AGRICULTURAL ASSESSMENT OF THE PROPOSED GAROB 1 WIND ENERGY FACILITY SITE

ON PORTION 5 OF THE FARM NELSPOORTJE NO. 103, SIYATHEMBA LOCAL MUNICIPALITY, NORTHERN CAPE PROVINCE

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I, Louis George du Pisani, hereby confirms my independence as specialist and declare that I have no interest, be it business, financial, personal or other, in any proposed activity, application or appeal in respect of which I was appointed other than fair remuneration for work performed on this project.

_____ 17 August 2012

L G du Pisani **Date**

Dr L G du Pisani (B.Sc. Agric., Hons B.Sc. Agric., M.Sc. Agric., Ph.D. Agric.)

Summary of Expertise

>>More than 20 years experience in pasture and natural resource management in the Karoo

>>Author or co-author of 20 publications in international and national journals and papers

>>Presented 5 papers at International Conferences, as well as 2 at Regional and 10 at National Conferences

>>Was a member of 13 National Committees of the Department of Agriculture

>>Completed several agricultural potential studies in South Africa, Namibia and Argentina

>>Registered as professional member of The South African Council for Natural Scientific Professions (SACNASP) (Agricultural Science), with registration number 400178/2012

EXECUTIVE SUMMARY

Site name and location: Garob 1 – Copperton/Prieska: A site on Portion 5 of the Farm Nelspoortje No. 103 (5520 ha) situated in the Siyathemba Local Municipality located approximately 50 km south-west of the town of Prieska (Northern Cape Province) on the R357 road.

Purpose of the study: To carry out an Agricultural Assessment of the site where the establishment of a wind energy facility is planned and provide a professional opinion on (i) whether the proposed site is of such high agricultural potential that the proposed development would lead to a significant loss of agricultural potential in the area and the property it is situated upon, (ii) whether the site is situated within agricultural sensitive areas and (iii) to assess the direct, indirect and cumulative impacts of the issues identified through the scoping study, as well as all other issues identified during the EIA phase, on the soil and agricultural resources.

Specialist: **Dr L G du Pisani** (B.Sc. Agric., Hons B.Sc. Agric., M.Sc. Agric., Ph.D. Agric.)
Pr. Sci. Nat. 400178/2012

Date of Report: 17 August 2012

CONCLUSIONS OF THE EIA PHASE STUDY:

1 The site is relatively poorly endowed with agricultural resources. The rainfall is low and erratic, the soils are generally shallow, rocky and non-arable, there are not sufficient water quantities available for irrigation and the grazing capacity is low and erratic. The best land-use for the site is for grazing with sheep and goats.

2 The contribution of the site to food security as a whole is negligible. The development of the site as a wind power facility will only have a short term negative impact on the production of agricultural products from the property. That is during the construction phase of the project when the construction activities may interfere with the normal management practices on the property. Thereafter, the livestock farming activities will return to normal and the presence of the wind turbines is not expected to have any negative effect on normal farming and management practices.

3 The soils on the site is susceptible to both water and wind erosion, although the susceptibility is categorized as low to medium.

4 The site is slightly undulating with the slopes less than 6% and no slopes exceeding 20%.

5 The site does not consist of unique agricultural land.

6 There is no evidence that any part of the site is currently under cultivation or has been cultivated in the last ten years, apart from a small olive orchard of approximately 1 ha close to the homestead that falls outside of the development footprint.

7 There is no evidence that the site has agricultural infrastructure (i.e. silos, irrigation lines, pivot points, channels, feeding structures, grazing camps, animal housing, farm roads, etc.) or any conservation works (i.e. contour banks, waterways, etc.) that will be interfered with.

There is a watercourse present on the site that is identified as a NO GO area.

8 Due diligence should be observed with the placement of the development footprint.

9 The identified impacts must be properly managed.

In summary, the agricultural potential of the site is relatively low, it is too small to contribute significantly to the economy or food security of the area, there are no slopes exceeding 20%, the soils are slightly susceptible to both water and wind erosion, it does not consist of unique agricultural land, there are no cultivated lands present, there are no agricultural infrastructure or conservation works that will be interfered with, there is a watercourse that is regarded as a NO GO area, due diligence should be observed with the correct placement of the developmental footprint and the identified impacts must be properly managed.

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1. INTRODUCTION

The consultant had the following brief:

i To conduct an Agricultural Assessment of Portion 5 of the Farm Nelspoortje No. 103 (area of the farm = 5520ha) situated in the Siyathemba Local Municipality, approximately 50 km south-west of the town of Prieska (Northern Cape Province) on the R357 road, where the establishment of a wind energy facility is planned (see Appendix 1 & 2).

ii To compile a report and provide a professional opinion on (i) whether the proposed site is of such high agricultural potential that the proposed development would lead to a significant loss of agricultural potential, (ii) whether the site is situated within agricultural sensitive areas and (iii) to assess the direct, indirect and cumulative impacts of the issues identified through the scoping study, as well as all other issues identified in the EIA phase, on the soil and agricultural resources.

2. BACKGROUND INFORMATION

The Department of Agriculture, Forestry and Fisheries (DAFF) (2010) published '' Regulations for the evaluation and review of applications pertaining to wind farming on agricultural land''. This report states that ''*it is important to conduct land use in a way that it optimally adheres to the potential of the land. Consequently, it is imperative that all available land with the potential for producing sustained high crop yields, thus land with a high agricultural production potential, as well as land with a potential carrying capacity for livestock, be effectively utilized and protected for agricultural use. Agricultural production or the use of land for any other purpose should nevertheless not be conducted in a way that it could result in the degradation or loss of the available natural resources. This especially has reference in ensuring that high potential and unique agricultural land is preserved for current and future production thereby ensuring sustainable utilization of the country's natural resource base and adhering to food security*.''

This report by DAFF (November 2010) provides a draft list of guidelines that must be taken into account and be adhered to before permission will be granted for the establishment of Wind Farms on agricultural land. They are:

2.1 No development will be allowed on high potential or unique agricultural land.

2.2 No development will be allowed on areas currently being cultivated (cultivated fields/ production areas) or on fields that have been cultivated in the last ten years. This is relevant to cultivated land utilized for dry land production as well as land under any form of irrigation.

2.3 No development will be allowed should it intervene with or impact negatively on existing or planned production areas (including grazing land) as well as agricultural infrastructure (silos, irrigation lines, pivot points, channels, feeding structures, dip tanks, grazing camps, animal housing, farm roads etc).

2.4 No development will be allowed should it result in the degradation of the natural resource base of the farm or surrounding areas. These include, but are not limited to, soil degradation or soil loss through erosion or any manner of soil degradation, the degradation of water resources (both quality and quantity) and the degradation of vegetation (composition and condition of both natural or established vegetation). It also includes establishment on or impacting on:

2.4.1 Wetlands (*land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil*). No development is allowed on a wetland, vlei, pan or any other water body unless otherwise approved by DAFF.

2.4.2 Flow pattern of run-off water and shall not in any manner divert any run-off water from a water course to any other watercourse or obstruct the natural flow pattern of run-off water.

2.4.3 Utilization and protection of vegetation. Every care should be taken to protect the vegetation and veld condition against deterioration and destruction.

2.5 No development will be allowed should it result in a degradation of existing soil conservation work. This includes but are not limited to:

2.5.1 Contour banks.

2.5.2 Waterways/Watercourses

2.6 No development will be allowed on slopes (*the vertical difference in height between the highest and the lowest points of that portion of land, expressed as a percentage of the horizontal distance between those two points*) of more than 20%.

