NICK HELME BOTANICAL SURVEYS

PO Box 22652 Scarborough 7975

Ph: 021 780 1420 Fax: 021 780 1868 cell: 082 82 38350 email: botaneek@iafrica.com

VAT Reg. # 4930216892

SPECIALIST IMPACT ASSESSMENT FOR PROPOSED ESKOM WIND ENERGY FACILITY ON THE CAPE WEST COAST: TERRESTRIAL VEGETATION COMPONENT

Prepared for: Savannah Environmental (Pty.) Ltd., Johannesburg

Client: Eskom

Revision 2: 20 Dec 2007

EXECUTIVE SUMMARY

This botanical impact assessment was requested in order to help inform decisions regarding the placement of a proposed Eskom wind energy facility (WEF) on the Cape west coast, just north of the Olifants River mouth, on a portion of three properties totalling 3700ha. The study area falls within the Namaqualand coastal region of the Cape Floristic Region, and is used primarily as a sheep grazing area, although there are old strip cultivation areas on about 600ha, which have not been cultivated for at least 12 years.

Two distinct vegetation types occur in the area, and where they meet a highly complex mosaic of both may be found. Namaqualand Strandveld (Succulent Karoo biome) occupies the coastal parts of the site, is an extremely widespread vegetation type along the west coast, and is regarded as a Least Threatened vegetation type in terms of the NSBA (Rouget et al 2004), with over 90% still intact, but with 0% formally conserved. At least two Red Data Book listed plant species occur in this area, in low numbers. Namaqualand Sand Fynbos (Fynbos biome) is found in the interior and lower parts of the site on a series of stabilised dunes and interdune slacks. Soils in this area are less alkaline, and about 60% of the species are the same as those found in the Strandveld. This vegetation type is also listed as Least Threatened in the NSBA, with 98% remaining, and a conservation target of 29% (1% currently conserved). At least one Red Data Book listed species was found in this area, in significant numbers, and the habitat is regarded as more sensitive than the Dune Strandveld area from an erosion and regional botanical point of view.

Particular areas of sensitivity include at least nine seasonal pans, a clay hill slope in the west, and some small rocky outcrops in the south. The pans and rocky outcrops should be excluded from the development footprint, with buffers of at least 50m. No other mitigation is acceptable in this regard.

The small patch of exposed clay (and associated Red Data Book plant species) on the hill in the far west will be impacted by WTG 1-3 and these should ideally be relocated off this sensitive area. It is not only the turbines that will cause damage to this area but also the roads and the crane used for installation. If moving the turbine positions is not possible then a botanist must be contracted to do a site-specific placement of all infrastructure in this area, which would partially reduce the impacts. Placement of turbines and infrastructure in this sensitive area cannot be viewed as a Fatal Flaw, but is not advisable from a botanical perspective, and cannot be regarded as complying with the best practice of “avoiding impacts”.

From a botanical point of view the least sensitive area is the previously strip cultivated portion (Low - Medium sensitivity) and is thus where most of the infrastructure (construction camp, operations base, substation) should ideally be concentrated. Most of the Strandveld portions are deemed to be of Medium

botanical sensitivity, with the Sand Fynbos areas, clay areas, seasonal pans and rocky outcrops being of Medium to High sensitivity.

Overall the impact of the proposed WEF on the vegetation on site is likely to have a Medium local (site scale; 3700ha site) and Low regional (southern Namaqualand coast; < 500 000ha) impact.

The primary negative impacts are direct, permanent loss of natural vegetation (~30ha to a worst case of 80ha) in development footprints, and direct, long term loss of natural vegetation (a further ~30ha to a worst case of 80ha) in areas that will be disturbed by heavy construction machinery, temporary dumping, etc. Most of these impacts cannot be avoided or mitigated in any significant way.

Apart from one portion of Alternative 1 the proposed 132 kV power line to Juno will have an acceptable overall Low negative impact throughout its length. The quartz patches north of Koekenaap must however be avoided, or else Alternative 1 will have an unacceptably High negative impact (No Go scenario). Alternative 1a is both shorter and avoids the sensitive quartz patches, and is thus clearly the equally preferred alternative, along with Alternative 2, from a botanical point of view.

Indirect impacts are difficult to quantify, largely because there are many unknowns in terms of the source of construction and road materials. If mitigation recommendations are implemented then indirect impacts on the vegetation on site and off site should be negligible. Cumulative effects are in many respects regional effects, and the impacts of this type of development will be significantly less than for various existing and proposed mining operations in the region.

Possible positive direct impacts are fairly small, and depend to a large degree on the management of the remaining natural vegetation on site (>3500ha) as a conservation area (both vegetation types are very underconserved, with less than 1% conserved), and the permanent removal of livestock. An indirect positive impact is obviously the small contribution that this WEF will make to reducing CO_2 emissions, and the associated very small reduction in global warming effects.

It is strongly recommended that Eskom should remove all livestock from the site, but this will obviously only be possible if Eskom owns the land, and this is thus also a firm recommendation. Removal of grazing pressure will have a beneficial effect on the natural vegetation, particularly in terms of natural rehabilitation, in that flowering and seed set of the remaining natural plants (especially pioneers such as the annuals) will be significantly better in the absence of grazing (which removes the flowers).

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DECLARATION OF INDEPENDENCE

In terms of Chapter 5 of the National Environmental Management Act of 1998 specialists involved in Impact Assessment processes must declare their independence and include an abbreviated Curriculum Vitae.

I, N.A. Helme, do hereby declare that I am financially and otherwise independent of the client and their consultants, and that all opinions expressed in this document are substantially my own.

NA Helme

Abridged CV:

Contact details as per letterhead.
Surname : HELME
First names : NICHOLAS ALEXANDER
Date of birth : 29 January 1969
University of Cape Town, South Africa. BSc (Honours) – Botany (Ecology & Systematics). 1990.

Since 1997 I have been based in Cape Town, and have been working as a specialist botanical consultant, specialising in the diverse flora of the south-western Cape. Since the end of 2001 I have been the Sole Proprietor of Nick Helme Botanical Surveys.

A selection of previous botanical work on the northern west coast is as follows:

- Scoping and Impact Assessment for proposed new Eskom powerline from Alexander Bay to Vredendal (SEFSA 2006)
- Assessment of proposed Bound for Gold mineral sands exploration program on the west coast south of Brand se Baai (Amathemba Environmental 2006)
- Fine Scale vegetation mapping project in NW Sandveld (CapeNature 2007)
- Vegetation survey of proposed Namakwa Sands heavy mineral sands expansion project at Brand se Baai and Koekenaap MSP (Crowther Campbell 2003)
- Impact Assessment of proposed Namakwa Sands expansion project, Brand se Baai (Golder 2005)
- Scoping and IA on upgrading of Lamberts Bay - Elands Bay road (Marion Thomas 2002; revised in 2004, for EPRMS).

1. INTRODUCTION

This botanical impact assessment was requested in order to help inform decisions regarding the selection and assessment of a site for an Eskom wind energy (WEF) facility on the Cape west coast, just north of the Olifants River mouth. The facility would initially comprise of 50 turbines, with another 50 to be installed as part of a second phase. Each structure is up to 80m tall, connected by underground cabling and 6m wide access roads, with further footprints associated with the construction phase crane tracks, etc. There will also be a small substation, and a new 132 kV power line connecting to the main electricity grid at Juno (near Vredendal). After a fairly extensive process to identify a suitable site in the area (but see Savannah Environmental 2007), a single study area ("the site") comprising three farms within the Matzikama Local Municipality has been chosen for more detailed investigation at the Scoping and Impact Assessment stage. The three farms together total about 3700ha, and consist of the farms Gravewaterkop 158 Portion 5, Portion 620 of the farm Olifantsrivier Nedersetting (also known as Olifants River Settlement), and Portion 617 of the farm Olifantsrivier Nedersetting. The site does not include the actual coastal strip, and is at least 2km from the coast. The total area spanned by the turbine network is anticipated to amount to about 2500ha.

2. LIMITATIONS AND ASSUMPTIONS

The scoping site visit was conducted at an appropriate time of the year (late winter/early spring) from a plant seasonality point of view. Due to good early rains many (but not all) plants were identifiable, including the bulbs and annuals. Due to limitations imposed by the lack of flowering specimens of some species, and the difficulty of getting accurate names for certain taxa (such as the vygies, especially *Ruschia* and *Drosanthemum* species, where taxonomic problems are legion) the species based approach was also supplemented by a habitat-based approach, in which habitat type, quality, and rarity were used as surrogates for conservation value. This knowledge of important habitats in the area has been gained from previous experience in the region. Given the very large study site and the difficulty of accessing certain areas (especially in the south, on Portion 620) it is possible that some important species or even small habitats were missed. Even in a 30ha site it is acknowledged to be impossible or at least very unlikely to record more than 75-80% of the plant species present at any one time, for the simple reason that many species flower at different times of the year (and some years not at all), and are often not identifiable when not flowering. Nevertheless, it is believed that a sufficiently accurate picture of the distribution and conservation value of the habitats on site has been obtained for the current purposes, and a confidence level of at least 80% is attached to the findings.

It should also be noted that mapping the extent of habitats and thus producing a sensitivity map of a site this large, and with numerous very subtle ecotones (transitions) and habitat mosaics, is not a particularly accurate undertaking, and thus the lines in the maps produced may be out by anything up to 30%. Furthermore the situation is complicated by property differences associated with grazing intensity, which alters the spectral characteristics of the satellite image used to map the site. A further site visit at the IA stage would perhaps have helped increase the accuracy of the findings to a certain degree, but this would have been too late in the flowering season to be really useful.

Development footprints were not available at the time of the field survey. A further field visit was not deemed necessary as I am sufficiently familiar with the area, having undertaken two further field trips (for other projects) to the general area, in September and October 2007.

