Proposed Wind Energy Facility and Associated Infrastructure: Terrestrial Fauna
Environmental Impact Assessment Report

Prepared by

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Savannah Environmental (PTY) Ltd
On behalf of

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EXECUTIVE SUMMARY

Eskom identified a potential site on the Cape West Coast for the establishment of a wind energy facility. The aim of this report is to describe the receiving environment in terms of its habitat and associated fauna, and to identify and describe potential impacts that the wind energy plant and associated access road and powerline could have on terrestrial fauna (excluding birds).

A wide range of vertebrate species, including threatened lizard and mammal species, are expected to occur in the general area where development will take place. Of the four faunal habitats identified in the immediate area (i.e., coastal strip, coastal dunes, rock and inland Succulent Karoo vegetation), the wind energy facility will only impact on the inland Succulent Karoo habitat (Namaqualand Strandveld and Namaqualand Sand Fynbos). Because of its extent and homogenous nature, this habitat should be the least sensitive of the four habitats, although at least two Red Data reptile and one Red Data mammal species may be associated with it.

Five risk sources are expected to be associated with the construction of a wind energy facility on the proposed site, the upgrading of the existing access road, and the erection of a transmission line between the Juno substation and the facility. These are direct mortality of animal species during construction, habitat destruction, increased road kills, the barrier effect of roads and fences, and bat collision fatality. With the exception of habitat loss the impacts have all been rated as of *low* significance. The impact of habitat loss is, however, rated of *medium* significance. If a serious effort can be made to restrict habitat destruction during construction, the significance of the impact could probably be lowered. The two transmission line alternatives (and sub-alternatives) do not differ in any significant way as far as potential impact on terrestrial fauna is concerned.

Profile of author:

P.le F.N. Mouton holds a PhD in Zoology, is currently an Associate Professor in Zoology (Vertebrate Ecology) at the University of Stellenbosch, and is registered with SACNASP. The author has no connections whatsoever with ESKOM and will not benefit in any way, should the proposed development be approved.

Prof. P.le F.N. Mouton

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1. INTRODUCTION

1.1. Background and Brief

Eskom identified an area of 37 km^2 on the Cape West Coast for the establishment of a wind energy facility (Figure 1). The facility is proposed to accommodate 100 turbines (approximately 78 m tower, hub height 80 m, 90 m diameter rotor (3 x 45 m blades), positioned in four, possibly five, rows on the site (Figure 2). The existing Skaapvlei Road is considered as the first option for providing access to the site and modifications will be made to the route where required to improve the condition of the road for safety. An on-site service road system will provide access to each wind turbine position (Figure 2). The service roads will be 6 m wide with a gravel surface and with a 3.5 m wide, compacted strip on each side for crane travel (Figure 3). Each turbine will have a concrete foundation of 15 m x 15 m and will require a 40 m x 40 m crane pad and equipment lay-down area (Figure 3). A substation, approximately 80 m x 80 m in size and with radial underground distribution cabling to each turbine, will be placed centrally in the facility (Figure 2). An overhead transmission line (132 kV) from the facility will feed into the electricity distribution network at the Juno Substation (approximately 35 km from the facility). The cabling will be underground from the facility substation and then come above ground once outside of the turbine field. There are two alternative alignments for the transmission line (one with a sub-alternative) identified for consideration in the EIA phase (Figure 4). There will also be a small office building and visitors centre at the facility entrance (approximately 150 m^2) (Figure 2). Eskom expects the project to be completed in two phases, the first phase being 50 turbines (i.e. 100 MW). Phase two would then be the remaining 50 turbines.

In this assessment the potential impacts associated with the micro-siting of the facility infrastructure are considered. The two alternative routes for the Juno-Wind Farm Transmission line are also compared in terms of potential impacts on the environment. The EIA report must include:

- An indication of the methodology used in determining the significance of potential environmental impacts.
- A description of all environmental issues that were identified during the environmental impact assessment process.
- An assessment of the significance of *direct*, *indirect* and *cumulative* impacts in terms of the following criteria:
  - the *nature* of the impact, which shall include a description of what causes the effect, what will be affected and how it will be affected
  - the *extent* of the impact, indicating whether the impact will be local (limited to the immediate area or site of development), regional, national or international
  - the *duration* of the impact, indicating whether the lifetime of the impact will be of a short-term duration (0–5 years), medium-term (5–15 years), long-term (> 15 years, where the impact will cease after the operational life of the activity) or permanent
  - the *probability* of the impact, describing the likelihood of the impact actually occurring, indicated as improbable (low likelihood), probable (distinct possibility),

highly probable (most likely), or definite (impact will occur regardless of any preventative measures)

   * the *severity/beneficial scale*, indicating whether the impact will be very severe/beneficial (a permanent change which cannot be mitigated/permanent and significant benefit, with no real alternative to 5 achieving this benefit), severe/beneficial (long-term impact that could be mitigated/long-term benefit), moderately severe/beneficial (medium- to long-term impact that could be mitigated/ medium- to long-term benefit), slight or have no effect
   * the *significance*, which shall be determined through a synthesis of the characteristics described above 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 resources
   * the *degree* to which the impact can be *mitigated*

- A description and comparative assessment of all alternatives identified during the environmental impact assessment process.
- Recommendations regarding practical mitigation measures for potentially significant impacts, *for inclusion in the Environmental Management Plan (EMP).*
- An indication of the extent to which the issue could be addressed by the adoption of achievable mitigation measures.
- A description of any assumptions, uncertainties and gaps in knowledge.
- An environmental impact statement which contains:
   * a summary of the key findings of the environmental impact assessment
   * an assessment of the positive and negative implications of the proposed activity (one alternative only in EIA phase)
   * a comparative assessment of the positive and negative implications of the distribution line alternatives
   * a comparative assessment of the positive and negative implications of the access road alternatives

The aim of this report is to provide the required information for terrestrial fauna, excluding birds. The study conforms to the requirements of Section 33 of the EIA Regulations in terms of the National Environmental Management Act (NEMA; Act No 107 of 1998) published in Government Notice R385. This study is also in line with the Western Cape DEA&DP guideline/requirements.

1.2. Study approach

A record of the environmental quality and sensitivity of the receiving environment is provided in terms of its terrestrial fauna by making use of data obtained from the literature as well as from a short visit to the area. Several previous surveys have been undertaken in the coastal area immediately to the north of the study area (e.g., De Villiers, 1990; Picker, 1990; Rautenbach, 1990; Mouton & Alblas, 2003, 2004; Mouton *et al*., 2007). The study focuses on vertebrates, but with cognition of invertebrate species and assemblages of conservation concern. Baseline descriptions of the fauna of the general area are given, placing the area in a regional and a national context. Species of special concern are highlighted. The description does not include a numerical assessment of faunal abundance and complete species lists are only provided for amphibians, reptiles and mammals.

The study area was visited twice (7-8 March and 8 November 2007) and all habitats relevant to fauna were noted and all species or signs of species observed were recorded. Because of the very low trapping success of Rautenbach (1990) and low mammal diversity in the general area (Rautenbach 1990), no trapping for mammals was conducted. The conclusions are mainly based on species that potentially could occur on the sites as deduced from the scientific literature and previous surveys in the same habitat types in the same general area (e.g., Mouton & Alblas 2004). It must also be emphasised that the invertebrate fauna is an immensely large and diverse group and that it would have been impossible to describe the invertebrate fauna of the site in any detail.