3. METHODOLOGY

During the scoping phase of the study the consultant prepared a compendium of available published data, information, maps and satellite images for the site.

During the field verification the site was traversed on foot and by vehicle (8 August 2012), listing, assessing and verifying the agricultural attributes described during the scoping phase.

The data collected during both the scoping and verification phases were used to prepare a professional opinion on whether any of the DAFF-guidelines (as was discussed in paragraph 2 of this report) will be contravened upon, after which an environmental impact assessment of the agricultural resources on the site was conducted.

4. SITE INFORMATION

The site is located on Portion 5 of the Farm Nelspoortje No. 103 situated in the Siyathemba Local Municipality, located approximately 50km south-west of the town of Prieska (Northern Cape Province) on the R357 road (area of the farm = 5520ha). The position of the site is indicated in the maps depicted in Appendix 1 & 2.

5. SPECIALIST

Dr L G du Pisani (B.Sc. Agric., Hons B.Sc. Agric., M.Sc. Agric., Ph.D. Agric.)
Pr. Sci. Nat. 4001178/2012

6. SCOPING RESULTS

Appendix 3 provides a compendium of the more important agricultural characteristics of the site as was collected from published sources during the scoping phase of the study.

6.1 Land capability and land-use

The site falls within Veld Type 29 (Arid Karoo – Acocks, 1988) and Biome NKb3 (Bushmanland Arid Grassland – Mucina & Rutherford, 2006) and occupy the driest parts of South Africa (Acocks, 1988). The most dominant plant species prevalent on this veld type and biome are *Rhigozum trichotomum, Pentzia spinescens, Stipagrostis obtusa* and *Stipagrostis ciliata* (Vorster, 1985).

The site is defined as non-arable (see Appendix 4). The best land-use is for grazing with sheep, goats and beef cattle (Vorster, 1985) (see Appendix 3).

The grazing capacity of the region varies between 26 ha/LSU and 32 ha/LSU (Vorster, 1985; Botha, 1998; Department of Agricultural Development, 1991) (see Appendix 5). The calculated carrying capacity of the site is at best 212 LSU's.

The site falls within a homogeneous farming area of 700 650 ha (see Appendix 3). The 5520 ha size of the site thus represents less than 1.1% of that of the homogeneous farming area it represents.

In terms of its size and carrying capacity, the site it is regarded as insignificant.

6.2 Geology, land types and soils

The site is situated within Land Type Ag (Appendix 6), with 85% of the site located in the Ag154 land type, 10% in the Ag137 land type, 4% in the Ag138 land type and 1% in the Ag6 land type (Land Type Survey Staff, 1987).

The geology of the site is described by Vorster (1985) as dominated by Granite and Meta-Sediments of the Namaqualand Metamorphic Complex.

The Land Type Survey Staff (1987) describe the geology as follows:

i Land Type Ag154 (85% of the site area) - Tillite, mudstone and shale (Dwyka Formation) predominantly; hills of quartzite, quartz schist, mica schist, amphibolites (Uitdraai and Dagbreek Formations); sporadic Karoo dolerite and granite-gneiss (Keimoes Suite); occasional small pans; coarse desert pavement on tillite common.

ii Land Type Ag137 (10% of the site area) - Quartzite, schist and amphibolites of the Uitdraai and Dagbreek Formations; conglomerate, sub greywacke, lava, tuff and amphibolites of the Prieskaspoort Subgroup (Marydale Group); Skalkseput granite; occasional outcrops of amphibolites and iron formation of the Doornfontein Subgroup.

iii Land Type Ag138 (4% of the site area) - Quartzite, schist and amphibolites of the Uitdraai and Dagbreek Formations predominantly; Skalkseput granite and amphibolites, iron formation, dolomite, sandstone, andesite and tuff of the Doornfontein Subgroup and Schmidtsdrif, Vryburg and Zeekoebaart Formations in the northeast; surface deposits of alluvium.

iv Land Type Ag6 (1% of the site area) - Migmatite, gneiss and granite; occasional small outcrops of ultra metamorphic rocks, mainly in the north-west, forming small hills. All rocks included in Namaqualand Metamorphic Complex. Lime nodules and calcrete abundant; dorbank in places. Occasional seif dunes in north.

The A group of land types has yellow and red apedal soils, without water tables, freely drained, a high base status and with an effective depth of less than 300mm deep on average (Department of Agricultural Development, 1991). According to the classification of the AGIS Website of the Department of Agriculture, Fisheries & Forestry – www.agis.agric.za – and the Department of Agricultural Development (1991) the site falls within an area with soils with minimum development, usually shallow, on hard or weathering rock, with or without intermittent diverse soils, and where lime is generally present in the landscape (see Appendix 7). The soils are therefore generally not suited for cultivation.

The following soil forms (as per the MacVicar *et al*, 1977 classification) are to be expected to occur on the site, i.e. Hutton, Oakleaf, Mispah, Glenrosa, Clovelley, Valsrivier and Dundee (Land Type Survey Staff, 1987). According to Vorster (1985) the area is dominated by moderately deep Hutton soils and shallow soils of the Glenrosa and Mispah forms (as per the MacVicar *et al*, 1977 classification).

The susceptibility of the soils to water and wind erosion is categorised as low to moderate (Vorster, 1985; AGIS Website of the Department of Agriculture, Fisheries & Forestry – www.agis.agric.za) (Appendix 8 & 9), while the soil loss potential is low (Appendix 10).

The slope of the land is flat to gently sloping (Appendix 11), with approximately 70% of the area having slopes of less than 2%, and 30% or the land with slopes between 3% and 5%.

6.3 Climate

The climate of the area is typical of the Desert Climatic Region (Schulze, 1980) and is arid. The mean annual rainfall of the area is approximately 200mm (Vorster, 1985) (Appendix 12), unreliable and erratic, with the precipitation mainly due to convectional showers in summer and autumn (Schulze, 1980), with the height of the rainfall season occurring between the months of February and April (Vorster, 1985). Single, very rare, heavy showers can account for as much as the normal annual precipitation (Schulze, 1980). The low and erratic rainfall does not allow for dryland cropping.

6.4 Agricultural sensitive areas or areas of high agricultural value (i.e. lands, wetlands and watercourses)

There are no wetlands or lands visible on either the 1:50,000 topographical maps or Google Earth Images.

There are watercourses visible on the site.

6.5 Agricultural infrastructure

There are no agricultural important infrastructure (i.e. silos, irrigation lines, pivot points, channels and feeding structures, etc.) or any conservation works (i.e. contour banks, waterways, etc.) that will be

interfered with, visible on the 1:50,000 topographic maps or Google Earth Images.

6.6 Accessibility to the site and roads

The site is easily accessible by road directly from the R357 between Prieska and Vanwyksvlei (49km from Prieska). The ESCOM power grid is situated near Copperton a few kilometers south of the site, while there is an ESCOM power line crossing over the site.

7 FIELD VERIFICATION OF SCOPING RESULTS

7.1 Land capability and land-use

The farm is currently used for sheep, goat and game farming, with Dorper sheep farming being the main enterprise. The land is currently stocked at approximately 20 ha/LSU.

There is no arable land present on the site, nor has there been any dryland farming practiced on any part of the land. There is plus minus a 1 ha olive grove under drip irrigation next to the homestead. This land falls outside of the wind farm footprint.

There are not sufficient quantities of water available that can be used for irrigation purposes. Water for livestock consumption is extracted from bore holes dispersed over the property. The average depth of the bore holes is 30m.

The average annual rainfall over the last 10 years is 300mm.