It is assumed that the layouts provided are 90% accurate. It is assumed that WTG foundations will permanently disturb an area of up to 20m by 20m; that permanent gravelled roads will be 6m wide; that adjacent laydown areas will temporarily disturb areas of up to 40m by 40m, and possibly permanently disturb areas of up to 20m by 20m; and that the compacted area (long term to permanent disturbance) for crane travel will be up to 13m wide and parallel to and inclusive of the 6m wide gravelled roads (and thus 3m either side of the gravel roads). Disturbance corridors for underground cabling are estimated at up to 6m wide (3m for the trench and digger track, 3m for the temporary placement of sand).

It is not known where concrete will be sourced from (the impact on limestone surface deposits is a potential indirect impact), and it is not known where the borrow pits ("commercial sources") for the road gravelling will be located. The latter may have a significant impact on vegetation and should have been clarified as part of this study, or should be the subject of a further EIA study.

3. TERMS OF REFERENCE

Terms of reference (TOR) for the Scoping and IA phases were the standard TOR as proposed by CapeNature, and DEA&DP's guidelines for biodiversity assessment (Brownlie 2005) were also adhered to. The CapeNature TOR are as follows:

- Describe the broad ecological characteristics of the site and its surrounds in terms of any mapped spatial components of ecological processes and/or patchiness, patch size, relative isolation of patches, connectivity, corridors, disturbance regimes, ecotones, buffering, viability, etc.
- In terms of biodiversity pattern, identify or describe:

Community and ecosystem level

a. The main vegetation type, its aerial extent and interaction with neighbouring types, soils or topography;

b. The types of plant communities that occur in the vicinity of the site.

c. Threatened or vulnerable ecosystems (*cf. SA vegetation map/National Spatial Biodiversity Assessment).*

Species level

a. Red Data Book (RDB) species (indicate position on map if possible).

b. The viability of and estimated population size of the RDB species that are present (include the degree of confidence in prediction based on availability of information and specialist knowledge, i.e. High=70-100% confident, Medium 40-70% confident, low 0-40% confident)

- The **process**, identify or describe:

a. The key ecological "likelihood of other RDB species, or species of conservation concern, occurring in the vicinity (include degree of confidence).

Other pattern issues

a. Any significant landscape features or rare or important vegetation associations such as seasonal wetlands, alluvium, seeps, quartz patches or salt marshes in the vicinity.

a. The extent of alien plant cover of the site, and whether the infestation is the result of prior soil disturbance such as ploughing or quarrying (alien cover resulting from disturbance is generally more difficult to restore than infestation of undisturbed sites).

b. The condition of the site in terms of current or previous land uses.

- In terms of "**biodiversity** drivers" of ecosystems on the site and in the vicinity, such as fire.
- Any mapped spatial component of an ecological process that may occur at the site or in its vicinity (i.e. *corridors* such as watercourses, upland-lowland gradients, migration routes, coastal linkages or inland-trending dunes, and *vegetation boundaries* such as edaphic interfaces, upland-lowland interfaces or biome boundaries)
- Any possible changes in key processes, e.g. increased fire frequency or drainage/artificial recharge of aquatic systems.
- What is the significance of the potential impact of the proposed project – with and without mitigation – on biodiversity pattern and process at the site, at local and regional scales?
- Recommend actions that should be taken to prevent or mitigate impacts. Indicate how these should be scheduled to ensure long-term protection, management and restoration of affected ecosystems and biodiversity.
- Indicate limitations and assumptions, particularly in relation to seasonality.

4. METHODOLOGY

The site was visited over two days in July 2007. Large parts of the site were driven and walked, using the sandy farm tracks and the main gravel road to Skaapvlei, and habitat types and any special species were recorded. Vegetation types used are as defined in the new SA vegetation map (Mucina & Rutherford 2006). The study approach was partly informed by the guidelines prepared by Brownlie (2005), and also by the TOR. The Impact Assessment was entirely a desktop exercise, but was based on detailed spring fieldwork for the Scoping Stage.

Reference was made to extensive, detailed work done in similar habitat on the Namakwa Sands property some 20km further north (Helme & Desmet 2003), as well as previous spring visits to the general area.

The study area falls just outside the Sandveld Fine Scale Vegetation Mapping Project (FSP) area recently conducted for CapeNature (Helme 2007), but both vegetation types in the study area were also present in the FSP area and I was thus able to gain valuable experience of these habitats just to the south of the Olifants River. For records of rare plants in the area I was able to access the GIS based information on the Cape Rares database (Spatial layer of rare and threatened plant localities managed by the Threatened Species Programme of SANBI (January 2007)), but not surprisingly there are no records from the exact area. In August 2007 I undertook 5 days of fieldwork in the Sandveld region as part of a broader study for a separate client and was able to make detailed observations of vegetation patterns and priority areas in the Namaqualand Sandveld, which helps me place the Eskom study area in a regional context. During this trip I was also able to collect and understand the distribution and habitat requirements of most of the rarer species recorded on the Eskom site.

5. DESCRIPTION OF THE AFFECTED ENVIRONMENT

5.1 Regional context

The primary description of the vegetation in the area can be found within the scoping study (Helme 2007b), and is not repeated here in full.

The study area falls within the Namaqualand coastal region of the Cape Floristic Region, and includes two biomes – the Fynbos biome, and the Succulent Karoo biome (Mucina & Rutherford 2006). The site also falls within the buffer area of the proposed Knersvlakte Biosphere Reserve, although it is located within a very different ecosystem from the core area of the Biosphere, which is a sparsely vegetated arid area (the Knersvlakte) within the Succulent Karoo biome, and is at least 30km to the east of the core area.

The site is used primarily as a stock grazing area, with sheep being the main livestock, although some cattle are also present on site. Portion 620 of the farm Olifants Rivier Nedersetting seems to have been significantly more heavily grazed than the other areas on site, and the difference can be seen on satellite imagery. An estimated 600ha on the farm Gravewaterkop 158 has been previously cultivated in the form of strips, and these strips were planted to winter cereals. However, the strips have not been cultivated for at least twelve years, according to the landowner.

The soil patterns, plus distance from the sea, largely determine the vegetation patterns in the area, which is typical of these coastal vegetation types, as fire is not an ecosystem driver in these arid areas (De Villiers *et al* 2005). Soils are typically deep, brown to orange to yellow sands, and range from fairly alkaline sands in the more coastal areas to neutral and even slightly acidic sands in the stabilised inland dunes. The soils in the central transitional areas are often loamy sands, with the additional clays coming from underlying clays which are exposed in various places. Exposed rock is rare, but can be found in some of the interdune slacks, with the biggest exposures (each of about six patches covering less than 0.5ha) occurring in the southern parts of the site on farm Portion 620 (mostly outside the proposed footprints). These rocks appear to be a form of ferricrete, and may form a hardpan layer below the surface. No quartz patches occur on site. The single large seasonal pan is located on a hardpan and clay area at the central low point of the site, and at least two much smaller pans are found elsewhere on site (see Figure 2).

There are two main vegetation types present on the site - Namaqualand Strandveld and Namaqualand Sand Fynbos (Mucina & Rutherford 2006; see Figures 1 and 2). The point where they meet is not at all clear cut in most cases (as is often the case with vegetation patterns), and they usually create a wide ecotonal (transitional) mosaic where they come together, and this has been depicted in Figure 2. This ecotonal mosaic is in effect a third, nameless vegetation type.

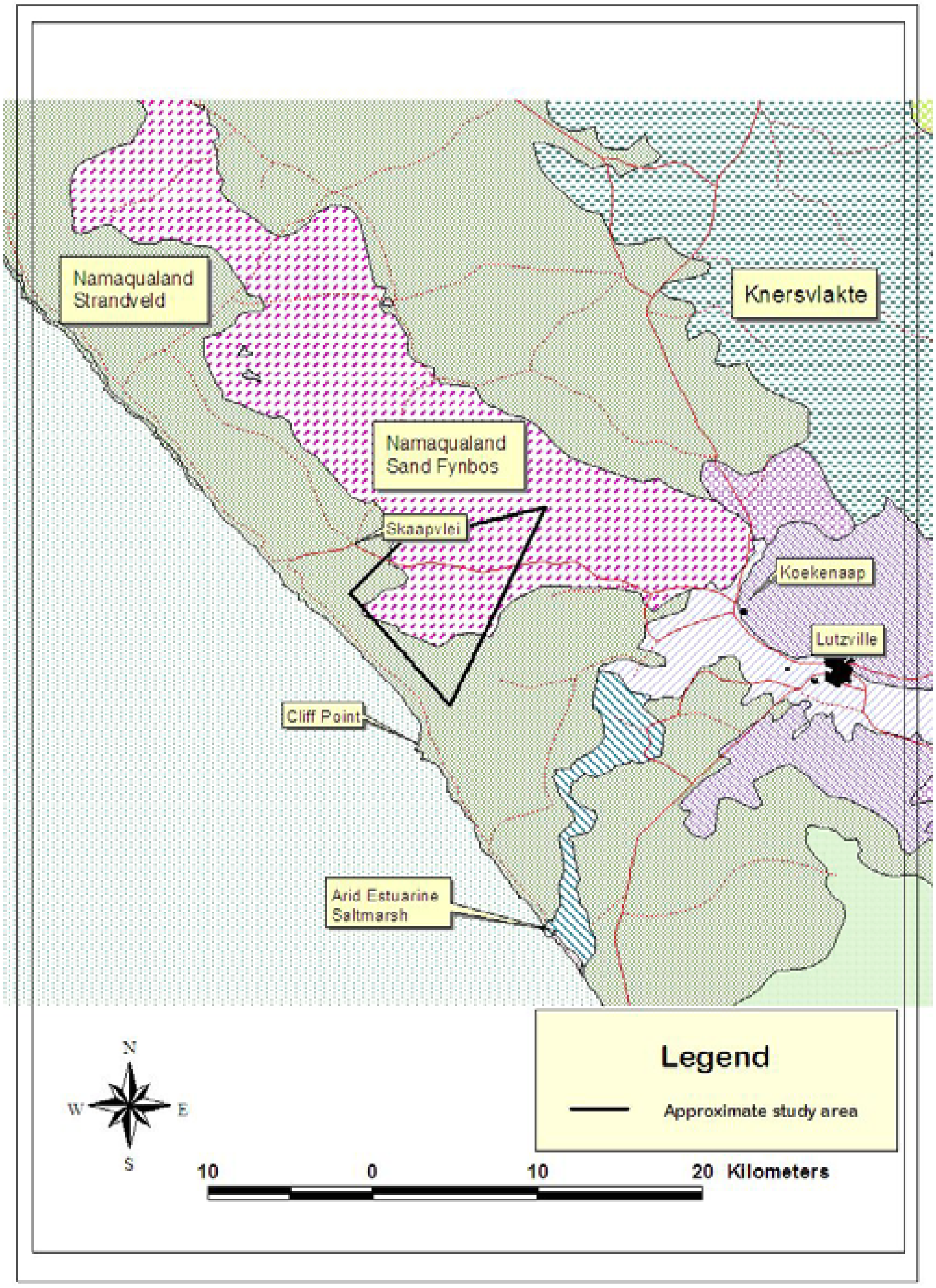

Figure 1: Extract from SA Vegetation map (Mucina & Rutherford 2006) showing that Namaqualand Strandveld and Namaqualand Sand Fynbos cover the site, and the bulk of the adjacent areas.

