ENVIRONMENTAL SCOPING REPORT:

Specialist ecological study on potential impacts of the proposed St Helena Wind Farm Project, Vredenburg, Western Cape

Prepared by

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on behalf of
Just Energy

February 2011

DRAFT SCOPING REPORT: 2st draft

David Hoare Consulting cc
Biodiversity Assessments, Vegetation Description / Mapping, Species Surveys

REGULATIONS GOVERNING THIS REPORT

This report has been prepared in terms the EIA Regulations promulgated under the *National Environmental Management Act* No. 107 of 1998 (NEMA) and is compliant with Regulation 385 Section 33 - Specialist reports and reports on specialized processes under the Act. Relevant clauses of the above regulation are quoted below and reflect the required information in the "Control sheet for specialist report" given above.

Regulation 33. (1): An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialized process.

Regulation 33. (2): A specialist report or a report on a specialized process prepared in terms of these Regulations must contain:

(a) details of (i) the person who prepared the report, and
(ii) the expertise of that person to carry out the specialist study or specialized process;
(b) declaration that the person is independent in a form as may be specified by the competent authority;
(c) indication of the scope of, and the purpose for which, the report was prepared;
(d) description of the methodology adopted in preparing the report or carrying out the specialized process;
(e) description of any assumptions made and any uncertainties or gaps in knowledge;
(f) description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
(g) recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;
(h) description of any consultation process that was undertaken during the course of carrying out the study;
(i) summary and copies of any comments that were received during any consultation process;
(j) any other information requested by the competent authority.

Appointment of specialist

David Hoare of David Hoare Consulting cc was commissioned by Arcus GIBB (Pty) Ltd to provide specialist consulting services for the Environmental Impact Assessment for the proposed St Helena Wind Farm Project near Vredenburg in the Western Province. The consulting services comprise an assessment of potential impacts on the fauna in the study area by the proposed project.

Details of specialist

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Summary of expertise

Dr David Hoare:

- Registered professional member of The South African Council for Natural Scientific Professions (Ecological Science, Botanical Science), registration number 400221/05.
- Founded David Hoare Consulting cc, an independent consultancy, in 2001.
- Ecological consultant since 1995.
- Conducted, or co-conducted, over 250 specialist ecological surveys as an ecological consultant.
- Published six technical scientific reports, 15 scientific conference presentations, seven book chapters and eight refereed scientific papers.
- Attended 15 national and international congresses & 5 expert workshops, lectured vegetation science / ecology at 2 universities and referee for 2 international journals.

Independence

David Hoare Consulting cc and its Directors have no connection with Just Energy. David Hoare Consulting cc is not a subsidiary, legally or financially, of the proponent. Remuneration for services by the proponent in relation to this project is not linked to approval by decision-making authorities responsible for authorising this proposed project and the consultancy has no interest in secondary or downstream developments as a result of the authorisation of this project. David Hoare is an independent consultant to Arcus GIBB (Pty) Ltd and has no business, financial, personal or other interest in the activity, application or appeal in respect of which he was appointed other than fair remuneration for work performed in connection with the activity, application or appeal. There are no circumstances that compromise the objectivity of this specialist performing such work. The percentage work received directly or indirectly from the proponent in the last twelve months is approximately 0% of turnover.

Scope and purpose of report

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

CONTROL SHEET FOR SPECIALIST REPORT

The table below lists the specific requirements for specialist studies, according to Regulation 33 of Government Notice No. R385 of 1996 EIA Regulations.

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

Conditions relating to this report

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

This report must not be altered or added to without the prior written consent of the author. This also refers to electronic copies of this report which are supplied for the purposes of inclusion as part of other reports, including main reports. Similarly, any recommendations, statements or conclusions drawn from or based on this report must make reference to this report. If these form part of a main report relating to this investigation or report, this report must be included in its entirety as an appendix or separate section to the main report.

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INTRODUCTION

Terms of reference and approach

Arcus GIBB (Pty) Ltd. was appointed by Just Energy to undertake an application for environmental authorisation through an Environmental Impact Assessment (EIA) for the proposed "St Helena Community Wind Farm Development Project." The project involves the establishment of a wind energy facility and associated infrastructure, including wind turbines, undergound cables between turbines, a sub-station and internal access roads. The purpose of the EIA is to identify environmental impacts associated with the project.

In November 2010 David Hoare Consulting cc was appointed by Arcus GIBB (Pty) Ltd to undertake an ecological assessment of the study area. The specific terms of reference for the ecological scoping study include:

- to provide a description of the environment that may be affected by the activity and the manner in which the environment may be affected by the proposed project;
- to provide a description and evaluation of potential environmental issues and potential impacts (including direct, indirect and cumulative impacts) that have been identified;
- identification of potentially significant impacts to be assessed within the EIA phase;
- to provide recommendations regarding the methodology to be adopted in assessing potentially significant impacts in the EIA phase (sufficiently detailed to be included within the Plan of Study for EIA and must include a description of the proposed method of assessing the potential environmental impactsassociated with the project).

This report provides details of the results of the Scoping phase. The findings of the study are based on a desktop assessment of the study area.

Study area

At a regional level the study area falls within the Western Province to the north of the town of Vredenburg. A more detailed description of the study area is provided in a section below.

METHODOLOGY

The EIA project is to be undertaken in two phases, a Scoping phase and an Environmental Impact Assessment phase. The objective of the Scoping phase study was to review flora and fauna patterns within the study area in order to identify any highly sensitive areas that should be avoided during development and any species of conservation concern that may occur on site. It was therefore necessary to provide checklists of sensitive species that could potentially occur in the study area as well as habitats with high conservation value. For potential species, only those of high conservation concern are provided. The results of the Scoping phase study are provided in this report.

Assessment philosophy

Many parts of South Africa contain high levels of biodiversity at species and ecosystem level. At any single site there may be large numbers of species or high ecological complexity. Sites also vary in their natural character and uniqueness and the level to which they have been previously disturbed. Assessing the potential impacts of a proposed development often requires evaluating the conservation value of a site relative to other natural areas and relative to the national importance of the site in terms of biodiversity conservation. A simple approach to evaluating the relative importance of a site includes assessing the following:

- Is the site unique in terms of natural or biodiversity features?
- Is the protection of biodiversity features on site of national/provincial importance?
- Would development of the site lead to contravention of any international, national or provincial legislation, policy, convention or regulation?

Thus, the general approach adopted for this type of study is to identify any critical biodiversity issues that may lead to the decision that the proposed project cannot take place, i.e. to specifically focus on red flags and/or potential fatal flaws. Biodiversity issues are assessed by documenting whether any important biodiversity features occur on site, including species, ecosystems or processes that maintain ecosystems and/or species. These can be organised in a hierarchical fashion, as follows:

Species

1. threatened plant species
2. protected trees
3. threatened animal species

Ecosystems

1. threatened ecosystems
2. protected ecosystems
3. critical biodiversity areas
4. areas of high biodiversity
5. centres of endemism

Processes

1. corridors
2. mega-conservancy networks
3. rivers and wetlands
4. important topographical features

It is not the intention to provide comprehensive lists of all species that occur on site, since most of the species on these lists are usually common or widespread species. Species that are Threatened, protected or otherwise of conservation concern, are considered to be the highest priority, the presence of which are most likely to result in significant negative impacts on the ecological environment. The focus on national and provincial priorities and critical biodiversity issues is in line with National legislation protecting environmental and biodiversity resources, including, but not limited to the following which ensure protection of ecological processes, natural systems and natural beauty as well as the preservation of biotic diversity in the natural environment:

1. Environment Conservation Act (Act 73 of 1989)
2. National Environmental Management Act, 1998 (NEMA) (Act 107 of 1998)
3. National Environmental Management Biodiversity Act, 2004. (Act 10 0f 2004)

Plant and animal species of concern

The purpose of listing Red List plant and animal species is to provide information on the potential occurrence of species of special concern in the study area that may be affected by the proposed infrastructure. Species appearing on these lists can then be assessed in terms of their habitat requirements in order to determine whether any of them have a likelihood of occurring in habitats that may be affected by the proposed infrastructure.

Lists were compiled specifically for any species of conservation concern previously recorded in the area and any other species with potential conservation value. Historical occurrences of threatened plant species were obtained from the South African National Biodiversity Institute for the quarter degree squares within which the study area is situated.

Regulations published for the National Forests Act provide a list of protected tree species for South Africa. The species on this list were assessed in order to determine which protected tree species have a geographical distribution that coincides with the study area and habitat requirements that may be met by available habitat in the study area.

Provincial and National legislation was evaluated in order to provide lists of any plant or animal species that have protected status. The most important legislation is the following: *National Environmental Management: Biodiversity Act (Act No 10 of 2004)*.

Lists of threatened animal species that have a geographical range that includes the study area were obtained from literature sources (for example, Alexander & Marais 2007, Branch 1988, 2001, du Preez & Carruthers 2009, Friedmann & Daly 2004, Mills & Hes 1997). The likelihood of any of them occurring was evaluated on the basis of habitat preference and habitats available at the proposed site. The three parameters used to assess the probability of occurrence for each species were as follows:

- *Habitat requirements*: most Red Data animals have very specific habitat requirements and the presence of these habitat characteristics within the study area were assessed;
- *Habitat status*: in the event that available habitat is considered suitable for these species, the status or ecological condition was assessed. Often, a high level of degradation of a specific habitat type will negate the potential presence of Red Data species (especially wetland-related habitats where water-quality plays a major role); and
- *Habitat linkage*: movement between areas used for breeding and feeding purposes forms an essential part of ecological existence of many species. The connectivity of the

study area to these surrounding habitats and adequacy of these linkages are assessed for the ecological functioning Red Data species within the study area.

For all threatened or protected organisms (flora and fauna) that occur in the general geographical area of the site, a rating of the likelihood of it occurring on site is given as follows:

- LOW: no suitable habitats occur on site / habitats on site do not match habitat description for species;
- MEDIUM: habitats on site match general habitat description for species (e.g. fynbos), but detailed microhabitat requirements (e.g. mountain fynbos on shallow soils overlying Table Mountain sandstone) are absent on the site or are unknown from the descriptions given in the literature or from the authorities;
- HIGH: habitats found on site match very strongly the general and microhabitat description for the species (e.g. mountain fynbos on shallow soils overlying Table Mountain sandstone);
- DEFINITE: species found in habitats on site.

Habitats of conservation concern

The purpose of producing a habitat sensitivity map is to provide information on the location of potentially sensitive features in the study area. This was compiled by taking the following into consideration:

1. The general status of the vegetation of the study area was derived by compiling a landcover data layer for the study area (*sensu* Fairbanks et al. 2000) using available satellite imagery and aerial photography. From this it can be seen which areas are transformed versus those that are still in a natural status.
2. Various provincial, regional or national level conservation planning studies have been undertaken in the area, e.g. the National Spatial Biodiversity Assessment (NSBA), Succulent Thicket Ecosystem Project (STEP), Eastern Cape Biodiversity Conservation Plan (ECBCP). The mapped results from these were taken into consideration in compiling the habitat sensitivity map.
3. Habitats in which various species of plants or animals occur that may be protected or are considered to have high conservation status are considered to be sensitive.

Any habitat considered important for species of concern was considered to be sensitive whereas habitat not important for species of conservation concern was considered to be not sensitive.

Table 1: Sensitivity analysis

Sensitivity class	Description
Low Sensitivity	Habitat with no breeding, inhabiting or foraging importance for animal species of conservation concern, not suitable for any plant species of conservation concern and not constituting vegetation of conservation concern in a natural state.
Medium Sensitivity	Habitat with breeding, inhabiting or foraging importance for animal species of lower conservation concern (Near Threatened, Declining, Rare or Restricted) or potentially suitable for plant species of lower conservation concern (Near Threatened, Declining, Rare or Restricted)

High Sensitivity	Habitat with breeding, inhabiting or foraging importance for animal species of high conservation concern (Critically Endangered, Endangered or Vulnerable) or habitat suitable for populations of plant species of high conservation concern (Critically Endangered, Endangered or Vulnerable)

Limitations and exclusions

- Red List species are, by their nature, usually very rare and difficult to locate. Compiling the list of species that could potentially occur in an area is limited by the paucity of collection records that make it difficult to predict whether a species may occur in an area or not. The methodology used in this assessment is designed to reduce the risks of ommitting any species, but it is always possible that a species that does not occur on a list may be located in an area where it was not previously known to exist.
- This ecological study excludes impacts on avifauna. this component will be undertaken in a separate specialist study.

DESCRIPTION OF STUDY AREA

Location

The study site is situated north of Vredenburg in the Western Province and falls within the quarter degree grid 3218CC (Figure 1). The farm on which the proposed wind farm is proposed to be situated is the farm Langeklip 47. No alternative site is currently being considered for the proposed wind energy facility.

The study area is on the north-western side of the road from Vredenburg to Velddrif (Figure 1). The road from Vredenburg to Velddrif passes the south-eastern side of the study area and a side road to St Helenabaai passes the eastern side of the study area. The site is therefore well-connected to regional routes. There is a farm access road running along the northern side of the study area.

Landuse / landcover and vegetation

A landcover map of the study area (Fairbanks *et al*. 2000) indicates that a significant proportion of the site consists of cultivation. An area in the centre of the site is indicated as natural (shrubland / low fynbos). The Surveyor General's 1:50 000 topocadastral maps for the study area supports this observation and so does aerial imagery of the site.

