of November 2016. During the site visit, the different biodiversity features, habitat, and landscape units present at the site were identified and mapped in the field. A preliminary habitat map for the site had been produced prior to the site visit and this was validated in the field and modified where necessary. The habitat map also served to guide the site visit and ensure that all the different habitats visible on the satellite imagery of the site were sampled in the field and that representative samples of all the affected areas were

included. Walk-through-surveys were conducted within representative areas across the different habitats units identified and all plant and animal species observed were recorded. Active searches for reptiles and amphibians were also conducted within habitats likely to harbour or be important for such species. Within the context of the site, there was no perennial water present and no areas where amphibians were active at the time of the site visit. The presence of sensitive habitats such as wetlands or pans and unique edaphic environments such as rocky outcrops or quartz patches were noted in the field if present and recorded on a GPS and mapped onto satellite imagery of the site or included on the draft habitat map produced for the site. An additional site visit to verify some changes to the layout also took place on the 9th of June 2017.

2.3 SENSITIVITY MAPPING & ASSESSMENT

An ecological sensitivity map of the site was produced by integrating the results of the site visit with the available ecological and biodiversity information available in the literature and various spatial databases as described above. As a starting point, mapped sensitive features such as wetlands, drainage lines, rocky hills and pans were collated and buffered where appropriate to comply with legislative requirements or ecological considerations. Additional sensitive areas where then identified from the satellite imagery of the site and delineated. All the different layers created were then merged to create a single coverage. Features that were specifically captured in the sensitivity map include drainage features, wetlands and pans, as well as rocky outcrops and steep slopes. The ecological sensitivity of the different units identified in the mapping procedure was rated according to the following scale:

- **Low** – Units with a low sensitivity where there is likely to be a low impact on ecological processes and terrestrial biodiversity. This category represents transformed or natural areas where the impact of development is likely to be local in nature and of low significance with standard mitigation measures.
- **Medium** - Areas of natural or previously transformed land where the impacts are likely to be largely local and the risk of secondary impact such as erosion low. Development within these areas can proceed with relatively little ecological impact provided that appropriate mitigation measures are taken.
- **High** – Areas of natural or transformed land where a high impact is anticipated due to the high biodiversity value, sensitivity or important ecological role of the area. Development within these areas is undesirable and should only proceed with caution as it may not be possible to mitigate all impacts appropriately.
- **Very High** – Critical and unique habitats that serve as habitat for rare/endangered species or perform critical ecological roles. These areas are essentially no-go areas from a developmental perspective and should be avoided as much as possible.

In some situations, areas where also categorised between the above categories, such as Medium-High, where an area appeared to be of intermediate sensitivity with respect to the two defining categories. However, it is important to note that there are no sensitivities that are identified as "Medium to High" or similar ranged categories because this adds uncertainty to the mapping as it is not clear if an area falls at the bottom or top of such a range.

3 DESCRIPTION OF THE AFFECTED ENVIRONMENT- BASELINE

3.1 BROAD-SCALE VEGETATION PATTERNS

The national vegetation map (Mucina & Rutherford 2006, 2012) for the study area is depicted below in Figure 4. The majority of the Xha! Boom grid connection site is mapped as falling within the Western Bushmanland Klipveld vegetation type, with a small proportion of Bushmanland Basin Shrubland along the eastern margin of the site. The site visit however revealed that the areas mapped as Bushmanland Basin Shrubland consist of a mosaic of Bushmanland Basin Shrubland and Bushmanland Arid Grassland. The On-site Substation Option 2 falls within the Western Bushmanland Klipveld vegetation type, while all the rest of the substation options and the majority of the power line corridors are mapped as falling within the Bushmanland Basin Shrubland vegetation type. Although the dominant and characteristic species associated with each of these vegetation types is described in Mucina & Rutherford, these lists are not repeated here as the actual vegetation as observed at the site is described in the next section.

With an extent of 34 690 km^2 Bushmanland Basin Shrubland is one of the most extensive vegetation types in South Africa. Bushmanland Basin Shrubland occurs on the extensive basin cantered on Brandvlei and Van Wyksvlei, spanning Granaatboskolk in the west to Copperton in the east, and Kenhardt in the north to around Williston in the south. The area is characterised by slightly irregular plains dominated by a dwarf shrubland, with succulent shrubs or perennial grasses in places. The geology consists largely of mudstones and shales of the Ecca group and Dwyka tillites with occasional dolerite intrusions. Soils are largely shallow to non-existent, with calcrete present in most areas. Rainfall ranges from 100-200 mm and falls mostly during the summer months as thunder storms. As a result of the arid nature of the area, very little of this vegetation type has been affected by intensive agriculture and it is classified as Least Threatened. There are few endemic and biogeographically important species present at the site and only *Tridentea dwequensis* is listed by Mucina and Rutherford as biogeographically important while *Cromidon minimum*, *Ornithogalum bicornutum* and *O.ovatum* subsp *oliverorum* are listed as being endemic to the vegetation type.

Bushmanland Arid Grassland is an extensive vegetation type and is the second most extensive vegetation type in South Africa and occupies an area of 45 478 km^2. It extends from around

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

The western two thirds of the !Xha Boom site consists of Western Bushmanland Klipveld, which forms part of the Succulent Karoo Biome and occurs on the northwestern plains of Bushmanland east of the Namaqualand Klipkoppe, north and south of Kliprand and west of Stofvlei. It consists of sparse plains of desertic character supporting dwarf succulent shrubs and drought-tolerant grasses. This vegetation type has an extent of 2297km2, of which 99% is still intact, with no major transformation, although erosion is extensive with as much as 70% considered to be suffering from significant erosion. Eight endemic species are reported for this vegetation type by Mucina & Rutherford, which is significant given the low extent of this vegetation type.

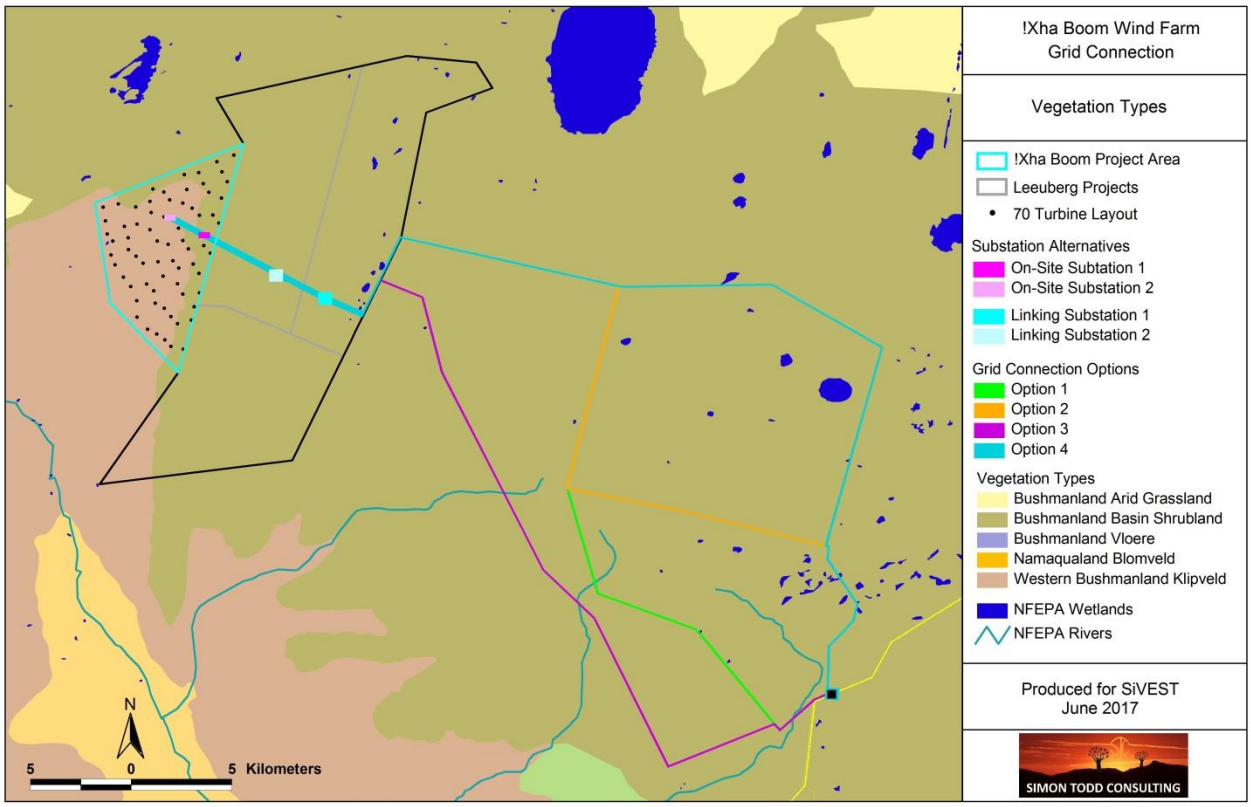

Figure 4. The national vegetation map (Mucina & Rutherford 2006/2012) for the study area. Rivers and wetlands (pans) delineated by the National Freshwater Ecosystem Priority Areas Assessment (Nel et al. 2011) are also depicted.

3.2 FINE-SCALE VEGETATION PATTERNS

The different habitats and landscape units associated with the various power line options and substation alternatives are described in detail below. Each unit is described and then the prevalence of this unit along the various power line routes and substation alternatives is discussed.

Bushmanland Arid Grassland

The site visit revealed that the eastern margin of the !Xha Boom as well as the majority of the rest of the greater Leeuberg site consists of open plains dominated by so-called “white grasses” and is clearly representative of the Bushmanland Arid Grassland vegetation type (Figure 5). This discrepancy with the vegetation map can be ascribed to the coarse nature of the national vegetation map and associated uncertainty along the boundaries of the vegetation units. In addition, boundaries between units have been mapped largely from aerial or satellite imagery and these boundaries are not always clearly visible. The main driver of vegetation pattern in the area is substrate. On gravels and stony soils, the vegetation consists of open shrub-dominated vegetation typical of Bushmanland Basin Shrubland, while on sandy soils the vegetation is typically dominated by various *Stipagrostis* species and is typical of Bushmanland Arid Grassland. There are also many areas on shallow soils, which consist of grassy shrublands and are clearly transitional areas between the two typical forms.

Figure 5. Looking west towards the boundary of the !Xha Boom site, showing the Bushmanland Arid Grassland habitat type that characterises this area. On-site Substation Option 1 is located within this habitat type.

The areas of Bushmanland Arid Grassland are associated with extensive flat to gently sloping open plains characterised by shallow red sands, sometimes with exposed calcrete as well (). This habitat tends to be very homogenous with low local and overall species richness and low species turnover. This unit is usually dominated by *Stipagrostis ciliata*, *S.brevifolia* and *s.obtusa* with low shrubs such as *Lebeckia spinescens*, *Monechma incanum*, *Asparagus capensis*, *Asparagus retrofractus*, *Eriocephalus microphyllus var. pubescens*, *Zygophyllum retrofactum* with occasional larger *Lycium pumilum* shrubs or small *Parkinsonia africana* trees. Protected or listed species are rare in this habitat and only an occasional *Hoodia gordonii* was observed within this vegetation type.

This habitat unit is present at On-site Substation Option 1 as well as the two Linking Substation options on Ithemba and Graskoppies Wind Farms to the east of the !Xha Boom site. Large sections of the power line options are also within this unit, especially the northern sections of alternatives, Option 1, Option 2 and Option 4 (Figure 6) as well as the majority of the central section of Option 3. This is not a sensitive habitat type as it is homogenous and has low diversity and abundance of SCC.

Figure 6. Bushmanland Arid Grassland along Power Line Option 4, looking east towards the R355.