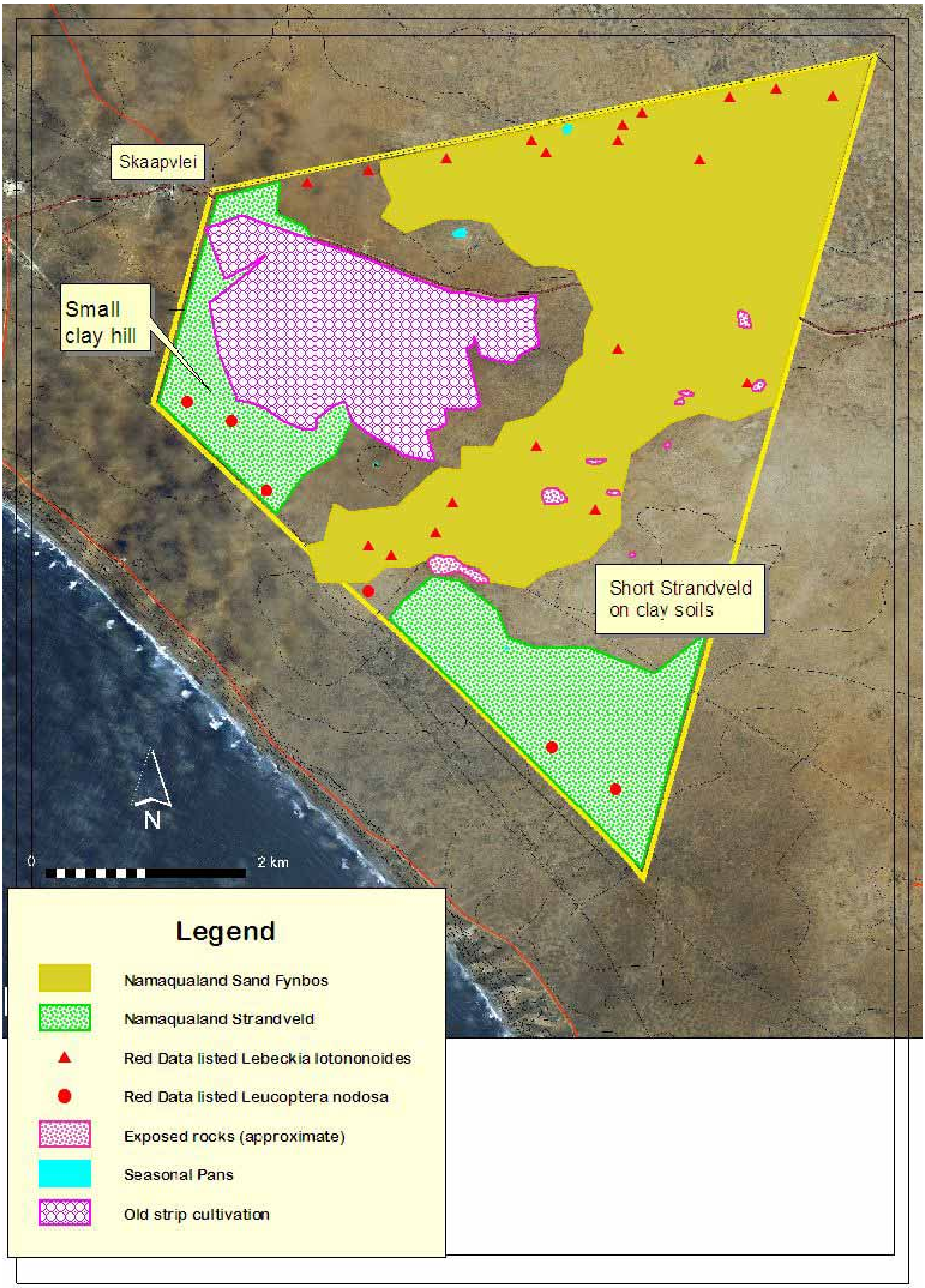

Figure 2: Satellite image of Site, showing key ecological and botanical features mentioned. All unhatched areas within site are transitional mosaic areas with a mix of both Namaqualand Strandveld and Sand Fynbos, and the eastern portion has a high proportion of Short Strandveld on clay sands. Red Data Book species locations approximate only.

5.2 Namaqualand Strandveld

Namaqualand Strandveld is an extremely widespread vegetation type, especially in the context of the Cape Floristic Region, of which it is a part. This vegetation type extends from the Doringbaai area, some 20km south of the Olifants River mouth, up the west coast for about 300km, to the Hondeklipbaai area, and is thus formally part of the Succulent Karoo biome. The vegetation type typically occurs in a band from 1 to 30km inland, on deep sands, which are often grey, red, brown or orange.

Namaqualand Strandveld is regarded as Least Threatened vegetation type in terms of the National Spatial Biodiversity Assessment (NSBA; Rouget et al 2004), with 92% of its original extent still intact. Although large areas of Namaqualand Strandveld (358 000ha; Rouget et al 2004) remain on the west coast, where it is used primarily for small stock grazing, it should be remembered that the NSBA is based on 1996 data, and is thus now 11 years out of date, with significant subsequent habitat losses having occurred in various mining areas, notably in the Namakwa Sands mining area (up to 40 000ha; pers.obs.). Furthermore, Namaqualand Strandveld is significantly underconserved in formal conservation areas, with less than 1% of the national target of 26% under some sort of conservation management, and it is thus vulnerable to future transformation.

A portion of this vegetation type will be protected within the proposed expansion of the Namaqua National Park in the area between the Groen and the Spoeg rivers. Agriculture typically occurs on the edges of this vegetation type where there is more clay in the soil, as is the case on this site.

There is significant variation within Namaqualand Strandveld in any one area (perhaps enough to separate them as distinct vegetation types with further work), and it is possible to recognise a number of different forms or subtypes (plant communities), some of which are present in the study area.

Typical features of true Namaqualand Strandveld include a high percentage of succulents and leaf deciduous shrubs, moderate bulb diversity, and no Fynbos elements such as Ericaceae (heaths) and Proteaceae (proteas), with few Restionaceae (Cape reeds). Rare, range restricted and/or threatened plant species are also usually not a major feature of this vegetation type. Perennial plant cover ranges from fairly low (30%) to fairly high (70%), and average height from 0.4 m to 1.2 m. Alien invasive vegetation is not normally a significant feature, and none was seen in this unit on site. Most of the Strandveld on site is tall (0.6-1.2m), but in areas where clay soils are present a much shorter and sparser type of Strandveld is found, more similar to Hardeveld (Heuweltjieveld).

Rare or localised plant species are not often recorded in this habitat, and few such species are likely to occur, at least in significant numbers. However, *Leucoptera nodosa* (see Helme 2007b) was found in the western areas, which is a rare succulent shrub in the daisy family, known only from seven collections in the Strandveld between Hondeklipbaai and Lamberts Bay (PRECIS data), and the species has recently been Red Data Book listed as Vulnerable (Raimondo & Helme – in prep). The species seems to occur as scattered individual plants (Figure 2, and in adjacent areas), and is never common, but the population on site is likely to comprise about 5% of the total population within 20km of the site.

Hermannia sp. nov. is possibly an undescribed (i.e. a "new" species) shrub (D. Gwynne- Evans – pers. comm) quite common on site. This 1m tall, attractive shrub is actually widespread in the Namaqualand Strandveld from the Olifants River north to the Groen River (pers. obs.), and is not threatened.

Lebeckia lotononoides is also a poorly known species that seems to be restricted to the Namaqualand Sand Fynbos (Boatwright and Van Wyk – in press; pers. obs). The sprawling species is quite common on site (see Figure 2), mainly in the Sand Fynbos areas, but also in the ecotones. It is not currently Red Data listed but will probably be listed as Near Threatened in the forthcoming revision, as some of its range is being impacted by mineral sand mining (Raimondo & Helme – in prep).

The vygie *Vanzijlia annulata* is restricted to the coastal area from Doringbaai to the Groen River, but is not yet Red Data listed and is fairly common in many areas, including here.

Ferraria foliosa is a fairly wide ranging coastal endemic known from the area, and a few plants of a not yet flowering *Ferraria* were found, which are likely to be this species. This species is currently Red Data listed as Rare (Hilton Taylor 1996), but is due to be downlisted to Least Threatened (Raimondo & Helme – in prep.).

There is a moderate possibility of other rare or localised plant species occurring on site and remaining undetected due to the large site and the seasonal constraints.

Sensitivity: This vegetation type is sensitive to vehicular damage and trampling at all times of the year, but especially during the winter and spring growing period (May – Oct). Numerous fine rootlets occur very close to the soil surface to capture fog condensation and these are destroyed by pressure and trampling.