Based on these sources, it is probable that the study area has been impacted upon by

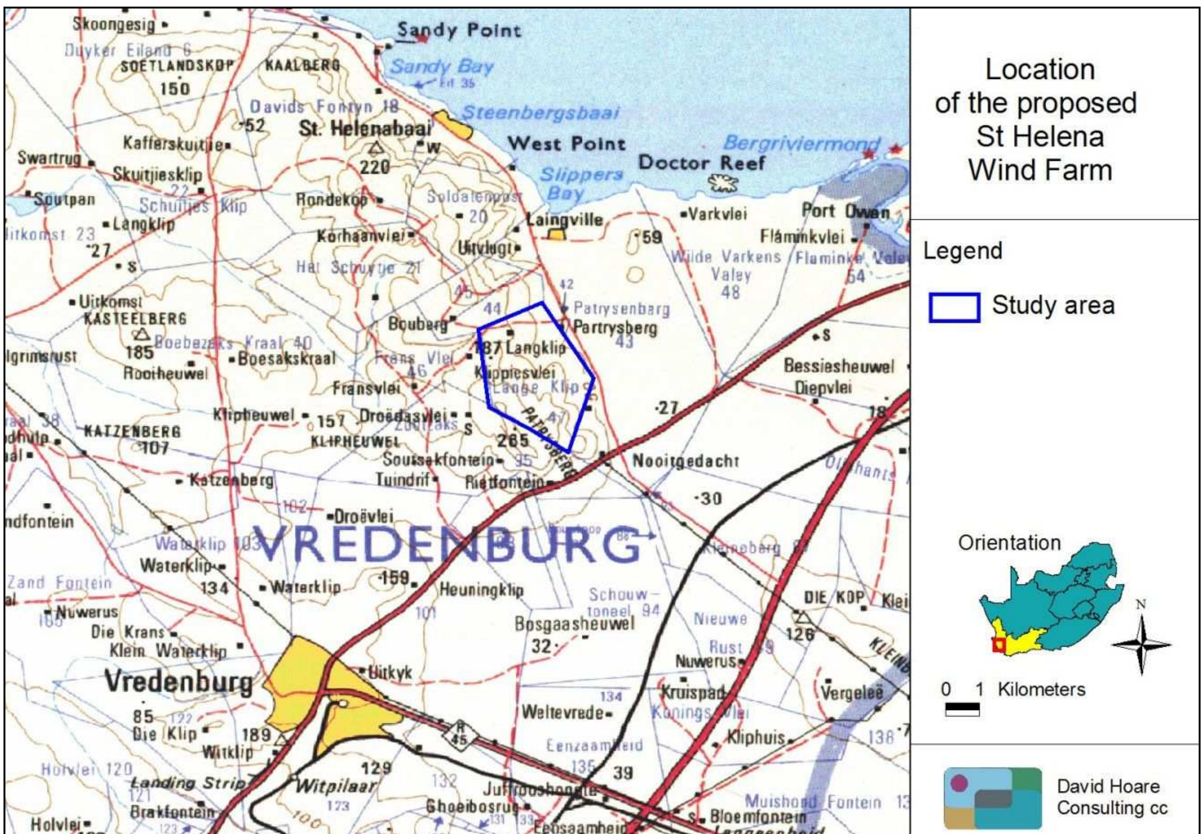

Figure 1: Location of the proposed St Helena Wind Farm near Vredenburg.

cultivation and that any remaining vegetation is possibly not in pristine condition. There may, however, be areas that could potentially support unique populations of plants or animals, depending on their habitat requirements.

Broad vegetation types

Vegetation may be described at various hierarchical levels from Biome, to broad Vegetation Type and down to Plant Community level associated with local habitat conditions. There are three general descriptions of the vegetation in the study area. Acocks (1953) published the first comprehensive description of the vegetation of South Africa, which was updated in 1988. This was followed by an attempted improvement (Low & Rebelo 1998) which became widely used due to the inclusion of conservation evaluations for each vegetation type, but is often less rigorous than Acocks's original publication. More recently, a detailed map of the country was produced (Mucina *et al.*, 2005). A companion guide to this map (Mucina & Rutherford 2006), contains up-to-date species information and a comprehensive conservation assessment of all vegetation types. According to this most recent vegetation map of the country the study area falls within one main vegetation types, ***Saldanha Granite Strandveld*** (Figure 2), which falls into the Fynbos Biome. Another vegetation type, ***Saldanha Flats Strandveld***, occurs along the eastern boundary of the site. It is likely that the site could contain floristic elements derived from either of these vegetation types within remaining patches of natural vegetation.

Saldanha Granite Strandveld is found on granite domes on the West Coast from Vredenburg to St Helena Bay, in numerous patches along the coast, including Paternoster and Saldanha's North Head, and around Langebaan town and at Postberg on the Langebaan

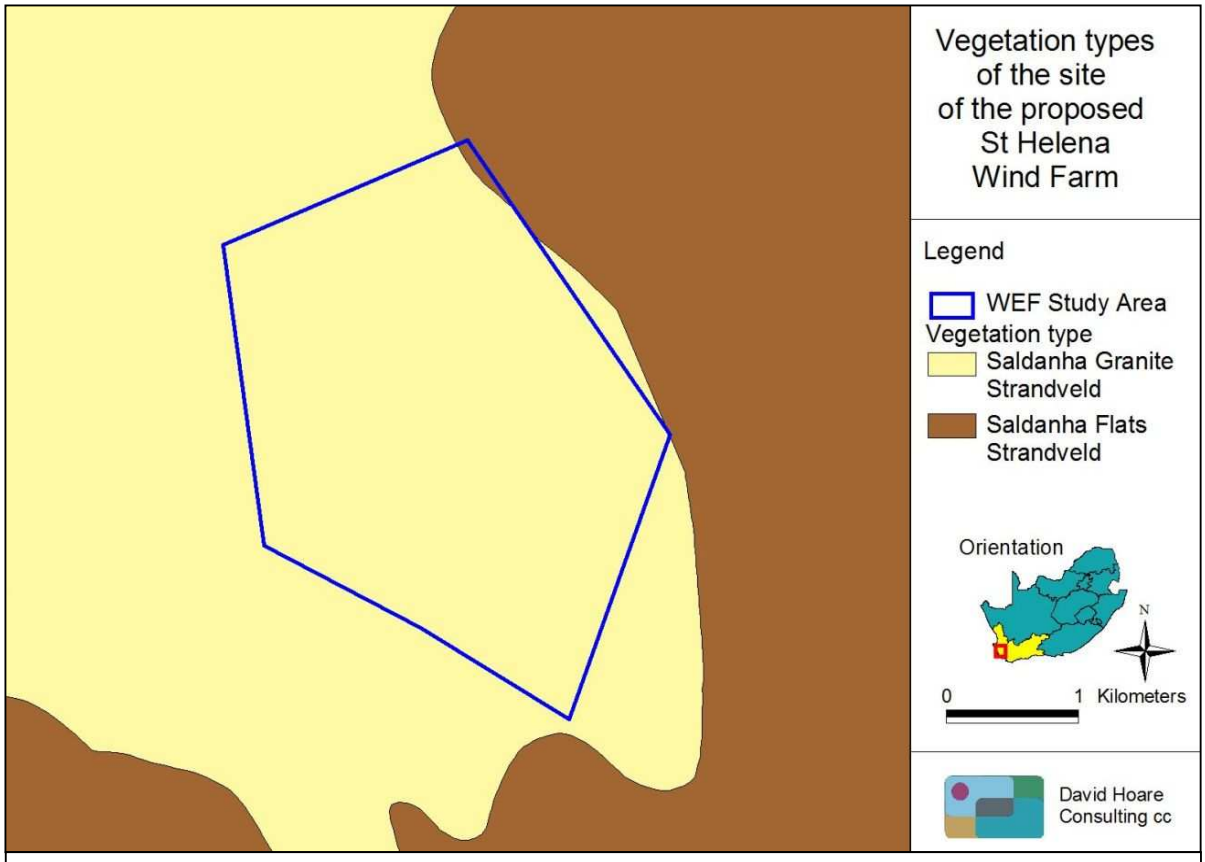

Figure 2: Vegetation types of the study site and surrounding areas.

Peninsula (Rebelo et al. 2006). It has a restricted distribution and it's original distribution was only 235 km^2. It is a low to medium height shrubland containing some succulent elements (Rebelo et al. 2006). This alternates with grassy and herb-rich spots that support a rich geophyte flora. This vegetation type constitutes most of the remaining natural areas within the site under assessment (Figure 2).

Saldanha Flats Strandveld occurs on the extensive coastal flats from St Helena Bay to Saldanha and Langebaan (Rebelo et al. 2006). It has a relatively restricted distribution and it's original distribution was 760 km^2. It is a sclerophyllous shrubland consisting of a sparse emergent and moderately tall shrub layer with an open succulent shrub layer forming the undergrowth. The vegetation has conspicuous displays of geophytes and annual herbs in spring (Rebelo et al. 2006). This vegetation type occurs along the eastern boundary of the site (Figure 2) and there may be little remaining of it on site.

Conservation status of broad vegetation types

The vegetation types of South Africa have been categorised according to their conservation status which is, in turn, assessed according to the degree of transformation and rates of conservation. The status of a habitat or vegetation type is based on how much of its original area still remains intact relative to various thresholds. On a national scale these thresholds are as depicted in Table 2, as determined by best available scientific approaches (Driver et al. 2005). The level at which an ecosystem becomes Critically Endangered differs from one ecosystem to another and varies from 16% to 36% (Driver et al. 2005).

Table 2: Determining ecosystem status (from Driver et al. 2005). *BT = biodiversity target (the minimum conservation requirement).

Habitat remaining (%)		
80–100	least threatened	LT
60–80	vulnerable	VU
*BT–60	endangered	EN
0–*BT	critically endangered	CR

Saldanha Granite Strandveld is classified in Mucina *et al*. (2006) as Endangered, with 10% conserved of a target of 24% and about 70% transformed (Mucina et al. 2006). The Draft National List of Threatened Ecosystems (GN1477 of 2009), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004), lists this vegetation type as Endangered.

Saldanha Flats Strandveld is classified in Mucina *et al*. (2006) as Endangered, with 11% conserved of a target of 24% and 55% transformed (Mucina et al. 2006). The Draft National List of Threatened Ecosystems (GN1477 of 2009), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004), lists this vegetation type as Vulnerable.

The Cape Floristic Region

The study area occurs within the Cape Floristic Region (see Figure 3), which is recognised as one of the principal centres of diversity and endemism in Africa (van Wyk & Smith 2001). Moreover, it is one of the earth's 25 hotspots, i.e. geographical areas that contain the world's greatest plant and animal diversity while also being subjected to high levels of pressure from

development and/or degradation (Mittermeier *et al*. 2000). The Cape Floristic region is also the only hotspot that encompasses an entire Floristic Kingdom. This region has the greatest extratropical concentration of plant species in the world, with 9000 plant species, 6210 of which are endemics (Cowling & Pierce 2000). Diversity and endemism are high at the generic and familial level as well, with five of South Africa's 12 endemic plant families.

The characteristic and most widespread vegetation of the Cape Floristic Region is fynbos, consisting of hard-leaved, evergreen, fire-prone shrubs. Other vegetation types occurring in the CFR are Renosterveld, Succulent Karoo, Subtropical Thicket and Afromontane forest, although only Fynbos and Renosterveld are considered to be the main vegetation types in the CFR. Fynbos is associated with the nutrient poor soils of the Cape fold Belt mountains. It is very species rich, with over 75% of the CFR species associated with it, including all the endemic families and most of the endemic genera (van Wyk & Smith 2001). The vegetation type is characterized by a preponderance of Restionaceae, Ericaceae and Proteaceae and a paucity of annuals and grasses. Fynbos is rich in geophytes, notably from the families Liliaceae, Iridaceae and Orchidaceae, and is thought to harbour the richest geophyte flora in the world (Cowling & Richardson 1995). Many different types of Fynbos vegetation are recognised: a total of 78 fynbos and 38 renosterveld vegetation types have been mapped in the recently compiled vegetation map of South Africa (Mucina, Rutherford & Powrie 2005) of a total of 435 vegetation types of the whole country (more than a quarter of the total).

The Fynbos Biome and the CFR are largely concurrent and also match the boundaries of the two main vegetation types, fynbos and renosterveld.

Permanent and complete transformation of habitat has affected 33% of the CFR hotspot. Less than 20% of the total area covered by the CFR hotspot can be considered close to the pristine

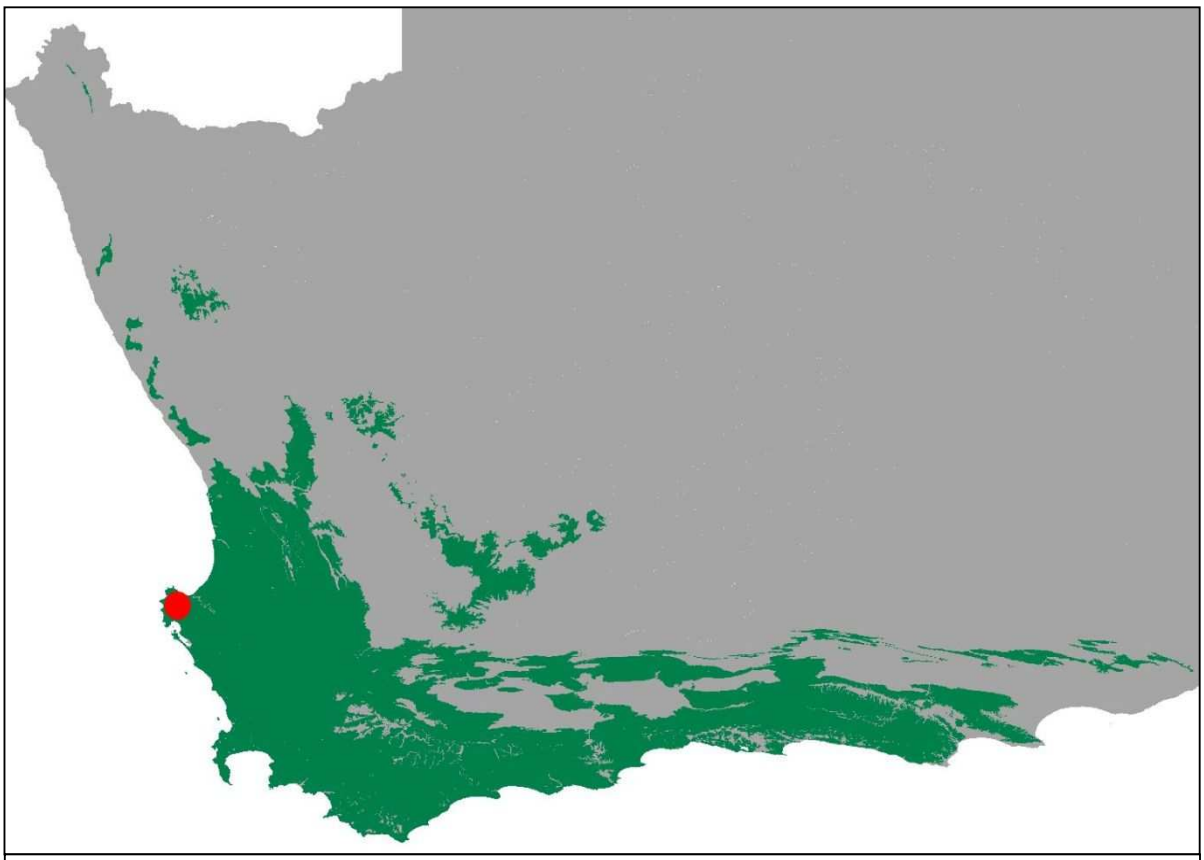

Figure 3: Relationship of the Fynbos Biome to the study area (red circle).

state in the sense that it is entirely free of alien plants and subjected to appropriate fire and grazing regimes (Cowling & Pierce 2000). The study area is within this hotspot area near its western end (see Figure 3) and, although the hotspot contains a wide variety of vegetation types, the study area contains a number of vegetation types that are typical of the areas of concern within the hotspot.