All threatened/sensitive species/assemblages occurring, or possibly occurring in the study area, were listed using the following authoritative sources: Approaches towards a critical evaluation and update of the Red Data List of South African butterflies by Ball (2005); the Atlas and Red Data Book of the Frogs of South Africa, Lesotho and Swaziland by Minter *et al*. (2004); a review by Baard *et al.* (1999) of the amphibians and reptiles of the Cape Floristic Region as indicators of centres of biodiversity, sensitive habitats and sites of special interest; and the Red Data Book of the Mammals of South Africa by Friedmann & Daly (2004).

Potential environmental impacts with regard to terrestrial fauna were identified and assessed and mitigation measures recommended.

2. STUDY AREA

2.1. Study area

At the smallest spatial scale, the study area encompasses the coastal zone between Brand-se-Baai and the Olifants River mouth (the R363 forming the eastern perimeter), and at the largest spatial scale which is relevant to the environmental impact assessment, the study area (referred to as the greater study area in the report) includes the area between 29° and 32°S and west of 20° E.

2.2. Site description

Within the study area, an area within the Matzikama Local Municipality and the DMA of Western Cape Municipal Area 1 (WCMA01) has been selected as potentially suitable for the establishment of a wind energy facility (Figure 1). The area of 37.5 km^2 comprises the following farms:

- Portion 5 of the farm Gravewaterkop 158
- A portion of Portion 620 of the farm Olifants River Settlement

- A portion of Portion 617 of the farm Olifants River Settlement

The western perimeter of the area is ± 2 km from the coast. The altitude of the area is roughly 100 m above sea level. Large parts of the area have been transformed for agricultural purposes (Figure 2). The vegetation is mainly Namaqualand Strandveld and Namaqualand Sand Fynbos (Figure 3) (Mucina & Rutherford, 2006).

The two alternative transmission line routes between the Juno substation and the Wind Farm are depicted in Figure 4. The sub-alternative for Alternative 1 is also indicated. Both alternatives are approximately 35 km in length.

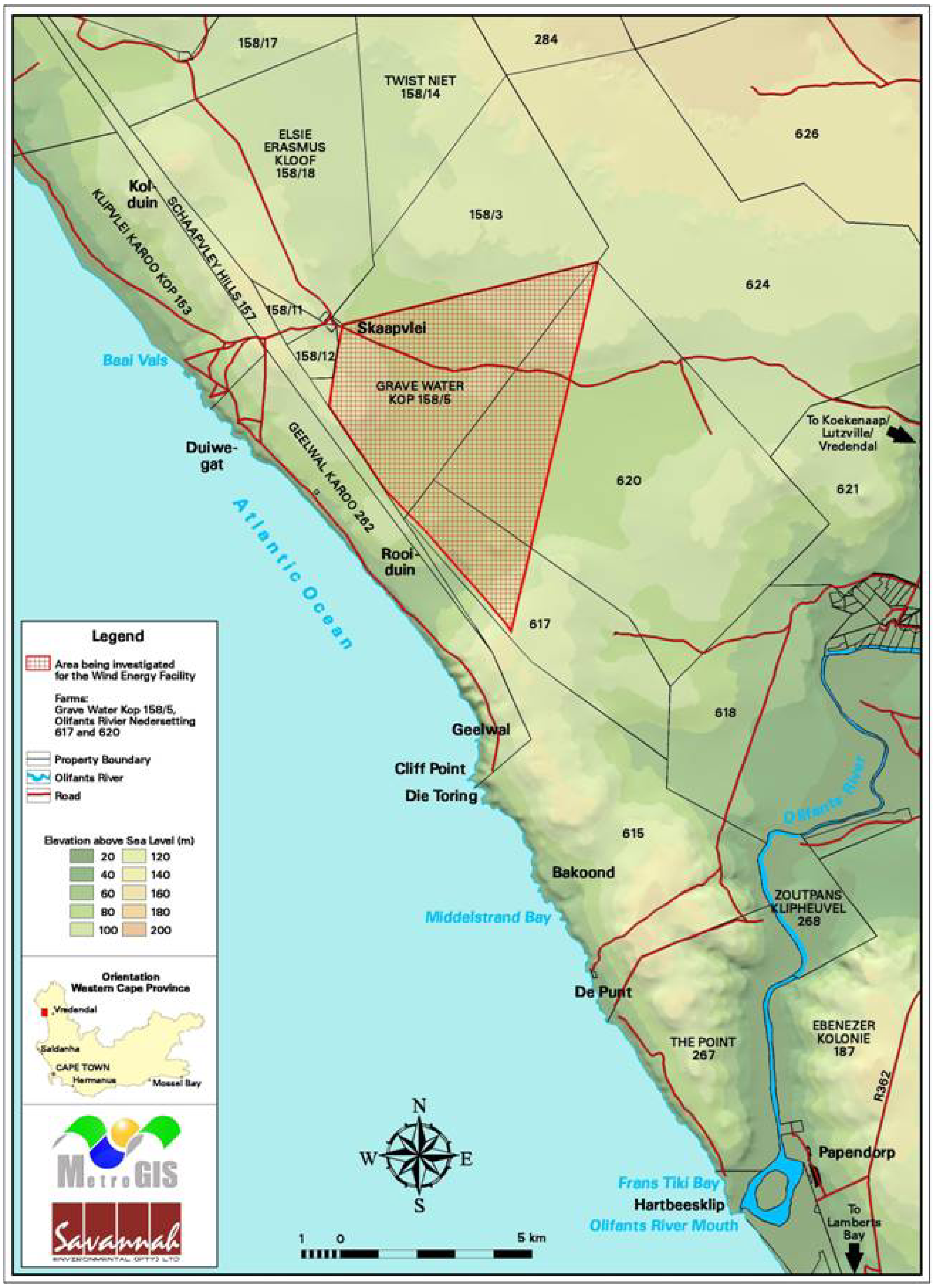

Figure 1. Location of the potential site in the study area for the establishment of a wind energy facility