5.3 Namaqualand Sand Fynbos

The Namaqualand Sand Fynbos on site is part of a much more extensive belt that can be seen in Figure 1, extending some 10km to the east, 15km southeast to the Doringbaai area (Helme 2007), and far (over 200km) to the north. The vegetation type tends to occur on neutral to slightly acidic sands that are lighter in colour than Strandveld sands, and with a lower clay fraction. The unit is also listed as a Least Threatened vegetation type by the NSBA, but it is equally poorly conserved, with only 1% of its 29% (of original extent) target formally conserved (Rouget *et al* 2004). This is one of the few vegetation types within Namaqualand that is formally regarded as part of the Fynbos biome, and it is also very unusual in that it appears to be the only Fynbos vegetation type that regenerates in the absence of fire (Mucina & Rutherford 2006; pers. obs.). Fires in such arid areas are extremely rare, and most landowners cannot remember their Fynbos areas ever having burnt.

The primary threats to Namaqualand Sand Fynbos are climate change and mining for heavy mineral sands. The Brand se Baai mining operations about 40km north of this site have already totally destroyed the north - south linkages of this vegetation type in that area (complete loss of vegetation cover and ecological connectivity within the Sand Fynbos), and mining now extends almost 10km inland (pers. obs.), with no sign of mining slowing down. Climate change is a serious threat throughout Namaqualand, and many patches of Sand Fynbos have suffered severe drought related mortality in the last ten years (pers. obs.), and it is predicted that this is one of the vegetation types most likely to be totally altered by climate change.

This vegetation type is typically found on paler, neutral to acid sands which are present in the lower lying areas and on the old dunes in the north (see Figure 2). A number of subtypes (communities) could be recognised, many of which are ecotonal (transitional) with the Strandveld.

Rare species include *Lebeckia lotononoides* and possibly the small, cryptic bulb *Eriospermum arenosum*. There is a Moderate likelihood of other undetected rare or range restricted species occurring in this habitat (such as *Babiana grandiflora* and *B. brachystachys*). The Red Data Listed proteoid *Leucospermum rodolentum* is not present.

Sensitivity: This vegetation type is sensitive to vehicular damage and trampling at all times of the year, and is also sensitive to wind erosion as soon as the vegetation cover is disturbed. Numerous fine rootlets occur very close to the soil surface to capture fog condensation and these are destroyed by pressure and trampling.

5.4. Strip Cultivation

Large parts of Portion 5 of Farm 158 have been cultivated using strip cultivation (see Figure 2; Plate 1), but significant natural rehabilitation has occurred in the strips since they were last cultivated approximately twelve years ago. The cultivated areas are primarily on the Fynbos / Strandveld ecotone, although the unploughed strips indicate that the primary vegetation type is Strandveld (see

Figure 2). It is evident that both the ploughed and unploughed strips have been quite heavily grazed over many years, as a number of the more sensitive species have disappeared (e.g. *Ehrharta calycina, Eriocephalus racemosus*, *Stoeberia utilis, Tripteris oppositifolia*), and diversity is significantly lower here than in the nearby Strandveld areas where no strips are located, with diversity being about 60% of what it is in the latter areas.

The ploughed strips have a lot of annuals, along with resilient shrubs such as *Exomis microphylla, Tetragonia fruticosa, Ruschia floribunda, Trachyandra divaricata, Drosanthemum* sp., *Hermannia trifurca* and *Zygophyllum morgsana*. No rare or localised species were recorded in the strip area, and none are expected, due to the low prevalence of rare species in this vegetation type and due to the previous disturbance. The area is consequently rated as being of lower sensitivity than anywhere else on site, and would therefore be the preferred areas for infrastructure development.

Plate 1: View of old strip cultivation on site, indicating significant extent of natural rehabilitation since cessation of cultivation. Natural Strandveld vegetation occurs between the ploughed strips (right hand side of picture, with redder areas being previously cultivated).

5.5 Seasonal pans

Approximately nine seasonal pans have been recorded on site by various authors, (P. Iligner and T. Hart – pers. comm), but only one of these (just north of the main road) is of any significant size (about 1ha), and the others would dry out very fast. The pans occur in a matrix of sandy soils, but are formed where the underlying clays come to the surface. The pans on this site do not appear to support any significantly different natural vegetation, which may be partly a result of disturbance in the form of heavy grazing. However, they have high ecological value, as the only natural open water sources in the area. These pans usually contain water for limited periods, typically during winter and spring, and may support numerous invertebrates, which attract wading birds such as spoonbills, ducks, etc. Many other birds visit the pans when they contain water, but they are usually too saline for frogs (pers. obs.).

5.6 Short Strandveld on Clay soils

The sparsely vegetated clay areas are present mainly in the southeastern part of the site and on a hill at the western edge of the strip ploughed area (Figure 2). The vegetation is reminiscent of Namaqualand Heuweltjieveld (Hardeveld), which occurs widely on granitic soils 30km to the northeast, but is still referred to in this report as being part of the Namaqualand Strandveld. Poorly developed heuweltjies (ancient, eroded termite mounds of higher fertility) are present, as are occasional quartz pebbles, but these are not sufficiently well developed to be termed “quartz patches”, which are such a feature of the Knersvlakte, 30km to the east. Water may accumulate in some of the low points, leading to the development of small pans (<20m diameter), and the rocky outcrops often occur in association with the clay areas. Nevertheless, these areas do support a distinct plant community that is not represented elsewhere on site (but which is very common in the Hardeveld to the NE), with species such as *Cephalophyllum* sp., *Drosanthemum* sp. (bead leaf vygie), *Salsola* sp. (gannabos), *Trachyandra involucrata, Bulbine praemorsa*, *Leipoldtia schultzei, Monilaria* sp., and *Psilocaulon junceum* (asbos).

It is possible that some of these succulents could be regarded as threatened, or that rare geophytes are present in these patches, and thus these areas have been assessed as having a Medium - High sensitivity (Figure 3).

Sensitivity: This community is sensitive to all forms of disturbance, especially during the winter and spring growing period (May – Oct).

Figure 3: Botanical Sensitivity Map of the site. Note that unhatched areas within site are of Medium Sensitivity. In this report "Botanical Sensitivity" is the same as "Botanical Conservation Value".

6. DESCRIPTION OF ISSUES IDENTIFIED AT THE SCOPING STAGE

Most of the key issues were included within the conclusions of the vegetation scoping document (Helme 2007b), and the relevant ones are repeated here:

- Loss of natural vegetation during the construction stage is the primary botanical impact. Much of this will be permanent, and about 10-20% will be temporary, as trampled and partly disturbed areas should eventually recover. As no footprints were provided at the scoping stage no estimate could be made of the extent or significance of the loss of vegetation.

- As there are no obvious concentrations of rare species or any especially threatened habitats or vegetation types on site there are no areas of High or Very High sensitivity indicated in Figure 3.
- It is clear that the least sensitive area is the previously cultivated area, which has a sensitivity of Low to Medium on a regional scale. In order to minimise direct impacts on the vegetation this is the area where the bulk of the infrastructure (such as the substation, construction camp and operations base) should be placed, if possible.
- The pure Namaqualand Strandveld areas have been assessed as being of Medium botanical sensitivity, and this dominates the ridge closest to the sea. At least one Red Data Book listed species occurs only in this part of the site (and is widespread but rare in the region), although it is unlikely to be feasible to find and translocate these few plants, especially outside the May – August period.
- The sparse vegetation on clay soils, all pans, all rocky areas, and all Sand Fynbos areas have been assessed as having a Medium to High sensitivity, and should ideally not be disturbed. Ideally no infrastructure of any sort should be constructed in these areas, as the best mitigation is to avoid them, and other mitigation will not significantly reduce the impacts.
- The proposed facilities could be developed in areas of Low to Medium sensitivity without the need for significant mitigation, as overall impacts in these areas are likely to be Low negative on a regional scale.
- Indirect negative effects on the vegetation (disruption or change in ecological processes, shading, disturbance of wind flow, etc.) are likely to be minimal, although a possible indirect effect may be reduced bird densities and hence possible infestations of pests such as caterpillars, which could damage some plants if not controlled in the normal way (primarily by foraging of birds).
- Cumulative effects on the relevant vegetation types are driven primarily by the ongoing negative effects of mining (plus existing limited agriculture), and the impacts of this development are likely to be significantly less than for various mining operations in the area.
- It is recommended that roads be kept to a minimum during planning, construction and operational stages, as this will be one of the primary sources of direct vegetation loss and habitat fragmentation (the latter an indirect effect).
- Indirect botanical impacts are likely to be positive in some cases, especially if the proponent purchases the land and removes the livestock. The IA should look at possible indirect botanical impacts in more detail, and should assess the need for possible biodiversity offsets (see DEA&DP 2007).

- In order to minimise damage most construction should ideally be timed to coincide with the dry season dormancy period for the vegetation (November – end April).
- It is strongly recommended that Eskom should remove all livestock from the site. This will obviously only be possible if Eskom owns the land, and this thus also becomes a firm recommendation. One of the primary reasons for this recommendation is that removal of grazing pressure will have a beneficial effect on the natural vegetation, particularly in terms of natural rehabilitation, in that flowering and seed set of the remaining natural plants (especially pioneers such as the annuals) will be significantly better in the absence of grazing (which removes the flowers). If the nearby annuals and other plants are not grazed this means that natural rehabilitation of the areas disturbed by the project will be significantly improved, as there wil be much more locally indigenous seed available nearby for establishment in the disturbed areas.