Red List plant species of the study area

Lists of plant species previously recorded in the quarter degree grids in which the study area is situated were obtained from the South African National Biodiversity Institute. These are listed in Appendix 1. This list contains 52 threatened and near threatened species, of which three are listed as Critically Endangered, sixteen as Endangered and 16 as Vulnerable (see Table 3 for explanation of categories). This is an exceptionally high number of threatened species, even by Fynbos biome standards, and is an indication of the potentially high conservation importance and sensitivity of all remaining natural habitat on site and in the surrounding area. There is a high probability that some of these species occur on site or that they are dependant on natural habitats on site remaining intact. These species are most likely to occur within untransformed natural vegetation. Transformed areas are unlikely to harbour populations of threatened plant species.

On condition natural vegetation on site is not disturbed by the proposed development, these species are unlikely to be affected by the proposed development of a wind farm on site. If, however, any infrastructure is proposed to occur within untransformed natural vegetation, a comprehensive botanical survey of these areas would be required in order to establish which species occur on site and their exact locality and population status.

Table 3: Explanation of IUCN Ver. 3.1 categories (IUCN, 2001), and Orange List categories (Victor & Keith, 2004).

IUCN / Orange List category	Definition	Class
EX	Extinct	Extinct
CR	Critically Endangered	Red List
EN	Endangered	Red List
VU	Vulnerable	Red List
NT	Near Threatened	Orange List
Declining	Declining taxa	Orange List
Rare	Rare	Orange List
Critically Rare	Rare: only one subpopulation	Orange List
Rare-Sparse	Rare: widely distributed but rare	Orange List
DDD	Data Deficient: well known but not enough information for assessment	Data Deficient
DDT	Data Deficient: taxonomic problems	Data Deficient
DDX	Data Deficient: unknown species	Data Deficient
LC	Least Concern	Least Concern

Red List animal species of the study area

Red List vertebrates (mammals, reptiles, amphibians) that have a geographical distribution that includes the study area are listed in Appendix 2. Based on habitat requirements, there are a number of threatened or near threatened species that were considered to have a medium to high possibility of occurring on site or making use of habitats available on site. These are the following:

- White-tailed Rat (EN)
- Cape Caco (VU)
- Cape Sand Snake (VU)
- Armadillo Girdled Lizard (VU)
- Namaqua Plated Lizard (NT)
- Gronovi's Dwarf Burrowing Skink (NT)

There were also a number of threatened or near threatened bat species that have a geographical distribution that includes the site and there is some possibility that they may be encountered on site, either foraging, nesting or roosting. These include the following:

- Lesueur's Wing-gland bat (NT)
- Natal long-fingered bat (NT)
- Cape horseshoe bat (NT)

The remaining species with a geographical range that includes the site were assessed as having a low chance of occurring in available habitats in the study area or the study site is at the margin of their distribution range.

Protected animals

There are a number of animal species protected under the Western Cape Nature Conservation Laws Amendment Act of 2000 (Act 3 of 2000) that have a geographical distribution that includes the site and that may, therefore, occur on site. These are listed in Appendix 3. According to the Western Cape Nature Conservation Laws Amendment Act, "*No person shall without a permit hunt or be in possession of any endangered wild animal or the carcass of any such animal*". The Act does not imply that habitat for these species should be regarded as sensitive and appears to be primarily concerned with protecting individual animals from hunting or trading. No permit requirements are contained in the Act for instances where such individuals may occur on land for which an application for development is being considered (as for protected trees - see below).

Protected trees

Tree species protected under the National Forest Act are listed in Appendix 4. Those that have a geographical distribution that includes the study area are *Sideroxylon inerme* subsp. *inerme* (white milkwood). *Sideroxylon inerme* subsp. *inerme* usually only occurs in coastal areas, in dune thicket and forest, but may also occur on termitaria in bushveld.

Based on habitat preferences, this species could occur on or near the site. According to National Herbarium records, *Sideroxylon inerme* subsp. *inerme* has not been previously recorded in the grid in which the study site is located (see Appendix 5). If this species occurs in the study area, the most likely places would be in the thicket in the drainage lines or in woodland patches.

Other features of conservation concern

There have been a number of regional conservation assessments produced within the Western Cape Province, including the following:

- Subtropical Thicket Ecosystem Programme (STEP)

- Succulent Karoo Ecosystems Programme (SKEP)
- National Spatial Biodiversity Assessment (NSBA)
- Critical Biodiversity Areas (CBAs) maps

These studies identify patterns and processes that are important for maintaining biodiversity in the region. Many of these studies have been done using coarse scale satellite imagery that does not provide spatial or spectral accuracy at the scale of the present study. They are, however, useful for understanding broad issues and patterns within the area. The exception is the CBA maps, which have been produced for each District Municipality of the Western Cape Province.

The Saldanha Bay Municipality Critical Biodiversity Areas (CBAs) map provides a synthesis of biodiversity information that advises which areas can be developed, and which areas of critical biodiversity value and their support zones should be protected against impacts (Maree & Vromans 2010). The main CBA Map categories are Critical Biodiversity Areas (Terrestrial and Aquatic), Ecological Support Areas (Critical and Other), Other Natural Remaining Areas and No Natural Remaining Areas. The first two categories represent the biodiversity priority areas which should be maintained in a natural to near natural state. The last two mentioned categories are not considered as priority areas and a loss of biodiversity within these areas may be acceptable (Maree & Vromans 2010). A map of CBAs within the site and immediate surroundings is given in Figure 4. There are a number of CBAs found on site, as follows:

- Aquatic CBA (in this case, strandveld hillslope seep);
- Aquatic CBA buffer;
- Terrestrial CBA, composed of the following:
    - Critically Endangered vegetation remnant,
    - Habitat for restricted plant taxa,
    - Irreplaceable wetland support area.

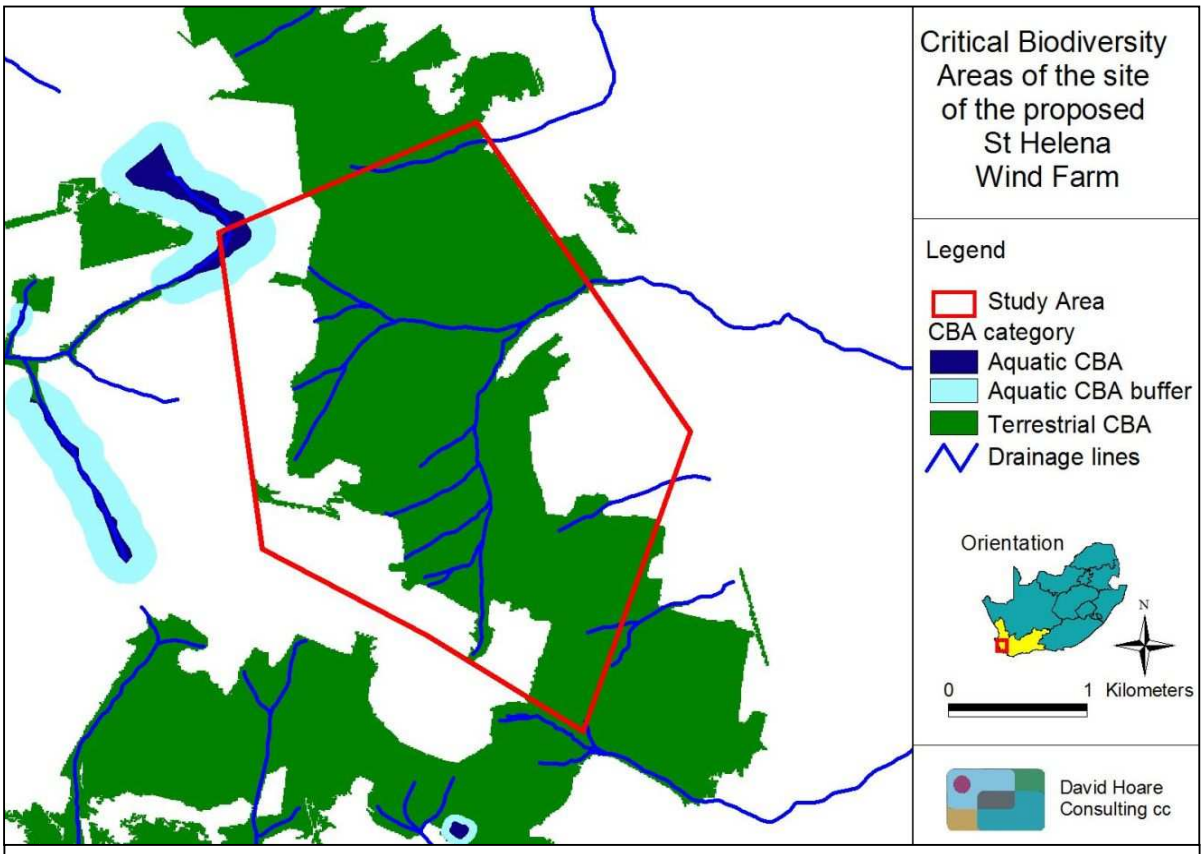

Figure 4: Important biodiversity areas of the study area (from Saldanha Bay Municipality Critical Biodiversity Areas (CBAs) map).

Preliminary sensitivity assessment

The preliminary sensitivity assessment identifies those parts of the study area that may have high conservation value or that may be sensitive to disturbance. Areas containing untransformed natural vegetation, high diversity or habitat complexity, Red List organisms or systems vital to sustaining ecological functions are considered sensitive. In contrast, any transformed area that has no importance for the functioning of ecosystems is considered to have low sensitivity (see Table 1). Broad scale mapping and this desktop assessments were used to provide information on the possible location of sensitive features on site. There are a number of features that need to be taken into account in order to evaluate sensitivity in the study area. These include the following:

1. vegetation of conservation importance: this is based primarily on the Saldanha Bay Municipality Critical Biodiversity Areas (CBAs) map (see Figure 4), the Draft Ecosystem List and the fact that the site falls within the Cape Floristic Region;
2. potential occurrence of populations of Red List organisms, including flora and fauna that have been evaluated as having a high chance of occurring within remaining natural habitats within the study area.
3. perennial and non-perennial rivers, streams and wetlands: this represents a number of ecological processes including groundwater dynamics, hydrological processes, nutrient cycling and wildlife dispersal;

These factors have been taken into account in mapping potentially sensitive areas within the study area. These are mapped in Figure 5 using available information. This map shows the

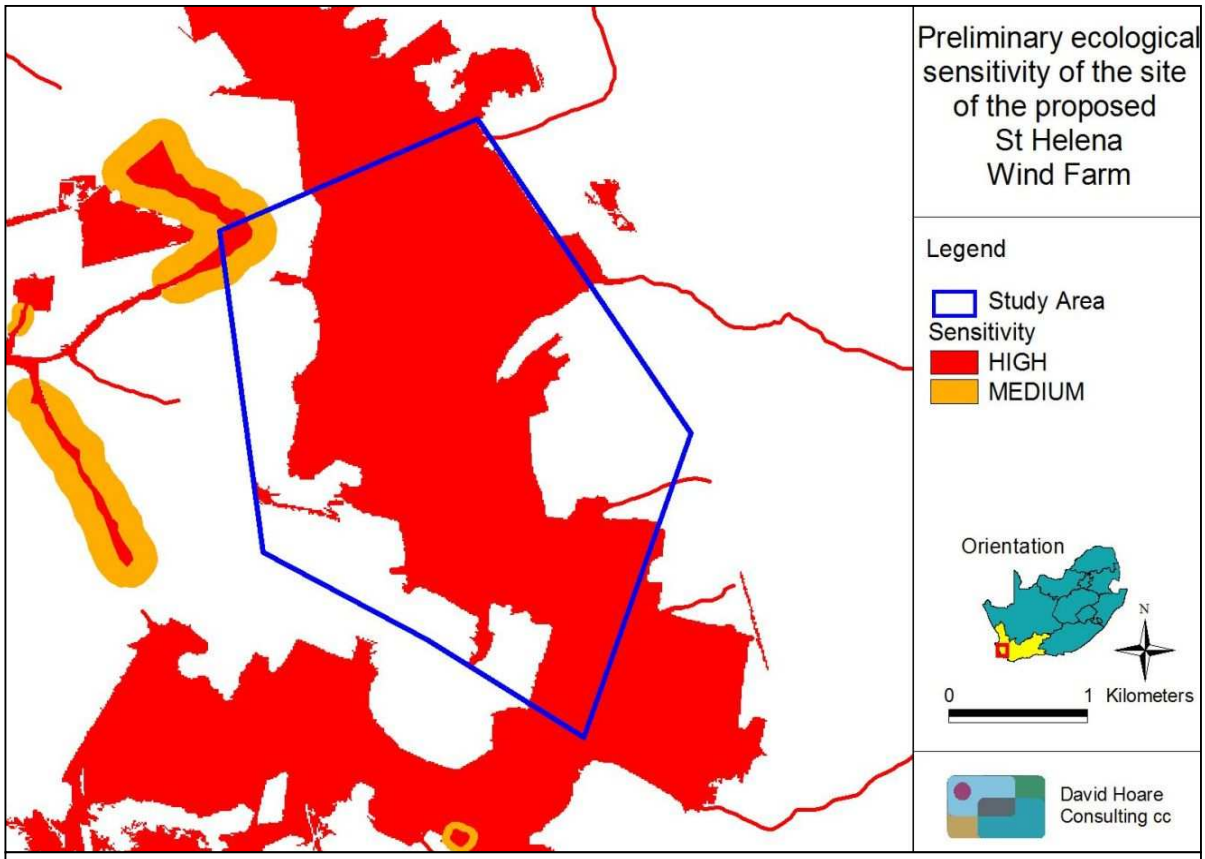

Figure 5: Sensitivity within different parts of the study area.

remaining natural vegetation on site as well as wetlands and drainage lines to have HIGH sensitivity and conservation value. The high sensitivity of these areas indicates that these should be considered to be "no-go" areas for development. This is determined by the stated desired management objectives for these areas, published as follows (Maree & Vromans 2010): "*Maintain natural land. Rehabilitate degraded to natural or near natural and manage for no further degradation*."