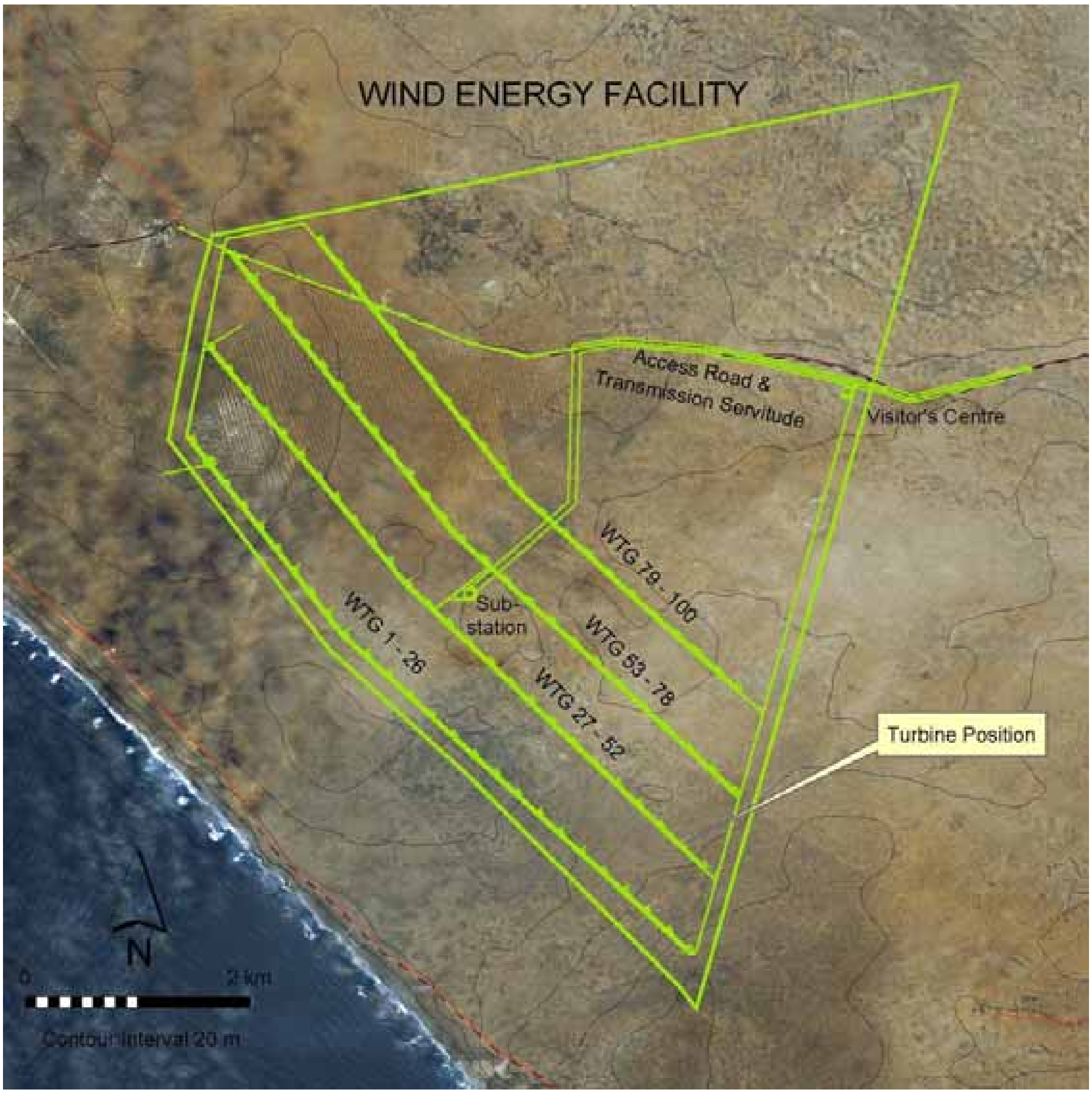

Figure 2. The layout plan for the wind energy facility showing the positions/rows of turbines, roads for access, substation position, and visitors centre position

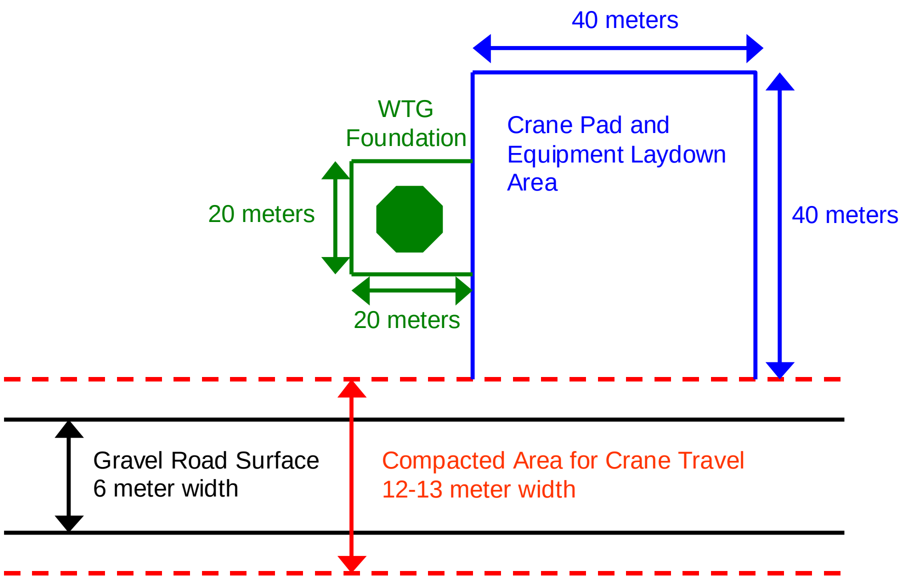

Figure 3. Diagram showing the dimensions/positions of turbine footprints, laydown areas, access roads relative to one another. This is not to scale.

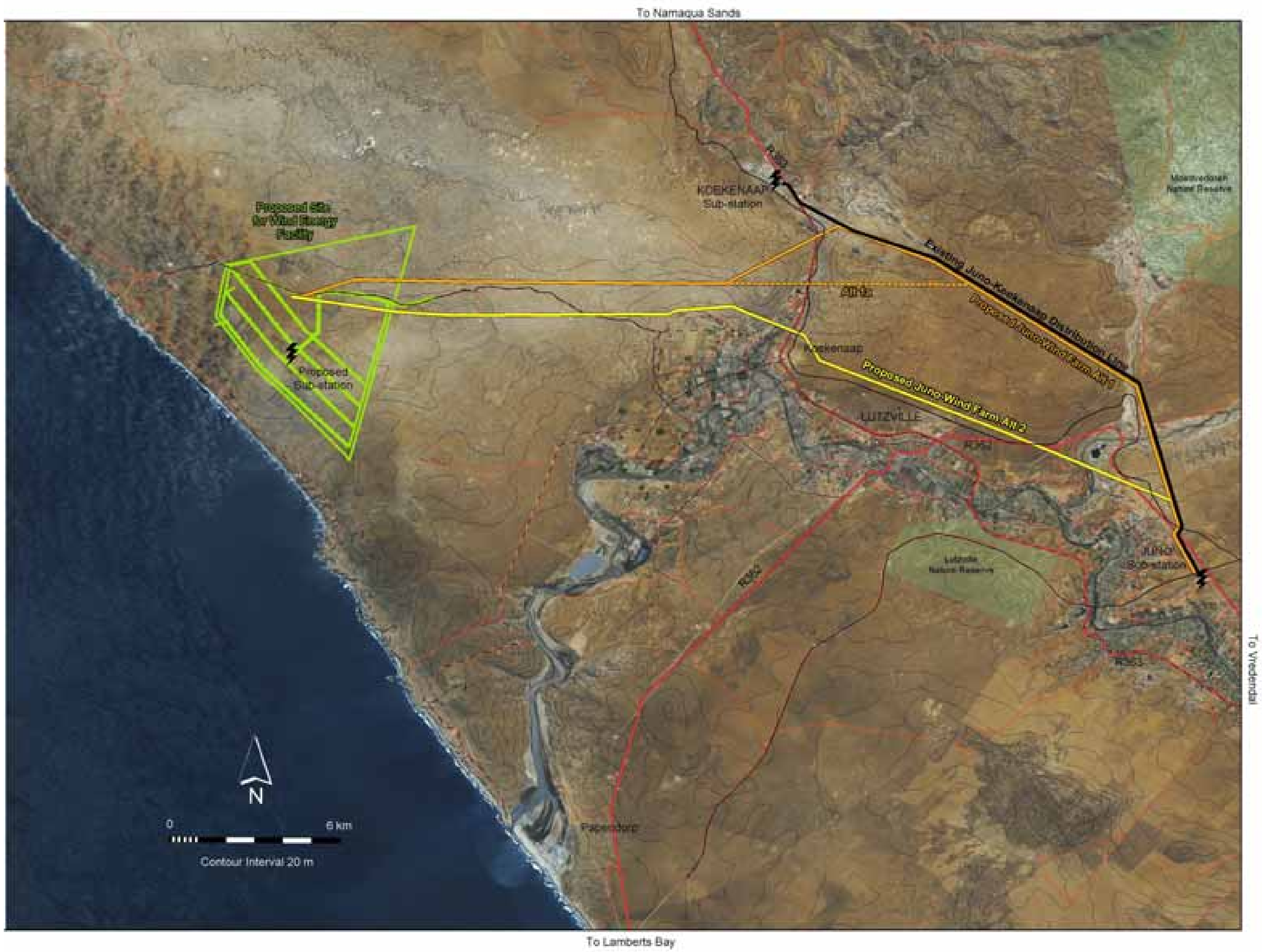

Figure 4. The two alternative transmission line routes between the Juno substation and the Wind farm

Figure 5. Namaqualand Strandveld vegetation in the study area.