Bushmanland Basin Shrubland

Shallow, stony soils dominate large parts of the site along the power line corridors and these areas are usually dominated by a sparse cover of low woody shrubs (Figure 7). This unit is representative of Bushmanland Basin Shrubland and are usually dominated by species such as *Pentzia incana*, *Zygophyllum lichtensteinianum*, *Eriocephalus spinescens*, *Aptosimum spinescens*, *Tripteris sinuata*, *Tetragonia fruticosa*, *Hermannia spinosa*, *Felicia clavipilosa*, *Osteospermum armatum*, *Pegolettia retrofracta*, *Pteronia glomerata*, *Pteronia sordida*, *Thesium* hystrix, *Euphorbia decussata* and *Salsola tuberculata*; as well as forbs such as *Aptosimum indivisum*, *Hypertelis salsoloides*, *Gazania lichtensteinii* and *Fockea sinuata*; succulent shrubs include *Aridaria noctiflora*, *Ruschia intricata* and *Sarcocaulon patersonii*; taller shrubs are usually restricted to run-on environments and consist of species such as *Lycium pilifolium* and *Rhigozum trichotomum*. There are occasional rocky outcrops present at the site of limited extent, which can also be attributed to this vegetation type; typical species include *Enneapogon scaber*, *Jamesbrittenia atropurpurea* subsp. *atropurpurea*, *Aloe falcata*, *Lycium oxycarpum*, *Dyerophytum africanum* and *Asparagus capensis*. The only species of significance observed on the plains was *Hoodia gordonii*, while *Aloe falcata* which is provincially protected is common on the rocky hills.

Figure 7. Bushmanland Basin Shrubland along Power Line Option 2, which exposed calcrete in the foreground, showing the low vegetation cover and lack of soil characteristic of this habitat type.

The Bushmanland Basin Shrubland habitat is not considered highly sensitive as it has low diversity and few species of concern present. This is a dominant habitat type along large sections

of all the power line corridors, once they leave the greater Leeuberg Wind Farm site (Figure 8). Along with the Grassland habitat type, these two units occupy the majority of the affected area.

Figure 8. Bushmanland Basin shrubland along the central section of Corridor Option 3, after it has left the greater Leeuberg study area, showing the exposed calcrete and low vegetation cover which characterises this habitat unit.

Western Bushmanland Klipveld

The majority of the Xha! Boom site as well as a small proportion of the Hartebeest Leegte Wind Farm site consists of Western Bushmanland Klipveld (Figure 9). These areas are dominated by shrub species such as *Pentzia incana*, *Zygophyllum lichtensteinianum*, *Zygophyllum retrofractum*, *Zygophyllum flexuosum*, *Eriocephalus spinescens*, *Aptosimum spinescens*, *Tripteris sinuata*, *Hermannia spinosa*, *Felicia clavipilosa*, *Osteospermum armatum*, *Pegolettia retrofracta*, *Pteronia glomerata*, *Pteronia sordida*, *Thesium hystrix, Euphorbia decussata* and *Salsola tuberculata*; succulent shrubs including *Aridaria noctiflora*, *Ruschia intricate*, *Prenia tetragonia* and *Sarcocaulon patersonii*; annual grasses such as *Aristida congesta*, *Stipagrostis anomala* and *Enneapogon desvauxii*. Taller shrubs are usually restricted to run-on environments and consist of species such as *Lycium pilifolium* and *Rhigozum trichotomum*. There are also a number of forbs and annuals present including *Sesamum capense*, *Galenia sarcophylla*, *Gazania lichtensteinii*, *Leysera tenella*, *Osteospermum pinnatum* and *Tribulis terrestris*. Cover across most of this area is very low and while this can be partly attributed to the aridity of the area,

livestock grazing also appears to have played a significant role in leading to the degradation of the area and further loss in the plant cover.

Overall, this is not considered a highly sensitive habitat as no species of conservation concern were observed in this habitat during the site visit. In addition, the affected area appears to have been negatively affected by livestock grazing which has had a negative effect on the diversity of this habitat. On the on-site substation Option 2 and the immediate adjacent section of power line are within this habitat.

Figure 9. Western Bushmanland Klipveld near to On-site Substation Option 2, showing the stony soils and very low vegetation cover which characterises this area.

Succulent Shrubland

Some of the low-lying areas in the south of the grid connection corridors consist of fine-textured soils overlying calcrete and are characterised by a higher proportion of succulent shrubs compared to the other shrub-dominated habitats. Typical and dominant species include *Brownanthus ciliatus*, *Euphorbia decussata*, *Ruschia robusta*, *Cephalophyllum rigidum*, *Aridaria noctiflora*, *Phyllobolus nitidus*, *Drosanthemum lique*, *Exomis microphylla*, *Octompoma quadrisepalum*, *Ruschia abbreviata*, *Galenia fruticosa*, *Sceletium tortuosum*, *Tetragonia fruticosa*, *Prenia tetragonia*, *Tripteris sinuata*, *Zygophyllum retrofractum*, *Lycium pumilum*. Although these

areas are considered somewhat more sensitive than the other plains habitats, diversity remains relatively low and the abundance of species of concern is low. As a result, these areas have been classified as higher sensitivity than the Arid Grassland and Shrubland habitats, but are not considered high sensitivity to the extent that they need to be avoided.

The Succulent Shrubland habitat is conspicuous only in the south of the study area and is prevalent only along sections of Power Line Option 1 and 3 (Figure 10). As discussed above, it is not considered highly sensitive but has a higher abundance of provincially protected species and somewhat higher diversity than the other habitats.

Figure 10. Succulent Shrubland habitat near the point where Power Line Corridor 1 and Power Line Corridor 3 merge, about 2.5km from the Helios substation.

Drainage Lines

The drainage lines of the site are not very well developed and do not have a tall woody component (Figure 11). Typical and dominant species include *Stipagrostis namaquensis*, *Stipagrostis obtusa*, *Osteospermum armatum*, *Arctotis fastuosa*, *Deverra denudata*, *Melianthus comosus*, *Salvia disermas*, *Lycium pumilum*, *Lycium oxycarpum*, *Galenia sarcophylla*, *Salsola aphylla* and *Sesamum capense*. Although the drainage lines are not well developed, which can be ascribed to aridity of the area, they are ecologically important because the higher cover and productivity of these areas is important for fauna forage and habitat availability and they also play an important hydrological role and regulate flow following occasional strong rainfall events. As such disturbance to these areas should be minimised as far as possible.

Figure 11. The drainage lines of the site such as this one along Power Line Option 3, are typically broad and not well-defined. Typical and dominant species includes *Lycium pumilum* as seen above, as well as grasses such as *Stipagrostis spp.* and *Aristida congesta*.

Pans

There are a number of small pans in the vicinity of the development footprint, the most conspicuous of which are those to the west of the power line corridors on the Graskoppies Wind Farm. The pans of the area are quite diverse and can be divided into at least three different types; non-saline pans with a bare centre and fringed by taller woody vegetation; non-saline pans vegetated by *Athanasia minuta* and saline pans that are not vegetated. In the north of the site, the pans are not saline and are bare or vegetated in their centre by *Athanasia minuta* with species such as *Lycium pumilum*, *Salsola glabrescens*, *Salsola aphylla*, *Rhigozum trichotomum*, *Parkinsonia africana*, *Psilocaulon coriarium* and *Osteospermum armatum* around the fringes. The saline pans are not vegetated on account of the salt present, but are nevertheless ecologically important as they support a variety of temporary water organisms when they contain water.

As already mentioned, the pans on the adjacent Graskoppies project area are the most significant and well-developed in the study area (Figure 12). There are however one or two smaller pans present near to power line Alternative 4. These are considered sensitive features and while a direct impact on these features is not likely as they are outside of the development footprint, the

low slope around some of these features makes them vulnerable to activities which can change the overland flow pattern of water, such as road construction.

Figure 12. One of the larger pans on the Graskoppies site north east of the Linking Substation Option 1. The power line, which includes all options at this point, runs across the face of the ridge on the other side of the pan, about 200m from the pan.

3.3 LISTED PLANT SPECIES

The study area has been very poorly sampled in the past and many of the quarter degree squares in the area have no data available. Listed and protected species observed in the area include the provincially protected species *Aloe falcata, A.claviflora* and *Hoodia gordonii* and *Aloinopsis luckhoffii* and *Euphorbia multiceps*. *Hoodia gordonii* is protected under NEMA and is listed as DDD (Data Deficient – insufficient information) while *Aloinopsis luckhoffii* is provincially protected is listed as taxonomically uncertain (DDT).

3.4 FAUNAL COMMUNITIES

Mammals

The site falls within the distribution range of 40 terrestrial mammals suggesting that potential mammalian diversity at the site is quite low. Species observed in the area include Steenbok

Raphicerus campestris, Cape Porcupine *Hystrix africaeaustralis*, Aardvark *Orycteropus afer*, Yellow Mongoose *Cynictis penicillata*, Cape Hare *Lepus capensis,* Cape Fox *Vulpes chama*, Bat-eared Fox *Otocyon megalotis* and Round-eared Elephant Shrew *Macroscelides proboscideus*. In terms of specific habitats which are likely to be of above average significance, the low ridges and drainage lines are likely to contain the highest fauna abundance and diversity.

The only mammal species of conservation concern which may occur at the site is the Black-footed cat *Felis nigripes* (Vulnerable). As this species has a broad distribution across South Africa, the relatively limited footprint of the development is not likely to compromise the local or regional populations of this species. In addition, the majority of the site would still be accessible to such fauna and it is likely that most predators will continue to use the site. In terms of the power line, there is little scope for interaction between mammals and the power line in the operational phase and long-term impacts would be low. The substations would be fenced and although some smaller fauna would use this area if there is any natural vegetation within the site, in general mammals would avoid this area and given the large amount of intact available habitat in the area, a significant disruption of landscape connectivity for fauna is highly unlikely.

Reptiles

The site lies in or near the distribution range of at least 40 reptile species (Appendix 3), comprising 5 tortoises, 12 snakes, 15 lizards and skinks, 8 geckos and 1 chameleon. This is a comparatively low total, suggesting that reptile diversity at the site is likely to be low. There are no listed species which are likely to occur at the site. Species which were observed in the area include the Karoo Girdled Lizard *Karusasaurus polyzonus*, Namaqua Sand Lizard *Pedioplanis namaquensis*, Spotted Desert Lizard *Meroles suborbitalis*, Western Sandveld Lizard *Nucras tessellata*, Southern Rock Agama *Agama atra*, Ground Agama *Agama aculeata* subsp. *aculeata* and Bushmanland Tent Tortoise *Psammobates tentorius verroxii*. There are no specific areas of high reptile importance at the site as it is homogenous with no rocky outcrops or other major features of high significance.

In terms of the likely impacts of the development on reptiles, habitat loss is not likely to be highly significant as the direct footprint of the development is not likely to exceed a hundred hectares and this would not be significant in context of the relatively homogenous and intact surrounding landscape. In some situations, the loss of vegetation cover associated with roads and other cleared areas can generate significant impact on reptiles as they may be vulnerable to predation while crossing such cleared areas, but as the site is arid, plant cover is already low and the reptile species present are mostly well-adapted to low-cover environments.

Amphibians

Given the aridity of the site and lack of surface water in the area, it is not surprising that only six frog species may occur in the area. Of these only those which are relatively independent of water such as the Karoo Toad *Vandijkophrynus gariepensis* are likely to occur within the site itself. Impacts on amphibians are likely to be low given the limited extent of the development as well as low likely density of amphibians in the area. Although there are some pans present in the area, these are not necessarily available to amphibians as many of the pans are saline and not suitable for amphibians.