It is important to note that this sensitivity assessment is based on a desktop study and that it identifies regional issues that apply to the site. The sensitivity assessment must be refined during fieldwork to be undertaken during the EIA phase of the project. The refinement will identify specific areas on site that are sensitive, taking the regional assessment into account. Of importance will be to identify any remaining areas of natural vegetation on site and to evaluate the condition of such vegetation.

RELEVANT LEGISLATIVE AND PERMIT REQUIREMENTS

Relevant legislation is provided in this section to provide a description of the key legal considerations of importance to the proposed project. The applicable legislation is listed below.

Legislation

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

NEMA requires, inter alia, that:

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

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

Environment Conservation Act No 73 of 1989 Amendment Notice No R1183 of 1997

The ECA states that:

Development must be environmentally, socially and economically sustainable. Sustainable development requires the consideration of inter alia the following factors:

- that pollution and degradation of the environment is avoided, or, where they cannot be altogether avoided, are minimised and remedied;
- that the use and exploitation of non-renewable natural resources is responsible and equitable, and takes into account the consequences of the depletion of the resource;
- that the development, use and exploitation of renewable resources and the ecosystems of which they are part do not exceed the level beyond which their integrity is jeopardised; and
- that negative impacts on the environment and on peoples' environmental rights be anticipated and prevented, and where they cannot be altogether prevented are minimised and remedied.

The developer is required to undertake Environmental Impact Assessments (EIA) for all projects listed as a Schedule 1 activity in the EIA regulations in order to control activities which might have a detrimental effect on the environment. Such activities will only be permitted with written authorisation from a competent authority.

National Forests Act (Act no 84 of 1998)

Protected trees

According to this act, the Minister may declare a tree, group of trees, woodland or a species of trees as protected. The prohibitions provide that ' no person may cut, damage, disturb, destroy or remove any *protected tree*, or collect, remove, transport, export, purchase, sell, donate or in any other manner acquire or dispose of any protected tree, except under a licence granted by the Minister'.

Forests

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

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

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

- The conservation of endangered ecosystems and restriction of activities according to the categorisation of the area (not just by listed activity as specified in the EIA regulations).

- Promote the application of appropriate environmental management tools in order to ensure integrated environmental management of activities thereby ensuring that all development within the area are in line with ecological sustainable development and protection of biodiversity.
- Limit further loss of biodiversity and conserve endangered ecosystems.

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

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

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

Integrated Coastal Zone Management Act (Act No. 24 of 2008)

The purpose of the Act is to establish a system of integrated coastal and estuarine management in the Republic, including norms, standards and policies, in order to promote the conservation of the coastal environment, and maintain the natural attributes of coastal landscapes and seascapes, and to ensure that development and the use of natural resources within the coastal zone is socially and economically justifiable and economically sustainable; to define rights and duties in relation to coastal areas; to determine the responsibilities of organs of state in relation to coastal areas; to prohibit incineration at sea; to control dumping at sea, pollution in the coastal zone, inappropriate development of the coastal environment and other adverse effects on the coastal environment; to give effect to South Africa's international obligation in relation to coastal matters; and to provide for matters connected therewith. The Act provides for integrated management of the coastal zone and contains a number of Chapters dealing with various components. Those that may affect the current project are as follows:

- A coastal protection zone is defined in which development is restricted or controlled. A relatively arbitrary distance of 1000 m is defined in the act as constituting this coastal protection zone, but sections of the act (sections 26 to 29) set out procedures whereby the various coastal areas may be specifically demarcated on a case-by-case basis.
- Assessing the environmental impact of activities which may detrimentally affect the coastal zone will be done in terms of the general environmental impact assessment regulations which were promulgated in terms of Chapter 5 of NEMA. Section 63 of Act 24 of 2008 provides the factors and criteria which the competent authority must consider when issuing environmental authorisations for activities affecting the coastal zone.

Sea Birds and Seals Protection Act (Act No. 46 of 1973)

Provides protection for certain species of marine birds, including the Damara Tern and the Bank Cormorant.

National Water Act (Act 36 of 1998)

Wetlands, riparian zones and watercourses are defined in the National Water Act as a water resource and any activities that are contemplated that could affect the wetlands

requires authorisation (Section 21 of the National Water Act of 1998). A "watercourse" in terms of the National Water Act (act 36 of 1998) means:

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

Any collection of water which the Minister may, by notice in the gazette, declare to be a watercourse, and a reference to a watercourse includes, where relevant, its bed and banks.

Western Cape Nature Conservation Laws Amendment Act of 2000 (Act 3 of 2000)

In terms of Section 26 of this Act, "*No person shall without a permit hunt or be in possession of any endangered wild animal or the carcass of any such animal*". Schedule 2 of this Act provides a list of Protected Wild Animals.

IDENTIFICATION OF RISKS AND POTENTIAL IMPACTS

Potential issues relevant to potential impacts on the fauna of the study area include the following:

- Impacts on biodiversity: this includes any impacts on populations of individual species of concern.
- Impacts on sensitive habitats: this includes impacts on any habitats that are important for threatened fauna.
- Impacts on ecosystem function: this includes impacts on any processes or factors that maintain ecosystem health and character, including the following:
    - disruption to nutrient-flow dynamics;
    - impedance of movement of material or water;
    - habitat fragmentation;
    - changes to abiotic environmental conditions;
    - changes to disturbance regimes, e.g. increased or decreased incidence of fire;
    - changes to successional processes;
    - effects on pollinators;
    - increased invasion by alien plants.

  Changes to factors such as these may lead to a reduction in the resilience of habitats and ecosystems or loss or change in ecosystem function.
- Secondary and cumulative impacts on fauna: this includes an assessment of the impacts of the proposed project taken in combination with the impacts of other known projects for the area or secondary impacts that may arise from changes in the social, economic or ecological environment.

A number of direct risks to ecosystems would result from construction of the proposed wind farm, as follows:

- Clearing of land for construction.
- Construction of internal access roads.
- Placement of underground cables linking turbines.
- Establishment of borrow and spoil areas.
- Chemical contamination of the soil by construction vehicles and machinery.
- Operation of construction camps.
- Storage of materials required for construction.

There are also risks associated with operation of the proposed wind farm, as follows:

- Collisions with flying animals (primarily birds and bats). This may have local impacts on populations as well as cumulative effects on species over wider areas.
- Maintenance of surrounding vegetation as part of management of the wind farm, including the use of fire.

Description of potential impacts

Major potential impacts are described briefly below. These are compiled from a generic list of possible impacts derived from previous projects of this nature and from a literature review of the potential impacts of wind energy facilities on the ecological environment. There are two major ways that wind-energy development may influence ecosystem structure and functioning—through direct impacts on individual organisms and through impacts on habitat structure and functioning. The most important potential negative ecological impacts of a wind

farm are related to bird and bat mortality and loss of habitat. Impacts on birds are covered in a separate avifaunal assessment. For the preliminary assessments below, it is assumed that impacts will definitely occur. The infrastructure layout is, however, unknown at this stage and some impacts may not occur.

Impact 1: Loss of habitat for threatened fauna

Threatened animal species are affected primarily by the overall loss of habitat, since direct construction impacts can often be avoided due to movement of individuals from the path of construction. Construction of pylons, access roads, electricity cables and other infrastructure associated with the wind farm will lead to direct loss of habitat. There are some small patches of natural habitat remaining on site. The condition of this is unknown. This vegetation potentially provides habitat for a number of threatened or near threatened species (threatened species include those classified as critically endangered, endangered or vulnerable), including the White-tailed Rat (EN), the Cape Caco (VU), the Cape Sand Snake (VU), the Armadillo Girdled Lizard (VU), the Namaqua Plated Lizard (NT) and Gronovi's Dwarf Burrowing Skink (NT). The potential value of this natural habitat for these species of conservation concern is affected by the particular requirements of each species and the availability of habitat on site.

For any other species a loss of individuals or localized populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened animal species, loss of a population or individuals could lead to a direct change in the conservation status of the species. The value of the site for each of these species can only be evaluated once the site has been evaluated during field work. Consequences may include:

1. fragmentation of populations of affected species;
2. reduction in area of occupancy of affected species; and
3. loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species overall survival chances.

Extent: The impact will occur at the site of the proposed wind farm, specifically at the scale of the infrastructure within the site. At it's greatest extent this may affect the entire site, but is likely to only affect a smaller proportion of the site. The potential impact may differ from one species to another, but could affect regional processes within species populations.

Potential significance: The suitability of the site for these species can only be assessed by assessing the habitat on site. This will provide an indication of the probability of this impact occurring for different species. However, due to the threatened status of the species concerned, the possible permanent duration of the impact and the potentially regional effect of the impact, the impact is most likely to be of moderate significance.

Impact 2: Collisions of bats with infrastructure

Bird and bat deaths are one of the most controversial biological issues related to wind turbines. The deaths of birds and bats at wind farm sites have raised concerns by conservation agencies internationally. In order to address this issue in South Africa, the Endangered Wildlife Trust (EWT) and BirdLife South Africa (BLSA) have combined efforts to lobby for the appropriate consideration of the potential negative effects of wind energy production.

Bats have been found to be particularly vulnerable to being killed by wind turbines. It has long been a mystery why they should be so badly affected since bat echo-location allows them to detect moving objects very well. A recent study in America has found that the primary cause for mortality is a combination of direct strikes and barotrauma (bats are killed when suddenly

passing through a low air pressure region surrounding the turbine blade tips causing low pressure damage the bat's lungs, Baerwald *et al*. 2008). The relative importance of this impact on bat populations depends on which species are likely to be affected, the importance of the site for those species and whether the site is within a migration corridor for particular bat species.

The most vulnerable species are those that are already classified as threatened species, including those classified as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localized populations is unlikely to lead to a change in the conservation status of the species unless the impact occurs across a wide area that co-incides with their overall distribution range. Loss of a population or individuals could lead to a direct change in the conservation status of the species. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations or the habitat that they depend on. Consequences may include:

1. fragmentation of populations of affected species;
2. reduction in area of occupancy of affected species; and
3. loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species overall survival chances.

It has been evaluated that there are three near threatened bat species that could potentially be affected by the proposed wind farm. These are Lesueur's Wing-gland bat (NT), Natal long-fingered bat (NT) and the Cape horseshoe bat (NT).

Extent: The impact will occur at the site of the proposed wind farm, but will have an impact at a more regional level, since it affects entire populations of affected species and may affect migration routes of species.

Potential significance: The suitability of the site for these species can only be assessed by assessing the habitat on site. This will provide an indication of the probability of this impact occurring for different species. Due to the near threatened status of the species concerned, which will potentially result in impacts of moderate magnitude (may result in population processes continuing in a modified way), the possible long-term duration of the impact and the potentially regional effect of the impact, the impact is most likely to be of moderate to high significance.

Impact 3: Impacts on threatened plants

Plant species are especially vulnerable to infrastructure development due to the fact that they cannot move out of the path of the construction activities, but are also affected by overall loss of habitat.

Threatened species include those classified as critically endangered, endangered or vulnerable. For any other species a loss of individuals or localized populations is unlikely to lead to a change in the conservation status of the species. However, in the case of threatened plant species, loss of a population or individuals could lead to a direct change in the conservation status of the species, possibly extinction. This may arise if the proposed infrastructure is located where it will impact on such individuals or populations. Consequences may include:

1. fragmentation of populations of affected species;
2. reduction in area of occupancy of affected species; and
3. loss of genetic variation within affected species.

These may all lead to a negative change in conservation status of the affected species, which implies a reduction in the chances of the species overall survival chances.

There are 52 Red List plant species that have a geographic distribution that includes the site and which have a chance of occurring in the study area. This includes three species listed as Critically Endangered, sixteen as Endangered, sixteen as Vulnerable and seventeen as Near Threatened. This is an exceptionally high number of threatened species, even by Fynbos biome standards. There is therefore a very high likelihood of more than one threatened plant species occurring on site or being dependant on natural habitats on site remaining in a natural state.

Extent: The impact will occur at the site of the proposed WEF, but will have an impact at a global level, since it potentially affects the global status of affected species. For plant populations, the location of infrastructure is critical - infrastructure placed in the wrong position could destroy sensitive populations.

Potential significance: The suitability of the site for these species can only be assessed by assessing the habitat on site. This will provide an indication of the probability of this impact occurring for different species. The initial assessment is that there is a very high probability of impacts occurring if infrastructure is planned to be placed within remaining natural habitat. Due to the threatened status of the species concerned, which will potentially result in impacts of very high magnitude (may result in population processes being altered to the extent that they temporarily or permanently cease), the possible permanent duration of the impact and the potentially global effect of the impact, the impact is most likely to be of high significance (for any infrastructure placed within remaining natural areas).