3. DESCRIPTION OF THE AFFECTED ENVIRONMENT

3.1. Phytogeographical setting

The study area is located within the Succulent Karoo Biome. The Succulent Karoo is the only arid region recognised as a world biodiversity hotspot (Mittermeier *et al*., 2000). Stretching along the Atlantic coast of Africa, from south-western South Africa into southern Namibia, this biodiversity hotspot covers 116 000 km^2 of semi-desert. It is one of the 25 richest and most threatened reservoirs of plant and animal life on Earth. The Succulent Karoo boasts the world's richest succulent flora (Mucina & Rutherford, 2006), as well as high reptile and invertebrate diversity. Compared to other hotspots, the vegetation remains relatively intact (Mucina & Rutherford, 2006), yet only 30,000 km^2 of the original vegetation remains in a relatively pristine state. Only 5.8% of the hotspot is formally conserved (Mucina & Rutherford, 2006). Nearly one-third of the floral species of the region is unique to the hotspot.

The hotspot is vulnerable to several land use pressures, particularly overgrazing on communal lands, ostrich farming in the southeast, mining, and the illegal collection of plants and animals for trade. Climate change is expected to have a serious impact on the region's biodiversity (Mucina & Rutherford, 2006).

The 20-year conservation targets that have been identified thus far for the Succulent Karoo are:

- Seventy-five percent of the conservation targets set in the Succulent Karoo Ecosystem Programme process for 135 vegetation types will be protected and conserved.
- Key climatic gradients and riverine corridors are taken into consideration in the creation or expansion of any protected areas.
- Globally threatened and endangered species listed in the Red Data sources will be under additional protection.
- Sites in the Succulent Karoo hotspot that house unique, endemic and globally threatened species will be identified and protected.

Namaqualand is a relatively mild desert where extremes are tempered by its proximity to the cold, upwelled waters of the Benguela Current (Desmet & Cowling, 1999a). Most of the area receives a winter rainfall of less than 150 mm per annum (Cowling *et al*., 1999). This low rainfall is highly predictable and prolonged droughts are rare (Desmet & Cowling, 1999a). Along the coastal margin, the meagre rainfall is supplemented by highly predictable coastal fog, and copious dewfalls are widespread. Temperatures are relatively mild throughout the year, especially along the coast, but high temperatures of up to 40ºC may occur during winter when hot, turbulent air known as ‘berg winds’ descends coastward from the high altitude plateau of southern Africa (Cowling *et al*., 1999).

The coastal topography around the study area is generally flat across a 40 km wide stretch of coastal lowland, which terminates against the mountain land of the Namaqua Metamorphic Province (Cowling *et al*., 1999). The coast south of Island Point is essentially straight and is generally rocky with a few sandy beaches. A thick blanket of riverine and wind blown sand (up to 30 m thick) covers most of the coastal plain (Desmet & Cowling, 1999b).

Mucina & Rutherford (2006) identify two vegetation types within the study area, namely Namaqualand Strandveld and Namaqualand Sand Fynbos. The biggest threat to Namaqualand Strandveld is coastal mining for heavy metals (Mucina & Rutherford, 2006). None of the area is conserved in a statutory conservation area, but some small private reserves protect some of its vegetation. About 10% of the area has been transformed. This vegetation is generally subject to extensive grazing, but erosion is very low (Mucina & Rutherford, 2006). The ecosystem status of Namaqualand Sand Fynbos is “least threatened” and only about 2% has been transformed for cultivation (Mucina & Rutherford, 2006). This vegetation type is subject to extensive sheep grazing.

3.2. Potential occurrence of terrestrial fauna species of conservation concern in the greater study area

3.2.1. Invertebrates

The mollusc (*Trichonephrus rocaceae*) is extremely abundant in the study area. The *Trichonephrus* species complex along the western coastal regions of South Africa is in urgent need of revision and there may be more than one species present in the study area (W.F. Sirgel, pers. comm.). The insect fauna of the area remains poorly known. The huge number of species involved and the problem of seasonality imposes considerable limitations on insect surveys of short duration. The survey of Picker (1990) has not revealed the presence of any rare or threatened species of insect in the immediate vicinity of the Namakwa Sands mine site, which is approximately 30 km to the north of the study area. Ball (2005) does not list any butterfly species of conservation concern occurring in the greater study area.

3.2.2. Amphibians

Sixteen frog species occur in the area between 29º-32ºS and west of 20ºE (Minter *et al.,* 2004). Of these, only three are Red Data species. The Desert Rain Frog (*Breviceps macrops*), listed as *Vulnerable*, occupies a narrow coastal strip along the north-western Namaqualand coast from Alexander Bay southward as far as the farm Skulpfontein north of Koingnaas (Minter *et al*., 2004). It inhabits coastal sand dunes vegetated by low succulent shrubs. The Desert Rain Frog is not expected to be present in the area selected for the proposed wind energy facility. The Namaqua Stream Frog (*Strongylopus springbokensis*), also listed as *Vulnerable*, occurs from the Orange River valley southward through Namaqualand to Garies. This frog is restricted to the proximity of springs and other permanent and non-permanent water bodies (Minter *et al*., 2004). It is seemingly absent from the immediate coastal regions (Minter *et al*., 2004) and therefore unlikely to be present on the site for the wind energy facility. The Karoo Caco (*Cacosternum karooicum*) is listed as *Data Deficient* and is endemic to the arid Karoo regions of the Western and Northern Cape Provinces. It occurs more inland and although the most northerly record is in the Vanrhynsdorp district, it has not yet been recorded close to the coast. It is therefore not expected to be present in the study area for the proposed wind energy facility.

Of the 16 species occurring in the greater study area, only the Namaqua Rain Frog (*Breviceps namaquensis*) and the Namaqua Caco (*Cacosternum namaquense*) potentially occur within the study area. The Karoo Toad *(Bufo gariepensis*) may be present further inland. The Namaqua Rain Frog breeds terrestrially, i.e., there is no larval stage and no water body is required for breeding. The Namaqua Caco, on the other hand, needs at least a temporary water body for breeding. None of the three species potentially occurring in the study area are classified as Red Data species (Minter *et al*., 2004).

3.2.3. Reptiles

At least four chelonian, 39 lizard and 22 snake species occur in the area between 29º-32ºS and west of 20ºE (Branch, 1998). From the literature (Branch, 1998) and from previous sampling in the Vredendal district (De Villiers, 1990; Mouton & Alblas, 2003, 2004), it is apparent that 44 reptile species may occur in the present smaller study area (Tables 3.1 and 3.2).