3.5 CRITICAL BIODIVERSITY AREAS & BROAD-SCALE PROCESSES

The recently completed Northern Cape Critical Biodiversity Areas (CBAs) map (Oosthuysen & Holness 2016) is depicted below for the study area (Figure 13). This biodiversity assessment identifies CBAs which represent biodiversity priority areas which should be maintained in a natural to near natural state. The CBA maps indicate the most efficient selection and classification of land portions requiring safeguarding in order to maintain ecosystem functioning and meet national biodiversity objectives. There are no CBAs within !Xha Boom or the other properties which make up the greater Leeuberg Wind Farm. However, there are some short sections of CBA 1 and CBA 2 along all of the grid connection options. These are associated with drainage lines and aimed at protecting these features. The power line would however not generate significant impact on these features and the associated CBAs with the appropriate mitigation. The site does not lie within a National Protected Area Expansion Strategy (NPAES) focus area and has therefore not been identified as an important area for future conservation area expansion.

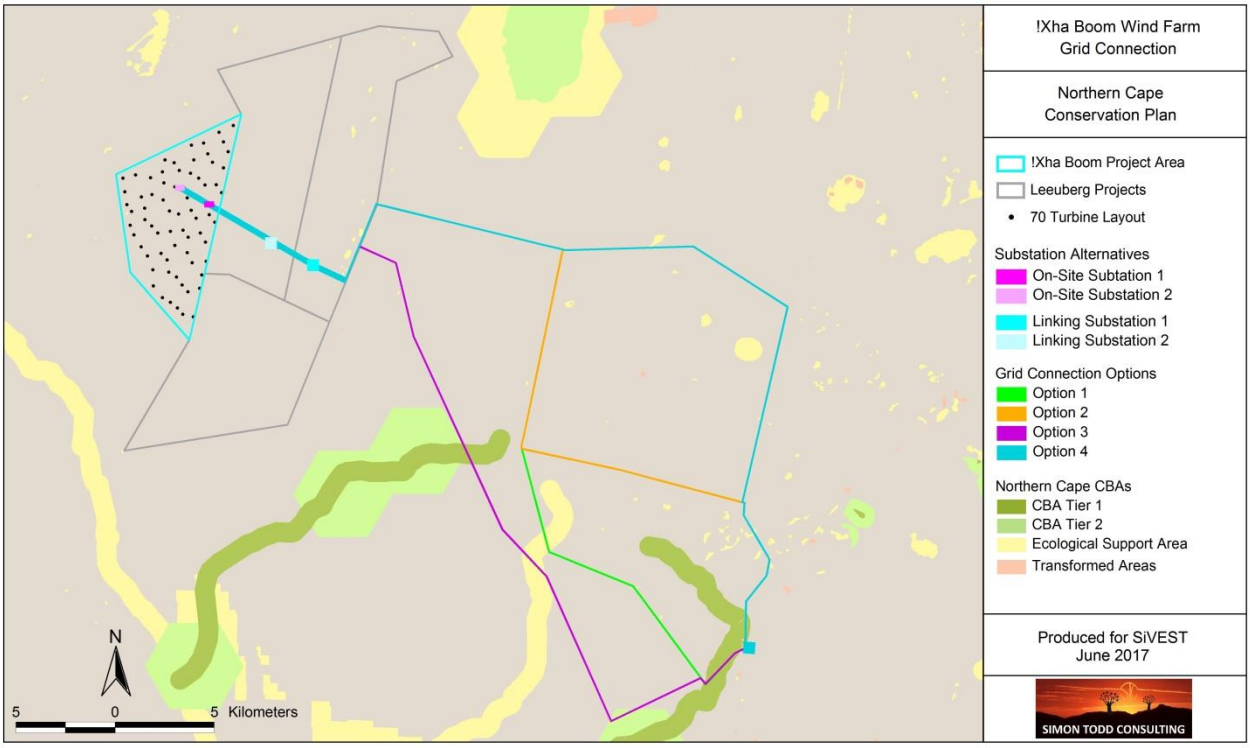

Figure 13. Extract of the Northern Cape Conservation Plan for the study area, showing that there are no CBAs within the !Xha Boom site.

3.6 CUMULATIVE IMPACTS

Where there other renewable energy developments within 30km of a site, a cumulative impact assessment is required. This includes a general assessment of cumulative impact as well as an assessment of different potential cumulative impact sources and an indication of the size or extent of the identified cumulative impact. It is important to note that this consultant has worked on all of the wind farms in the area and as such has intimate knowledge of the affected environment of each as well as the distribution of impact and the recommended mitigation measures associated with each approved or in-process facility.

The majority of the footprint from the grid connection would come from the substations, with the on-site substation listed at 15ha and the linking substation listed at 36ha. These are however the maximum values required and the actual size of the substations that would be built would occupy only about 25% of this area. Some of this footprint has already been considered as part of the wind farm, but as the features are shared, a portion of the footprint is allocated to the power line as well. The grid connection is however associated with a wind energy facility and as such, the development of the two components of the wind farm are not independent of one another. As such, the consideration of cumulative impact for the power line considered here, includes the associated wind farm impact. The analysis and discussion of cumulative impact provided below

is taken from the Ecological Study for the !Xha Boom Wind Farm, but is repeated here for consistency. The total footprints listed below for the wind farms has taken account of and included the footprint of the power line and substations.

In terms of existing impacts in the area and the potential for the !Xha Boom grid connection sites to contribute to cumulative impacts, other renewable energy developments are detailed below in Table 1 and the affected land portions shown in Figure 14. Although the DEA also maintains a map of approved and in-process renewable energy facilities that are part of the RE IPPP, this is currently not up to date and is not illustrated here as a result. All of the other wind energy and grid connection developments in the area are to the east of the !Xha Boom site, mostly between the site and the Helios substation, with only the Dwarsrug facility further east.

It is clear that a node of renewable energy development is developing around the Helios Substation. The large amount of development in the area would potentially generate significant cumulative impact in terms of habitat loss and potential disruption of landscape connectivity. These two major potential cumulative impacts are further explored and described with regards to the area.

In terms of developments that are preferred bidders or under construction, there are three projects, the Khobab and Loeriesfontein 2 Wind Farms and the Hantam Solar Facility. The total extent of habitat loss from these developments is approximately 500ha. In terms of already authorised wind farm projects that have not been awarded preferred bidder status and thus may or may not be built, there is only the 140MW Dwarsrug Wind Farm with the remaining authorised projects in the area being four solar PV projects. There are a number of projects which are currently still in the EIA process, which includes the Graskoppies, Hartebeest Leegte and Ithemba Wind Farms which are part of the larger Leeuwberg development of which the current development is a part and then the three Kokerboom wind farms. All of the latter projects are 235-240MW in output but would not have a significantly larger footprint than the older 140MW projects due to technology advances and the larger output of the current and future turbines. The estimated footprint of each wind farm is estimated to be 100ha. As such, there is 100ha of potential habitat loss due to the authorised Dwarsrug Wind Farm and approximately 700ha of habitat loss due to the projects currently in process if they are all authorised. The total extent of habitat loss from the 4 solar projects would be up to 1600ha, although it is highly unlikely that all proposed projects would ever be built. It is important to note that the footprint of wind energy facilities is decreasing relative to solar PV plants on a per MW basis due to the increasing output of wind turbines but the relatively static nature of PV panel output. The total actual and potential extent of habitat loss is therefore 500ha of existing habitat loss, about 1700ha of potential habitat loss due to already approved projects and 700ha due to projects in process, giving rise to a total of just under 3000ha of total habitat loss.

The majority of the above footprint is located within the Bushmanland Basin Shrubland vegetation type. This vegetation unit has an extent of 34 690 km^2 and is one of the most extensive vegetation types in the country. The total extent of potential habitat loss from all developments in the current study area would amount to less than 0.1% of this vegetation unit. Consequently, it is clear that there is no potential for habitat loss to significantly impact the national availability of this unit or elevate it to a higher threat status. Within a 30km radius of the Helios substation, the potential habitat loss from all projects would amount to approximately 1% of the area. This suggests that even if all projects are built, the total extent of habitat loss would not be significant at this local landscape level either. At a more local level, the affected area is relatively homogenous and there are few species or habitats of conservation concern that would be affected by the developments in the area. There are also no large drainage features or other obvious environmental corridors present in the area that would be directly affected by the development of the area. These results indicate that direct habitat loss is not a highly significant concern in the area and the low fauna and flora diversity of the area further reduces the potential significance of cumulative impact in the area due to habitat loss.

The potential impacts of the current developments on landscape connectivity are more difficult to quantify as this is not directly related to the footprint of the facilities. Wind energy facilities are not fenced but occur within the general farming landscape, whereas solar PV plants are generally fenced with electrified fencing and thus prevent most fauna from traversing the fenced area. On the other hand, PV facilities are concentrated within a limited area compared to wind farms which occupy a large area at low density. A significant proportion of the impact associated with wind farms results from access roads which usually far exceed the footprint of the turbines and their hard stands. Roads pose a significant obstacle to some fauna which cannot or do not cross roads and experience habitat fragmentation as a result. Species that are typically affected by roads include subterranean and fossorial mammals and reptiles as well as many smaller above-ground species which avoid open ground on account of predation risk. However, as there is little soil in the study area, which consists mostly of exposed gravels or calcrete, subterranean species are not common at the site so this is not likely to be a significant impact. In addition, the arid nature of the area means that vegetation cover is naturally low with the result that most fauna are adapted to or accustomed to traversing open ground and not likely to be significantly affected by wind farm roads, which are gravel in any case.

Some fauna may be affected by turbine noise and thus experience habitat loss as a result of wind farms. However, this has not been documented for any fauna and indications are that most fauna quickly become habituated to turbines and do not avoid them to any significant degree. Wind farms are thus not likely to significantly contribute to landscape connectivity for most fauna present in the area and would remain porous for most species. The potential for significant disruption of landscape connectivity due to the wind farms of the area is therefore considered low.

In addition, this is not considered directly relevant here as the power line and substations considered under this application would generate low operational impacts on fauna.

In terms of the potential for the !Xha Boom Wind Farm to contribute to the above cumulative impacts, the total extent of habitat loss would be about 100ha, which is not highly significant and the potential for habitat fragmentation would also be low. In terms of the acceptability of a node of high renewable energy development and associated grid connection infrastructure to occur at the site, this is seen as a positive aspect rather than a negative factor. The area has generally low ecological sensitivity and the concentration of development within this low sensitivity area is seen as positive compared to a more dispersed development pattern which would generate an overall greater impact. As such, the current development is therefore seen as being acceptable in terms of its contribution to cumulative impact.