The above information was supplied by the farm owner, Mr. Pieter Fourie, during a personal interview with him.

7.2 Soils

Research conducted by Vorster (1985) in the Karoo, there is a close correlation between the vegetation present on a particular terrain unit, the terrain form (= relief of the land) and the presence of specific soil forms.

Due to the large size of the site (5520ha) it was not possible to conduct intensive soil sampling on the site. Instead, the following methodology

was adopted (based on the fact that there is an expected good correlation between terrain form and soil forms present on a particular site):

i) The relief map and the latest Google Earth image of the site was used to delineate the different terrain units on the site and produce a map with areas of ''similar terrain units'' with expected ''similar soils present''.

ii) Points were identified on the map where soil samples were to be taken to verify if there is indeed a good correlation between the identified terrain units and the soil forms present.

iii) During the reconnaissance of the site, soil cores were taken with a soil auger at the pre-identified points (see paragraph ii above), as well as other points deemed necessary during the field work, and the soil forms present were identified according to the classification of MacVicar *et al* (1977 & 1991).

The following soil forms (as per the MacVicar *et al*, 1991 classification) were identified on the site, i.e. Plooysburg, Coega and Mispah.

The Plooysburg soil-form consists of an Ortic A-horizon over a red apedal B-horizon over a hardpan carbonate horizon. It is a moderately deep soil of between 200mm and 600mm, with an average agricultural potential (restricted to veld and grazing). Of the three soils present on the site it has the best agricultural potential. The clay content of the topsoil is 6% and less. This soil is freely drained and physically and chemically inactive. It is slightly susceptible to water erosion and moderately susceptible to wind erosion. The current soil surface condition is generally good with little wind and/or water erosion visible (see Appendix 13 for photographs of the soil form)

The Coega-form consists of an Ortic A-horizon over hardpan carbonate. It is shallow and has an effective soil depth of between 30mm and less, with a low agricultural potential (restricted to veld and grazing). It is physically and chemically inactive. The clay content of the topsoil is 6% and less. The soil is freely drained and slightly sensitive to both wind and water erosion. The soil is generally covered with desert pavement, which suggests that the soil was historically impacted by wind and/or water erosion (see Appendix 14 for photographs of the soil form)

The Mispah-form consists of an Ortic A-horizon over rock. It is shallow and at the most 30mm deep, with a low agricultural potential (restricted to veld and grazing). It is physically and chemically inactive. The clay content is 6% and less. The soil is freely drained and slightly sensitive to both wind and water erosion. The current soil surface condition is generally good with little wind and/or water erosion visible (see Appendix 15 for photographs of the soil form).

As was expected, there was indeed a close correlation between the terrain forms on the site and the soils present. The Plooysburg soil-form dominates the low lying areas, while the Mispah soil-form dominates the high ground, with the Coega soil-form occurring on the levels in between the high and low ground.

A verified soil map of the site is represented in Appendix 16, while the soil core sample results are displayed in Appendix 17.

From this verification process of the soils, it is concluded that:

(i) The site has a low agricultural potential and is not arable and that the wind and/or water erosion hazard can be regarded as low.

(ii) The deeper Plooysburg-soils has the best agricultural potential and should where possible not be used for the establishment of wind turbines. As they are prevalent in the lower lying areas of the landscape, where less wind is expected, it is highly unlikely that any of the wind turbines will be positioned on these soils. The proposed positioning of the wind turbines are shown in Appendix 18, which shows that just a few are actually planned to be erected on areas with Plooysburg soils.

(iii) The Coega- and Mispah-soils are shallow, have a low agricultural potential and is only slightly susceptible to either wind and/or water erosion. The Coega and Mispah soil forms covers the higher lying areas of the site and is best suited for the positioning of the wind turbines.

(iv) The position of three alternative routes for the construction of power lines on the site, are displayed in Appendix 19. From a soil perspective and the distances the power lines must cross over the site, the two power lines to the top of the picture (A & B) are the better options. Power line A adjoins the existing power lines

crossing over the site. This option will therefore have the least impact.

7.3 Vegetation and veld resources

As was expected, there was a close correlation between the soil-forms present and the dominant plants growing on them.

The Plooysburg soil-form consisted of a mixture of small trees and shrubs, grasses and karoo bushes (see Appendix 13 for photographs). The following plants dominate on the Plooysburg soil-form:

i) Small trees and shrubs – *Rhigozum trichotomum, Pheaoptilum spinosum, Lycium cinerium*
ii) Grasses – *Stipagrostis obtusa, Stipagrostis ciliata, Aristida adscencionis, Aristida congesta, Enneapogon cenchroides*
iii) Karoo bushes – *Salsola tuberculata, Salsola glabrescens, Pentzia spinescens, Zygophyllum microphyllum, Aptosimum spinescens*

The Coega soil-form is dominated by karoo bushes, with only a few small, prostrate growing grasses, small trees and shrubs present in the landscape (see Appendix 14 for photographs). The following plants dominate on the Coega soil-form:

i) Small trees and shrubs – *Acacia mellifera subsp. detinens, Lycium cinerium*
ii) Grasses – *Tragus racemosus, Oropetium capense, Aristida congesta*
iii) Karoo bushes – *Salsola tuberculata, Pentzia spinescens, Aptosimum marlothii, Pteronia sordida, Rosenia humulis, Eberlanzia ferox*

The Mispah soil-form is dominated by grasses and small trees and shrubs, with karoo bushes rare (see Appendix 15 for photographs). The following plants dominate on the Mispah soil-form:

i) Small trees and shrubs – *Acacia mellifera subsp. detinens*
ii) Grasses – *Digitaria eriantha, Anthephora pubescens, Heteropogon contortus, Cenchrus ciliaris*
iii) Karoo bushes – Rare

Recovery of the vegetation is fairly rapidly after mechanical disturbance on the Plooysburg soil-form and the Mispah soil-form (see Appendix 21 for photographs). It is specifically grasses that recruit fairly quickly after disturbance on these two soil types. Due to the low abundance of grasses on the Coega soil-form, it is expected that this landscape will recover slower after mechanical disturbance as the recruitment of karoo bushes is slow after mechanical disturbance.

There are three plant species present on the site which can invade disturbed soil. They are *Rhigozum trichotomum, Acacia mellifera subsp. detinens* and the alien invader species *Prosopis glandulosa.*

The veld is generally in an average to good condition. The estimated current grazing capacity of the site is 30 ha/LSU, giving this 5520 ha site a carrying capacity equivalent to 184 LSU's or 782 dorper ewes.

It is expected that during the construction phase, the current land-use (which is grazing with livestock and game) will be slightly impacted upon, with the construction activities possibly restricting the normal grazing system as some of the infrastructure, i.e. fences and the water reticulation systems, may be temporarily disrupted. If managed and coordinated well by the construction team, this impact does not have to be major. After completion of the construction phase, the impact on the land-use will be negligible and the land owner will be in a position to continue with his normal grazing practices in spite of the presence of the wind turbines. It is thus expected that the loss of production will be low during the construction phase and little thereafter.

7.4 Slope

The land is gently sloping, with slopes of less than 5% on the whole site.

7.5 Agricultural sensitive areas or areas of high agricultural value (i.e. lands, wetlands and watercourses)

There are no wetlands or lands (current or old) on the site.

There is one watercourse on the site that is considered a NO GO area (see Appendix 20). It drains relatively large water volumes over a short period of time as it is situated at the end of a narrow gorge.

There is an existing ESCOM power line that runs to the eastern side of this watercourse (marked with an A on the map in Appendix 19), which do not impact or interfere with this watercourse in any way.