Baard *et al.* (1999) list nine of the reptile species potentially occurring in the study area as Red Data species (Tables 3.1, 3.2). Of these, three are classified as *Vulnerable*:

i) Lomi's Blind Legless Skink (*Typhlosaurus lomii*) is found in sand dunes along the West Coast. It is threatened due to habitat destruction from alluvial diamond mining. This species was recorded in the inland Succulent Karoo habitat just south of Groenriviermond (Mouton *et al.,* 2007) and it may be present further south as far as the present study area.

ii) Due to its gregarious nature (big family groups) and popularity as a pet, the Armadillo Girdled Lizard (*Cordylus cataphractus*) is vulnerable to over-exploitation for the pet trade (Mouton *et al*., 1987). This species requires high levels of solar radiation and will not be present close to the coast. It is not expected to be present on the proposed site for the wind farm.

iii) The Namaqua Dwarf Adder (*Bitis schneideri*) prefers semi-stable, vegetated coastal sand dunes and its habitat along the coast is threatened by mining activities (Branch, 1998). At Namakwa Sands, this species was recorded in the inland Succulent Karoo habitat (J. Blood, personal communication) and it may be present in the study area.

Two lizard species potentially occurring in the study area are classified as *Near threatened*, because of their restricted ranges or low numbers (Baard *et al*., 1999) (Table 3.1):

i) The Large-scaled Girdled Lizard (*Cordylus macropholis*) has a relatively restricted range along the West Coast. It is a habitat specialist and is vulnerable to over-collection and habitat degradation. The preferred microhabitat of this species is the succulent plant, *Euphorbia caput-medusae* (and related species). The lizard shelters between the stems of this plant, but may, however, also shelter underneath limestone rocks and debris of various sorts. It is unlikely that dense *E. caput-medusae* stands are present on the proposed site for the erection of a wind energy facility.

ii) The Namaqua Plated Lizard (*Gerrhosaurus typicus*) has an extensive range in South Africa, but is nowhere very common. Its main threat is habitat destruction (Baard *et al*., 1999). Although this species was not recorded during a survey at Namakwa Sands, there is a strong possibility that it may occur in the general area, as it has been recorded in Succulent Karoo habitat elsewhere in the greater study area (CapeNature Database). Because of its secretive nature, it will only be possible to confirm its presence in a given area by setting pitfall traps.

Four reptile species occurring in the greater study area are listed as *Data Deficient* (Baard *et al*., 1999) (Table 3.1, 3.2), namely Cuvier's Blind Legless Skink (*Typhlosaurus caecus*), Austen's Thick-toed Gecko (*Pachydactylus austeni*), the Rough Thick-toed Gecko (*Pachydactylus rugosus*), and the Speckled Padloper tortoise (*Homopus signatus cafer*).

Table 3.1. Lizards potentially occurring in the study area. The conservation category of sensitive and/or threatened species is provided, following (Baard *et al.*, 1999).

Species	**Common name**	**Conservation category**
Acontias lineatus	Striped Legless Skink	
Acontias litoralis	Coastal Legless Skink	
Typhlosaurus caecus	Cuvier's Blind Legless Skink	Data Deficient
Typhlosaurus lomii	Lomi's Blind Legless Skink	Vulnerable
Typhlosaurus vermis	Boulenger's Dwarf Burrowing Skink	
Scelotes sexlineatus	Striped Dwarf Burrowing Skink	
Trachylepis capensis	Cape Skink	
Trachylepis sulcata	Western Rock Skink	
Trachylepis variegata	Variegated Skink	
Meroles ctenodactylus	Smith's Desert Lizard	
Meroles knoxii	Knox's Desert Lizard	
Nucras tessellata	Western Sandveld Lizard	
Pedioplanis lineoocellata	Spotted Sand Lizard	
Cordylosaurus subtessellatus	Dwarf Plated Lizard	
Gerrhosaurus typicus	Namaqua Plated Lizard	Near Threatened
Cordylus cataphractus	Armadillo Girdled Lizard	Vulnerable
Cordylus macropholis	Large-scaled Girdled Lizard	Near Threatened
Cordylus polyzonus	Karoo Girdled Lizard	
Agama sp nov.	Southern Rock Agama	
Agama hispida	Southern Spiny Agama	
Bradypodion occidentale	Namaqua Dwarf Chameleon	
Pachydactylus austeni	Austen's Thick-toed Gecko	Data Deficient
Pachydactylus formosus	Rough Thick-toed Gecko	Data Deficient
Chondrodactulus angulifer	Giant Ground Gecko	
Goggia lineata	Striped Dwarf Leaf-toed Gecko	
Pachydactylus bibronii	Bibron's Thick-toed Gecko	
Pachydactylus labialis	Western Cape Thick-toed Gecko	
Pachydactylus geitje	Ocellated Thick-toed Gecko	
Pachydactylus mariquensis	Marico Thick-toed Gecko	
Pachydactylus weberi	Weber's Thick-toed Gecko	

These species are considered to be threatened, but lack of information does not allow more conclusive evaluations. Of these, the first two may occur in the study area and on the proposed site, since elsewhere along the West Coast they have been recorded in similar coastal Succulent Karoo habitat (CapeNature Database). The latter two are associated with inland rocky habitat and are not expected to be present on the proposed site.

Table 3.2. Tortoises and snakes potentially occurring in the study area. The conservation category of sensitive and/or threatened species is provided, following (Baard *et al.,* 1999).

Species	**Common name**	**Conservation category**
TORTOISES		
Homopus signatus cafer	Speckled Padloper	Data Deficient
Chersina angulata	Angulate Tortoise	
Psammobates tentorius trimeni	Tent Tortoise	
SNAKES		
Rhinotyphlops lalandii	Delalande's Beaked Blind Snake	
Lamprophis guttatus	Spotted House Snake	
Pseudaspis cana	Mole Snake	
Prosymna sundevalli	Sundevall's Shovel-snout Snake	
Psammophis leightoni namibiensis	Namib Fork-marked Sand Snake	
Psammophis notostictus	Karoo Sand Snake	
Dasypeltis scabra	Common Egg-eater	
Aspidelaps lubricus	Coral Snake	
Naja nivea	Cape Cobra	
Bitis cornuta	Many-horned Adder	
Bitis schneideri	Namaqua Dwarf Adder	Vulnerable

3.2.4. Mammals

Sixty-six mammal species, 11 of which are listed as Red Data species, occur in the area between 29º-32ºS and west of 20ºE (Friedmann & Daly, 2004). Rautenbach (1990) recorded 19 mammal species and confidently expects a further 16 species to occur in the Namakwa Sands mining area at Brand-se-Baai, 30 km to the north of the proposed site (Table 3.3). Most of these species are also expected to occur in the present study area as the habitat is very similar. The 35 species include six insectivores, four bats, two hare/rabbit species, 10 rodents, one felid, three canids, one mustelid, five viverrids, the dassie, and two antelope species.

Only two of the 11 Red Data species occurring in the greater study area, may be present in the study area:

i) Grant's Golden Mole (*Eremitalpa granti*), is listed as *Vulnerable* (Friedmann & Daly, 2004), but Rautenbach (1990) is of the opinion that this species cannot be considered as rare, vulnerable or endangered as it is quite common along the western coastal regions from Langebaan to the Namib desert. In the Namakwa Sands mining area, Rautenbach (1990) recorded this species in both the coastal white sand dunes and inland red sand dunes.

ii) Namaqua Dune Mole-rat (*Bathyergus janetta*), is listed as *Near Threatened* (Friedmann & Daly, 2004). The present study area lies at the southern limits of its known range (Friedmann & Daly, 2004) and its presence in the study area is unconfirmed.