7. METHODOLOGY FOR DETERMINING SIGNIFICANCE OF IMPACTS

Direct, indirect and cumulative impacts of the above issues, as well as all other issues identified, are assessed in terms of the following criteria:

» The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
» The **extent**, where it will be indicated whether the impact will be local (limited to the immediate area or site of development), regional, national or international. A score between 1 and 5 will be assigned as appropriate (with a score of 1 being low (site only) and a score of 5 being high (national or international extent).
» The **duration**, where it will be indicated whether:
  * the lifetime of the impact will be of a very short duration (0–1 years) – assigned a score of 1;
  * the lifetime of the impact will be of a short duration (2-5 years) - assigned a score of 2;
  * medium-term (5–15 years) – assigned a score of 3;
  * long term (> 15 years) - assigned a score of 4; or
  * permanent - assigned a score of 5.
» The **magnitude**, quantified on a scale from 0-10, where a score is assigned:
  * 0 is small and will have no effect on the environment;
  * 2 is minor and will not result in an impact on processes;
  * 4 is low and will cause a slight impact on processes;
  * 6 is moderate and will result in processes continuing but in a modified way;
  * 8 is high (processes are altered to the extent that they temporarily cease); and

  * 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
- The **probability** *of occurrence*, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale, and a score assigned:
  * Assigned a score of 1–5, where 1 is very improbable (probably will not happen);
  * Assigned a score of 2 is improbable (some possibility, but low likelihood);
  * Assigned a score of 3 is probable (distinct possibility);
  * Assigned a score of 4 is highly probable (most likely); and
  * Assigned a score of 5 is definite (impact will occur regardless of any prevention measures).
- the **significance**, which shall be determined through a synthesis of the characteristics described above (refer formula below) and can be assessed as low, medium or high.
- the **status**, which will be described as either positive, negative or neutral.
- the *degree* to which the impact can be *reversed*.
- the *degree* to which the impact may cause *irreplaceable loss of reso*urces.
- the *degree* to which the impact can be *mitigated.*

The **significance** is determined by combining the criteria in the following formula:

S=(E+D+M)P; where

S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability

The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e. where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e. where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- > 60 points: High (i.e. where the impact must have an influence on the decision process to develop in the area).

8. IMPACT ASSESSMENT

Impacts may be both direct and indirect, with the former occurring mostly at the construction stage and the latter mostly at the operational stage.

In the case of this project the primary direct impacts are loss of natural vegetation within the development footprints. All hard infrastructure will result in the permanent loss of existing vegetation. The primary sources of permanent loss include (in descending order of importance) the access roads, the turbine footprints, the substation footprint, the information centre footprint, and power line footprints. The primary sources of temporary, long-term loss include excavation for foundations and cabling, the lay down areas, crane tracks, and roads alongside the power lines.

The main indirect impact is likely to be the borrow pits which may be used to provide the gravel for the roads (these have not yet been identified, but the client noted that material would be obtained from “commercial sources”). Other indirect impacts would be the invasion of disturbed areas by alien invasive plants, and a possible positive impact in the form of removal of grazing livestock from the property. Large amounts of concrete will be needed for the turbine footings (450m^3 each), and the limestone and crushed stone needed to produce this concrete may be derived from surface deposits in sensitive areas (e.g. near Moorreesburg or Saldanha), but as the concrete suppliers are currently undetermined the impacts cannot be assessed as yet.

The impacts are typically at the site scale. The site is 3700ha in extent, and the vegetation on the site is regarded as typical of the region, and thus impacts are greater at the site (**local**) scale than the regional scale.

8.1 Direct Impact: Permanent loss of natural vegetation

The development footprints will not impact on any botanical “No Go” habitats or areas. Direct loss of vegetation in this area (due to construction) is unlikely to amount to more than 20% (possibly no more than 15%) of the Strandveld, and 5% (possibly no more than 3%) of the Sand Fynbos on site. Approximately 25km of linear disturbance could be caused by the four turbine lines and associated 6m wide roads (16ha in total), plus another 4ha of access roads, plus a further 7-9ha of turbine bases and laydown areas, plus a substation (1ha) and visitor centre (<1ha), and it is thus estimated that between 27 and 50ha will ultimately be permanently lost, which is less than 1.3% of the total site.

Table 1:

Nature: Permanent loss of vegetation in footprint		
	Description	**Score**
Extent	Local and regional	2
Duration	Permanent	5
Magnitude	Low - Medium	5
Probability	Definite	5

Significance	Medium - High	60
Status	Negative	
Is impact reversible?	No	
Irreplaceable loss of vegetation?	No	
Can impacts be mitigated?	Partially	

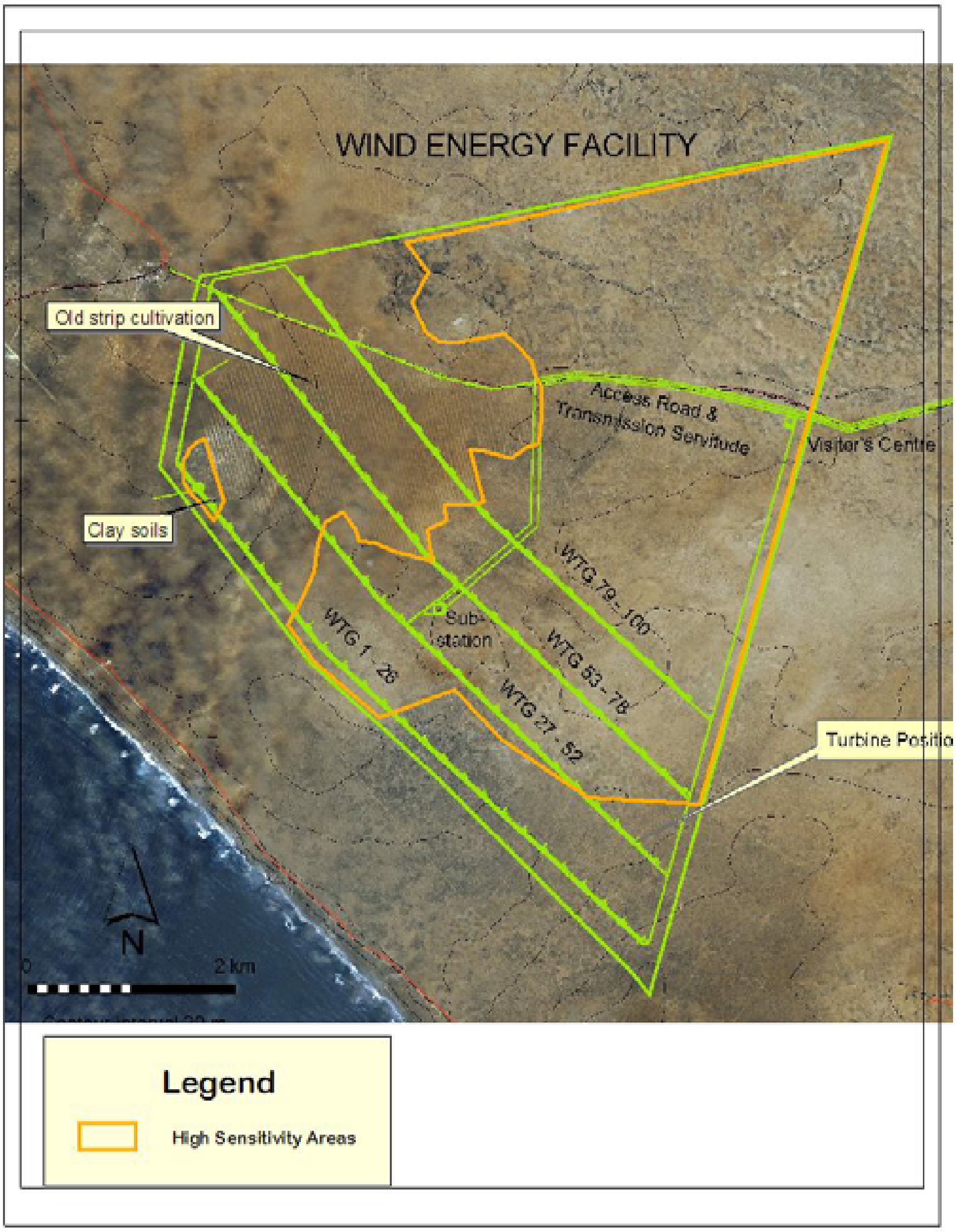

Figure 4: Proposed turbine layout in relation to areas of relatively High (local scale) botanical sensitivity on site. Areas not indicated as High sensitivity are Moderate or Low relative sensitivity.

8.2 Direct Impact: Long term but temporary loss of natural vegetation

The existing natural vegetation will be severely disturbed in various areas, mostly as a result of heavy machinery and cable excavation. These areas should eventually recover to a significant degree (if natural vegetation is retained in the adjacent areas), but the crushed and dug up vegetation in this semi-arid area will take at least 15 years (and possibly much longer if rainfall is below normal) in order to recover to a point where at least 80% of the original diversity is once again present. Certain species may not return for many additional years, due to changes in soil structure (compaction). The impacts in this case thus rate as being long term.

Primary sources of disturbance will be the large crane that is used to put up the machinery, which has caterpillar tracks and a width of 13m (15ha disturbance); the crane base and laydown areas next to the turbines (16ha disturbance; some of which may be better described as permanent rather than long-term disturbance); the construction of the new power line (Juno –WEF; 15ha disturbance); and the burying of the underground cabling on site (up to 25km of cabling, with disturbance corridors maybe 6m wide; 15ha disturbance). Thus a total of at least 61ha of currently mostly natural vegetation may suffer long term but temporary disturbance, and this could very easily be as much as 80ha, allowing for turning circles, dumping of materials, etc.

Table 2:

Nature: Long term but temporary loss of vegetation in footprint		
	Description	**Score**
Extent	Local and regional	2
Duration	Long term	4
Magnitude	Low - Medium	5
Probability	Definite	5
Significance	**Medium**	**55**
Status	Negative	
Is impact reversible?	Partly	
Irreplaceable loss of vegetation?	No	
Can impacts be mitigated?	Partially	

8.3 Direct Impact : Power line infrastructure

A 132kV power line will need to be constructed between the WEF and the Juno substation north of Vredendal, a distance of about 40km. The impact assessment for this has been included in the above assessments of permanent and longterm impacts of the WEF and associated infrastructure, but due to some important areas of very high sensitivity along Alternative 1 (see Figure 5) the topic is addressed here in more detail. The alternative routings were not available at the time of the Scoping report.

A consolidation of new and existing infrastructure is typically preferred, as this is an effective way to minimise many overall impacts, but in some cases this is not possible. In this case Alternative 1 follows an existing line for about 40% of its length, with the remainder being a new routing, and Alternative 2 is virtually all a new routing.