In Appendix 19 there are 3 alternative power lines proposed for this project. Although the power line marked as A is situated fairly close to the NO GO watercourse, it does not interfere with this specific watercourse.

7.6 Agricultural infrastructure

There are no important agricultural infrastructure (i.e. silos, irrigation lines, pivot points, channels and feeding structures, etc.) or any conservation works (i.e. contour banks, waterways, etc.) that will be interfered with.

7.7 Accessibility of the site and access roads

The site is easily accessible by road directly from the R357 between Prieska and Vanwyksvlei (approximately 50km from Prieska).

There are several internal roads on the site (see Appendix 18). They are generally in a good condition. A few of the roads, those situated on sandy slopes, display minor water erosion taking place due to the absence of cross mounds to slow down the speed of the drainage water. The roads on the more gravelly areas of the site display no water erosion, even on slopes.

7.8 Groundwater, soil and geological stability of the site

	YES	NO
Shallow water table (less than 1.5m deep)		X
Dolomite, sinkhole, or doline areas		X
Seasonally wet soils (often close to water bodies)		X
Unstable rocky slopes or steep slopes with loose soil		X
Dispersive soils (soils that dissolve in water)		X
Soils with high clay content (clay fraction more than 40%)		X
Any other unstable soil or geological feature		X

An area sensitive to erosion	X	

8 ASSESSMENT OF IMPACTS

8.1 Assessment method and criteria

Direct, indirect and cumulative impacts of the issues identified through the scoping study, as well as all other issues identified during the EIA phase are assessed in terms of the following criteria:

» The **nature**, which include a description of what causes the effect, what will be affected and how it will be affected.
» The **extent**, wherein it is indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 is assigned as appropriate (with 1 being low and 5 being high):
» The **duration**, wherein it is 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 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 describe the likelihood of the impact actually occurring. Probability is estimated on a scale of 1–5, where 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).

» the **significance**, is determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
» the **status**, which is 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.*

The **significance** is calculated 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).

8.2 Activities that may have an impact

» Wind farm footprint (i.e. construction and positioning of the concrete foundations of the wind turbines, positioning and construction of underground cabling between the wind turbines, construction and positioning of the on-site substation, construction and positioning of a workshop, office, maintenance and storage area)
» Construction and positioning of internal access roads
» Construction and positioning of the overhead power line/s
» Presence of contaminants on the site (i.e. oil, petrol, diesel and other contaminants used by the vehicles and equipment)

It is uncertain what impact the wind turbines will exercise on the local climate, specifically rainfall, as well as animal behavior.

8.3 Agricultural resources that may be impacted upon

- **Impact 1**: Soil and watercourses (degradation due to wind and water erosion, as well as by contamination with oil, petrol, diesel and other contaminants used by the construction vehicles and equipment)
- **Impact 2**: Vegetation and grazing capacity (degradation due to a decrease in species composition, vegetation cover, the recruitment of alien invaders and/or indigenous invader plants and a loss of grazing capacity)
- **Impact 3**: Underground water (degradation due to contamination by oil, petrol, diesel and other contaminants used by the construction vehicles and equipment)
- **Impact 4**: Livestock production systems (interference with farm and livestock management activities and a decline in the long term food production)

8.4 Assessment of the identified impacts

8.4.1 Wind farm footprint

Impact 1 Soil and Watercourses

The soil erosion potential of the site is relatively low, due to the absence of steep slopes, the specific soil forms present and soil surface condition of the soils.

a) Nature: Soil erosion on construction sites during and after the construction phase due to decreased vegetation cover and increased water run-off		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Probable (3)
Significance	**35 (Medium)**	**15 (Low)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of	Yes	Yes

resources?		
Can impacts be mitigated?	Yes	
Mitigation: » Care must be taken with the ground cover during and after construction on the site. If it is not possible to retain a good plant cover during construction, technologies should be employed to keep the soil covered by other means, i.e. straw, mulch, erosion control mats, etc., until a healthy plant cover is again established » Care should also be taken to control and contain storm water run-off » Rehabilitate construction sites by establishing it with indigenous grasses like Anthephora pubescens, Cenchrus ciliaris, Eragrostis curvula, etc.		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

b) Nature: Siltation of watercourses and other natural resources downstream as a result of improper storm water management and soil erosion due to increased and concentrated water run-off		
	Without mitigation	**With mitigation**
Extent	Regional (3)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Improbable (2)
Significance	**45 (Medium)**	**10 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: See a & b above. Control and stop soil degradation at the source		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

c) Nature: Dust production and dust pollution of grazing plants		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance	**21 (Low)**	**10 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No

Can impacts be mitigated?	Yes
Mitigation: Apply dust control measures, i.e. water spraying.	
Cumulative Impacts: Little with the necessary mitigation in place	
Residual Impacts: Little with the necessary mitigation in place	

Impact 2 Vegetation and grazing capacity

Firstly, the construction activities, specifically the construction of underground cabling between the wind turbines and the sub-station, will lead to areas where the soil will be denuded of vegetation. Secondly, there is a potential that the alien invader species *Prosopis glandulosa* and the indigenous invader species *Rhigozum trichotomum* and *Acacia mellifera* subsp. detinens (all present on the site) may recruit on the construction sites.

The Plooysburg-soils has the best agricultural potential and should where possible not be used for the establishment of the wind farm footprint features. As they are prevalent in the lower lying areas of the landscape, with less wind, it is highly unlikely that any of the wind turbines will be positioned on these soils.

a) Nature: Denudation of the soil due to construction activities and loss of carrying capacity		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Medium-term (3)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Definite (5)
Significance	**40 (Medium)**	**25 (Low)**
Status	Negative	Negative
Reversibility	Medium	High
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: *Rehabilitate construction sites by establishing it with indigenous grasses like* Anthephora pubescens, Cenchrus ciliaris, Eragrostis curvula*, etc.*		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

b) Nature: Invasion of alien and indigenous invader plants after soil disturbance on construction sites		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Long-term (4)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Improbable (2)
Significance	**45 (Medium)**	**10 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: Control invader plants recruiting on construction sites chemically and/or chemically		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

Impact 3 Underground water

It is highly unlikely that the wind farm footprint will have any impact on the underground water resources.

Impact 4: **Livestock production systems**

During the construction phase there will be an impact on the normal day-to-day management of the livestock and the veld management system, due to interference with systems like water reticulation and fencing.

a) Nature: Interference with the day-to-day management of the livestock and veld due to construction and other activities on the site		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Probable (3)
Significance	**35 (Medium)**	**15 (Low)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No

Can impacts be mitigated?	Yes
Mitigation: » *When farming infrastructure, i.e. fences, water pipelines, water troughs, etc., is removed or damaged, it should be replaced as soon as possible.* » *Construction and other activities must be communicated and co-ordinated with the land owner to put him in a position to properly plan his management activities.*	
Cumulative Impacts: Little with the necessary mitigation in place	
Residual Impacts: Little with the necessary mitigation in place	

8.4.2 Construction and positioning of internal access roads

Impact 1 Soil and Watercourses

A few of the roads on the site, specifically those situated on sandy slopes, display minor water erosion taking place due to the absence of cross mounds which slow down the speed and force of the drainage water. The roads on the more gravelly areas of the site display no such water erosion, even on slopes.

a) Nature: Soil erosion from road surfaces		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Improbable (2)
Significance	**35 (Medium)**	**10 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation*:* » *Care should be taken to put gravel on access road surfaces to protect the soil against wind and water erosion, with special care taken on soils of the Plooysburg form and specifically on slopes.* » *Cross mounds and other storm water drainage techniques must be employed to decrease the speed and force of the storm water properly from road surfaces.*		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

Impact 2 Vegetation and grazing capacity

New roads will contribute to the loss of vegetation and carrying capacity, although the impact is considered to be negligible taking into account the relatively low grazing capacity of the veld. Care should be taken, though, to make use of existing roads on the site and to minimise the construction of new roads.

a) Nature: Loss of vegetation and carrying capacity		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Minor (2)
Probability	Definite (5)	Definite (5)
Significance	**40 (Medium)**	**40 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: *Make use of existing roads as far as possible to minimise the construction of new roads.*		
Cumulative Impacts: Little, as long as the roads are not an additional source of erosion and storm water		
Residual Impacts: Permanent		

Impact 3 Underground water

No impact expected.