The coastal rocky outcrops in the study area are probably too small and too isolated to support viable populations of rockdwelling mammals such as the Cape Rock Elephant Shrew (*Elephantulus edwardii*), the Rock Dormouse (*Graphiurus platyops*), the Spectacled Dormouse (*G. ocularis*), and Smith's Red Rock Rabbit (*Pronolagus rupestris*).
It is concluded that the study area contains no unique or important mammalian habitats relative to the surrounding West Coast area. Furthermore, the area appears to have low species diversity.

3.3. Faunal habitats in the study area

Four main faunal habitats were identified in the study area: i.e. coastal strip, rocky habitat, white coastal dunes, and inland Succulent Karoo (Namaqualand Sand Fynbos and Namaqualand Strandveld). The coastal strip is a mixture of alternating fine grain sandy beaches and rocky shoreline. At a few locations, rocks extend to well above the high water mark, constituting a distinct habitat for rock-dwelling animal species. The white coastal sand dunes include both vegetated and exposed ones. The inland areas feature low to moderate relief and short xeric Succulent Karoo vegetation on red aeolian sand. The proposed site for the erection of the wind energy facility only offers one faunal habitat type, namely Succulent Karoo on red aeolian sand (Figure 5).

Table 3.3. Mammal species that are confidently expected to occur in the study area (Rautenbach, 1990; Skinner & Smithers, 1990; Friedmann & Daly, 2004).

Species name	**Common name**	**Conservation category**
Myosorex varius	Forest Shrew	
Crocidura cyanea	Reddish-grey Musk Shrew	
Suncus varilla	Lesser Dwarf Shrew	
Macroscelides proboscideus	Round-eared Elephant Shrew	
Chrysocloris asiatica	Cape Golden Mole	
Eremitalpa granti	Grant's Golden Mole	Vulnerable
Eptesicus hottentotus	Long-tailed Serotine Bat	

Eptesicus capensis	Cape Serotine Bat	
Tadarida pumila	Little Free-tailed Bat	
Tadarida aegyptiaca	Egyptian Free-tailed Bat	
Otocyon megalotus	Bat-eared Fox	
Vulpes chama	Cape Fox	
Canis mesomelas	Black-backed Jackal	
Ictonyx striatus	Striped Polecat	
Genetta genetta	Small-spotted Genet	
Genetta tigrina	Large-spotted Genet	
Suricata suricatta	Suricate (meerkat)	
Cynictis penicillata	Yellow Mongoose	
Galerella pulverulenta	Small Grey Mongoose	
Felis sylvestris lybica	African Wild Cat	
Procavia capensis	Rock Hyrax	
Sylvicapra grimmia	Common Duiker	
Raphicerus campestris	Steenbok	
Bathyergus suillus	Cape Dune Mole-rat	
Bathyergus janetta	Namaqua Dune Mole-rat	Near Threatened
Cryptomys hottentotus	Common Molerat	
Hystrix africaeaustralis	Porcupine	
Otomys unisulcatus	Bush Karroo Rat	
Gerbillurus paeba	Hairy-footed Gerbil	
Tatera afra	Cape Gerbil	
Aethomys namaquensis	Namaqua Rock Mouse	
Malacothrix typica	Large-eared Mouse	
Dendromys melanotus	Grey Climbing Mouse	
Steatomys krebsii	Kreb's Fat Mouse	
Rhabdomys pumilio	Striped Mouse	
Mus minutoides	Pygmy Mouse	
Lepus capensis	Cape Hare	
Lepus saxatilis	Scrub Hare	

4. ENVIRONMENTAL ISSUES AND POTENTIAL IMPACTS

4.1. Identification of risk sources

From the previous sections, it is clear that numerous reptile and mammal species potentially occur in the study area and that many of them may be present on the proposed site for the erection of the wind energy facility. Few of them are, however, of conservation concern. Only three frog species are expected to be present in the study area, none of which are of conservation concern. Very little information is available on invertebrates, but there are no Red Data invertebrate species expected to occur in the study area.

The establishment of a wind energy facility and associated infrastructure (including access roads and a powerline) could potentially affect fauna in various ways. Those species that cannot effectively vacate the affected areas by themselves during the construction phase of the wind energy facility, e.g., invertebrates, tortoises, burrowing lizards and burrowing mammals, could potentially suffer direct mortality. The construction of the wind energy facility and associated infrastructure will inevitably result in the loss of faunal habitat. Traffic on the access road to and from the facility would most likely result in elevated numbers of road kills (especially during the construction phase) and the roads themselves, as well as fencing, may pose significant barriers to animal movement. Bats occurring in the area may potentially suffer mortality from the rotor blades of the turbines when these animals forage at night. The significance of these potential impacts will, in part, be determined by the number of species of conservation concern actually present in the affected areas.

4.2. Transmission line alternatives

The two alternative routes (and sub-alternatives) for the Juno-Wind farm transmission line do not differ in any significant way as far as faunal habitat which they will traverse is concerned. There should accordingly be no significant differences in the potential impacts on terrestrial fauna associated with the erection of a transmission line along any of the routes.

4.3. Risk assessment

4.3.1. Direct mortality

Nature: Those species that cannot flee from the affected areas by themselves during the construction phase of the wind energy facility, the upgrading of the access road to the site, and the erection of a transmission line from the Juno substation to the facility, could potentially suffer direct mortality. Birds, large snakes and medium-sized mammals would be able to flee from the affected areas at the start of site clearing and/or construction. Tortoises and many other reptiles, as well as amphibians and small mammals, will not be able to flee effectively, either because they are too slow or because they are predisposed to take shelter. These species could therefore suffer direct mortality due to site clearing and excavations. Several species potentially occurring in the areas to be affected, are fossorial and will also not be able to flee.

Extent: Due to the relatively small area that would be affected and the relatively large ranges of most species that may be affected, the impact of direct mortality on species would only be of local extent.

Duration: The impact will be limited to the construction phase and its lifetime will therefore be of very short duration (0-1 years)

Magnitude: With the exception of the Angulate Tortoise (*Chersina angulata*), the Variegated Skink (*Trachylepis variegata*), Knox's Sand Lizard (*Meroles knoxii*), the Bush Karoo Rat (*Otomys unisulcatus*), and the Striped Mouse (*Rhabdomys pumilio*), which generally occur in high numbers, population densities of vertebrate species in the study area are low. The presence of Red Data species on the proposed site and other areas in the study area to be affected by the access road and transmission line, has not been confirmed. All other species occurring in the study area and which could suffer direct mortality have wide distributions in South Africa. Because of the low densities of most species which could be affected, the magnitude of the impact would be minor and would not result in an impact on processes.

Probability: The probability that faunal species would suffer direct mortality during site clearing is high.

Significance: Using the rating methodology outlined in Appendix 1, the significance of the impact is rated as *Low*, i.e. this impact would not have a direct influence on the decision to develop in the area.

Status: Some species may be negatively influenced by the impact.

Reversibility: Not applicable.

Loss of resources: The impact will not cause the loss of any resources.

Mitigation: Removal of animals from the affected areas before the start of site clearing/ construction and relocating these to safe areas would only be a valid mitigation option in the case of tortoises. All other reptile and small mammal species are extremely difficult to catch and it would be a futile attempt to try and relocate them. Before site clearing, affected areas should be thoroughly searched for tortoises and meerkat colonies (presence on site confirmed by Tim Hart). Tortoises found must be released in adjacent unaffected areas. Meerkat colonies in affected areas should be dug up manually giving the animals a fair chance to escape before heavy machinery is sent in to do site clearing.