The bulk of the two routes – Alternative 1 and Alternative 2 – do not pose any major problems in terms of running a powerline through them. Powerlines usually have relatively small footprints and have little influence on the vegetation, especially in arid areas where there is no fire risk and the vegetation does not need to be bushcut beneath the line. Vegetation types crossed include Namaqualand Strandveld, Namaqualand Sand Fynbos, Namaqualand Riviere, Namaqualand Spinescent Grassland and Vanrhynsdorp Gannabosveld. None of these is considered to be a threatened ecosystem in terms of the NSBA analysis (Rouget et al 2004), and all have large untransformed portions within the Knersvlakte or on the Namaqualand coastal plain. It is unlikely that any populations of threatened plants in these habitats will be impacted by the proposed powerline.

The areas of significant concern occur along the route of Alternative 1, between Koekenaap and the Koekenaap substation at the Namakwa Sands processing plant. As indicated in Figure 5 there are significant patches of Very High sensitivity vegetation in this area, mostly in the form of Knersvlakte Quartz Vygieveld. Typical white quartzite pebble patches are the main feature of importance, although there also some unusual outcrops of virtually black rock. The quartz patches support a very high density of rare, threatened and localised plant species, most of which are bulbs and dwarf succulents. From a distance the areas may look totally devoid of plant life, but actually this is a high diversity habitat, and one that it very sensitive to any form of disturbance at all, as the dwarf succulents are easily crushed. This habitat type is one of the two most important habitats with the Knersvlakte Biosphere Reserve, and supports well over 50% of the 225 or so Knersvlakte endemic plant species (Desmet et al 1999).

A powerline through these highly sensitive quartz patches would cause significant and permanent damage, in the form of plant loss due to crushing, and permanent habitat alteration. The fine covering of quartz pebbles is key to the habitat, and any heavy machinery severely disturbs this layer, effectively rendering the habitats unsuitable for these specialised plants for many decades thereafter. Given that the quartz patches are fairly small and localised on a landscape scale it is unacceptable to have infrastructure routed through them, when they are easy to avoid.

Alternative 1a was thus proposed as a suitable alternative (see Figure 5), and entirely avoids the most sensitive habitats and is also shorter and with fewer bends, and is thus presumably cheaper. Alternative 1a is likely to have only a Low negative impact, compared to the Very High Negative impact of Alternative 1 (which is a Red Flag (No Go) situation), and Alternative 1a or Alternative 2 are thus the equally preferred alternatives from a botanical point of view.

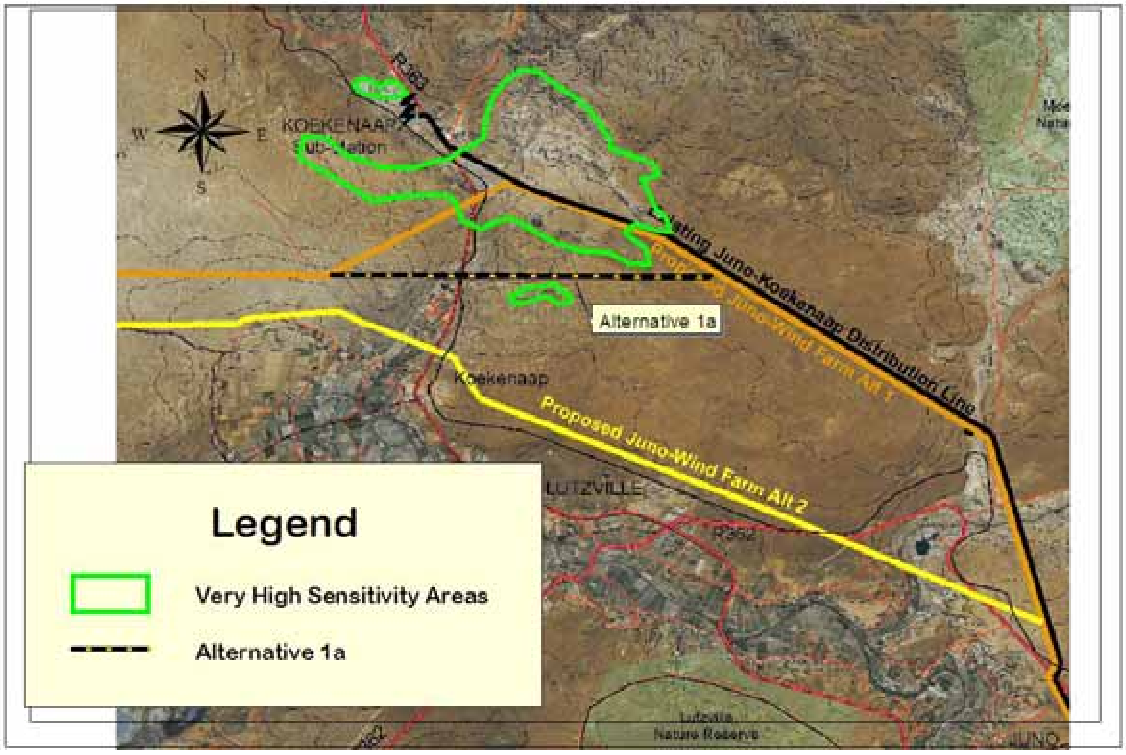

Figure 5: Proposed power line alternatives showing very high sensitivity areas in the Koekenaap and Lutzville area that should be avoided, and proposed Alternative 1a that is both shorter and crosses only lower sensitivity areas. No other high sensitivity botanical areas are crossed by either of the power line alternatives.

As can be seen in Tables 4 & 5 Alternatives 1a and 2 are likely to have similar botanical impacts, which are regarded as Medium negative in a regional context according to the rating scale (because of the high probability), but which in reality are more likely to be Low negative.

Table 3:

Nature: Long term to permanent loss of vegetation and habitat in quartz patches near Koekenaap: Powerline Alternative 1		
	Description	**Score**
Extent	Local, regional and national	4
Duration	Long term to permanent	5
Magnitude	Medium - High	6
Probability	Definite	5

Significance	**Very High**	**75**
Status	Negative	
Is impact reversible?	Partly, but only over >100yrs	
Irreplaceable loss of vegetation?	Yes	
Can impacts be mitigated?	Only by use of alternative route 1a	

Table 4:

Nature: Temporary to permanent loss of vegetation: Powerline Alternative 1a		
	Description	**Score**
Extent	Local	2
Duration	Short term to permanent	3
Magnitude	Low	4
Probability	Definite	5
Significance	**Medium**	**45**
Status	Negative	
Is impact reversible?	Partly, but only over >10 yrs	
Irreplaceable loss of vegetation?	No	
Can impacts be mitigated?	Not significantly	

Table 5:

Nature: Temporary to permanent loss of vegetation: Powerline Alternative 2		
	Description	**Score**
Extent	Local	2
Duration	Short term to permanent	3
Magnitude	Low	4
Probability	Definite	5
Significance	**Medium**	**45**
Status	Negative	
Is impact reversible?	Partly, but only over >10 yrs	
Irreplaceable loss of vegetation?	No	
Can impacts be mitigated?	Not significantly	

8.4 Indirect impacts

Indirect ecological impacts are often difficult to identify, and even more difficult to quantify. Indirect negative effects on the vegetation (disruption or change in ecological processes, shading, disturbance of wind flow, etc.) are likely to be minimal.

In the Scoping report a possible impact was identified in the form of a possible negative impact on insectivorous birds within the turbine areas, leading to a possible increase in plant eating insects, and thus possibly an impact on the plants. However, although this is arguably a potential impact, it is felt that there are too many unknowns in this scenario in order to make an assessment of the likely impacts, which are in any case unlikely to be particularly severe on a regional scale.

Overall effects of habitat fragmentation may be more important, but are still likely to be relatively insignificant on both local and regional scales. The WEF is relatively permeable from a biological point of view and should not disrupt ecological processes to any significant extent. Insects, wind and birds (all important pollinators and some also seed dispersers) should be able to move around in at least a fairly natural pattern, provided that natural vegetation corridors are retained between the turbines and turbine rows/roads. Fire is not a feature of the vegetation types in this area and thus one does not need to factor appropriate fire regime into the long-term ecological management of the site.

Further possible indirect effects include the source of road surfacing material, and the source of concrete. The former is usually quarried from borrow pits, which may be in sensitive ecological areas, and the large quantities (at least 2km by 6m) needed could have significant negative impacts if not sourced from an appropriate area. However, at this stage the source has not been confirmed. It is suggested in this report that a suitable source may be the crushed dorbank (laterite) layer that is removed by mining in the Namakwa Sands mining operation. Large quantities of crushed dorbank are generated by the mine, and most is simply dumped back on site once the site is ready for rehabilitation, but in my opinion the dorbank does not contribute to enhanced rehabilitation in any way (Desmet & Helme 2005), and would make ideal road surfacing gravel. If Namakwa Sands could provide all the road gravel for the WEF that would probably be the lowest impact option, and would have a negligible botanical impact, as opposed to an unknown but possibly high negative impact for material sourced from other commercial sources.

Large quantities (up to 450 000m^3) of concrete will be needed for the turbine foundations, and this could also have a significant negative effect on natural vegetation if this is sourced from an area where limestone and stone quarries have a negative impact on surrounding natural vegetation. Unfortunately no source has as yet been identified, and thus an accurate assessment of this possible indirect impact can be made. West coast limestone and stone quarries that may impact negatively on remaining natural vegetation include those at Saldanha, Tygerberg, and along the Berg River east of Moorreesburg.

A concern has been raised that the turbines may alter local moisture patterns, particularly in respect of coastal fog and mist, which is a major feature of this coastline. There is very little way of providing a reliable assessment of this, other than studying existing wind farms in similar semi-arid climates elsewhere in the world (e.g. Chile, southern California), but it is strongly suspected that no regionally significant effect will be noted in terms of the vegetation. Based on observations on existing Eskom pylons in the area it is likely that fog will condense on the turbines (and blades, if they are not turning) and drip down onto the ground surrounding the turbines. The extra moisture will be locally significant, and will result in a localised increase in plant growth over time (period of years). This is not a negative impact, and can perhaps be viewed as a small positive impact, at least on a very local scale. On a regional scale the turbines are highly unlikely to have any significant effect on fog and air moisture movement (and thus on plant growth), as the installation is extremely permeable to air movement. In areas where fog catching devices have been installed (e.g. Rietpoort in Namaqualand; and on the west coast of Chile) there is no noticeable reduction in moisture in nearby areas (pers. obs.)