Impact 4: Livestock production systems

During the construction phase there will be an impact on the normal day-to-day management of the livestock and the veld management system.

a) Nature: Interference with the day-to-day management of the livestock and veld due to construction and other activities on the site		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Probable (3)

Significance	**35 (Medium)**	**15 (Low)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: *Construction and other activities must be communicated and co-ordinated with the land owner in order for him to properly plan his management activities.*		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

8.4.3 Construction and positioning of the overhead power lines

Impact 1 Soil and Watercourses

The position of three alternative routes for power lines is displayed in Appendix 19. From a soil perspective and the distances the power lines must cross over the site, Power line Option 1 as well as alternatives 1(a) and 1(b) of Option 2 are the better options. Option 1 joins into the existing power lines crossing over the site. This option will therefore have the least impact.

a) Nature: Soil erosion on construction sites during and after the construction phase due to decreased vegetation cover and increased water run-off		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Probable (3)
Significance	**35 (Medium)**	**15 (Low)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: » *Care must be taken with the ground cover during and after construction on the site. If it is not possible to retain a good plant cover during construction, technologies should be employed to keep the soil covered by other means, i.e. straw, mulch, erosion control mats, etc., until a healthy plant cover is again established* » *Care should also be taken to control and contain storm water run-off* » *Rehabilitate construction sites by establishing it with indigenous grasses like Anthephora pubescens, Cenchrus ciliaris, Eragrostis curvula, etc.* »		

Cumulative Impacts: Little with the necessary mitigation in place
Residual Impacts: Little with the necessary mitigation in place

Impact 2 Vegetation and grazing capacity

No impact expected.

Impact 3 Underground water

No impact expected.

Impact 4: **Livestock production systems**

During the construction phase there will be an impact on the normal day-to-day management of the livestock and the veld management system.

a) Nature: Interference with the day-to-day management of the livestock and veld due to construction and other activities on the site		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Short-term (2)	Short-term (2)
Magnitude	Low (4)	Minor (2)
Probability	Definite (5)	Probable (3)
Significance	**35 (Medium)**	**15 (Low)**
Status	Negative	Negative
Reversibility	High	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: *Construction and other activities must be communicated and co-ordinated with the land owner in order for him to properly plan his management activities.*		
Cumulative Impacts: Little with the necessary mitigation in place		
Residual Impacts: Little with the necessary mitigation in place		

8.4.4 Presence of contaminants on the site (i.e. oil, petrol, diesel and other contaminants used by the vehicles and equipment)

Impact 1 Soil and Watercourses

Nature: Contamination and degradation of the soil due to spillages of oil, petrol, diesel and other contaminants used by vehicles and equipment on the site or stored on the site		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**30 (Low)**	**20 (Low)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: *Vehicles and equipment must be serviced regularly and maintained in a good running condition. Storage of contaminants must be limited to low quantities and done under strict industry standards. There must be strict control over the safe usage of vehicles and equipment to minimise vehicle accidents and damage to vehicles by rocks and boulders which may cause spillages.*		
Cumulative Impacts: None		
Residual Impacts: Spillages of contaminants will have a long residual effect on the natural resources, specifically to the soil and vegetation, and possibly the underground water depending on the quantum of the spillage.		

Impact 2 Vegetation and grazing capacity

Nature: Contamination and degradation of the soil & vegetation due to spillages of oil, petrol, diesel and other contaminants used by vehicles and equipment on the site or stored on the site		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Probable (3)	Improbable (2)
Significance	**30 (Medium)**	**20 (Medium)**
Status	Negative	Negative
Reversibility	Low	Low
Irreplaceable loss of resources?	Yes	Yes

Can impacts be mitigated?	Yes
Mitigation: *Vehicles and equipment must be serviced regularly and maintained in a good running condition. Storage of contaminants must be limited to low quantities and done under strict industry standards. There must be strict control over the safe usage of vehicles and equipment to minimise vehicle accidents and damage to vehicles by rocks and boulders which may cause spillages.*	
Cumulative Impacts: None	
Residual Impacts: Spillages of contaminants will have a long residual effect on the natural resources, specifically to the soil and vegetation, and possibly the underground water depending on the quantum of the spillage.	

Impact 3 Underground water

Nature: Contamination and degradation of the soil due to spillages of oil, petrol, diesel and other contaminants used by vehicles and equipment on the site or stored on the site		
	Without mitigation	**With mitigation**
Extent	Local (1)	Local (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (4)	Low (4)
Probability	Improbable (2)	Very improbable (1)
Significance	**30 (Medium)**	**10 (Low)**
Status	Negative	Negative
Reversibility	Unlikely	Unlikely
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	
Mitigation: *Vehicles and equipment must be serviced regularly and maintained in a good running condition. Storage of contaminants must be limited to low quantities and done under strict industry standards. There must be strict control over the safe usage of vehicles and equipment to minimise vehicle accidents and damage to vehicles by rocks and boulders which may cause spillages.*		
Cumulative Impacts: None		
Residual Impacts: Spillages of contaminants will have a long residual effect on the natural resources, specifically to the soil and vegetation, and possibly the underground water depending on the quantum of the spillage.		

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Impact 4: **Livestock production systems**

No impact expected.

8.5 Measures for inclusion in the draft environmental management Plan

a)

OBJECTIVE: Limit water erosion of soil and siltation of watercourses	
Project component/s	Maintenance of soil cover and the correct placement of footprint infrastructure
Potential Impact	Increased water run-off, soil degradation due to water erosion and sediment generation
Activity/risk source	Complete denudation of the soil, poor placement of the site and poor planning of storm water run-off control
Mitigation: Target/Objective	Prevention and control of water erosion on the site

Mitigation: Action/control	**Responsibility**	**Timeframe**
Plan and implement proper soil cover measures and storm water drainage mechanisms	Engineer and construction personnel	Duration of the construction phase

Performance Indicator	Minimum soil surface erosion Immediate action should be taken when negative impacts are experienced
Monitoring	Monitor erosion rates and erosion sites on a weekly basis and after each storm water event.

b)

OBJECTIVE: Limit construction and vehicle impact on dust production and wind erosion	
Project component/s	Covering all access and construction routes with gravel Control of water run-off from road surfaces Proper placement of new roads
Potential Impact	Soil degradation due to increased wind erosion and dust production Soil degradation due to water erosion caused by poor water run-off control from roads
Activity/risk source	Poor road construction and maintenance
Mitigation: Target/Objective	Proper road construction and maintenance

Mitigation: Action/control	**Responsibility**	**Timeframe**
Plan and implement proper soil cover measures and storm water drainage mechanisms	Engineer and construction personnel	Duration of the project

Performance Indicator	Minimum dust formation and water erosion along roadsides and construction sites Immediate action should be taken when negative impacts are experienced
Monitoring	Monitor roads and construction sites on a regular basis

c)

OBJECTIVE: Prevent contamination of the soil, vegetation and underground water by oil, diesel, petrol and other contaminants use by vehicles and construction equipment

Project component/s	Preventing spills of contaminants on any part of the site
Potential Impact	Contamination of soil, vegetation and underground water
Activity/risk source	Vehicles and construction equipment on the site
Mitigation: Target/Objective	Vehicles and equipment must be serviced regularly and maintained in a good running condition. Storage of contaminants must be limited to low quantities and done under strict industry standards. There must be strict control over the safe usage of vehicles and equipment to minimise vehicle accidents and damage to vehicles by rocks and boulders which may cause spillages. Contingency plans must be in place to deal with spillages.