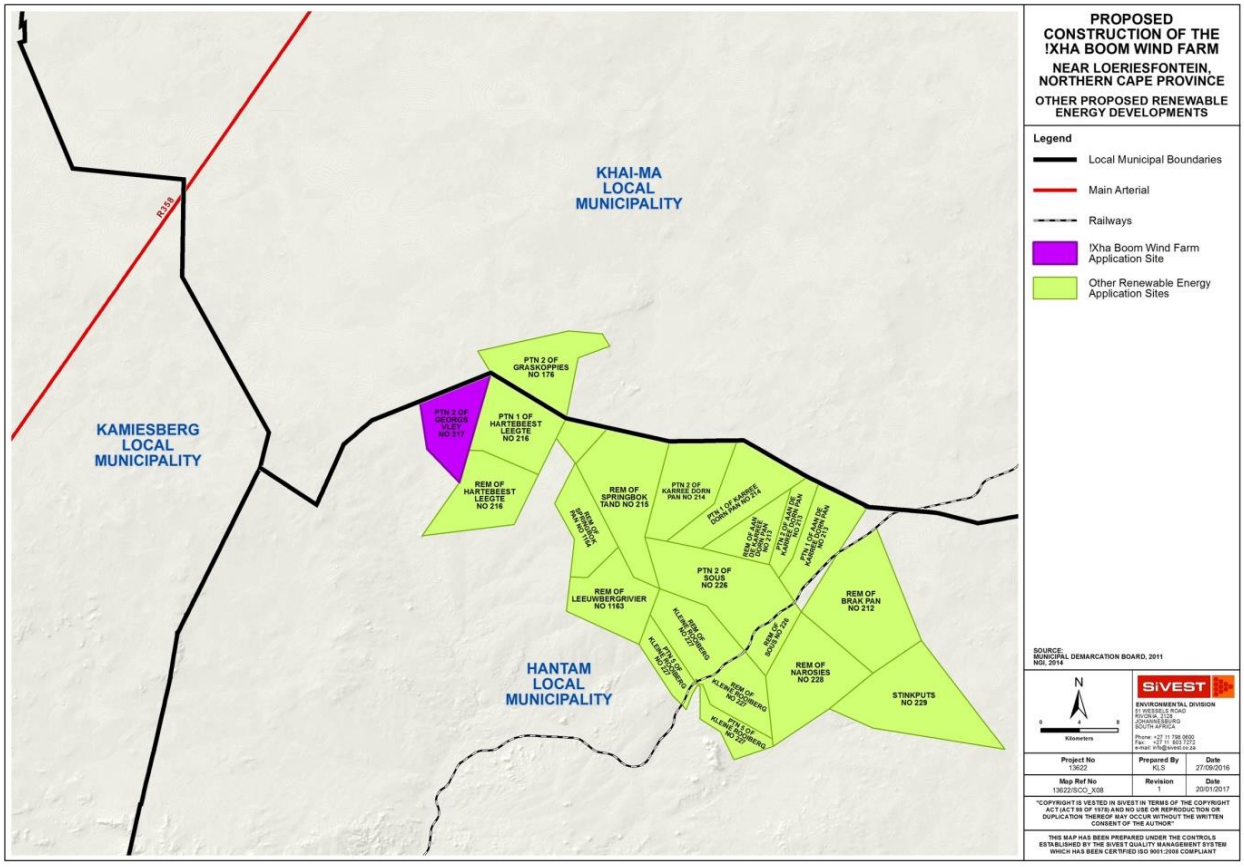

Figure 14. Renewable energy projects known from the vicinity of the !Xha Boom grid connection (purple) and showing the other Leeuwberg WEFs as well as other developments in the wider area.

Table 1. Renewable energy developments in the vicinity of the !Xha Boom grid connection site. So far only the Loeriesfontein 2 and Khobab wind farms and the Hantam PV Solar Energy Facility are under construction or have preferred bidder status.

Development	Current status of EIA/development	Proponent	Capacity	Farm Portions
Dwarsrug Wind Farm	Environmental Authorisation issued	Mainstream Renewable Power	140MW	Remainder of Brak Pan No 212
Khobab Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Portion 2 of the Farm Sous No 226
Loeriesfontein 2 Wind Farm	Under Construction	Mainstream Renewable Power	140MW	Portions 1& 2 of Aan de Karree Doorn Pan No 213
Graskoppies Wind Farm	EIA ongoing	Mainstream Renewable Power	235MW	Portion 2 of the Farm Graskoppies No 176 & Portion 1 of the Farm Hartebeest Leegte No 216
Hartebeest Leegte Wind Farm	EIA ongoing	Mainstream Renewable Power	140MW	Remainder of Hartebeest Leegte No 216
Ithemba Wind Farm	EIA ongoing	Mainstream Renewable Power	140MW	Portion 2 of Graskoppies No 176 & Portion 1 of Hartebeest Leegte No 216
Loeriesfontein PV3 Solar Energy Facility	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of Aan de Karree Doorn Pan No 213
Hantam PV Solar Energy Facility	Environmental Authorisation issued	Solar Capital (Pty) Ltd	Up to 525MW	Remainder of Narosies No 228
PV Solar Energy Facility	Environmental Authorisation issued	Mainstream Renewable Power	100MW	Portion 2 of the Farm Aan de Karree Doorn Pan 213
PV Solar Power Plant	Environmental Authorisation issued	BioTherm Energy	70MW	Portion 5 of Kleine Rooiberg No 227
Kokerboom 1 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Leeuwbergrivier No. 1163 & Remainder of the Farm Kleine Rooiberg No. 227
Kokerboom 2 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Leeuwbergrivier No. 1163 & Remainder of the Farm Kleine Rooiberg No. 227
Kokerboom 3 Wind Farm	Environmental Impact Assessment (EIA) underway	Business Venture Investments No. 1788 (Pty) Ltd (BVI)	240MW	Remainder of the Farm Aan De Karree Doorn Pan No. 213;

Development	Current status of EIA/development	Proponent	Capacity	Farm Portions
				Portion 1 of the Farm Karree Doorn Pan No. 214; and Portion 2 of the Farm Karree Doorn Pan No. 214.
Wind Farm	Environmental Authorisation issued, however the project is no longer active.	Mainstream Renewable Power	50MW	Portion 1 of the Farm Aan de Karree Doorn Pan 213

4 !XHA BOOM GRID CONNECTION SENSITIVITY ASSESSMENT

The sensitivity map for the study area is depicted below in Figure 15. The majority of the site consists of arid grasslands or low open shrublands on open plains that are not considered highly sensitive. The substation alternatives are all located within the Western Bushmanland Klipveld or Arid Grassland habitat types which are low sensitivity with few species of concern present. There are few significant features present along the power line corridors and the only sensitive features present are the occasional drainage lines. As the drainage lines are not very large, they would easily be spanned by the power line and a significant impact on these features can easily be avoided. The overall impact of the development would be local in nature and there are no highly significant impacts that cannot be reduced to a low level.

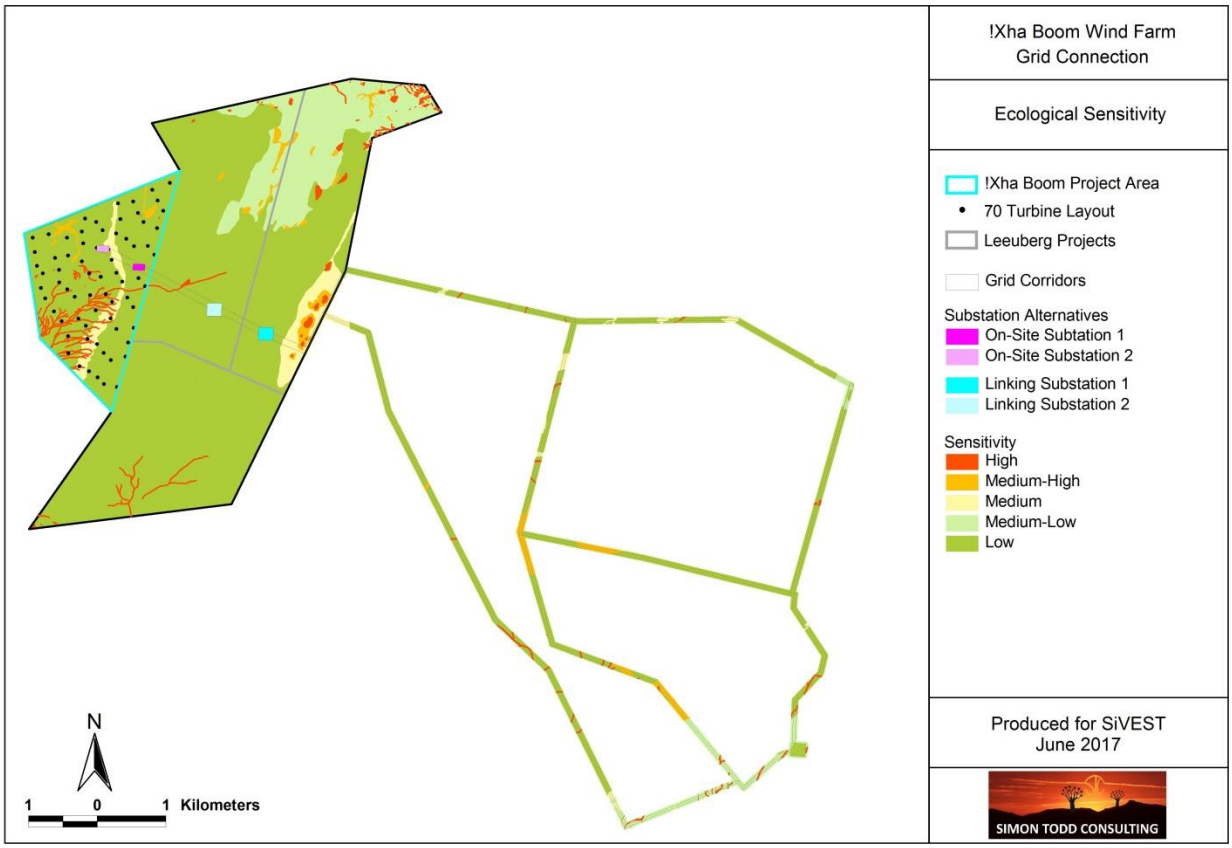

Figure 15. Ecological sensitivity map for the !Xha Boom study area. The majority of the site is arid grassland or low open shrublands of low sensitivity.

5 IMPACTS AND ISSUES IDENTIFICATION

The development of the !Xha Boom grid connection, is likely to result in a variety of impacts, associated largely with the disturbance, loss and transformation of intact vegetation and faunal habitat to hard infrastructure such as substations, access roads and powerlines, etc. The following impacts are identified as the major impacts that are likely to be associated with the development and which are assessed for the !Xha Boom grid connection, for the preconstruction, construction, operational and decommissioning phases of the development.

The likely impacts on the terrestrial ecology of the site resulting from the development of the !Xha Boom grid connection are identified and discussed below with reference to the characteristics and features of the site. The major risk factors and contributing activities associated with the development are identified and briefly outlined and summarised below before the impacts are assessed

Impact 1. Impacts on vegetation and listed or protected plant species

The development would require vegetation clearing for the substations, access roads and pylon foundations. Apart from the direct loss of vegetation within the development footprint, listed and protected species would potentially be impacted. These impacts are likely to occur during the construction phase of the development, with additional vegetation impacts during operation likely to be relatively low. This impact is therefore assessed for the development, for the construction phase only.

Impact 2. Direct Faunal Impacts

Increased levels of noise, pollution, disturbance and human presence during construction will be detrimental to fauna. Sensitive and shy fauna are likely to move away from the area during the construction phase as a result of the noise and human activities present, while some slow-moving species would not be able to avoid the construction activities and might be killed if proper management and monitoring is not in place. Traffic at the site during all phases of the project would pose a risk of collisions with fauna. Slower types such as tortoises, snakes and amphibians would be most susceptible and the impact would be largely concentrated to the construction phase when vehicle activity was high. Some mammals and reptiles would be vulnerable to illegal collection or poaching during the construction phase as a result of the large number of construction personnel that are likely to be present. During the operational phase, impacts associated with the power line and substation would be low and are not considered significant. Faunal impacts will therefore be assessed only during the construction and decommissioning phases of the development.

Impact 3. Increased Erosion Risk

Disturbance created during construction would leave the site vulnerable to wind and water erosion. Soil disturbance associated with the development will render the impacted areas vulnerable to erosion and measures to limit erosion will need to be implemented. This impact is likely to manifest during construction and would persist into the operational phase and is therefore be assessed for both phases.