8.5 Cumulative impacts

To some extent a cumulative impact is a regional impact, rather than the local site scale impact, *i.e*. if something has a regional impact it also has a cumulative impact. In the west coast scenario the primary impacts on the two vegetation types on site are mining (mainly heavy mineral sands and diamonds) and agriculture (some cereal cultivation, and stock farming). Currently heavy mineral sand mining (mainly at Namakwa Sands) has the largest direct negative impact, and has already resulted in the loss of close to 30 000ha of natural vegetation (in less than 10 years; Desmet & Helme 2005), which is about 8 times the size of the entire WEF site, and about 375 times the size of the probable maximum footprint of the proposed WEF. Furthermore, the mining footprint is continually expanding, and is thus a severe future threat.

The proposed WEF thus has a negligible cumulative impact in comparison to current and proposed mining operations, and in many respects is a positive impact in this regard, as the development of expensive and long-life wind farm infrastructure effectively prevents the establishment of large scale open cast mining in the immediate area.

8.6 Positive impacts

The proposed WEF may have at least two slight positive impacts, in addition to the small global scale positive impact of helping to reduce CO_2 emissions by generating “clean energy”. As climate change is predicted to hit Namaqualand particularly hard it is perhaps appropriate that wind energy facilities should be located in this area.

The first potentially positive impact is contentious, and has been referred to in Sect 7.5, and relates to the effect that a WEF would have on the chances of large scale open cast mining occurring on the site in the immediate future. Expensive infrastructure is unlikely to be moved to make way for a mine, and this is positive from a botanical point of view, provided that intact natural vegetation remains on the site.

The second potentially positive impact will only come about if recommendations noted under Mitigation (Sect. 11) are implemented and enforced. Permanent removal of livestock from the site could have a positive effect on the natural vegetation, in that it would allow plants to flower and set seed more readily, without being grazed. Disturbed areas will not only rehabilitate faster without livestock grazing but many rarer, currently heavily grazed species may have a chance of increasing their numbers. It is not suggested that locally indigenous buck (steenbok and duiker) be removed, but neither should other wild animals be introduced. The buck already present will maintain the plant populations in a healthy state, and will graze and browse appropriately. Healthy plant populations on site could act as a seed source for overgrazed adjacent properties. Thus if the site is managed as a formal conservation area it will have a small positive local and regional effect. Both Sand Fynbos and Namaqualand Strandveld vegetation types are barely conserved (1% and 0% respectively, with national targets of 29% and 26% respectively), and thus a formal conservation area of almost 3700ha will go a small way to helping achieve national conservation targets for these two vegetation types.

9. IMPACT STATEMENT AND SUMMARY TABLE

Overall the impact of the proposed WEF on the vegetation on site is likely to have a Medium local (site scale; 3700ha site) and Low regional (southern Namaqualand coast; < 500 000 ha) impact.

The primary negative impacts are direct, permanent loss of natural vegetation (30-80ha) in development footprints, and direct, long term loss of natural vegetation (30-80ha) in areas that will be disturbed by heavy construction machinery, temporary dumping, etc. Most of these impacts cannot be avoided or mitigated in any significant way.

Apart from one portion of Alternative 1 the proposed 132 kV power line to Juno will have an acceptable overall Low negative impact throughout its length. The quartz patches north of Koekenaap must be avoided, or else Alternative 1 will have an unacceptably High negative impact (No Go scenario). Alternative 1a has been proposed in this report and is both shorter and avoids the sensitive quartz patches, and is thus clearly the preferred alternative from a botanical perspective.

Indirect impacts are difficult to quantify, largely because there are many unknowns in terms of the source of construction and road materials. If mitigation recommendations are implemented then indirect impacts on the vegetation on site and off should be negligible.

Possible positive direct impacts are fairly small, and depend to a large degree on the management of the remaining natural vegetation on site (>3500ha) as a conservation area, and the permanent removal of livestock. An indirect positive impact is obviously the small contribution that this WEF will make to reducing CO_2 emissions, and the associated very small reduction in global warming effects.

Table 4: Overall summary table of proposed WEF impacts on vegetation (local scale)

Nature: Long term to permanent loss of vegetation and habitat		
	Description	**Score**
Extent	Local, regional and national	2
Duration	Long term to permanent	4
Magnitude	Low	3
Probability	Definite	5
Significance	**Medium**	**45**
Status	Negative	
Are impacts reversible?	Not in direct building footprints (<50ha), but are in other disturbance areas (<80ha), although will take many decades.	
Irreplaceable loss of vegetation (after mitigation)?	No	
Can impacts be mitigated?	Yes, many can be mitigated (see Sect 10)	

10. ASSESSMENT OF ALTERNATIVES

According to a study prepared by Savannah Environmental (2007) there are suitable areas for development in the vicinity of the Namakwa Sands mining operation at Brand se Baai. Map 9 of that study indicates very clearly that, taking various factors into account (visual, transformation of vegetation, and landform), there are large areas of suitable terrain, with adequate and similar wind resources (pers. obs.). Having worked extensively at Namakwa Sands (Helme & Desmet 2003; Desmet & Helme 2005) I can confirm that I would consider the previously mined areas at Namakwa Sands ideal sites for the establishment of a WEF or other development, and that the construction of a WEF in this area would have minimal environmental impact, due to the highly disturbed nature of the vegetation. IAP comments suggest that mine management would not be opposed to the establishment of a WEF in the area, and it thus appears to be a very viable site, provided that the wind resource is suitable. As wind erosion is one of the primary problems limiting rehabilitation success at Namakwa Sands (Desmet &

Helme 2005) it would strongly suggest that the wind resource is indeed adequate for the establishment of a WEF in this area.

Prior to the formal scoping stage three alternative sites were examined in the area, extending as far south as the Olifants River mouth, but these were abandoned based on the results of the regional assessment, and the current site was chosen as the one for detailed analysis. Thus at and beyond the scoping stage no formal alternatives were investigated.

11. REHABILITATION GUIDELINES AND EMP CONSIDERATIONS

Areas requiring rehabilitation will include all areas disturbed during the construction phase and that are not required for regular maintenance operations. The main areas thus requiring rehabilitation will be parts of the laydown areas next to the turbines, the crane tracks alongside the permanent 6m roads, any cable routings where these fall outside the abovementioned areas, and disturbed areas around the planned visitor centre and substation.

Rehabilitation should only commence once all construction related disturbance associated with Phase 1 of the project has been completed. A second round of rehabilitation will be required on completion of Phase 2 of the project.

1. Before and during construction all development footprints for roads, buildings, underground cables, laydown areas and turbine footings should be fenced off with two strand wire and clearly indicated with flags and/or danger tape strips. Only once this has been done can anything else proceed. It should be made very clear to all contractors that there is to be no disturbance outside these demarcated areas, at least not without the permission of the ECO.
2. Road construction will presumably be the first major task on site. Prior to any earthworks a major plant Search and Rescue program should be undertaken. Search and Rescue (S&R) of certain translocatable, selected succulents, shrubs and bulbs occurring in long term & permanent, hard surface development footprints (i.e. all buildings, new roads and tracks, laydown areas, and turbine positions) should take place. All such development footprints must be surveyed and pegged out as soon as possible, and then a horticulturist with West Coast Search and Rescue experience should be appointed to undertake the S&R. All rescued species should be bagged (and cuttings taken where appropriate) and kept in an on-site shade nursery (if water can be provided; otherwise off site) and should be returned to site once all construction is completed and rehabilitation of disturbed areas is required. Replanting should only occur in autumn or early winter (April – May), once the first rains have fallen, in order to facilitate establishment. Key focus species that need to be translocated are *Leucoptera nodosa, Trachyandra involucrata*, *Boophone*

haemanthoides (gifbol), *Brunsvigia orientalis* (kandelaarlelie; maartblom), *Lebeckia lotononoides,* all *Ferraria* species, all *Lachenalia* species (viooltjies), all *Babiana* species, and *Eriospermum arenosum*.

3. Once Search and Rescue has been completed all the fenced off development areas should be bushcut using a tractor powered "bossieslaner". The substantial cut plant material must then be gathered up and stored for later use as mulch on the areas in need of rehabilitation. The material should be stored in a shaded and dry area, with at least some airflow (a shade cloth wall with a proper waterproof roof is ideal), and should be stored for as short a period as possible before use.
4. An ECO must be present during the duration of the construction phase.
5. Any excavation, including those for cables, must be supervised by the ECO. No excavations may be left open for more than 1 week, and they should preferably be closed up much quicker, using the carefully stockpiled soil that came out of the trench. Mulched local plant material (see point 3) should be scattered on top of the disturbed areas once the cables have been laid and the sand replaced.
6. No dumping or temporary storage of any materials may take place outside designated and demarcated laydown areas.
7. Substantial excess sand will be removed from the turbine foundations, and this should not be dumped all over the site in an uncontrolled manner. Where possible the sand should be used as fill for the roads and the crane tracks. If excess sand is still available it should be dumped in a single designated area that is not within a sensitive area such as a pan or rocky outcrop.
8. Compacted areas that are no longer needed after construction (e.g. parts of the laydown areas, and the crane tracks) should be ripped or scarified to break up the compacted surface. The areas should then be sown with seed mix collected on site (see point 9), and should also be mulched with the stored plant material noted in point 3.
9. The appointed horticulturist must collect a locally indigenous seed mix from the natural vegetation on site and must store this for use in areas in need of rehabilitation, such as the laydown areas, crane tracks, and cable routings.
10. Only suitable locally indigenous Strandveld species, as listed in the botanical Scoping Report (Helme 2007), should be used for rehabilitation or planting anywhere on site. This means that no exotic or invasive species should be used for rehabilitation, and this includes commonly used invasive grass species such as ryegrass (*Lolium* spp).
11. Wind erosion is a major problem in this area, especially in areas that have lost their plant cover. Loss of plant cover must therefore be minimised at all times. In certain instances dark green or black shade (least visually obtrusive) netting may have to be erected as wind screens, at the

discretion of the ECO. The screens should be at least 1.5m tall, and oriented 90^0 to the prevailing winds.