Mitigation: Action/control	Responsibility	Timeframe
Plan and implement proper usage and maintenance of vehicle and construction equipment. Plan and document contingency plans and train personal to contain spillages when and where they take place. Keep quantity of contaminants stored on the site to a minimum.	Engineer and construction personnel	Duration of the construction phase

Performance Indicator	Zero spillages of contaminants Immediate action should be taken when spillages take place to contain damage to agricultural resources
Monitoring	Monitor contaminants storage facilities and the condition and maintenance of vehicles/equipment on a regular basis

d)

OBJECTIVE: Prevent invader plants from recruiting on construction sites and areas with soil disturbance

Project component/s	Controlling invaders plant when and where they recruit on areas with soil disturbance
Potential Impact	Loss of grazing capacity
Activity/risk	Areas with soil disturbance

source	
Mitigation: Target/Objective	Mechanical and/or chemical control of invader plants when and where they recruit on areas with soil disturbance

Mitigation: Action/control	**Responsibility**	**Timeframe**
Monitor areas with soil disturbance regularly (at least once a year) for the recruitment of invader plants	Engineer, as well as the construction and maintenance personnel	Duration of the project (construction and production phases)

Performance Indicator	Zero invader plants on any of the areas where soil disturbance has taken place
Monitoring	Monitor the prevalence of invader plants on disturbed soil surfaces once a year

9 DISCUSSION AND CONCLUSIONS

9.1 The site is relatively poorly endowed with agricultural resources. The rainfall is low and erratic, the soils are generally shallow, rocky and non-arable, there are not sufficient water quantities available for irrigation and the grazing capacity is low and erratic. The best land-use for the site is for grazing with sheep and goats.

9.2 The contribution of the site to food security as a whole is negligible. The development of the site as a wind power facility will only have a short term negative impact on the production of agricultural products from the property. That is during the construction phase of the project when the construction activities may interfere with the normal management practices on the property. Thereafter, the livestock farming activities will return to normal and the presence of the wind turbines is not expected to have any negative effect on normal farming and management practices.

9.3 The soils on the site are susceptible to both water and wind erosion, although the susceptibility is categorized as low to medium.

9.4 The site is slightly undulating with the slopes less than 6% and no slopes exceeding 20%.

9.5 The site does not consist of unique agricultural land.

9.6 There is no evidence that any part of the site is currently under cultivation or has been cultivated the last ten years, apart from a small olive orchard

of approximately 1 ha close to the homestead that falls outside of the development footprint.

9.7 There is no evidence that the site has agricultural infrastructure (i.e. silos, irrigation lines, pivot points, channels, feeding structures, grazing camps, animal housing, farm roads, etc.) or any conservation works (i.e. contour banks, waterways, etc.) that will be interfered with.

There is a watercourse present on the site that is identified as a NO GO area.

9.8 Due diligence should be observed with the placement of the development footprint.

9.9 The identified impacts must be properly managed.

In summary, the agricultural potential of the site is relatively low, it is too small to contribute significantly to the economy or food security of the area, there are no slopes exceeding 20%, the soils are slightly susceptible to both water and wind erosion, it does not consist of unique agricultural land, there are no cultivated lands present, there are no agricultural infrastructure or conservation works that will be interfered with, there is a watercourse that is regarded as a NO GO area, due diligence should be observed with the correct placement of the developmental footprint and the identified impacts must be properly managed.