Impact 4. Alien Plant Invasion

The disturbance associated with the construction phase of the project will render the disturbed areas vulnerable to alien plant invasion. Some woody aliens are already present and additional alien plant invasion is inevitable and regular alien plant clearing activities would be required to limit the extent of this problem. Once the natural vegetation has returned to the disturbed areas, the site will be less vulnerable to alien plant invasion, however, roadsides are likely to remain foci of alien plant invasion for years. This impact would manifest during the operational phase, although some of the required measures to reduce this impact are required during construction.

Impact 5. *Cumulative Impact 1. Impacts on broad-scale ecological processes and cumulative habitat loss*

The development will contribute to cumulative impacts on habitat loss in the area and potentially the ability to meet future conservation targets. The main source of impact in this regard would come from the substations as well as access and service roads associated with the power line. This impact is however assessed for the project as a whole and not just the power line as this would not be built without the establishment of the wind farm. This impact would persist for the life of the development and is thus assessed for the operational phase of the grid connection.

6 ASSESSMENT OF IMPACTS

An assessment of the likely extent and significance of each impact identified above is made below for each phase of the development.

6.1 CONSTRUCTION PHASE

Impact 1.Impacts on vegetation and protected plant species

Impact 1. Impacts on vegetation and protected plant species	
Environmental Parameter	Vegetation and protected plant species
Issue/Impact/Environmental Effect/Nature	Vegetation clearing for powerline, access roads and substations will impact on vegetation and protected plant species.
Extent	The extent of the impact will be restricted to the grid connection footprint and as such would be local in nature.
Probability	This impact will definitely occur as vegetation clearing will be required for the construction and establishment of the project.
Reversibility	This impact is not highly reversible as it would take a long time for any cleared areas to return to their former state and rehabilitation of arid environments is very difficult.
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources.
Duration	The construction phase itself will be of short duration, but the resulting impact would persist for a long time.
Cumulative effect	The clearing would contribute to vegetation impacts in the area, the contribution of the grid connection development itself would be low, but as there are several facilities in the area, the cumulative impact would be moderate at the local level, but low at a broader scale.

Impact 1. Impacts on vegetation and protected plant species		
Intensity/magnitude	The intensity of the impact would be low as the extent of the footprint to be cleared is limited and localised.	
Significance Rating	Without mitigation, this impact would be of low significance, but with avoidance this impact can be reduced to a very low level.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	4	4
Reversibility	2	2
Irreplaceable loss	2	1
Duration	3	3
Cumulative effect	2	2
Intensity/magnitude	2	1
Significance rating	-28 (low negative)	-13 (very low negative)
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) Placement of pylons and other infrastructure within the High Sensitivity areas and drainage lines should be avoided. 2) Preconstruction walk-though of the approved development footprint to ensure that sensitive habitats and species are avoided where possible. 3) Ensure that lay-down and other temporary infrastructure is within low sensitivity areas, preferably previously transformed areas if possible. 4) Minimise the development footprint as far as possible and rehabilitate disturbed areas that are no longer required by the operational phase of the development. 5) Preconstruction environmental induction for all construction staff on site to ensure that basic environmental principles are adhered to. This includes topics such as no littering, appropriate handling of pollution and chemical spills, avoiding fire hazards, minimizing wildlife interactions, remaining within demarcated construction areas etc. 6) Demarcate all areas to be cleared with construction tape or other appropriate and effective means. However caution should be exercised to avoid using material that might entangle fauna.	

Impact 2. Impacts on fauna due to construction phase activities

Impact 2. Impacts on fauna during construction		
Environmental Parameter	Faunal impacts due to construction activities	
Issue/Impact/Environmental Effect/Nature	Vegetation clearing, the use of heavy machinery and human presence during construction is likely to negatively affect resident fauna during construction.	
Extent	The extent of the impact will be restricted the site and as such would be local in nature.	
Probability	This impact is likely to occur and some impact is certain to occur.	
Reversibility	Noise and disturbance is largely reversible but habitat loss due to transformation of intact habitat is not considered easily reversible.	
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources in terms of fauna.	
Duration	The construction phase itself will be of relatively short duration.	
Cumulative effect	The clearing would contribute to cumulative habitat loss for fauna in the area, but this would be largely local in nature and limited in extent.	
Intensity/magnitude	The intensity of the impact would be moderate to low.	
Significance Rating	Construction phase impact would be of relatively short duration (2 years) but of low to moderate intensity. Overall significance is likely to be low before mitigation and very low thereafter.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	2	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	3	2
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-24 (low negative)	-20 (low negative)
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) Preconstruction walk-through of the substation and powerline sites to identify areas of faunal sensitivity. 2) During construction any fauna directly threatened by the construction activities should be removed to a safe location by the ECO or other suitably qualified person.	

Impact 2. Impacts on fauna during construction	
	3) Any trenches that are required for cabling etc, should not be left open for extended periods as fauna such as tortoises will fall in an become trapped. Any open trenches should be checked regularly for trapped fauna. 4) The illegal collection, hunting or harvesting of any plants or animals at the site should be strictly forbidden. Personnel should not be allowed to wander off the construction site. 5) No fires should be allowed within the site as there is a risk of runaway veld fires. 6) No fuelwood collection should be allowed on-site. 7) No dogs or cats should be allowed on site apart from that of the landowners. 8) If any parts of site such as construction camps must be lit at night, this should be done with low-UV type lights (such as most LEDs) as far as practically possible, which do not attract insects and which should be directed downwards. 9) All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. 10) No unauthorized persons should be allowed onto the site and site access should be strictly controlled 11) All construction vehicles should adhere to a low speed limit (40km/h for cars and 30km/h for trucks) to avoid collisions with susceptible species such as snakes and tortoises and rabbits or hares. 12) All personnel should undergo environmental induction with regards to fauna and in particular awareness about not harming or collecting species such as snakes, tortoises and snakes which are often persecuted out of fear or superstition.

6.2 OPERATIONAL PHASE IMPACTS

Impact 3. Increased Erosion Risk

Impact 3. Increased Soil Erosion Risk	
Environmental Parameter	Ecosystem integrity and the delivery of ecosystem services such as grazing and clean water.

Impact 3. Increased Soil Erosion Risk		
Issue/Impact/Environmental Effect/Nature	Following construction, the site will be vulnerable to soil erosion due to the disturbance created and likely low natural revegetation of disturbed areas.	
Extent	The extent of the impact will be restricted to the grid connection and as such would be local in nature.	
Probability	This impact would be likely to occur due to the disturbance generated during construction.	
Reversibility	Reversibility would be high for mild erosion, but would become increasingly low with increasing severity of erosion.	
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources if this impact is managed.	
Duration	The risk of this impact is likely to persist for several years after construction.	
Cumulative effect	Erosion would contribute to cumulative ecosystem degradation in the area, but with mitigation, this impact can be avoided.	
Intensity/magnitude	The intensity of the impact would be low as the site is not considered highly vulnerable to erosion.	
Significance Rating	Without mitigation, this impact would be of moderate to low significance, but with avoidance this impact can be reduced to a very low level.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	3	2
Cumulative effect	2	1
Intensity/magnitude	2	1
Significance rating	-24 (low negative)	-10 (very low negative)
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) Erosion management at the site should take place according to the Erosion Management Plan and Rehabilitation Plan. 2) All hardened surfaces should have runoff control features which redirect water flow and dissipate any energy in the water which may pose an erosion risk. 3) Regular monitoring for erosion after construction to ensure that no erosion problems have developed as result of the disturbance, as per the Erosion Management and Rehabilitation Plans for the project.	

Impact 3. Increased Soil Erosion Risk	
	4) All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques. 5) All cleared areas should be revegetated with indigenous perennial shrubs and grasses from the local area. These can be cut when dry and placed on the cleared areas if natural recovery is slow.

Impact 4. Alien plant invasion risk

Impact 4. Alien Plant Invasion		
Environmental Parameter	Biodiversity, ecosystem integrity and the delivery of ecosystem services such as forage.	
Issue/Impact/Environmental Effect/Nature	Following construction, the site will be vulnerable to alien plant invasion due to disturbance.	
Extent	The extent of the impact will be restricted the powerline and substation sites and as such would be local in nature.	
Probability	This impact would be likely to occur as there are already some alien species at the site and these would be likely to increase in response to disturbance.	
Reversibility	Reversibility would be high for mild infestation, but would become increasingly low with extensive invasion.	
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources if this impact is managed.	
Duration	This impact is likely to persist for several years after construction.	
Cumulative effect	Alien invasion would contribute to cumulative ecosystem degradation in the area, but with mitigation, this impact can be avoided.	
Intensity/magnitude	The intensity of the impact would be low as the site is not considered highly vulnerable to invasion.	
Significance Rating	With avoidance this impact can be reduced to a very low level.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	2
Duration	3	2

Impact 4. Alien Plant Invasion		
Cumulative effect	1	1
Intensity/magnitude	2	1
Significance rating	-24 (Low negative)	-10 (very low negative)
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) Wherever excavation is necessary, topsoil should be set aside and replaced after construction to encourage natural regeneration of the local indigenous species. 2) Due to the disturbance at the site as well as the increased runoff generated by the hard infrastructure, alien plant species are likely to be a long-term problem at the sites and a long-term control plan will need to be implemented. Problem woody species such as *Prosopis* are already present in the area and are likely to increase rapidly if not controlled. 3) Regular monitoring for alien plants within the development footprint should be carried out. 4) Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible.	

6.3 DECOMMISSIONING PHASE IMPACTS

Impact 5. Impacts on fauna due to decommissioning phase activities

Impact 5. Impacts on fauna during decommissioning	
Environmental Parameter	Faunal impacts due to decommissioning activities
Issue/Impact/Environmental Effect/Nature	Fauna will be negatively affected by the decommissioning of the grid connection due to the human disturbance, the presence and operation of vehicles and heavy machinery on the site and the noise generated.
Extent	The extent of the impact will be restricted the site and as such would be local in nature.
Probability	This impact is likely to occur to some degree.
Reversibility	Noise and disturbance would be of relatively short duration and are considered reversible.
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources in terms of fauna.
Duration	This impact would be transient and persist for the active decommissioning period only.

Impact 5. Impacts on fauna during decommissioning		
Cumulative effect	There would be transient contribution to cumulative disturbance impacts, but this would cease after decommissioning and ultimately if decommissioned, the impacts associated with the development would largely cease.	
Intensity/magnitude	The intensity of the impact would be moderate.	
Significance Rating	This impact would occur at a moderate intensity but would be transient in nature and overall significance is likely to be moderate before mitigation and low thereafter.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	2	2
Cumulative effect	1	1
Intensity/magnitude	2	2
Significance rating	-20 (low negative)	-18 (low negative)
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) Any potentially dangerous fauna such as snakes or fauna threatened by the decommissioning activities should be removed to a safe location prior to the commencement of decommissioning activities. 2) All hazardous materials should be stored in the appropriate manner to prevent contamination of the site. Any accidental chemical, fuel and oil spills that occur at the site should be cleaned up in the appropriate manner as related to the nature of the spill. 3) All vehicles accessing the site should adhere to a low speed limit (40km/h max) to avoid collisions with susceptible species such as snakes and tortoises. 4) No excavated holes or trenches should be left open for extended periods as fauna may fall in and become trapped. 5) All above-ground infrastructure should be removed from the site. Below-ground infrastructure such as cabling can be left in place if it does not pose a risk, as removal of such cables may generate additional disturbance and impact, however, this should be in accordance with the decommissioning and	

Impact 5. Impacts on fauna during decommissioning	
	recycling plan, and as per the agreements with the land owners concerned.