Impact 4: Impacts on protected tree species

There are a number of tree species that are protected according to Government Notice no. 1012 under section 12(I)(d) of the National Forests Act, 1998 (Act No. 84 of 1998). In terms of section1 5(1) of the National Forests Act, 1998 "no person may cut, disturb, damage or destroy any protected tree or possess, collect, remove, transport, export, purchase, sell donate or in any other manner acquire or dispose of any protected tree or any forest product derived from a protected tree, except under a license granted by the Minister to an (applicant and subject to such period and conditions as may be stipulated".

One species has a geographic distribution that includes the study area and may occur on site: *Sideroxylon inerme* subsp. *inerme* (white milkwood). It may occur within thicket in drainage lines on site.

Extent: The impact will occur at the site of the proposed wind farm. It may affect single individuals of the protected species.

Potential significance: One protected tree species was assessed as possibly occurring on site. If this species occurs on site, it is likely to only be a small number of individuals. The possible presence of these species on site can only be assessed by assessing the habitat on site. This will provide an indication of the probability of this impact occurring. If protected trees are affected by the project, the impact is likely to be of moderate magnitude (may result in population processes continuing in a modified way), of permanent duration and the impact could potentially have an effect on a scale of site and surroundings. The impact is therefore likely to be of moderate to high significance. A permit would need to be obtained for any protected trees that are affected, so a legal obligation remains irrespective of the significance

of the impact. A knowledge of the location of any protected trees could assist in planning the location of infrastructure to avoid the impact.

Impact 5: Impacts on indigenous natural vegetation (terrestrial)
Construction of infrastructure may lead to direct loss of vegetation. This will lead to localised or more extensive reduction in the overall extent of fynbos vegetation. Where this vegetation has already been stressed due to degradation and transformation at a regional level, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat. Consequences of the impact occurring may include:

1. negative change in conservation status of habitat (Driver et al. 2005);
2. increased vulnerability of remaining portions to future disturbance;
3. general loss of habitat for sensitive species;
4. loss in variation within sensitive habitats due to loss of portions of it;
5. general reduction in biodiversity;
6. increased fragmentation (depending on location of impact);
7. disturbance to processes maintaining biodiversity and ecosystem goods and services; and
8. loss of ecosystem goods and services.

It has been established that most of the site falls within a vegetation type classified as Endangered (listed in scientific literature and on Draft Ecosystem List as Endangered). All remaining natural habitat on site falls within this vegetation type.

The site falls within the Cape Floristic Region and also affects areas classified as important corridors or habitats in the Saldanha Bay Municipality Critical Biodiversity Areas (CBAs) map.

Extent: The impact will occur at the site of the proposed wind farm, but will have an impact at a more regional level, since it potentially affects areas classified regionally as having high conservation value (Cape Floristic Region, Endangered vegetation type and a Critical Biodiversity Area). The construction of wind turbines and associated infrastructure could potentially affect a significant proportion of natural vegetation on site.

Potential significance: The proportion of the site containing vegetation in a moderate to good condition needs to be established before this impact can be properly assessed. A proper assessment also requires a plan of the exact position of all proposed infrastructure. Due to the fact that remaining patches of natural vegetation fall within a vegetation type classified as Endangered, the potential magnitude of this impact could potentially be high at a local (site) and regional scale. Impacts will be of permanent duration. The impact is therefore likely to be of high significance.

Impact 6: Impacts on wetlands
Construction may lead to some direct or indirect loss of or damage to seasonal marsh wetlands or drainage lines or impacts that affect the catchment of these wetlands. This will lead to localised loss of wetland habitat and may lead to downstream impacts that affect a greater extent of wetlands or impact on wetland function. Where these habitats are already stressed due to degradation and transformation, the loss may lead to increased vulnerability (susceptibility to future damage) of the habitat. Physical alteration to wetlands can have an impact on the functioning of those wetlands. Consequences may include:

1. increased loss of soil;
2. loss of or disturbance to indigenous wetland vegetation;
3. loss of sensitive wetland habitats;

4. loss or disturbance to individuals of rare, endangered, endemic and/or protected species that occur in wetlands;
5. fragmentation of sensitive habitats;
6. impairment of wetland function;
7. change in channel morphology in downstream wetlands, potentially leading to further loss of wetland vegetation; and
8. reduction in water quality in wetlands downstream of road.

The site contains a number of drainage lines in which wetlands occur, one of which is identified in the Saldanha Bay Municipality Critical Biodiversity Areas (CBAs) map as being of significant importance.

Extent: The impact will occur at the site of the proposed wind farm, but could have downstream impacts. The extent of the potential impact is therefore on the site and surroundings.

Potential significance: The potential magnitude of this impact could potentially be moderate due to the sensitivity of wetlands to disturbance - impacts on wetlands may result in processes continuing but in a modified way. Impacts are likely to be long-term to permanent. The potential significance of this impact is therefore likely to be high. An understanding of the location of wetlands could ensure that mitigation measures could be put in place to avoid or reduce the potential impact to a low significance. There is also a legal obligation to apply for a Water Use Licence for any wetlands that may be affected, since they are classified in the National Water Act as a water resource.

Impact 7: Change in runoff and drainage patterns

Infrastructure and roads crossing landscapes cause local hydrological and erosion effects resulting in major peak-flow and sediment impacts (Forman & Alexander 1998). This may occur around construction sites, but also in areas where the infiltration rates of the landscape are changed due to an impermeable surface being constructed. Increased runoff associated with infrastructure may increase the rates and extent of erosion, reduce percolation and aquifer recharge rates, alter channel morphology and increase stream discharge rates. Consequences may include:

1. increased loss of soil;
2. loss of or disturbance to indigenous vegetation, especially in wetlands;
3. loss of sensitive habitats, especially in wetlands;
4. loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
5. fragmentation of sensitive habitats;
6. impairment of wetland function;
7. change in channel morphology in downstream wetlands, potentially leading to loss of wetland vegetation; and
8. reduction in water quality in wetlands downstream of road.

There are both steep slopes and wetlands potentially occurring on site and wetlands occurring down stream.

Extent: The impact will occur at the site of the proposed wind farm, but may also affect downstream and down-slope areas. The potential impact may therefore occur at a scale of the site and surrounding areas.

Potential significance: The potential significance of this impact depends almost entirely on ecological processes and patterns that may be affected, should this impact take place. The substrate on site is probably a combination of shallow soil over rock in some places and sandy substrates in others, which could potentially erode very easily. Severe soil erosion could cause ecological and hydrological processes to continue, but in a modified way, which is defined as an impact of moderate magnitude. This alteration is likely to be of permanent duration. The impact is therefore likely to be of moderate to high significance, depending on the planned location of infrastructure.

Impact 8: Establishment and spread of declared weeds and alien invader plants

Major factors contributing to invasion by alien invader plants includes high disturbance. Exotic species are often more prominent near infrastructural disturbances than further away (Gelbard & Belnap 2003, Watkins *et al*. 2003). Consequences of this may include:

1. loss of indigenous vegetation;
2. change in vegetation structure leading to change in various habitat characteristics;
3. change in plant species composition;
4. change in soil chemical properties;
5. loss of sensitive habitats;
6. loss or disturbance to individuals of rare, endangered, endemic and/or protected species;
7. fragmentation of sensitive habitats;
8. change in flammability of vegetation, depending on alien species;
9. hydrological impacts due to increased transpiration and runoff; and
10. impairment of wetland function.

It is not known what alien plants currently occur on site. A checklist of species previously recorded in the grid in which the site is located and botanical knowledge of the area indicates that the following woody species are likely to invade the site, given the right conditions: *Acacia cyclops* and *Acacia mearnsii*. The potential exists for extensive invasion of the site. The habitats most likely to be affected are watercourses and any natural vegetation adjacent to existing disturbance.

Extent: The impact will occur at the site of the proposed wind farm, but could potentially spread extensively into the surrounding landscape, depending on the habitat and the alien species that could potentially invade the site. The impact will therefore be evaluated at a scale of site and surroundings or regional.

Potential significance: There is a moderate likelihood that alien species will spread on site in the absence of control measures. It is likely to be a long-term impact with potentially high magnitude of impact on local ecosystems. The impact is therefore likely to be of moderate to high significance. Standard control measures, if put in place, would adequately control this impact and reduce the significance to low.

Impact 9: Increased risk of veld fires

During construction there is a higher risk of veld fires around construction sites due to the use of fires for cooking and warmth by construction workers. During operation, various factors may lead to fire within the vegetation surrounding the infrastructure. Impacts that may arise from this may include:

1. Damage to sensitive habitats, especially damage to strandveld vegetation;
2. Damage to populations of sensitive plant species;

3. Loss of vegetation biomass; and
4. Increased soil erosion due to loss of vegetation cover.

The site is within an area of strandveld that is partially in a natural state. This is an area that does not experience high frequencies of natural fires. Fire in strandveld along the West Coast hardly ever occurs due to low fuel loads. It can, however, be important for maintaining vegetation mosaics. It is important that the fire frequency is not significantly elevated or that uniform burns do not reduce ecosystem diversity otherwise it may lead to negative impacts on species and ecosystems. It is possible that increased fire frequencies would occur as a result of the construction or operation of the infrastructure.

Extent: The impact will occur at the site of the proposed wind farm and possibly surrounding areas, if fires spread.

Potential significance: The magnitude of the impact could be medium due to the potential to disrupt natural processes. The impact could affect ecological processes in the long-term. There is a distinct possibility that the impact could occur. The potential significance of this impact is therefore likely to be medium.

DISCUSSION AND CONCLUSIONS

The study site is located within the Cape Floristic Region (CFR), which is recognized as one of the principal centres of diversity and endemism in Africa. Fynbos and Renosterveld are considered to be the main vegetation types in the CFR. Fynbos is very species rich, but has been transformed or degraded to a high degree and is therefore considered to be of high conservation concern.

The site occurs within one main vegetation type: Saldanha Granite Strandveld, classified as Endangered (Mucina *et al*. 2005, Mucina & Rutherford 2006). There is also a small area of Saldanha Flats Strandveld along the eastern boundary, classified as Endangered (Mucina *et al*. 2005, Mucina & Rutherford 2006). The Endangered vegetation types are protected under the Draft National List of Threatened Ecosystems (GN1477 of 2009), published under the National Environmental Management: Biodiversity Act (Act No. 10, 2004). Any remaining patches of natural vegetation on site therefore have a very high conservation value.

Large parts of the study area appear to be in a transformed state and consists primarily of agricultural lands. There are, however, significant areas of remaining natural vegetation. The vegetation-type descriptions provide an indication that remaining natural vegetation on site consists primarily of strandveld. There are, however, also strips of thicket along drainage lines in the areas of steeper topography and wetland vegetation within the remaining drainage lines.

Drainage lines (wetlands) represent particularly vital natural corridors as they function both as wildlife habitat, providing resources needed for survival, reproduction and movement, and as biological corridors, providing for movement between habitat patches. Both functions are potentially critical to conservation of biological diversity as the landscape becomes increasingly fragmented into smaller, more isolated patches (Rosenberg *et al.*, 1997).

Despite high levels of transformation on site, there are a number of different habitat types that may provide suitable habitat for a variety of flora and fauna species.There are a number of plant and animal species of conservation concern that may occur in habitats within the study area. There are 52 Red List plant species that have a geographic distribution that includes the site and which have a chance of occurring in the study area. This includes three species listed as Critically Endangered, sixteen as Endangered, sixteen as Vulnerable and seventeen as Near Threatened. This is an exceptionally high number of threatened species, even by Fynbos biome standards. There is therefore a very high likelihood of more than one threatened plant species occurring on site or being dependant on natural habitats on site remaining in a natural state.

There are nine animal species of conservation concern that may occur in habitats within the study area or that may be affected by the proposed wind farm. This includes one species classified as Endangered (EN), three as Vulnerable (VU) and five as Near Threatened, including the White-tailed Rat (EN), the Cape Caco (VU), the Cape Sand Snake (VU), the Armadillo Girdled Lizard (VU), the Namaqua Plated Lizard (NT), Gronovi's Dwarf Burrowing Skink (NT), Lesueur's Wing-gland bat (NT), Natal long-fingered bat (NT) and the Cape horseshoe bat (NT).

Bat deaths are one of the most controversial biological issues related to wind turbines. Bats have been found to be particularly vulnerable to being killed by wind turbines. It has long been a mystery why they should be so badly affected since bat echo-location allows them to detect moving objects very well. A recent study in America has found that the primary cause for

mortality is a combination of direct strikes and barotrauma (bats are killed when suddenly passing through a low air pressure region surrounding the turbine blade tips causing low pressure damage the bat's lungs, Baerwald *et al*. 2008). The relative importance of this impact on bat populations depends on which species are likely to be affected, the importance of the site for those species and whether the site is within a migration corridor for particular bat species.

Steep slopes can be problematic in constructing infrastructure due to the fact that any impact can have an effect downslope from that point. Depending on the steepness and the length of the slope, particular areas may be more sensitive to disturbance than others. Any steep slopes are therefore considered to have elevated sensitivity. Potential issues that may arise from development of these areas includes erosion of substrates downslope and the impacts of stormwater runoff.

Other than protected ecosystems and threatened plant and animal species, forests and wetlands are both protected under national legislation (National Forests Act and National Wetlands Act respectively). Any impacts on these areas would require a permit from the relevant National Department. There is one tree species that is protected under the National Forests Act that has a geographic distribution that includes this area (*Sideroxylon inerme* subsp. *inerme*), which has a moderate likelihood of occurring on site. Any impacts on individuals of this species requires a permit from the National Department.

A risk assessment was undertaken which identified nine main potential negative impacts on fauna, flora and ecology of the site. The significance of these impacts will be assessed during the EIA phase after collection of relevant field data. An initial assessment indicates that these impacts are likely to be significant. The identified potential impacts are the following (likely significance of impacts in brackets):

1. Impacts on habitats of threatened fauna (MEDIUM)
2. Impacts due to collision of bats with infrastructure (MEDIUM to HIGH)
3. Impacts on threatened plants (HIGH).
4. Impacts on protected tree species (MEDIUM to HIGH).
5. Impacts on indigenous natural vegetation (HIGH).
6. Impacts on wetlands (HIGH).
7. Change in runoff and drainage patterns (MEDIUM to HIGH).
8. Establishment and spread of declared weeds and alien invader plants (MEDIUM to HIGH).
9. Increased risk of veld fires (MEDIUM).