Table 4.1. Assessment of the potential impact of direct mortality on terrestrial fauna during construction of the wind energy facility and associated infrastructure (see Appendix 1 for an outline of the assessment methodology)

CRITERIA	**IMPACT**			
	CONSTRUCTION		**OPERATION**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (2)	Local (1)	N/A	N/A
Duration	Short-term (1)	Short-term (1)	N/A	N/A
Magnitude	Minor (2)	Minor (2)	N/A	N/A
Probability	Highly probable (4)	Highly probable (4)	N/A	N/A
Significance	Low (20)	Low (16)	N/A	N/A

Status	Negative	Negative	N/A	N/A

4.3.2. Loss of faunal habitats

Nature: The construction of the wind energy facility, the erection of a transmission line and the upgrading of the access road will result in the loss of faunal habitat, which may impact on terrestrial fauna species.
Extent: Of the four faunal habitats identified in the study area, the inland Succulent Karoo one is the only one that will be affected by the proposed project. This habitat type has a considerable geographic extent along the west coast and no vertebrate species are specifically associated with it. The chances that the Succulent Karoo habitat at the proposed site, and other areas in the study area to be affected by the project, contains any Red Data species are small. The Namaqua Dwarf Adder (*Bitis schneideri*), and Grant's Golden Mole (*Eremitalpa granti*), if present in the area, are expected to occur in the white coastal dunes and not inland (at Namakwa Sands, J. Blood, however, recorded the adder further inland). Just south of Groenriviermond, Mouton *et al*. (2007) also recorded Lomi's Blind Legless Skink (*Typhlosaurus lomii*) in Namaqualand Strandveld. In light of the above-mentioned, the impact of habitat destruction would only be of local extent.
Duration: A large section of the affected habitat will be lost permanently.
Magnitude: Given the low faunal species diversity in the inland Succulent Karoo habitat and the low probability of more than one endemic Red Data species occurring in this habitat, the magnitude of the impact would be minor.
Probability: The probability of some impact on faunal species is high.
Significance: The significance rating for the impact, without mitigation, is Medium (30-60 pts; see Appendix 1).
Status: Negative.
Reversibility: In many cases the impact will be irreversible.
Loss of resources: The impact will not result in the irreplaceable loss of any resource.
Mitigation: Instead of blanket site clearing for the erection of the wind turbines within the proposed site, the goal should be to keep as much as possible of the natural habitat within the site intact. By doing this, the significance rating of the impact could probably be lowered to *Low*.

Table 4.2. Assessment of the potential impact of habitat loss on terrestrial fauna associated with the construction of the wind energy facility and associated infrastructure (see Appendix 1 for an outline of the assessment methodology).

CRITERIA	IMPACT			
	CONSTRUCTION		OPERATION	
	Without mitigation	With mitigation	Without mitigation	With mitigation
Extent	Local (2)	Local (1)	N/A	N/A
Duration	Long-term (4)	Long-term (4)	N/A	N/A
Magnitude	Minor (2)	Small (0)	N/A	N/A
Probability	Highly probable (4)	Highly probable (4)	N/A	N/A
Significance	Medium (32)	Low (20)	N/A	N/A
Status	Negative	Negative	N/A	N/A

4.3.3. Increased road kill rate

Nature: Two important impacts of the South African road system on terrestrial fauna in general are that of road kills and dispersal barriers. During the last three decades, collisions with vehicles probably overtook hunting as the leading direct human cause of vertebrate mortality on land (Forman & Alexander, 1998).

Extent: Amphibians and reptiles tend to be particularly susceptible on two-lane roads with low to moderate traffic (Romin & Bissonette, 1996). In the study area, road kills along the access road will particularly affect tortoises and snakes. The Angulate Tortoise is abundant in the area, especially along the section of the Skaapvlei access road closest to the coast. Worldwide, studies have shown that despite high mortality on roads, road kills in general do not significantly impact populations and are apparently significant only for a few species listed as nationally endangered or threatened. Due to the low number of Red Data vertebrate species in the area (if any), the impact would only be of local extent.

Duration: During the construction phase of the wind energy facility, the traffic volume on the access road will be high, but once the facility is operational the volume will be similar to the current volume on the road. The impact will thus only be of short duration during the construction phase of the project.

Magnitude: In the study area, the Red Data species which may be present, Lomi's Blind Legless Skink (*Typhlosaurus lomii*), the Namaqua Dwarf Adder (*Bitis schneideri*), and Grant's Golden Mole (*Eremitalpa granti*), would not be affected to any large degree by road kills as the skink and the mole are subterranean species and the adder has low mobility. Grant's Golden Mole would probably only on occasion attempt to cross roads. Most road kills of small mammals occur at night when they are blinded by the lights of oncoming traffic. Because of the low faunal species diversity, low population densities, low traffic volume once operational, short distance over which the impact would be effective, and the possible absence of Red Data species, or, if present, low activity above ground, the impact will be minor and will not result in an impact on processes.

Probability: There is a distinct possibility of road kills occurring as a result of the project, especially of tortoises and snakes. The Angulate Tortoise is abundant in the area and large numbers will be crossing the access road on a daily basis.

Significance: In terms of the criteria and rating methodology outlined in Appendix 1, the significance rating for this impact, without and with mitigation, will be *Low*.

Status: Negative

Reversibility: Not applicable

Loss of resources: The impact will not result in the irreplaceable loss of any resource.

Table 4.3. Assessment of the potential impact of road kills on terrestrial fauna during construction of the wind energy facility and associated infrastructure (see Appendix 1 for an outline of the assessment methodology).

CRITERIA	**IMPACT**			
	CONSTRUCTION		**OPERATION**	
	Without mitigation	**With mitigation**	**Without mitigation**	**With mitigation**
Extent	Local (1)	Local (1)	N/A	N/A
Duration	Short-term (1)	Short-term (1)	N/A	N/A
Magnitude	Minor (2)	Small (0)	N/A	N/A
Probability	Probable (3)	Probable (3)	N/A	N/A
Significance	Low (12)	Low (6)	N/A	N/A
Status	Negative	Negative	N/A	N/A

Mitigation: During the construction phase, a speed limit of 80 kmph on the access road should be enforced. The access road should be cleared of tortoises in advance of heavy equipment being transported along the route in order to avoid unnecessary fatalities. Eskom will need to dedicate a resource to do this or it must be the clear responsibility of some body on the site.

4.3.4. Barrier effect of roads and fencing

Nature: In contrast to road kills, the barrier effect of roads probably impacts more species than the effects of either road kills or road avoidance, and may emerge as the greatest ecological impact of roads with vehicles (Forman & Alexander, 1998). While it is particularly mammals, with their greater mobility and larger home ranges, that are seemingly heavily impacted on by road kills, lower vertebrates and invertebrates, on the other hand, may find hard road surfaces impassable barriers. The barrier effect of roads and fencing will only impact on species in the long term. The risk will therefore only be applicable tot the operational phase of the wind energy facility.

Extent: The access road to the wind energy facility, as well as the on-site service road, may form significant barriers preventing movement of small animals, particularly fossorial skinks (*Typhlosaurus lomii*, *T. vermis*, and *Acontias litoralis*). These species are, however, expected to have highest densities close to the coast and not inland. This may also be true for the Golden Moles (*Chrysocloris assiatica* and *Eremitalpa granti*). Of these species, only Lomi's Blind Legless Skink and Grant's Golden Mole are Red Data species. Because of the low number of Red Data species that may be affected, the impact will only be of local extent.