12. It may be necessary to use geotextiles to limit wind erosion in certain areas. These should be spread out over the ground and staked down. The geotextiles should be used in areas where wind erosion seems problematic, at the discretion of the ECO, and may be more effective than wind screens.
13. In order to minimise damage to vegetation, primary construction should ideally be timed to coincide with the dry season dormancy period for the vegetation (November – end of April). Although this is unlikely to be realistic for the client it would help reduce impacts on the vegetation, and will allow for rehabilitation at the optimal period of late autumn to early winter.
14. It is strongly recommended that Eskom should remove all livestock from the site, and manage it as a conservation area. One of the primary reasons for this is that removal of livestock grazing pressure will have a beneficial effect on the natural vegetation, particularly in terms of natural rehabilitation, in that flowering and seed set of the remaining natural plants (especially pioneers such as the annuals) will be significantly better in the absence of grazing (which removes the flowers). If the nearby annuals and other plants are not grazed this means that natural rehabilitation of the areas disturbed by the project will be significantly improved, as there will be much more locally indigenous seed available nearby for establishment in the disturbed areas, and the site will also act as a seed source for surrounding overgrazed areas.
15. All natural areas on site should be managed as a conservation area. A formal conservation manager probably does not need to be appointed, but all livestock should be removed, no additional wild animals should be introduced, and no hunting should be allowed. Internal fences should be removed. Ongoing alien plant monitoring and removal should be undertaken on an annual basis. No new roads should be created in the conservation areas. Erosion monitoring and rehabilitation (with suitable locally indigenous plants) should be undertaken on an annual basis.
16. A botanist familiar with the vegetation of the area should monitor the rehabilitation success on an annual basis in August or September, and make recommendations to Eskom on how to improve any problem areas. This monitoring need not take more than four days annually (two days on site, one day writeup, one day for travel).
17. All temporary fencing and danger tape should be removed once the construction phase has been completed.
18. Eskom should make sure that there is sufficient budget to implement all management recommendations noted above.

12. CONCLUSIONS

- As there are no obvious concentrations of rare species or any especially threatened habitats or vegetation types on site there are no areas of regionally High or Very High sensitivity indicated in Figure 3.
- It is clear that the least sensitive area is the previously cultivated area, which has a sensitivity of Low to Medium on a regional scale. In order to minimise direct impacts on the vegetation this is the area where the bulk of the infrastructure (such as the substation, construction camp and operations base) should be placed, if possible.
- Direct permanent and temporary loss of vegetation in this area (due to construction) is unlikely to amount to more than 20% of the Strandveld on site, and no more than 5% of the Sand Fynbos on site.
- The pure Namaqualand Strandveld areas have been assessed as being of Medium botanical sensitivity, and are where much of the turbine infrastructure will be placed, as this is along the ridge closest to the sea. At least one Red Data Book listed species occurs only in this part of the site (but is widespread and rare in the region). If possible Search and Rescue should locate any such plants before development and remove them to secure areas.
- The Namaqualand Sand Fynbos areas have been assessed as being of Medium to High botanical sensitivity. At least one Red Data Book listed species occurs in this vegetation type on the site (but is widespread and rare in the region). If possible Search and Rescue should locate any such plants before development and remove them to secure areas.
- The sparse vegetation on clay soils, all pans, and all rocky areas have a Medium to High sensitivity, and should ideally not be disturbed. It appears that the rocky areas and pans will not be impacted by the development layout, but the relocation of the first three turbines (WTG 1-3) should be considered to avoid the clay hill area and associated Red Data Book species. Placement of turbines and infrastructure in this sensitive area cannot be viewed as a Fatal Flaw, but is not advisable from a botanical perspective, and cannot be regarded as complying with the best practice of "avoiding impacts".
- Indirect negative effects on the vegetation (disruption or change in ecological processes, shading, disturbance of wind flow, etc.) are likely to be minimal.
- Cumulative effects are in many respects regional effects, and the impacts of this type of development will be significantly less than for various existing and proposed mining operations in the region.
- If the site is managed as a formal conservation area it will have a small positive local and regional effect. Both Sand Fynbos and Namaqualand Strandveld vegetation types are barely conserved (1% and 0% respectively, with national targets of 29% and 26% respectively), and thus a formal conservation area of almost 3700ha will go a small way to helping achieve national conservation targets for these two vegetation types.

- It would appear that potentially suitable alternative development sites exist at Brand Se Baai, notably in the previously mined and partly rehabilitated areas of the Namakwa Sands site, but these were not identified by Eskom for a WEF as part of this Scoping or Impact Assessment process.

13. RECOMMENDED SITE SPECIFIC MITIGATION

- The high local sensitivity area (clay hill) at the western corner of the site should not be developed, as this supports an unusual mix of species on heavier clay soils, including at least one Red Data Book listed species (*Leucoptera nodosa*). This is likely to affect the first three turbine positions (WTG 1-3), and suggested mitigation is to move these three out of this area (best practice requires avoidance of impacts). If this is not done then a suitably qualified botanist should be contracted to position the turbines and infrastructure in this area with the least impact possible, and to plan a Search & Rescue program for any plants of concern that can be translocated.
- Apart from one portion of Alternative 1 the proposed 132 kV power line (Juno – Wind Farm) will have an acceptable overall Low negative impact throughout its length. The quartz patches north of Koekenaap must however be avoided, or else Alternative 1 will have an unacceptably high negative impact. Alternative 1a has been proposed in this report and is both shorter and avoids the quartz patches, and is thus clearly the preferred botanical alternative, along with Alternative 2.
- Search and Rescue (S&R) of certain translocatable, selected succulents, shrubs and bulbs occurring in permanent, hard surface development footprints (i.e. all buildings, new roads, and turbine positions) should take place. All development footprints should be surveyed and pegged out as soon as possible and a horticulturist with suitable Search and Rescue experience should be appointed to undertake the S&R. All rescued species should be bagged (and cuttings taken where appropriate) and kept in an on-site nursery (if water can be provided; otherwise off site) and should be returned to site once all construction is completed and rehabilitation of disturbed areas is required. Replanting should only occur in autumn (April – May), once the first rains have fallen, in order to facilitate establishment. Key focus species that need to be translocated are *Leucoptera nodosa, Trachyandra involucrata*, *Boophone haemanthoides* (gifbol), *Brunsvigia orientalis* (kandelaarlelie; maartblom), *Lebeckia lotononoides,* all *Ferraria* species, all *Lachenalia* species (viooltjies), all *Babiana* species, and *Eriospermum arenosum*.
- It is recommended that roads be kept to a minimum (as per draft layouts presented, with only one or two links between turbine rows) during planning, construction and operational stages, as this will be one of the primary sources of direct vegetation loss and habitat fragmentation (an indirect effect).
- In order to minimise damage, primary construction should ideally be timed to coincide with the dry season dormancy period for the vegetation (November –

end of April). Although this is unlikely to be realistic for the client it would help reduce impacts on the vegetation.

- The proposed visitor centre and substation should ideally be developed in the previously cultivated areas as this would reduce their fairly small impact on the vegetation, but as they are relatively small footprints (<2ha) this is not a definite requirement.
- As the two vegetation types concerned are regarded as Least Threatened ecosystems in terms of the NSBA, and as overall impacts are likely to be Low on a regional scale (Medium on a local scale) no additional off-site biodiversity offsets are required. Unavoidable residual impacts are small and can be adequately mitigated by managing the 3700ha site as a conservation area.
- It is strongly recommended that Eskom should remove all livestock from the site, and manage it as a conservation area. This will obviously only be possible if Eskom owns the land, and this is thus also a recommendation. One of the primary reasons for this is that removal of livestock grazing pressure will have a beneficial effect on the natural vegetation, particularly in terms of natural rehabilitation, in that flowering and seed set of the remaining natural plants (especially pioneers such as the annuals) will be significantly better in the absence of grazing (which removes the flowers). If the nearby annuals and other plants are not grazed this means that natural rehabilitation of the areas disturbed by the project will be significantly improved, as there will be much more locally indigenous seed available nearby for establishment in the disturbed areas, and the site will also act as a seed source for surrounding overgrazed areas.
- A botanist familiar with the vegetation of the area should ensure that adequate botanical inputs are made into the construction and operational phase EMPs.
- As part of the Operational Phase EMP there should be recommendations for managing all natural areas on site as a conservation area. All livestock should be removed. No additional wild animals should be introduced, and no hunting should be allowed. Internal fences should be removed. Ongoing alien plant monitoring and removal should be undertaken on an annual basis. No new roads should be created in the conservation areas. Ongoing erosion monitoring and rehabilitation (with suitable locally indigenous plants) should be undertaken on an annual basis. No plants not locally indigenous to the site may be introduced or cultivated on site (see species in Helme 2007b for lists of indigenous species).
- During construction all development footprints for roads, buildings and turbine footings should be fenced off with two strand wire and clearly indicated with flags and/or danger tape strips.
- An ECO must be permanently on site throughout the road construction, cable laying, and turbine foundation excavation periods, and at other times should visit the site at least once a week.

- Any excavation, including those for cables, must be supervised by the ECO. No excavations may be left open for more than 1 week, and they should preferably be closed up much quicker, using the carefully stockpiled soil that came out of the trench. In the case of turbine footings some 45m^3 of sand will presumably be displaced by the concrete, and this should not be dumped on any natural vegetation outside any permanent footprints. Suitable disposal areas for this sand will have to be identified, but it should not be dumped anywhere on site where there is natural vegetation.
- No dumping or temporary storage of any materials may take place outside designated and demarcated laydown areas.

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