The majority of these impacts would only be significant if remaining areas of natural vegetation are developed. If infrastructure is restricted to previously transformed areas (primarily cultivated lands), the significance of impacts would be LOW for most of these impacts.

Recommendations

- It is <u>not</u> recommended that any remaining natural vegetation on site is disturbed by the proposed development. This is on the basis of the Endangered status of the vegetation on site, the fact that it occurs within a Critical Biodiversity Area and also due to the high number of threatened plant species that have a potential to occur on site within natural habitats. It is recommended that these natural areas become part of a "no-go" zone within the site and that a buffer zone of a minimum of 30 m is maintained around these areas. The initial assessment of potential impacts indicates that there is a

probability of seven impacts of HIGH significance if infrastructure is planned to be placed within remaining areas of natural vegetation. For impacts rated as having high significance, the decision whether to develop the area is at stake.

- If it is decided to go against the advice of the first recommendation, a comprehensive threatened plant species specialist study is required of all remaining natural areas on site to determine the presence, identity and position of any populations of threatened and near threatened plant species on site. This survey will have to undertaken during the appropriate flowering time of the species listed in Appendix 1 and may require more than one survey.
- It is recommended that a bat specialist study be undertaken to determine the presence, identity and relative density of bats in the area.

Summary of proposed EIA methodology

The following assessments will be done during the EIA phase in order to properly assess potential impacts on the ecological receiving environment by the proposed WEF:

- The vegetation status in different parts of the site will be confirmed. This is due to the fact that large parts of the site have been previously cultivated and it is important to identify any remaining patches of natural vegetation on site.
- The presence and distribution of wetlands and drainage lines on site will be confirmed. This will be done primarily using aerial photograph interpretation, but will be confirmed in the field using topographic and floristic indicators.
- Searches will be undertaken in the thicket in the drainage lines to determine whether any protected trees occur on site or not. The species that is likely to occur on site is *Sideroxylon inerme* (white milkwood), but other species may also occur.
- The identity of any alien woody plants in and around the site will be documented.
- The potential presence of species of concern will be evaluated during the EIA phase. This will be done by assessing habitat suitability for those plant and animal species of conservation concern that have been assessed as potentially occurring in the area. The lists provided in this Scoping Report will form the basis for this assessment. Particular attention will be paid to those plant and animal species classified as threatened (VU, EN or CR), Near Threatened or Critically Rare, including 52 plant species and nine animal species. It must be noted that this assessment does not constitute a detailed search for these species, which requires separate specialist studies, if required (as indicated above in the section on "Recommendations").

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Appendix 1: Plant species of conservation importance that have historically been recorded in the study area.

*IUCN (3.1) Categories:
VU = Vulnerable
EN = Endangered
CR = Critically Endangered
NT = Near Threatened

Table A: Threatened, Near Threatened and Declining plant species that have been previously recorded in the study area

Taxon	Family	Global IUCN (3.1) category*
ASTERACEAE	Cotula filifolia Thunb.	CR
HYACINTHACEAE	Lachenalia mathewsii W.F.Barker	CR
HYACINTHACEAE	Lachenalia viridiflora W.F.Barker	CR
ASTERACEAE	Cotula eckloniana (DC.) Levyns	EN
HYACINTHACEAE	Daubenya zeyheri (Kunth) J.C.Manning & A.M.van der Merwe	EN
BORAGINACEAE	Echiostachys spicatus (Burm.f.) Levyns	EN
HYPOXIDACEAE	Empodium veratrifolium (Willd.) M.F.Thomps.	EN
IRIDACEAE	Ferraria densepunctulata M.P.de Vos	EN
MALVACEAE	Hermannia procumbens Cav. subsp. myrrhifolia (Thunb.) De Winter	EN
MESEMBRYANTHEMACEAE	Lampranthus reptans (Aiton) N.E.Br.	EN
MESEMBRYANTHEMACEAE	Lampranthus scaber (L.) N.E.Br.	EN
PLUMBAGINACEAE	Limonium depauperatum (Boiss.) R.A.Dyer	EN
GERANIACEAE	Pelargonium chelidonium (Houtt.) DC.	EN
RHAMNACEAE	Phylica greyii Pillans	EN
IRIDACEAE	Romulea barkerae M.P.de Vos	EN
IRIDACEAE	Romulea saldanhensis M.P.de Vos	EN
PROTEACEAE	Serruria fucifolia Salisb. ex Knight	EN
FABACEAE	Wiborgia fusca Thunb. subsp. macrocarpa R.Dahlgren	EN
FABACEAE	Xiphotheca reflexa (Thunb.) A.L.Schutte & B.-E.van Wyk	EN
APIACEAE	Arctopus dregei Sond.	VU
FABACEAE	Aspalathus lotoides Thunb. subsp. lagopus (Thunb.) R.Dahlgren	VU
FABACEAE	Aspalathus ternata (Thunb.) Druce	VU
ASTERACEAE	Cotula duckittiae (L.Bolus) K.Bremer & Humphries	VU
RUTACEAE	Diosma guthriei P.E.Glover	VU
ASTERACEAE	Felicia elongata (Thunb.) O.Hoffm.	VU
HYACINTHACEAE	Lachenalia mediana Jacq. var. mediana	VU
PROTEACEAE	Leucospermum rodolentum (Salisb. ex Knight) Rourke	VU
RUTACEAE	Macrostylis crassifolia Sond.	VU
SCROPHULARIACEAE	Manulea corymbosa L.f.	VU
POLYGALACEAE	Muraltia macropetala Harv.	VU
MESEMBRYANTHEMACEAE	Oscularia vredenburgensis (L.Bolus) H.E.K.Hartmann	VU
FABACEAE	Otholobium venustum (Eckl. & Zeyh.) C.H.Stirt.	VU
MESEMBRYANTHEMACEAE	Ruschia cupulata (L.Bolus) Schwantes	VU
PROTEACEAE	Serruria decipiens R.Br.	VU
ASTERACEAE	Steirodiscus tagetes (L.) Schltr.	VU
ASPHODELACEAE	Aloe microstigma Salm-Dyck subsp. framesii (L.Bolus) Glen & D.S.Hardy	NT
IRIDACEAE	Babiana angustifolia Sweet	NT
CRASSULACEAE	Crassula decumbens Thunb. var. brachyphylla (Adamson) Toelken	NT
RUTACEAE	Diosma aspalathoides Lam.	NT
MESEMBRYANTHEMACEAE	Drosanthemum marinum L.Bolus	NT

IRIDACEAE	Ferraria foliosa G.J.Lewis	NT
IRIDACEAE	Geissorhiza monanthos Eckl.	NT
AMARYLLIDACEAE	Gethyllis ciliaris (Thunb.) Thunb. subsp. ciliaris	NT
ASTERACEAE	Helichrysum tricostatum (Thunb.) Less.	NT
IRIDACEAE	Hesperantha erecta (Baker) Benth. ex Baker	NT
HYACINTHACEAE	Lachenalia pustulata Jacq.	NT
SCROPHULARIACEAE	Nemesia strumosa (Herb.Banks ex Benth.) Benth.	NT
RUBIACEAE	Nenax hirta (Cruse) T.M.Salter subsp. calciphila Puff	NT
THYMELAEACEAE	Passerina filiformis L. subsp. glutinosa (Thoday) C.L.Bredenkamp & A.E.van Wyk	NT
SCROPHULARIACEAE	Phyllopodium capillare (L.f.) Hilliard	NT
FABACEAE	Podalyria sericea (Andrews) R.Br. ex Aiton f.	NT
SCROPHULARIACEAE	Zaluzianskya parviflora Hilliard	NT
MESEMBRYANTHEMACEAE	Ruschia langebaanensis L.Bolus	Thr*
IRIDACEAE	Babiana tubiflora (L.f.) Ker Gawl.	Declining
APIACEAE	Capnophyllum leiocarpon (Sond.) Manning & Goldblatt	Declining

* Conservation Status Category assessment according to IUCN Ver. 3.1 (IUCN, 2001), as evaluated by the Threatened Species Programme of the South African National Biodiversity Institute in Pretoria

Appendix 2: Threatened vertebrate species with a geographical distribution that includes the current study area.

MAMMALS

Common name	Taxon	Habitat[1]	Status[2]	Likelihood of occurrence
Grant's golden mole	*Eremitalpa granti*	Strandveld Succulent Karoo, Namib Desert, in subterranean habitats in shifting sands	LC (previously VU)	**HIGH**, previously recorded in grid.
White-tailed rat	*Mystromus albicaudatus*	Highveld and montane grassland, requires sandy soils with good cover. Found throughout South Africa except Northern Cape and Limpopo	EN	**MEDIUM**, previously recorded in nearby grid to the north, presence of suitable substrate unknown, but sandy soils probably present
Lesueur's Wing-gland bat	*Cistugo lisueuri*	Rock crevices in fynbos.	NT	**MEDIUM**, not previously recorded in grid, but overall geographical distribution includes this area
Natal long-fingered bat	*Miniopterus natalensis*	Caves and sub-terranean habitats in Fynbos, savanna, woodland, succulent and Nama Karoo, grassland; cave-dwelling aerial insectivore.	NT	**HIGH**, previously recorded in neighbouring grid
Cape horseshoe bat	*Rhinolophus capensis*	Caves and subterranean habitats; fynbos, shrubland and Nama-karoo.	NT	**HIGH**, previously recorded in neighbouring grid

[1]Distribution according to Friedmann & Daly 2004.
[2]Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org). Downloaded on 08 November 2010.

AMPHIBIANS

Common name	Species	Habitat[3]	Status[4]	Likelihood of occurrence
Cape Caco	*Cacosternum capense*	Lowlands west of the Cape Fold mountains, from the Cape Flats northwards to Graafwater. Vredenburg (3217DD) is at the western limit of its distribution range. Inhabits flat or gently undulating low-lying areas with poorly drained loamy to clay soil, where it breeds in shallow, temporary, rain-filled pools and pans that form during the winter months. Also occurs in more sandy habitats. About 90% of recorded breeding sites occur in modified habitat, particularly agricultural lands.	VU	**HIGH**, previously recorded in grid and suitable habitat probably available on site.

[3]Distribution according to du Preez & Carruthers 2009.
[4]Status according to IUCN 2010. IUCN Red List of Threatened Species. Version 2010.3. (www.iucnredlist.org). Downloaded on 08 November 2010.

REPTILES

Common name	Species	Habitat[5]	Status[6]	Likelihood of occurrence
Cape sand snake	*Psammophis leightoni leightoni*	Coastal renosterveld, coastal fynbos and transitional strandveld in the extreme south-western Cape.	VU	**HIGH**, within known distribution range, suitable habitat probably occurs on site.
Armadillo girdled lizard	*Cordylus cataphractus*	Rock cracks and crevices. Diet consists mainly of termites, beetles and grasshoppers	VU	**MEDIUM**, on edge of known distribution range.
Namaqua plated lizard	*Gerrhosaurus typicus*	Dry sandy areas and bare rocky hillsides	NT	**HIGH**, overall geographical distribution includes this area; suitable habitat probably occurs on site
Southern speckled padloper	*Homopus signatus cafer*	Rocky outcrops and ridges in regions of relatively low rainfall. Occurs west of Cedarberg to the coast.	NT	**LOW**, just outside known distribution range. Small amount of suitable habitat may occur on site.
Geometric tortoise	*Psammobates geometricus*	Flat, low-lying renosterveld of the south-western Cape. Tortoises prefer relatively open habitat.	EN	**LOW**, outside known distribution range.

Fisk's house snake	*Lamprophis fiskii*	Karoo, fynbos and succulent karoo.	VU	**LOW**, overall geographical distribution includes this area, but not recorded from area near site
Yellowbellied house snake	*Lamprophis fuscus*	Old termitaria and under stones, underground. Found throughout more mesic parts of South Africa (Cape, east coast, Highveld).	NT	**LOW**, not previously recorded in neighbouring grids, but within overall distribution range
Southern Adder	*Bitis armata*	Low-lying coastal fynbos in the south-western Cape. Habitat largely transformed.	Not listed, but rare	**HIGH**, site within distribution range
Gronovi's dwarf burrowing skink	*Scelotes gronovii*	West Coast from Vredendal to Robben Island. Under flat rocks or litter in sandy areas.	NT	**HIGH**, within geographical distribution range, previously recorded nearby and suitable habitat may occur on site.
Kasner's dwarf burrowing skink	*Scelotes kasneri*	Coastal dune areas from Lambert's Bay to Vredenburg. Coastal dunes under flat stones or under litter.	VU	**LOW**, just outside geographical distribution range, suitable habitat unlikely to occur on site.

[5]Distribution according to Branch 1988 and Marais 2004.
[6]Status according to Branch 1988 and Alexander & Marais 2008.

Appendix 3: Protected animal species with a geographical distribution that includes the current study area.