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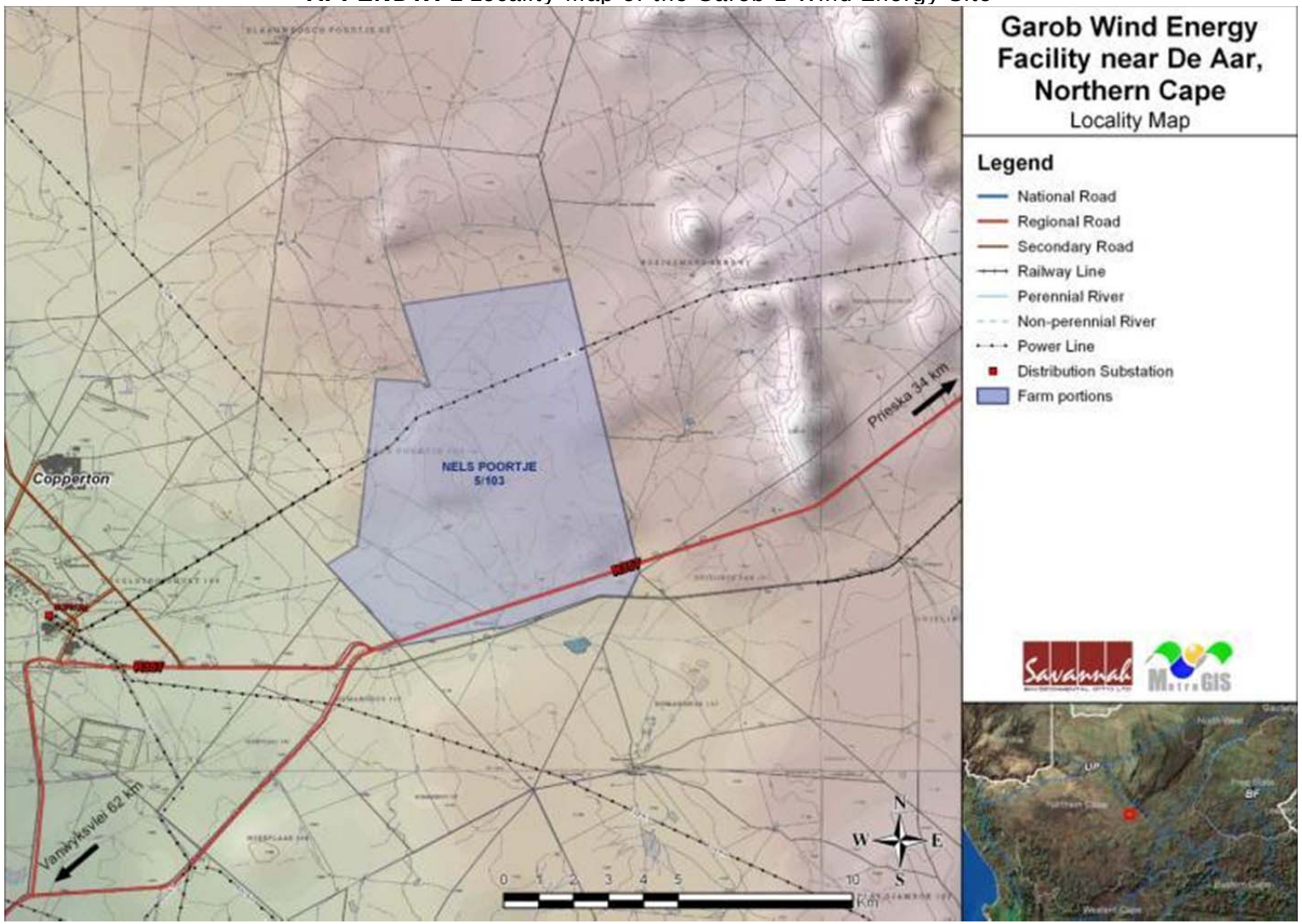
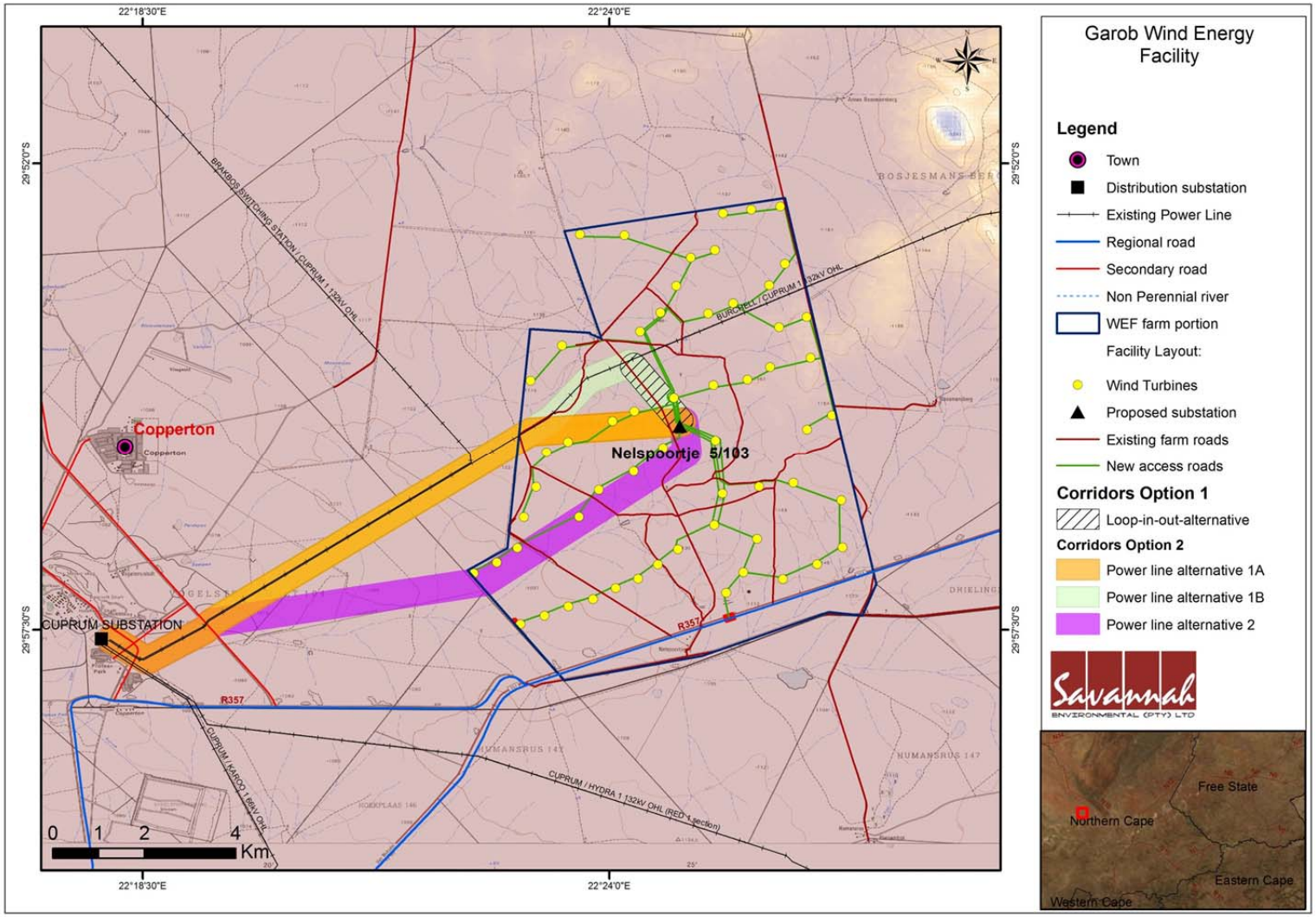
APPENDIX 1 Locality map of the Garob 1 Wind Energy Site



APPENDIX 2 Garob 1 Wind Energy Site

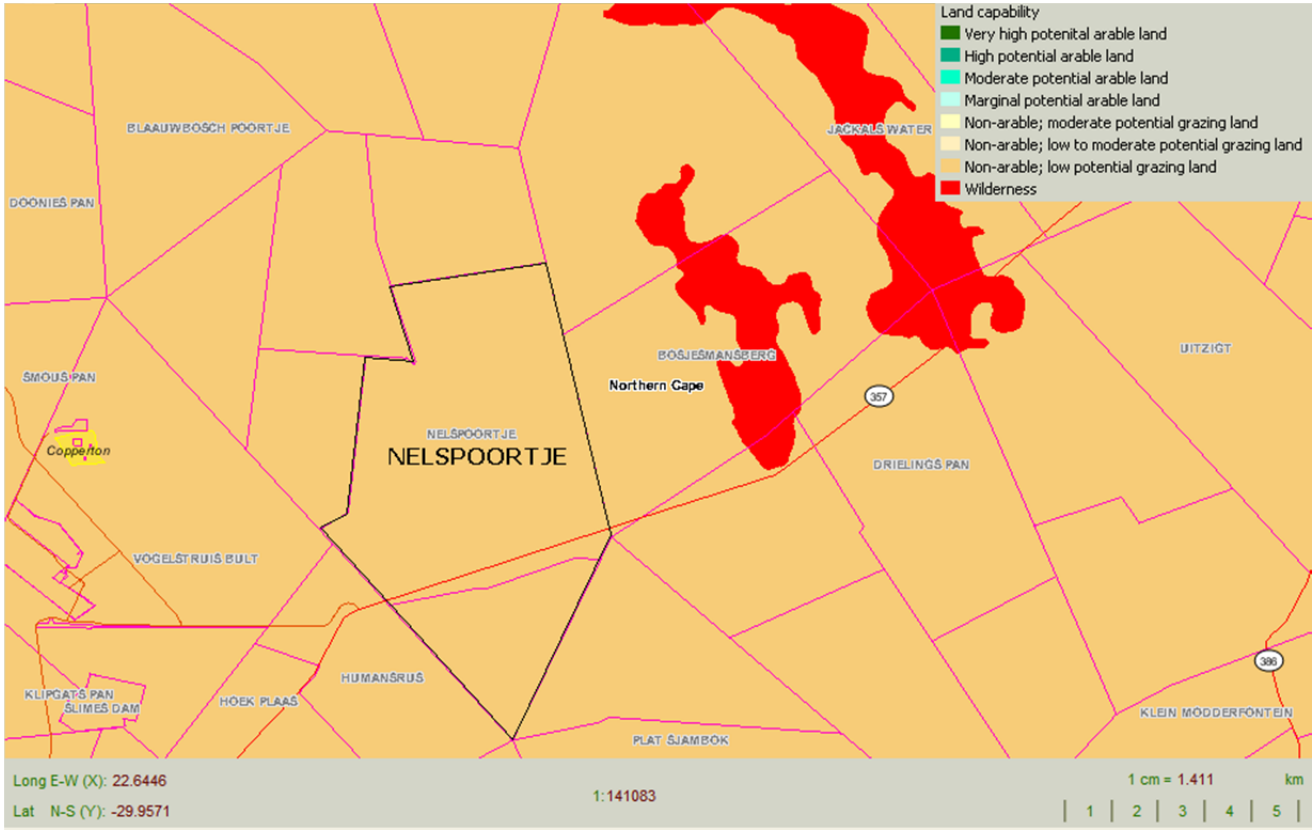


APPENDIX 3 Compendium of the agricultural characteristics of the Garob 1 Wind Energy Site