Impact 6. Increased Erosion Risk due to Decommissioning

Impact 6. Increased Soil Erosion Risk		
Environmental Parameter	Ecosystem integrity	
Issue/Impact/Environmental Effect/Nature	Following decommissioning, the site will be vulnerable to soil erosion due to the disturbance created by the removal of infrastructure from the site.	
Extent	The extent of the impact will be restricted the powerline and substation sites and as such would be local in nature.	
Probability	This impact would be likely to occur due to the large amount of disturbance generated during decommissioning.	
Reversibility	Reversibility would be high for mild erosion, but would become increasingly low with increasing severity of erosion.	
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources if this impact is managed.	
Duration	This impact is likely to persist for several years after decommissioning.	
Cumulative effect	Erosion would contribute to cumulative ecosystem degradation in the area, but with mitigation, this impact can be avoided.	
Intensity/magnitude	The intensity of the impact would be low as the site is not considered highly vulnerable to erosion and is limited in extent.	
Significance Rating	Without mitigation, this impact would be of moderate significance, but with avoidance this impact can be reduced to a very low level.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	2	1
Duration	3	2
Cumulative effect	1	1
Intensity/magnitude	2	1
Significance rating	-24 (low negative)	-9 (very low negative)

Impact 6. Increased Soil Erosion Risk	
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) There should be regular monitoring for erosion for at least 2 years after decommissioning by the applicant to ensure that no erosion problems develop as a result of the disturbance, and if they do, to immediately implement erosion control measures. 2) All erosion problems observed should be rectified as soon as possible, using the appropriate erosion control structures and revegetation techniques. 3) All disturbed and cleared areas should be revegetated with indigenous perennial shrubs and grasses from the local area.

Impact 7. Alien plant invasion risk following decommissioning

Impact 7. Alien Plant Invasion	
Environmental Parameter	Ecosystem integrity and diversity.
Issue/Impact/Environmental Effect/Nature	Following decommissioning, the site will be vulnerable to alien plant invasion due to disturbance
Extent	The extent of the impact will be restricted to the site and as such would be local in nature.
Probability	This impact would be likely to occur as there are already some alien species at the site and these would be likely to increase in response to disturbance.
Reversibility	Reversibility would be high for mild infestation, but would become increasingly low with extensive invasion.
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources if this impact is managed.
Duration	This impact is likely to persist for several years after decommissioning.
Cumulative effect	Alien invasion would contribute to cumulative ecosystem degradation in the area, but with mitigation, this impact can be avoided.
Intensity/magnitude	The intensity of the impact would be moderate as the site is not considered highly vulnerable to invasion and is limited in extent.
Significance Rating	Without mitigation, this impact would be of moderate significance, but with avoidance this impact can be reduced to a very low level.

Impact 7. Alien Plant Invasion		
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	1	1
Probability	3	2
Reversibility	2	2
Irreplaceable loss	1	1
Duration	3	2
Cumulative effect	1	1
Intensity/magnitude	3	2
Significance rating	-33 (medium negative)	-18 (low negative)
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) Wherever excavation is necessary for decommissioning, topsoil should be set aside and replaced after construction to encourage natural regeneration of the local indigenous species. 2) Due to the disturbance at the site alien plant species are likely to be a long-term problem at the site following decommissioning and regular control will need to be implemented until a cover of indigenous species has returned. 3) Regular monitoring for alien plants within the disturbed areas for at least two years after decommissioning or until alien invasives are no longer a problem at the site. 4) Regular alien clearing should be conducted using the best-practice methods for the species concerned. The use of herbicides should be avoided as far as possible.	

6.4 CUMULATIVE IMPACTS

Cumulative Impact 1. Cumulative habitat loss and fragmentation

Impact 8. Cumulative impacts and loss of broad-scale connectivity	
Environmental Parameter	Broad-scale ecological processes, especially habitat fragmentation.
Issue/Impact/Environmental Effect/Nature	Transformation and presence of the development will contribute to cumulative habitat loss and impacts on broad-scale ecological processes such as fragmentation.
Extent	Should all the developments in the area go ahead, then this would result in a landscape-level impact.

Impact 8. Cumulative impacts and loss of broad-scale connectivity		
Probability	This impact is likely to occur as some facilities have already been built and some additional habitat loss would occur if the current development proceeds.	
Reversibility	This impact would to some degree be reversible when the facilities are decommissioned.	
Irreplaceable loss of resources	It is not likely that there would be significant irreplaceable loss of resources.	
Duration	This impact would persist for the lifespan of the development.	
Cumulative effect	The development would contribute to cumulative impacts on habitat loss and fragmentation in the area, and while the contribution of a single facility would be low, there are several facilities in the area and so overall cumulative impacts are likely to be moderate.	
Intensity/magnitude	The intensity of the impact would be moderate to low as the area is not sensitive and the overall total footprint is not highly significant.	
Significance Rating	Due to the relatively low contribution of the development and the low overall current level of impact in the area, the significance of this impact is likely to be low.	
	Pre-mitigation impact rating	Post mitigation impact rating
Extent	2	2
Probability	4	3
Reversibility	2	2
Irreplaceable loss	2	1
Duration	3	3
Cumulative effect	2	2
Intensity/magnitude	2	2
Significance rating	-30 (medium negative)	-26 (low negative)
Mitigation measures	Mitigation measures to reduce residual risk or enhance opportunities: 1) Minimise the development footprint within the high sensitivity areas. 2) There should be an integrated management plan for the development area during operation, which is beneficial to fauna and flora. 3) All disturbed areas should be rehabilitated with locally occurring shrubs and grasses after construction and decommissioning to reduce the overall footprint of the development.	

7 IDENTIFICATION OF PREFERRED ALTERNATIVES

As described, there are two alternatives each for the on-site and linking substation and then four different power line routes being considered. Overall, there is not a lot of difference between the different substation options as these are all within a very similar environment with few features of concern present. Although the power line options each take different routes to the Helios substation, their overall sensitivity is not widely different and the shorter options, that being Alternative 3 and Alternative 1 are seen as the most favourable as a result. However, all of the power line options are seen as being acceptable as no route has any highly significant features present.

The comparative assessment is provided below, for each component of the development.

COMPARATIVE ASSESSMENT OF ALTERNATIVES

Key

PREFERRED	The alternative will result in a low impact / reduce the impact
FAVOURABLE	The impact will be relatively insignificant
NOT PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Alternative	Preference	Reasons (incl. potential issues)
ON-SITE SUBSTATION ALTERNATIVES		
On-site Substation Option 1	Preferred	The site is located on the eastern plateau area of the site dominated by *Stipagrostis* grasslands. There are no sensitive features of SCC within the footprint area. No significant issues associated with the site. This is clearly the preferred option for the substation.
On-site Substation Option 2	Not Preferred	The site is located in a transitional area between the arid grasslands in the east and the Klipveld in the west. There are numerous small drainage features or washes in the site and it is not considered favourable in comparison with the preferred alternative.
Linking Substation Alternatives		
Linking Substation Option 1	Preferred	Located within the Arid Grassland habitat type, there are so features of concern within the site and it is considered favourable. The only distinguishing feature which makes this alternative less preferred

Alternative	Preference	Reasons (incl. potential issues)
		is the proximity to the nearby pans as well as the slightly greater slope of the site.
Linking Substation Option 2	Favourable	Located on a homogenous open *Stipagrostis ciliata*-dominated plain. There are no features of significance in the footprint or vicinity of the site. The is identified as the preferred alternative as the site is flatter than the alternative, but the difference in preference is marginal and there is not real difference between the two alternatives.
GRID LINE CORRIDOR ALTERNATIVES		
Grid Corridor Option 1	(Less) Favourable	Traverses some low hills in the south that are considered moderately sensitive as well as some succulent shrubland habitat that is also more sensitive than the other shrubland and grassland types. Considered acceptable, but only as the third Option, with both Option 2 and Option 4 being seen as more favourable alternatives.
Grid Corridor Option 2	Preferred	No highly sensitive features along the route and the last third of the line towards Helios is located along existing roads and disturbed areas. Overall impact is considered the lowest of the options. Proximity to existing disturbance and power lines make this the preferred option.
Grid Corridor Option 3	Not Preferred	This Option traverses more drainage features than the other alternatives and the also runs through a long section where there are no other power lines and as such the additional disturbance is considered greater than for the other routes. The route traverses an extensive area of currently little-disturbed habitat and includes some more sensitive succulent shrubland habitat in the south. As a result this is considered the least favourable option.
Grid Corridor Option 4	(More) Favourable	There are no high sensitivity features along the route and as it runs adjacent to existing roads for much of its length, the additional disturbance generated during construction is likely to be low.

Alternative	Preference	Reasons (incl. potential issues)
		The route is adjacent to existing main access routes for large sections of the route with the result that overall impact is low and is identified as the next preferred alternative after Option 2.

8 CONCLUSION & RECOMMENDATIONS

The on-site substation Option1 as well as both the Linking Substation alternatives are located within the Bushmanland Arid Grassland habitat type. The on-site Substation Option 2 is located within the Western Bushmanland Klipveld. These are extensive vegetation units with low diversity and low abundance of species of conservation concern. Consequently, nearly all of the substation alternatives are considered acceptable and would generate low impact. Only on-site Substation Option 2 is considered unfavourable as there a numerous small drainage lines in the affected area. On-site Substation Option 1 was identified as the preferred on-site substation alternatives and while differences are small, Linking Substation Option 1 was identified as the preferred linking substation alternative.

In terms of the grid corridors, there was also not a lot of difference between the alternatives and preferences were based on relatively small differences in potential impact as no alternatives were considered fatally-flawed. Grid Corridor Option 2 was identified as the preferred route as there are no highly sensitive features along the route and the last third of the line towards Helios substation is located along existing roads and disturbed areas. The overall impact of this option would be the lowest of the options considered. Grid Corridor Option 4 is considered the next most favourable option as the route is adjacent to existing access routes or power lines for large sections of the route with the result that construction-phase disturbance is likely to be relatively low.

Although the current assessment is only for the grid connection and substations, the grid connection is contingent on a wind energy facility being built and as such, the development of the power line and the wind farm are not independent of one another. Consequently, cumulative impacts for the power line have been considered in context of the wind farm as a whole, including the grid connection. An analysis of potential cumulative impacts in the area indicates that a node of renewable energy facilities is developing round the Helios Substation. The total potential extent of direct habitat loss from all proposed developments if they were all to be built would amount to about 3000ha. This represents about 1% of the local area and less than 0.1% of the Bushmanland Basin Shrubland or Bushmanland Arid Grassland vegetation type. This indicates that the current developments at the site do not pose a risk of significantly impacting the national availability of the affected units or elevate them to a higher threat status. The development of the !Xha Boom

Wind Farm with associated grid connection would generate about 100ha of direct habitat loss which is not considered highly significant and the potential for habitat fragmentation from the development would also be low. The broader study area has low ecological sensitivity and the concentration of development within this low sensitivity area is seen as having significantly less ecological impact compared to a more dispersed development pattern over a wider area. Based on these results, total cumulative impacts and the contribution of the !Xha Boom Wind Farm and associated grid connection to cumulative impacts in the region are seen as being acceptable and would remain of low overall significance.

With the application of relatively simple mitigation and avoidance measures, the impact of the !Xha Boom Wind Farm's grid connection can be reduced to a low overall level. There are no specific long-term impacts likely to be associated with the grid connection that cannot be reduced to an acceptable level through mitigation and avoidance. As such, there are no fatal flaws associated with the development and no terrestrial ecological considerations that should prevent it from proceeding.

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10 ANNEX 1. LIST OF PLANTS

List of plant species known from the vicinity of the !Xha Boom grid connection study site, based on the SANBI SIBIS database. Conservation status is from the South African Red Data List of Plants 2016.