MAMMALS

Common name	Taxon
Red Hartebeest	*Alcelaphus buselaphus*
Springbok	*Antidorcas marsupialis*
Reddish-grey Musk Shrew	*Crocidura cyanea*
Greater Musk Shrew	*Crocidura flavescens*
Cape Rock Elephant-shrew	*Elephantulus edwardii*
Long-tailed Serotine Bat	*Eptesicus hottentotus*
Forest Shrew	*Myosorex varius*
Cape Serotine Bat	*Neoromicia capensis*
Egyptian slit-faced bat	*Nycteris thebaica*
Klipspringer	*Oreotragus oreotragus*
Aardvark	*Orycteropus afer*
Bat-eared Fox	*Otocyon megalotis*
Leopard	*Panthera pardus*
African weasel / Snake mongoose	*Poecilogale albinucha*
Aardwolf	*Proteles cristatus*
Steenbok	*Raphicerus campestris*
Grysbok	*Raphicerus melanotis*
Geoffroy's horseshoe bat	*Rhinolophus clivosus*
Roberts's Flat-headed Bat	*Sauromys petrophilus*
Lesser Dwarf Shrew	*Suncus varilla*
Grey Duiker	*Sylvicapra grimmia*
Egyptian Free-tailed Bat	*Tadarida aegyptica*
Cape Fox / Silver Jackal	*Vulpes chama*

AMPHIBIANS

Common name	Species
Cape River Frog	*Amietia fuscigula*
Namaqua Rain Frog	*Breviceps namaquensis*
Sand Rain Frog	*Breviceps rosei rosei*
Clicking Stream Frog	*Strongylopus grayii*
Cape Sand Frog	*Tomopterna delalandii*
Cape Sand Toad	*Vandijkophrynus angusticeps*
Common platanna	*Xenophus laevis*

REPTILES

Common name	Species
Western Dwarf Chameleon	*Bradypodion occidentale*
Southern Rock Agama	*Agama atra*
Southern Spiny Agama	*Agama hispida*
Knox's Desert Lizard	*Meroles knoxii*
Western Sandveld Lizard	*Nucras tessellata*
Spotted Sand Lizard	*Pedioplanis lineoocellata*
Cuvier's Blind Legless Skink	*Typhlosaurus caecus*
Cape Legless Skink	*Acontias meleagris*
Bloubergstrand Dwarf Burrowing Skink	*Scelotes montispectus*
Cape Dwarf Burrowing Skink	*Scelotes caffer*
Cape Skink	*Trachylepis capensis*
Western Rock Skink	*Trachylepis sulcata*
Black Girdled Lizard	*Cordylus niger*
Cape Girdled Lizard	*Cordylus cordylus*
Karoo Girdled Lizard	*Cordylus polyzonus*
Large-scaled Girdled Lizard	*Cordylus macropholis*
Common Long-tailed Seps	*Tetradactylus tetradactylus*
Yellow-throated Plated Lizard	*Tetrodactylus seps*
Marbled African Leaf-toed Gecko	*Afrogecko porphyreus*
Striped Dwarf Leaf-toed Gecko	*Goggia lineata*
Austen's Dune Gecko	*Pachydactylus austeni*
Marico Gecko	*Pachydactylus mariquensis*
Marsh Terrapin	*Pelomedusa subrufa*
Angulate Tortoise	*Chersina angulata*
Common Brown Water Snake	*Lycodonomorphus rufulus*

Brown House Snake	*Lamprophis capensis*
Olive House Snake	*Lamprophis inornatus*
Spotted Rock Snake	*Lamprophis guttatus*
Common Slug-eater	*Duberria lutrix*
Mole Snake	*Pseudaspis cana*
Sundevall's Shovel-snout	*Prosymna sundevalli*

Appendix 4: List of protected tree species (National Forests Act).

Acacia erioloba	*Acacia haematoxylon*
Adansonia digitata	*Afzelia quanzensis*
Balanites subsp. *maughamii*	*Barringtonia racemosa*
Boscia albitrunca	*Brachystegia spiciformis*
Breonadia salicina	*Bruguiera gymnhorrhiza*
Cassipourea swaziensis	*Catha edulis*
Ceriops tagal	*Cleistanthus schlectheri* var. *schlechteri*
Colubrina nicholsonii	*Combretum imberbe*
Curtisia dentata	*Elaedendron transvaalensis*
Erythrophysa transvaalensis	*Euclea pseudebenus*
Ficus trichopoda	*Leucadendron argenteum*
Lumnitzera racemosa var. *racemosa*	*Lydenburgia abottii*
Lydenburgia cassinoides	*Mimusops caffra*
Newtonia hildebrandtii var. *hildebrandtii*	*Ocotea bullata*
Ozoroa namaquensis	*Philenoptera violacea* (*Lonchocarpus capassa*)
Pittosporum viridiflorum	*Podocarpus elongatus*
Podocarpus falcatus	*Podocarpus henkelii*
Podocarpus latifolius	*Protea comptonii*
Protea curvata	*Prunus africana*
Pterocarpus angolensis	*Rhizophora mucronata*
Sclerocarya birrea subsp. *caffra*	*Securidaca longependunculata*
Sideroxylon inerme subsp. *inerme*	*Tephrosia pondoensis*
Warburgia salutaris	*Widdringtonia cedarbergensis*
Widdringtonia schwarzii	

Sideroxylon inerme subsp. *inerme* has a geographical distribution that coincides with the study area.

Appendix 5: Checklist of plant species recorded during previous botanical surveys in the study area is located.
(quarter degree in which the study area is located and the immediately adjacent grid to the south)

Family	Scientific Name
FABACEAE	Acacia mearnsii De Wild.
MOLLUGINACEAE	Adenogramma teretifolia (Thunb.) Adamson
RUTACEAE	Agathosma bisulca (Thunb.) Bartl. & H.L.Wendl.
POACEAE	Aira cupaniana Guss.
AIZOACEAE	Aizoon paniculatum L.
ASPHODELACEAE	Aloe microstigma Salm-Dyck subsp. framesii (L.Bolus) Glen & D.S.Hardy
ASTERACEAE	Amellus asteroides (L.) Druce subsp. asteroides
ASTERACEAE	Amellus tenuifolius Burm.
MESEMBRYANTHEMACEAE	Amphibolia laevis (Aiton) H.E.K.Hartmann
MALVACEAE	Anisodontea biflora (Desr.) Bates
APIACEAE	Arctopus dregei Sond.
ASTERACEAE	Arctotheca calendula (L.) Levyns
ASTERACEAE	Arctotheca populifolia (P.J.Bergius) Norl.
ASTERACEAE	Arctotis cuprea Jacq.
ASTERACEAE	Arctotis hirsuta (Harv.) Beauverd
ASTERACEAE	Arctotis revoluta Jacq.
FABACEAE	Aspalathus acuminata Lam. subsp. acuminata
FABACEAE	Aspalathus ericifolia L. subsp. minuta R.Dahlgren
FABACEAE	Aspalathus lotoides Thunb. subsp. lagopus (Thunb.) R.Dahlgren
FABACEAE	Aspalathus spinescens Thunb. subsp. lepida (E.Mey.) R.Dahlgren
FABACEAE	Aspalathus spinosa L. subsp. spinosa
FABACEAE	Aspalathus ternata (Thunb.) Druce
ASPARAGACEAE	Asparagus declinatus L.
ASPARAGACEAE	Asparagus exuvialis Burch. forma exuvialis
ASPARAGACEAE	Asparagus fasciculatus Thunb.
ASPARAGACEAE	Asparagus kraussianus (Kunth) J.F.Macbr.
ASPARAGACEAE	Asparagus lignosus Burm.f.
ASPARAGACEAE	Asparagus rubicundus P.J.Bergius
ASPARAGACEAE	Asparagus undulatus (L.f.) Thunb.
CHENOPODIACEAE	Atriplex cinerea Poir. subsp. bolusii (C.H.Wright) Aellen var. adamsonii Aellen
POACEAE	Avena fatua L.
IRIDACEAE	Babiana ambigua (Roem. & Schult.) G.J.Lewis
IRIDACEAE	Babiana angustifolia Sweet
IRIDACEAE	Babiana hirsuta (Lam.) Goldblatt & J.C.Manning
IRIDACEAE	Babiana mucronata (Jacq.) Ker Gawl. subsp. mucronata
IRIDACEAE	Babiana ringens (L.) Ker Gawl. subsp. ringens
IRIDACEAE	Babiana tubiflora (L.f.) Ker Gawl.
BRASSICACEAE	Barbarea verna (Mill.) Asch.
CHENOPODIACEAE	Bassia diffusa (Thunb.) Kuntze
BRASSICACEAE	Brassica rapa L.
POACEAE	Briza maxima L.

POACEAE	Bromus catharticus Vahl
POACEAE	Bromus diandrus Roth
POACEAE	Bromus pectinatus Thunb.
ASPHODELACEAE	Bulbine minima Baker
ASPHODELACEAE	Bulbine sedifolia Schltr. ex Poelln.
FABACEAE	Calobota angustifolia (E.Mey.) Boatwr. & B.-E.van Wyk
FABACEAE	Calobota cytisoides (Berg.) Eckl. & Zeyh.
FABACEAE	Calobota lotononoides (Schltr.) Boatwr. & B.-E.van Wyk
APIACEAE	Capnophyllum leiocarpon (Sond.) Manning & Goldblatt
VALERIANACEAE	Centranthus ruber (L.) DC.
SCROPHULARIACEAE	Chaenostoma uncinatum (Desr.) Kornhall
POACEAE	Chaetobromus involucratus (Schrad.) Nees subsp. involucratus
SINOPTERIDACEAE	Cheilanthes hastata (L.f.) Kunze
SINOPTERIDACEAE	Cheilanthes multifida (Sw.) Sw. var. multifida
CHENOPODIACEAE	Chenopodium ambrosioides L.
ANTHERICACEAE	Chlorophytum comosum (Thunb.) Jacques
ASTERACEAE	Chrysanthemoides incana (Burm.f.) Norl.
POACEAE	Cladoraphis cyperoides (Thunb.) S.M.Phillips
MESEMBRYANTHEMACEAE	Conicosia pugioniformis (L.) N.E.Br. subsp. pugioniformis
BRASSICACEAE	Coronopus didymus (L.) Sm.
ASTERACEAE	Cotula duckittiae (L.Bolus) K.Bremer & Humphries
ASTERACEAE	Cotula eckloniana (DC.) Levyns
ASTERACEAE	Cotula filifolia Thunb.
CRASSULACEAE	Crassula decumbens Thunb. var. brachyphylla (Adamson) Toelken
CRASSULACEAE	Crassula dejecta Jacq.
CRASSULACEAE	Crassula expansa Dryand. subsp. expansa
CRASSULACEAE	Crassula glomerata P.J.Bergius
CRASSULACEAE	Crassula thunbergiana Schult. subsp. thunbergiana
FABACEAE	Crotalaria excisa (Thunb.) Baker f. subsp. excisa
CONVOLVULACEAE	Cuscuta nitida Choisy
APIACEAE	Cynorhiza meifolia (Eckl. & Zeyh.) Magee
APIACEAE	Cynorhiza typica Eckl. & Zeyh.
LOBELIACEAE	Cyphia crenata (Thunb.) C.Presl var. crenata
FUMARIACEAE	Cysticapnos vesicaria (L.) Fedde subsp. vesicaria
POACEAE	Dactylis glomerata L.
HYACINTHACEAE	Daubenya zeyheri (Kunth) J.C.Manning & A.M.van der Merwe
SCROPHULARIACEAE	Diascia capensis (L.) Britten
SCROPHULARIACEAE	Diascia longicornis (Thunb.) Druce
ASTERACEAE	Didelta carnosa (L.f.) Aiton var. carnosa
ASTERACEAE	Didelta carnosa (L.f.) Aiton var. tomentosa (Less.) Roessler
ASTERACEAE	Dimorphotheca sinuata DC.
RUTACEAE	Diosma acmaeophylla Eckl. & Zeyh.
RUTACEAE	Diosma aspalathoides Lam.
RUTACEAE	Diosma guthriei P.E.Glover
EBENACEAE	Diospyros austro-africana De Winter var. rugosa (E.Mey. ex A.DC.) De Winter
MESEMBRYANTHEMACEAE	Dorotheanthus bellidiformis (Burm.f.) N.E.Br. subsp. bellidiformis

MESEMBRYANTHEMACEAE	Drosanthemum marinum L.Bolus
BORAGINACEAE	Echiostachys spicatus (Burm.f.) Levyns
POACEAE	Ehrharta brevifolia Schrad. var. brevifolia
POACEAE	Ehrharta calycina Sm.
HYPOXIDACEAE	Empodium veratrifolium (Willd.) M.F.Thomps.
ERICACEAE	Erica flacca E.Mey. ex Benth.
ERICACEAE	Erica inaequalis (N.E.Br.) E.G.H.Oliv.
HYACINTHACEAE	Eucomis regia (L.) L'Hér.
EUPHORBIACEAE	Euphorbia peplus L.
ASTERACEAE	Euryops linifolius (L.) DC.
ASTERACEAE	Felicia elongata (Thunb.) O.Hoffm.
ASTERACEAE	Felicia filifolia (Vent.) Burtt Davy subsp. schlechteri (Compton) Grau
ASTERACEAE	Felicia merxmuelleri Grau
ASTERACEAE	Felicia tenella (L.) Nees subsp. pusilla (Harv.) Grau
IRIDACEAE	Ferraria densepunctulata M.P.de Vos
IRIDACEAE	Ferraria foliosa G.J.Lewis
ASTERACEAE	Foveolina tenella (DC.) Källersjö
IRIDACEAE	Freesia viridis (Aiton) Goldblatt & J.C.Manning
AIZOACEAE	Galenia africana L.
RUBIACEAE	Galium tomentosum Thunb.
IRIDACEAE	Geissorhiza lewisiae R.C.Foster
IRIDACEAE	Geissorhiza monanthos Eckl.
AMARYLLIDACEAE	Gethyllis afra L.
AMARYLLIDACEAE	Gethyllis ciliaris (Thunb.) Thunb. subsp. ciliaris
AMARYLLIDACEAE	Gethyllis lanuginosa Marloth
IRIDACEAE	Gladiolus alatus L.
IRIDACEAE	Gladiolus floribundus Jacq.
IRIDACEAE	Gladiolus gracilis Jacq.
IRIDACEAE	Gladiolus orchidiflorus Andrews
NEURADACEAE	Grielum humifusum Thunb. var. humifusum
ASTERACEAE	Gymnodiscus capillaris (L.f.) DC.
SCROPHULARIACEAE	Hebenstretia dentata L.
SCROPHULARIACEAE	Hebenstretia repens Jaroscz
ASTERACEAE	Helichrysum bachmannii Klatt
ASTERACEAE	Helichrysum litorale Bolus
ASTERACEAE	Helichrysum revolutum (Thunb.) Less.
ASTERACEAE	Helichrysum tricostatum (Thunb.) Less.
BRASSICACEAE	Heliophila macowaniana Schltr.
MALVACEAE	Hermannia heterophylla (Cav.) Thunb.
MALVACEAE	Hermannia pinnata L.
MALVACEAE	Hermannia prismatocarpa E.Mey. ex Harv.
MALVACEAE	Hermannia procumbens Cav. subsp. myrrhifolia (Thunb.) De Winter
MALVACEAE	Hermannia scordifolia Jacq.
MALVACEAE	Hermannia trifurca L.
IRIDACEAE	Hesperantha erecta (Baker) Benth. ex Baker
IRIDACEAE	Hesperantha radiata (Jacq.) Ker Gawl.