Duration: The lifetime of the impact will be of long-term duration (> 15 years).

Magnitude: Only a few fossorial vertebrate species would potentially be influenced by the barrier effect of the access and service roads. The available information suggests that most of the fossorial species have higher densities closer to the coast. The potential impact of the barrier effect will thus only be minor.

Probability: Little information is available on the ability of fossorial lizards to cross hard surfaces such as gravel- and surfaced roads, but there is a distinct possibility that some animal species in the study area may find it impossible to cross the access road or the on-site service road.

Significance: The impact is rated of *low* significance, using the rating system outlined in Appendix 1. The impact would not have a direct influence on the decision to develop in the area.
Status: Negative.
Reversibility: Reversible
Loss of resources: The impact will not result in the irreplaceable loss of any resource.
Mitigation: The effect of surface quality on the ability of small animals to cross hard surfaces is not known, but it is expected that gravel surfaces will be less daunting for them than asphalt ones.

Table 4.4. Assessment of the potential impact of the barrier effect of roads and fencing on terrestrial fauna during operation of the wind energy facility and associated infrastructure (see Appendix 1 for an outline of the assessment methodology).

CRITERIA	IMPACT			
	CONSTRUCTION		OPERATION	
	Without mitigation	With mitigation	Without mitigation	With mitigation
Extent	N/A	N/A	Local (2)	Local (2)
Duration	N/A	N/A	Long-term (4)	Long-term (4)
Magnitude	N/A	N/A	Minor (2)	Minor (2)
Probability	N/A	N/A	Probable (3)	Probable (3)
Significance	N/A	N/A	Low (24)	Low (24)
Status	N/A	N/A	Negative	Negative

4.3.5. Bat collision fatalities

Nature: Bat mortality at wind energy plants has been reported world-wide (e.g., Johnson *et al*., 2003: Kerns & Kerlinger, 2004). Bats occurring in the area may potentially suffer mortality from the rotor blades of the turbines when these animals forage at night.
Extent: At least four bat species are expected to frequent the study area (Table 3.3), none of which are of conservation importance (Friedmann & Daly, 2004). The Long-tailed Serotine Bat (*Eptesicus hottentotus*) is not common anywhere and seems to prefer broken or mountainous country and during the day roost in caves (Skinner & Smithers, 1990). The Cape Serotine Bat (*Eptesicus capensis*) has an extensive distribution in Africa. They roost in any available place, commonly in the roofs of houses (Skinner & Smithers, 1990). They readily come to lights at night to catch flying insects attracted to lights. The Little Free-tailed Bat (*Tadarida pumila*) is very similar in behaviour to the Cape Serotine Bat and also has an extensive distribution in Africa (Skinner & Smithers, 1990). The Egyptian Free-tailed Bat (*Tatarida aegyptiaca*) is gregarious and occurs in large colonies. They roost in caves and rock crevices. Like the former two species, it has a wide distribution in Africa and is insectivorous (Skinner & Smithers, 1990). Because of the relatively extensive distributions of the four bat species occurring in the study area and the absence of Red Data bat species, the impact will only be of local importance.
Duration: The lifetime of the impact will be of long term duration (> 15 years).
Magnitude: The intensity of bat mortality at wind farms generally appears to be low and restricted to migrating bats rather than resident populations (e.g., Johnson *et al*., 2003: Kerns & Kerlinger, 2004). Intensity of fatalities will probably vary seasonally and among

species. Because of the low number of bat species involved and the absence of Red Data species, the impact will be minor.
Probability: Although the impact will be minor, there is a distinct possibility of the impact actually occurring.
Significance: Using the method outlined in Appendix 1, the significance weighting for the potential impact is *Low* (< 30 points).
Status: Negative.
Reversibility: Reversible
Loss of resources: The impact will not result in the irreplaceable loss of any resource.
Mitigation: Excessive lighting at the facility may attract flying insects and therefore also bats, which may lead to increased mortality. Excessive lighting at the facility should be avoided.

Table 4.5. Assessment of the potential impact of collision fatalities on bats associated with the wind energy facility (see Appendix 1 for an outline of the assessment methodology).

CRITERIA	IMPACT			
	CONSTRUCTION		OPERATION	
	Without mitigation	With mitigation	Without mitigation	With mitigation
Extent	N/A	N/A	Local (1)	Local (1)
Duration	N/A	N/A	Long-term (4)	Long-term (4)
Magnitude	N/A	N/A	Minor (2)	Small (1)
Probability	N/A	N/A	Probable (3)	Probable (3)
Significance	N/A	N/A	Low (21)	Low (18)
Status	N/A	N/A	Negative	Negative

4.4. Environmental Impact Statement

Five potential impacts on terrestrial fauna are expected to be associated with the construction of a wind energy facility on the proposed site, the upgrading of the existing access road, and the erection of a transmission line between the Juno substation and the facility. With the exception of *habitat loss*, the impacts have all been rated of low significance. The impact of *habitat loss* is, however, rated of medium significance. If a serious effort can be made to restrict habitat destruction on the site, the significance of the impact could probably be lowered. The two transmission line alternatives (including sub-alternatives) do not differ in any significant way as far as potential impact on terrestrial fauna is concerned.

5. DISCUSSION

Invertebrates (especially insects) of the West Coast area are still poorly known and will probably remain so until a detailed, long-term survey can be conducted. Most surveys that have been conducted in the area to date were associated with environmental impact assessments. These assessments normally have stringent time constraints and do not allow for long-term surveys.

The wind energy facility will probably be fenced as Eskom will regard it as a National Key Point. The effect of keeping small/large mammals out of the terrain by fencing will largely depend on the extent of remaining natural habitat within the terrain. If large portions of vegetation remain intact, access for small mammal predators to the terrain may be required to keep rodent populations inside under control.

Relatively few studies have investigated the impact that wind energy generation facilities may have on bats. The studies that have been done in the US, however, found that wind turbines do not pose a significant threat to bat populations (Sagrillo, 2003). An important finding so far is that bat collision mortality during the breeding season is virtually non-existent, despite the fact that relatively large numbers of bat species have been documented in close proximity to wind energy generation plants. It appears as if wind farms do not impact resident breeding populations, but rather migrant or dispersing bats in the late summer and autumn. Migrant bats, since they are not searching for insects or feeding, probably 'turn off' their echolocation in order to conserve their energy resources. Preliminary data for the US also indicate that the populations of bats susceptible to turbine collisions are usually large enough that the observed mortality is not sufficient to cause population declines. Only anecdotal information is available on bat fatalities at wind energy facilities in South Africa. According to Ian Smit (Eskom; personal communication) there is no indication of bat fatalities at the Klipheuwel wind energy facility.

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APPENDIX 1
Methodology for the Assessment of Potential Impacts

Direct, indirect and cumulative impacts of the above issues, as well as all other issues identified will be 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**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional :
  - Local extending only as far as the development site area – assigned a score of 1;
  - Limited to the site and its immediate surroundings (up to 10 km) – assigned a score of 2;
  - Will have an impact on the region – assigned a score of 3;
  - Will have an impact on a national scale – assigned a score of 4; or
  - Will have an impact across international borders – assigned a score of 5.
- The **duration**, wherein 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 resources.
- The *degree* to which the impact can by *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).