Family	Species	IUCN Status	Family	Species	IUCN Status
ACANTHACEAE	*Acanthopsis disperma*	LC	ACANTHACEAE	*Blepharis furcata*	LC
AIZOACEAE	*Aizoon canariense*	LC	AIZOACEAE	*Galenia africana*	LC
AIZOACEAE	*Galenia fruticosa*	LC	AIZOACEAE	*Galenia sarcophylla*	LC
AIZOACEAE	*Galenia squamulosa*	LC	AIZOACEAE	*Plinthus karooicus*	LC
AIZOACEAE	*Tetragonia arbuscula*	LC	AIZOACEAE	*Tetragonia fruticosa*	LC
AIZOACEAE	*Tetragonia microptera*	LC	AMARYLLIDACEAE	*Brunsvigia comptonii*	LC
APOCYNACEAE	*Gomphocarpus filiformis*	LC	APOCYNACEAE	*Fockea sinuata*	LC
APOCYNACEAE	*Hoodia gordonii*	DDD	APOCYNACEAE	*Quaqua incarnata*	LC
ASPARAGACEAE	*Asparagus africanus*	LC	ASPARAGACEAE	*Asparagus capensis var. capensis*	LC
ASPHODELACEAE	*Aloe claviflora*	LC	ASPHODELACEAE	*Aloe falcata*	LC
ASTERACEAE	*Amellus microglossus*	LC	ASTERACEAE	*Amellus strigosus subsp. pseudoscabridus*	LC
ASTERACEAE	*Arctotis fastuosa*	LC	ASTERACEAE	*Dicoma capensis*	LC
ASTERACEAE	*Didelta carnosa var. carnosa*	LC	ASTERACEAE	*Didelta spinosa*	LC
ASTERACEAE	*Dimorphotheca polyptera*	LC	ASTERACEAE	*Eriocephalus ericoides subsp. ericoides*	LC
ASTERACEAE	*Eriocephalus microphyllus var. pubescens*	LC	ASTERACEAE	*Eriocephalus spinescens*	LC
ASTERACEAE	*Felicia clavipilosa subsp. clavipilosa*	LC	ASTERACEAE	*Foveolina dichotoma*	LC
ASTERACEAE	*Gazania lichtensteinii*	LC	ASTERACEAE	*Gazania jurineifolia*	LC
ASTERACEAE	*Helichrysum herniarioides*	LC	ASTERACEAE	*Lasiopogon glomerulatus*	LC
ASTERACEAE	*Osteospermum pinnatum var. pinnatum*	LC	ASTERACEAE	*Osteospermum spinescens*	LC
ASTERACEAE	*Pegolettia retrofracta*	LC	ASTERACEAE	*Pentzia spinescens*	LC
ASTERACEAE	*Pteronia adenocarpa*	LC	ASTERACEAE	*Pteronia glauca*	LC
ASTERACEAE	*Pteronia glomerata*	LC	ASTERACEAE	*Pteronia leucoclada*	LC
ASTERACEAE	*Pteronia mucronata*	LC	ASTERACEAE	*Pteronia oblanceolata*	LC
ASTERACEAE	*Rosenia humilis*	LC	ASTERACEAE	*Senecio niveus*	LC
ASTERACEAE	*Senecio abbreviatus*	LC	ASTERACEAE	*Tripteris sinuata var. linearis*	LC
ASTERACEAE	*Tripteris sinuata var. sinuata*	LC	ASTERACEAE	*Ursinia nana subsp. nana*	LC
BIGNONIACEAE	*Rhigozum trichotomum*	LC	BRASSICACEAE	*Heliophila arenosa*	LC

BRASSICACEAE	*Lepidium desertorum*	LC	CARYOPHYLLACEAE	*Dianthus namaensis var. dinteri*	LC
CHENOPODIACEAE	*Atriplex vestita var. appendiculata*	LC	CHENOPODIACEAE	*Bassia salsoloides*	LC
CHENOPODIACEAE	*Exomis microphylla var. axyrioides*	LC	CHENOPODIACEAE	*Salsola aellenii*	LC
CHENOPODIACEAE	*Salsola aphylla*	LC	CHENOPODIACEAE	*Salsola henriciae*	LC
CHENOPODIACEAE	*Salsola procera*	LC	CHENOPODIACEAE	*Salsola tuberculata*	LC
CHENOPODIACEAE	*Suaeda fruticosa*	LC	CHENOPODIACEAE	*Suaeda merxmuelleri*	LC
CHENOPODIACEAE	*Sasola kali*	Alien	CHENOPODIACEAE	*Atriplex semibaccata*	Alien
CHENOPODIACEAE	*Atriplex lindleyi subsp inflata*	Alien	EUPHORBIACEAE	*Euphorbia aequoris*	LC
EUPHORBIACEAE	*Euphorbia multiceps*	LC	FABACEAE	*Lebeckia spinescens*	LC
FABACEAE	*Lessertia macrostachya var. macrostachya*	LC	FABACEAE	*Lotononis leptoloba*	LC
FABACEAE	*Melolobium candicans*	LC	FABACEAE	*Parkinsonia africana*	LC
FABACEAE	*Sutherlandia frutescens*	LC	FABACEAE	*Prosopis glandulosa*	Alien
FRANKENIACEAE	*Frankenia pulverulenta*	LC	GERANIACEAE	*Pelargonium minimum*	LC
GERANIACEAE	*Sarcocaulon patersonii*	LC	HYACINTHACEAE	*Drimia intricata*	LC
IRIDACEAE	*Moraea pallida*	LC	IRIDACEAE	*Tritonia karooica*	LC
LAMIACEAE	*Salvia disermas*	LC	LORANTHACEAE	*Septulina glauca*	LC
MALVACEAE	*Hermannia paucifolia*	LC	MALVACEAE	*Hermannia spinosa*	LC
MALVACEAE	*Radyera urens*	LC	MELIANTHACEAE	*Melianthus comosus*	LC
MESEMBRYANTHEMACEAE	*Aloinopsis luckhoffii*	DDT	MESEMBRYANTHEMACEAE	*Antimima evoluta*	LC
MESEMBRYANTHEMACEAE	*Aridaria noctiflora subsp. straminea*	LC	MESEMBRYANTHEMACEAE	*Cephalophyllum fulleri*	Rare
MESEMBRYANTHEMACEAE	*Conophytum uviforme subsp. uviforme*	LC	MESEMBRYANTHEMACEAE	*Drosanthemum lique*	LC
MESEMBRYANTHEMACEAE	*Lampranthus haworthii*	LC	MESEMBRYANTHEMACEAE	*Lampranthus uniflorus*	LC
MESEMBRYANTHEMACEAE	*Lithops otzeniana*	VU	MESEMBRYANTHEMACEAE	*Mesembryanthemum crystallinum*	LC
MESEMBRYANTHEMACEAE	*Mesembryanthemum stenandrum*	LC	MESEMBRYANTHEMACEAE	*Psilocaulon coriarium*	LC
MESEMBRYANTHEMACEAE	*Psilocaulon junceum*	LC	MESEMBRYANTHEMACEAE	*Ruschia abbreviata*	LC
MESEMBRYANTHEMACEAE	*Ruschia robusta*	LC	MESEMBRYANTHEMACEAE	*Stoeberia frutescens*	LC
MESEMBRYANTHEMACEAE	*Stomatium mustellinum*	LC	MOLLUGINACEAE	*Hypertelis salsoloides var. salsoloides*	LC
MOLLUGINACEAE	*Limeum aethiopicum*	LC	NEURADACEAE	*Grielum humifusum var. parviflorum*	LC
OXALIDACEAE	*Oxalis beneprotecta*	LC	PEDALIACEAE	*Sesamum capense*	LC
PLUMBAGINACEAE	*Dyerophytum africanum*	LC	POACEAE	*Aristida adscensionis*	LC
POACEAE	*Ehrharta calycina*	LC	POACEAE	*Enneapogon desvauxii*	LC
POACEAE	*Enneapogon scaber*	LC	POACEAE	*Fingerhuthia africana*	LC
POACEAE	*Schismus barbatus*	LC	POACEAE	*Stipagrostis anomala*	LC

POACEAE	*Stipagrostis brevifolia*	LC	POACEAE	*Stipagrostis ciliata var. capensis*	LC
POACEAE	*Stipagrostis namaquensis*	LC	POACEAE	*Stipagrostis obtusa*	LC
POLYGALACEAE	*Polygala seminuda*	LC	RUTACEAE	*Agathosma virgata*	LC
SANTALACEAE	*Thesium hystricoides*	LC	SANTALACEAE	*Thesium hystrix*	LC
SANTALACEAE	*Thesium lineatum*	LC	SCROPHULARIACEAE	*Aptosimum indivisum*	LC
SCROPHULARIACEAE	*Aptosimum procumbens*	LC	SCROPHULARIACEAE	*Aptosimum spinescens*	LC
SCROPHULARIACEAE	*Jamesbrittenia atropurpurea subsp. atropurpurea*	LC	SCROPHULARIACEAE	*Nemesia calcarata*	LC
SCROPHULARIACEAE	*Peliostomum leucorrhizum*	LC	SCROPHULARIACEAE	*Selago albida*	LC
SCROPHULARIACEAE	*Selago pinguicula*	LC	SOLANACEAE	*Lycium cinereum*	LC
SOLANACEAE	*Lycium pilifolium*	LC	SOLANACEAE	*Lycium oxycarpum*	LC
SOLANACEAE	*Solanum burchellii*	LC	SOLANACEAE	*Solanum capense*	LC
URTICACEAE	*Forsskaolea candida*	LC	ZYGOPHYLLACEAE	*Tribulus terrestris*	LC
ZYGOPHYLLACEAE	*Tribulus zeyheri*	LC	ZYGOPHYLLACEAE	*Zygophyllum flexuosum*	LC
ZYGOPHYLLACEAE	*Zygophyllum lichtensteinianum*	LC	ZYGOPHYLLACEAE	*Zygophyllum retrofractum*	LC
ZYGOPHYLLACEAE	*Zygophyllum simplex*	LC			

11 ANNEX 2. LIST OF MAMMALS

List of mammals which are likely to occur in the broad vicinity of the !Xha Boom grid connection study area. Habitat notes and distribution records are based on Skinner & Chimimba (2005), while conservation status is from the IUCN Red Lists 2016.