POACEAE	Holcus lanatus L.
POACEAE	Hordeum geniculatum All.
FABACEAE	Indigofera incana Thunb.
FABACEAE	Indigofera procumbens L.
FABACEAE	Indigofera venusta Eckl. & Zeyh.
CYPERACEAE	Isolepis levynsiana Muasya & D.A.Simpson
JUNCACEAE	Juncus effusus L.
JUNCACEAE	Juncus tenuis Willd.
ASPHODELACEAE	Kniphofia uvaria (L.) Oken
HYACINTHACEAE	Lachenalia mathewsii W.F.Barker
HYACINTHACEAE	Lachenalia mediana Jacq. var. mediana
HYACINTHACEAE	Lachenalia pustulata Jacq.
HYACINTHACEAE	Lachenalia viridiflora W.F.Barker
MESEMBRYANTHEMACEAE	Lampranthus reptans (Aiton) N.E.Br.
MESEMBRYANTHEMACEAE	Lampranthus scaber (L.) N.E.Br.
IRIDACEAE	Lapeirousia anceps (L.f.) Ker Gawl.
IRIDACEAE	Lapeirousia jacquinii N.E.Br.
MYRTACEAE	Leptospermum laevigatum (Gaertn.) F.Muell.
FABACEAE	Lessertia herbacea (L.) Druce
FABACEAE	Lessertia rigida E.Mey.
PROTEACEAE	Leucadendron pubescens R.Br.
ASTERACEAE	Leucanthemum vulgare Lam.
PROTEACEAE	Leucospermum rodolentum (Salisb. ex Knight) Rourke
ASTERACEAE	Leysera gnaphalodes (L.) L.
MOLLUGINACEAE	Limeum africanum L. subsp. africanum
PLUMBAGINACEAE	Limonium capense (L.Bolus) L.Bolus
PLUMBAGINACEAE	Limonium depauperatum (Boiss.) R.A.Dyer
PLUMBAGINACEAE	Limonium peregrinum (P.J.Bergius) R.A.Dyer
POACEAE	Lolium perenne L.
POACEAE	Lolium rigidum Gaudin
POACEAE	Lophochloa pumila (Desf.) Bor
FABACEAE	Lotononis involucrata (P.J.Bergius) Benth. subsp. involucrata
FABACEAE	Lotononis sabulosa T.M.Salter
RUTACEAE	Macrostylis crassifolia Sond.
RUTACEAE	Macrostylis squarrosa Bartl. & H.L.Wendl.
SCROPHULARIACEAE	Manulea corymbosa L.f.
SCROPHULARIACEAE	Manulea rubra (P.J.Bergius) L.f.
SCROPHULARIACEAE	Manulea thyrsiflora L.f.
IRIDACEAE	Melasphaerula ramosa (L.) N.E.Br.
MELIANTHACEAE	Melianthus elongatus Wijnands
FABACEAE	Melilotus indicus (L.) All.
FABACEAE	Melolobium aethiopicum (L.) Druce
FABACEAE	Melolobium candicans (E.Mey.) Eckl. & Zeyh.
POACEAE	Merxmuellera arundinacea (P.J.Bergius) Conert
ASTERACEAE	Metalasia brevifolia (Lam.) Levyns
ASTERACEAE	Metalasia densa (Lam.) P.O.Karis

NYCTAGINACEAE	Mirabilis jalapa L.
IRIDACEAE	Moraea albiflora (G.J.Lewis) Goldblatt
IRIDACEAE	Moraea caeca Barnard ex Goldblatt
POLYGALACEAE	Muraltia dumosa (Poir.) DC.
POLYGALACEAE	Muraltia macropetala Harv.
BORAGINACEAE	Myosotis discolor Pers.
SCROPHULARIACEAE	Nemesia affinis Benth.
SCROPHULARIACEAE	Nemesia bicornis (L.) Pers.
SCROPHULARIACEAE	Nemesia ligulata E.Mey. ex Benth.
SCROPHULARIACEAE	Nemesia strumosa (Herb.Banks ex Benth.) Benth.
RUBIACEAE	Nenax hirta (Cruse) T.M.Salter subsp. calciphila Puff
RUBIACEAE	Nenax hirta (Cruse) T.M.Salter subsp. hirta
POLYGALACEAE	Nylandtia scoparia (Eckl. & Zeyh.) Goldblatt & J.C.Manning
POLYGALACEAE	Nylandtia spinosa (L.) Dumort.
ONAGRACEAE	Oenothera rosea L'Hér. ex Aiton
ASTERACEAE	Oncosiphon suffruticosum (L.) Källersjö
APOCYNACEAE	Orbea variegata (L.) Haw.
HYACINTHACEAE	Ornithogalum juncifolium Jacq. var. juncifolium
HYACINTHACEAE	Ornithogalum maculatum Jacq.
GENTIANACEAE	Orphium frutescens (L.) E.Mey.
ORTHOTRICHACEAE	Orthotrichum diaphanum (Schrad. ex Brid.) Lindb.
MESEMBRYANTHEMACEAE	Oscularia vredenburgensis (L.Bolus) H.E.K.Hartmann
ASTERACEAE	Osteospermum pinnatum (Thunb.) Norl. var. pinnatum
FABACEAE	Otholobium venustum (Eckl. & Zeyh.) C.H.Stirt.
ASTERACEAE	Othonna arborescens L.
POACEAE	Parapholis incurva (L.) C.E.Hubb.
THYMELAEACEAE	Passerina corymbosa Eckl. ex C.H.Wright
THYMELAEACEAE	Passerina filiformis L. subsp. glutinosa (Thoday) C.L.Bredenkamp & A.E.van Wyk
GERANIACEAE	Pelargonium carnosum (L.) L'Hér. subsp. carnosum
GERANIACEAE	Pelargonium chelidonium (Houtt.) DC.
GERANIACEAE	Pelargonium grossularioides (L.) L'Hér.
GERANIACEAE	Pelargonium hirtum (Burm.f.) Jacq.
POACEAE	Pennisetum clandestinum Hochst. ex Chiov.
POACEAE	Pentaschistis airoides (Nees) Stapf subsp. airoides
POACEAE	Pentaschistis barbata (Nees) H.P.Linder subsp. barbata
POACEAE	Phalaris minor Retz.
MOLLUGINACEAE	Pharnaceum elongatum (DC.) Adamson
RHAMNACEAE	Phylica cephalantha Sond.
RHAMNACEAE	Phylica greyii Pillans
SCROPHULARIACEAE	Phyllopodium capillare (L.f.) Hilliard
SCROPHULARIACEAE	Phyllopodium heterophyllum (L.f.) Benth.
SCROPHULARIACEAE	Phyllopodium phyllopodioides (Schltr.) Hilliard
SOLANACEAE	Physalis peruviana L.
PLANTAGINACEAE	Plantago lanceolata L.
PLANTAGINACEAE	Plantago major L.
POACEAE	Poa annua L.

FABACEAE	Podalyria sericea (Andrews) R.Br. ex Aiton f.
ASTERACEAE	Poecilolepis ficoidea (DC.) Grau
POLYGALACEAE	Polygala myrtifolia L. var. myrtifolia
POLYGONACEAE	Polygonum maritimum L.
POACEAE	Polypogon monspeliensis (L.) Desf.
MESEMBRYANTHEMACEAE	Prenia pallens (Aiton) N.E.Br. subsp. pallens
ASTERACEAE	Pseudognaphalium luteo-album (L.) Hilliard & B.L.Burtt
MESEMBRYANTHEMACEAE	Psilocaulon junceum (Haw.) Schwantes
ASTERACEAE	Pteronia divaricata (P.J.Bergius) Less.
ASTERACEAE	Pteronia onobromoides DC.
POACEAE	Puccinellia angusta (Nees) C.A.Sm. & C.E.Hubb.
CELASTRACEAE	Putterlickia pyracantha (L.) Szyszyl.
FABACEAE	Rafnia angulata Thunb. subsp. angulata
FABACEAE	Rafnia capensis (L.) Schinz subsp. capensis
BRASSICACEAE	Raphanus raphanistrum L.
ASTERACEAE	Rhynchopsidium pumilum (L.f.) DC.
RICCIACEAE	Riccia purpurascens Lehm.
IRIDACEAE	Romulea barkerae M.P.de Vos
IRIDACEAE	Romulea saldanhensis M.P.de Vos
IRIDACEAE	Romulea tabularis Eckl. ex Bég.
MESEMBRYANTHEMACEAE	Ruschia cupulata (L.Bolus) Schwantes
MESEMBRYANTHEMACEAE	Ruschia klipbergensis L.Bolus
MESEMBRYANTHEMACEAE	Ruschia langebaanensis L.Bolus
CHENOPODIACEAE	Salicornia meyeriana Moss
SALICACEAE	Salix caprea L.
LAMIACEAE	Salvia africana-caerulea L.
LAMIACEAE	Salvia lanceolata Lam.
THEOPHRASTACEAE	Samolus porosus (L.f.) Thunb.
APIACEAE	Sanicula elata Buch.-Ham. ex D.Don
CHENOPODIACEAE	Sarcocornia mossiana (Toelken) A.J.Scott
CHENOPODIACEAE	Sarcocornia perennis (Mill.) A.J.Scott var. perennis
CHENOPODIACEAE	Sarcocornia pillansii (Moss) A.J.Scott var. pillansii
ORCHIDACEAE	Satyrium odorum Sond.
POACEAE	Schismus barbatus (Loefl. ex L.) Thell.
ANACARDIACEAE	Searsia dissecta (Thunb.) Moffett
ANACARDIACEAE	Searsia glauca (Thunb.) Moffett
ANACARDIACEAE	Searsia undulata (Jacq.) T.S.Yi, A.J.Mill. & J.Wen
SCROPHULARIACEAE	Selago scabribractea Hilliard
ASTERACEAE	Senecio arenarius Thunb.
ASTERACEAE	Senecio littoreus Thunb. var. hispidulus Harv.
ASTERACEAE	Senecio littoreus Thunb. var. littoreus
ASTERACEAE	Senecio maritimus L.
ASTERACEAE	Senecio sarcoides C.Jeffrey
PROTEACEAE	Serruria decipiens R.Br.
PROTEACEAE	Serruria fucifolia Salisb. ex Knight
SOLANACEAE	Solanum nigrum L.

POACEAE	Spartina maritima (Curtis) Fernald
CARYOPHYLLACEAE	Spergularia media (L.) C.Presl ex Griseb.
POACEAE	Sphenopus divaricatus (Gouan) Rchb.
HYPOXIDACEAE	Spiloxene serrata (Thunb.) Garside var. serrata
POACEAE	Sporobolus virginicus (L.) Kunth
LAMIACEAE	Stachys arvensis L.
ASTERACEAE	Steirodiscus tagetes (L.) Schltr.
POACEAE	Stipa capensis Thunb.
THYMELAEACEAE	Struthiola fasciata C.H.Wright
THYMELAEACEAE	Struthiola leptantha Bolus
FABACEAE	Sutherlandia frutescens (L.) R.Br.
AIZOACEAE	Tetragonia fruticosa L.
AIZOACEAE	Tetragonia rosea Schltr.
RESTIONACEAE	Thamnochortus spicigerus (Thunb.) Spreng.
SANTALACEAE	Thesium elatius Sond.
SANTALACEAE	Thesium patulum A.W.Hill
ASPHODELACEAE	Trachyandra scabra (L.f.) Kunth
COMMELINACEAE	Tradescantia fluminensis Vell.
POACEAE	Tribolium acutiflorum (Nees) Renvoize
POACEAE	Tribolium echinatum (Thunb.) Renvoize
ASTERACEAE	Trichogyne verticillata (L.f.) Less.
FABACEAE	Trifolium repens L.
JUNCAGINACEAE	Triglochin bulbosa L.
JUNCAGINACEAE	Triglochin striata Ruíz & Pav.
ASTERACEAE	Tripteris dentata (Burm.f.) Harv.
ASTERACEAE	Ursinia anthemoides (L.) Poir. subsp. anthemoides
VERBENACEAE	Verbena officinalis L.
SCROPHULARIACEAE	Veronica agrestis L.
FABACEAE	Vicia benghalensis L.
POACEAE	Vulpia bromoides (L.) Gray
HAEMODORACEAE	Wachendorfia multiflora (Klatt) J.C.Manning & Goldblatt
CAMPANULACEAE	Wahlenbergia adpressa (Thunb.) Sond.
CAMPANULACEAE	Wahlenbergia hispidula (Thunb.) A.DC.
CAMPANULACEAE	Wahlenbergia obovata Brehmer
FABACEAE	Wiborgia fusca Thunb. subsp. macrocarpa R.Dahlgren
FABACEAE	Wiborgia leptoptera R.Dahlgren subsp. leptoptera
FABACEAE	Wiborgia obcordata (P.J.Bergius) Thunb.
RESTIONACEAE	Willdenowia incurvata (Thunb.) H.P.Linder
FABACEAE	Xiphotheca reflexa (Thunb.) A.L.Schutte & B.-E.van Wyk
SCROPHULARIACEAE	Zaluzianskya parviflora Hilliard
SCROPHULARIACEAE	Zaluzianskya villosa F.W.Schmidt
ZYGOPHYLLACEAE	Zygophyllum flexuosum Eckl. & Zeyh.
ZYGOPHYLLACEAE	Zygophyllum pygmaeum Eckl. & Zeyh.
ZYGOPHYLLACEAE	Zygophyllum spinosum L.