Scientific Name	Common Name	Status	Habitat	Likelihood
Afrosoricida (Golden Moles):				
Chrysochloris asiatica	Cape Golden Mole	LC	Coastal parts of the Northern and Western Cape	High
Macroscledidea (Elephant Shrews):				
Macroscelides proboscideus	Round-eared Elephant Shrew	LC	Species of open country, with preference for shrub bush and sparse grass cover, also occur on hard gravel plains with sparse boulders for shelter, and on loose sandy soil provided there is some bush cover	Confirmed
Tubulentata:				
Orycteropus afer	Aardvark	LC	Wide habitat tolerance, being found in open woodland, scrub and grassland, especially associated with sandy soil	Confirmed
Hyracoidea (Hyraxes)				
Procavia capensis	Rock Hyrax	LC	Outcrops of rocks, especially granite formations and dolomite intrusions in the Karoo. Also erosion gullies	Low
Lagomorpha (Hares and Rabbits):				
Pronolagus rupestris	Smith's Red Rock Rabbit	LC	Confined to areas of krantzes, rocky hillsides, boulder-strewn koppies and rocky ravines	Low
Lepus capensis	Cape Hare	LC	Dry, open regions, with palatable bush and grass	High
Lepus saxatilis	Scrub Hare	LC	Common in agriculturally developed areas, especially in crop-growing areas or in fallow lands where there is some bush development.	Confirmed
Rodentia (Rodents):				
Cryptomys hottentotus	African Mole Rat	LC	Wide diversity of substrates, from sandy soils to heavier compact substrates such as decomposed schists and stony soils	High
Hystrix africaeaustralis	Cape Porcupine	LC	Catholic in habitat requirements.	Confirmed
Graphiurus ocularis	Spectacled Dormouse	LC	Associated with sandstones of Cape Fold mountains, which have many vertical and horizontal crevices.	Low
Rhabdomys pumilio	Four-striped Grass Mouse	LC	Essentially a grassland species, occurs in wide variety of habitats where there is good grass cover.	Confirmed
Mus minutoides	Pygmy Mouse	LC	Wide habitat tolerance	High
Aethomys namaquensis	Namaqua Rock Mouse	LC	Catholic in their habitat requirements, but where there are rocky koppies, outcrops or boulder-strewn hillsides they use these preferentially	High

Parotomys brantsii	Brants' Whistling Rat	LC	Associated with a dry sandy substrate in more arid parts of the Nama-karoo and Succulent Karoo. Species selects areas of low percentage of plant cover and areas with deep sands.	High
Parotomys littledalei	Littledale's Whistling Rat	LC	Riverine associations or associated with Lycium bushes or Psilocaulon absimile	High
Otomys unisulcatus	Bush Vlei Rat	LC	Shrub and fynbos associations in areas with rocky outcrops Tend to avoid damp situations but exploit the semi-arid Karoo through behavioural adaptation.	Confirmed
Desmodillus auricularis	Cape Short-tailed Gerbil	LC	Tend to occur on hard ground, unlike other gerbil species, with some cover of grass or karroid bush	High
Gerbillurus paeba	Hairy-footed Gerbil	LC	Gerbils associated with Nama and Succulent Karoo preferring sandy soil or sandy alluvium with a grass, scrub or light woodland cover	High
Malacothrix typica	Gerbil Mouse	LC	Found predominantly in Nama and Succulent Karoo biomes, in areas with a mean annual rainfall of 150-500 mm.	High
Petromyscus collinus	Pygmy Rock Mouse	LC	Arid areas on rocky outcrops or koppies with a high rock cover	Low
Primates:				
Papio ursinus	Chacma Baboon	LC	Can exploit fynbos, montane grasslands, riverine courses in deserts, and simply need water and access to refuges.	Low
Eulipotyphla (Shrews):				
Crocidura cyanea	Reddish-Grey Musk Shrew	LC	Occurs in relatively dry terrain, with a mean annual rainfall of less than 500 mm. Occur in karroid scrub and in fynbos often in association with rocks.	High
Carnivora:				
Proteles cristata	Aardwolf	LC	Common in the 100-600mm rainfall range of country, Nama-Karoo, Succulent Karoo Grassland and Savanna biomes	High
Caracal caracal	Caracal	LC	Caracals tolerate arid regions, occur in semi-desert and karroid conditions	High
Felis silvestris	African Wild Cat	LC	Wide habitat tolerance.	High
Felis nigripes	Black-footed cat	VU	Associated with arid country with MAR 100-500 mm, particularly areas with open habitat that provides some cover in the form of tall stands of grass or scrub.	High
Genetta genetta	Small-spotted genet	LC	Occur in open arid associations	High
Suricata suricatta	Meerkat	LC	Open arid country where substrate is hard and stony. Occur in Nama and Succulent Karoo but also fynbos	High
Cynictis penicillata	Yellow Mongoose	LC	Semi-arid country on a sandy substrate	Confirmed
Herpestes pulverulentus	Cape Grey Mongoose	LC	Wide habitat tolerance	High
Vulpes chama	Cape Fox	LC	Associated with open country, open grassland, grassland with scattered thickets and coastal or semi-desert scrub	Confirmed

Canis mesomelas	Black-backed Jackal	LC	Wide habitat tolerance, more common in drier areas.	High
Otocyon megalotis	Bat-eared Fox	LC	Open country with mean annual rainfall of 100-600 mm	Confirmed
Ictonyx striatus	Striped Polecat	LC	Widely distributed throughout the sub-region	High
Mellivora capensis	Ratel/Honey Badger	IUCN LC/SA RDB EN	Catholic habitat requirements	Low
Rumanantia (Antelope):				
Sylvicapra grimmia	Common Duiker	LC	Presence of bushes is essential	Moderate
Pelea capreolus	Grey Rhebok	LC	Associated with rocky hills, rocky mountainsides, mountain plateaux with good grass cover.	Low
Antidorcas marsupialis	Springbok	LC	Arid regions and open grassland.	Low
Raphicerus campestris	Steenbok	LC	Inhabits open country,	Confirmed
Oreotragus oreotragus	Klipspringer	LC	Closely confined to rocky habitat.	Low
Chiroptera (Bats)				
Sauromys petrophilus	Flat-headed free-tailed bat	LC	Rocky areas and the availability of narrow rock fissures essential requirements	Low
Neoromicia capensis	Cape Serotine Bat	LC	Wide habitat tolerances, but often found near open water	High
Tadarida aegyptiaca	Egyptian Free-tailed Bat	LC	In arid areas. often associated with water sources	High
Nycteris thebaica	Egyptian Slit-faced Bat	LC	Wide habitat tolerance	High
Rhinolophus clivosus	Geoffroy's horsehoe bat	LC	Wide habitat tolerance but Roost in caves	Low
Rhinolophus capensis	Cape horseshoe bat	LC	Many records from coastal caves	Low

12 ANNEX 3. LIST OF REPTILES

List of reptiles which are likely to occur in the broad vicinity of the !Xha Boom grid connection site, based on records from the SARCA database, conservation status is from Bates et al. 2013.

Type	Family	Genus	Species	Subspecies	Common name	Red list category
Chameleon	*Chamaeleonidae*	*Chamaeleo*	*namaquensis*		Namaqua Chameleon	Least Concern
Geckos	*Gekkonidae*	*Chondrodactylus*	*angulifer*	*angulifer*	Common Giant Ground Gecko	Least Concern
Geckos	*Gekkonidae*	*Chondrodactylus*	*bibronii*		Bibron's Gecko	Least Concern
Geckos	*Gekkonidae*	*Goggia*	*lineata*		Striped Pygmy Gecko	Least Concern
Geckos	*Gekkonidae*	*Pachydactylus*	*capensis*		Cape Gecko	Least Concern
Geckos	*Gekkonidae*	*Pachydactylus*	*labialis*		Western Cape Gecko	Least Concern
Geckos	*Gekkonidae*	*Pachydactylus*	*latirostris*		Quartz Gecko	Least Concern
Geckos	*Gekkonidae*	*Pachydactylus*	*weberi*		Weber's Gecko	Least Concern
Geckos	*Gekkonidae*	*Ptenopus*	*garrulus*	*maculatus*	Spotted Barking Gecko	Least Concern
Lizards	*Agamidae*	*Agama*	*aculeata*	*aculeata*	Common Ground Agama	Least Concern
Lizards	*Agamidae*	*Agama*	*atra*		Southern Rock Agama	Least Concern
Lizards	*Cordylidae*	*Karusasaurus*	*polyzonus*		Karoo Girdled Lizard	Least Concern
Lizards	*Cordylidae*	*Namazonurus*	*peersi*		Peers' Girdled Lizard	Least Concern
Lizards	*Gerrhosauridae*	*Cordylosaurus*	*subtessellatus*		Dwarf Plated Lizard	Least Concern
Lizards	*Lacertidae*	*Meroles*	*suborbitalis*		Spotted Desert Lizard	Least Concern
Lizards	*Lacertidae*	*Nucras*	*tessellata*		Western Sandveld Lizard	Least Concern
Lizards	*Lacertidae*	*Pedioplanis*	*laticeps*		Karoo Sand Lizard	Least Concern
Lizards	*Lacertidae*	*Pedioplanis*	*lineoocellata*	*lineoocellata*	Spotted Sand Lizard	Least Concern
Lizards	*Lacertidae*	*Pedioplanis*	*lineoocellata*	*pulchella*	Common Sand Lizard	Least Concern
Lizards	*Lacertidae*	*Pedioplanis*	*namaquensis*		Namaqua Sand Lizard	Least Concern
Lizards	*Scincidae*	*Acontias*	*lineatus*		Striped Dwarf Legless Skink	Least Concern
Lizards	*Scincidae*	*Trachylepis*	*occidentalis*		Western Three-striped Skink	Least Concern
Lizards	*Scincidae*	*Trachylepis*	*sulcata*	*sulcata*	Western Rock Skink	Least Concern
Lizards	*Scincidae*	*Trachylepis*	*variegata*		Variegated Skink	Least Concern
Snakes	*Colubridae*	*Boaedon*	*capensis*		Brown House Snake	Least Concern
Snakes	*Colubridae*	*Dasypeltis*	*scabra*		Rhombic Egg-eater	Least Concern
Snakes	*Colubridae*	*Dipsina*	*multimaculata*		Dwarf Beaked Snake	Least Concern
Snakes	*Colubridae*	*Lamprophis*	*guttatus*		Spotted House Snake	Least Concern

Snakes	*Colubridae*	*Psammophis*	*crucifer*		Cross-marked Grass Snake	Least Concern
Snakes	*Colubridae*	*Psammophis*	*notostictus*		Karoo Sand Snake	Least Concern
Snakes	*Colubridae*	*Pseudaspis*	*cana*		Mole Snake	Least Concern
Snakes	*Colubridae*	*Telescopus*	*beetzii*		Beetz's Tiger Snake	Least Concern
Snakes	*Elapidae*	*Aspidelaps*	*lubricus*	*lubricus*	Coral Shield Cobra	Not listed
Snakes	*Elapidae*	*Naja*	*nivea*		Cape Cobra	Least Concern
Snakes	*Typhlopidae*	*Rhinotyphlops*	*lalandei*		Delalande's Beaked Blind Snake	Least Concern
Snakes	*Viperidae*	*Bitis*	*arietans*	*arietans*	Puff Adder	Least Concern
Tortoises	*Testudinidae*	*Chersina*	*angulata*		Angulate Tortoise	Least Concern
Tortoises	*Testudinidae*	*Homopus*	*signatus*	*signatus*	Namaqua Speckled Padloper	Not listed
Tortoises	*Testudinidae*	*Psammobates*	*tentorius*	*subsp. ?*	Tent Tortoise (subsp. ?)	Least Concern
Tortoises	*Testudinidae*	*Psammobates*	*tentorius*	*tentorius*	Karoo Tent Tortoise	Not listed
Tortoises	*Testudinidae*	*Psammobates*	*tentorius*	*verroxii*	Verrox's Tent Tortoise	Not listed

13 ANNEX 4. LIST OF AMPHIBIANS

List of amphibians which are likely to occur in in the broad vicinity of the !Xha Boom grid connection site. Habitat notes and distribution records are based on Du Preez and Carruthers (2009), while conservation status is from the Minter et al. 2004.

Scientific Name	Common Name	Status	Habitat	Distribution	Likelihood
Vandijkophrynus gariepensis	Karoo Toad	Least Concern	Karoo Scrub	Widespread	High
Xenopus laevis	Common Platanna	Least Concern	Any more or less permanent water	Widespread	Very Low
Amietia fuscigula	Cape River Frog	Least Concern	Large still bodies of water or permanent streams and rivers.	Widespread	Very Low
Cacosternum namaquense	Namaqua Caco	Least Concern	Marshy areas, vleis and shallow pans	Widespread	Moderate
Cacosternum boettgeri	Common Caco	Least Concern	Marshy areas, vleis and shallow pans	Widespread	Moderate
Tomopterna tandyi	Tandy's Sand Frog	Least Concern	Nama karoo grassland and savanna	Widespread	High