Relative Homogeneous Farming Area Number (Vorster, 1985)	22.3
Magisterial Districts	Kenhardt & Prieska
Area (ha)	700 650ha
Land Types Prevalent (Land Type Staff, 1987)	Ag154 (85% of the site area) Ag137 (10% of the site area) Ag138 (4% of the site area) Ag6 (1% of the site area)
Floristic Climatic Region Most prominent plant species prevalent (Dept. Agric., 1991; Vorster, 1985)	FCR 24 *Rhigozum trichotomum, Pentzia spinescens, Stipagrostis obtusa* and *Stipagrostis ciliata*
Climatic Region (Schulze, 1980)	W (Desert)
Average Rainfall (mm per annum) (Schulze, 1980)	200mm
Main Rainfall Season (Schulze, 1980)	February to April
Average Annual Temperature (°C) (Schulze, 1980)	20 – 22,5
Prevalence of Snowfalls (Schulze, 1980)	Very rare
Geology	Granite & Meta Sediments of the Namaqualand Metamorfic Complex
General Soil Patterns (Dept. Agric., 1991)	Soils with minimum development, usually shallow, on hard or weathering rock, with or without intermittent diverse soils, and where lime is rare or absent in the landscape Yellow and red apedal soils, without water tables, freely drained, a high base status and with an effective depth of less than 300mm deep on average
Soil Forms (Vorster, 1985; Land Type Staff, 1987) to be expected (as per the MacVicar *et al*, 1977 classification)	Hutton, Mispah, Glenrosa, Oakleaf, Clovelly Valsrivier & Swartland (in pans) Dundee (in river beds)
Soil Series (Land Type Staff, 1987) to be expected (as per the MacVicar *et al*, 1977 classification)	Mangano, Maitengwe, Klipplaat, Zwartfontein, Kalkbank, Southfield, Vaalbank, Mispah, Muden, Lalakata, Shorrocks, Shigalo, Malonga, Letaba, Leeufontein, Torquay, Dudfield, Dunvegan, Lomondo, Killarney, Lindley, Nyoka, Vergenoeg, Portsmouth, Loskop, Dundee
Erodibility of Soils Vorster, 1985 Agis Website, Dept. Agric., Forestry & Fisheries (www.agis.agric.za)	Low to Medium Water Erosion Hazard Low to Medium Wind Erosion Hazard
Land Types (Vorster, 1985)	% of Area (Vorster, 1985)
* Ridge (Bult) * Rante * Plain * Watercourse	77 2 15 6
Veld Type (Acocks, 1988) Biome (Mucina & Rutherford, 2006)	Veld Type 29 (Arid Karoo) Biome NKb3 (Bushmanland Arid Grassland)
Grazing Capacity (ha/LSU) (Botha, 1998, Vorster 1985, Dept. Agric. Dev., 1991, Agis Website, Dept. Agric., Forestry & Fisheries - www.agis.agric.za)	26 – 40
Best Agricultural Use (Vorster, 1985)	Grazing for sheep, goats & beef cattle

Appendix 4 Land capability

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



Proposed Garob 1 Wind Energy Site

Farm Portion

EDUPLAN
MULTIDISSIPLINÊRE PRAKTYK / MULTI DISCIPLINARY PRACTICE
"Ons kliente is ons advertensie" • "We sell by word of mouth"

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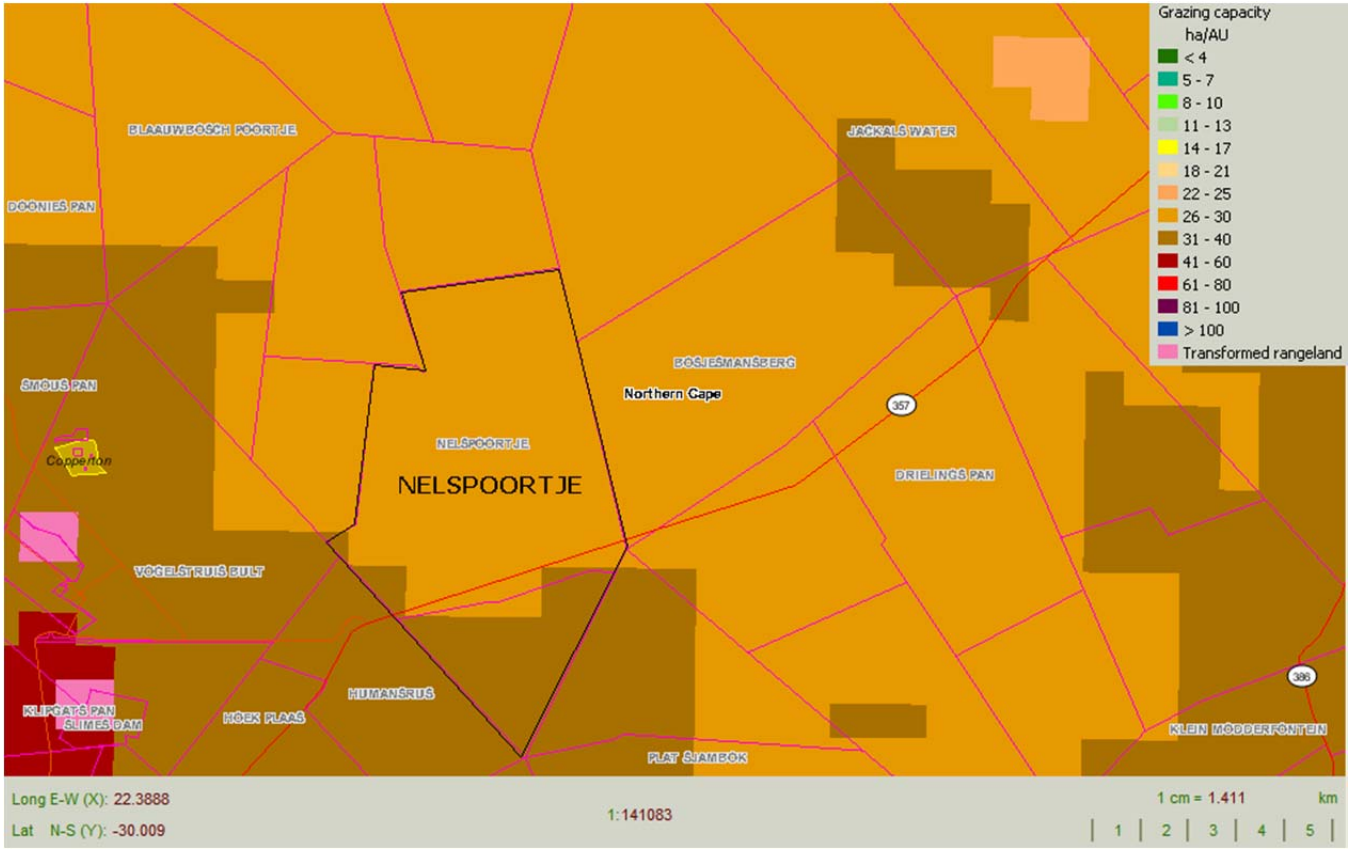
Appendix 5 Grazing capacity

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



Proposed Garob 1 Wind Energy Site

Farm Portion

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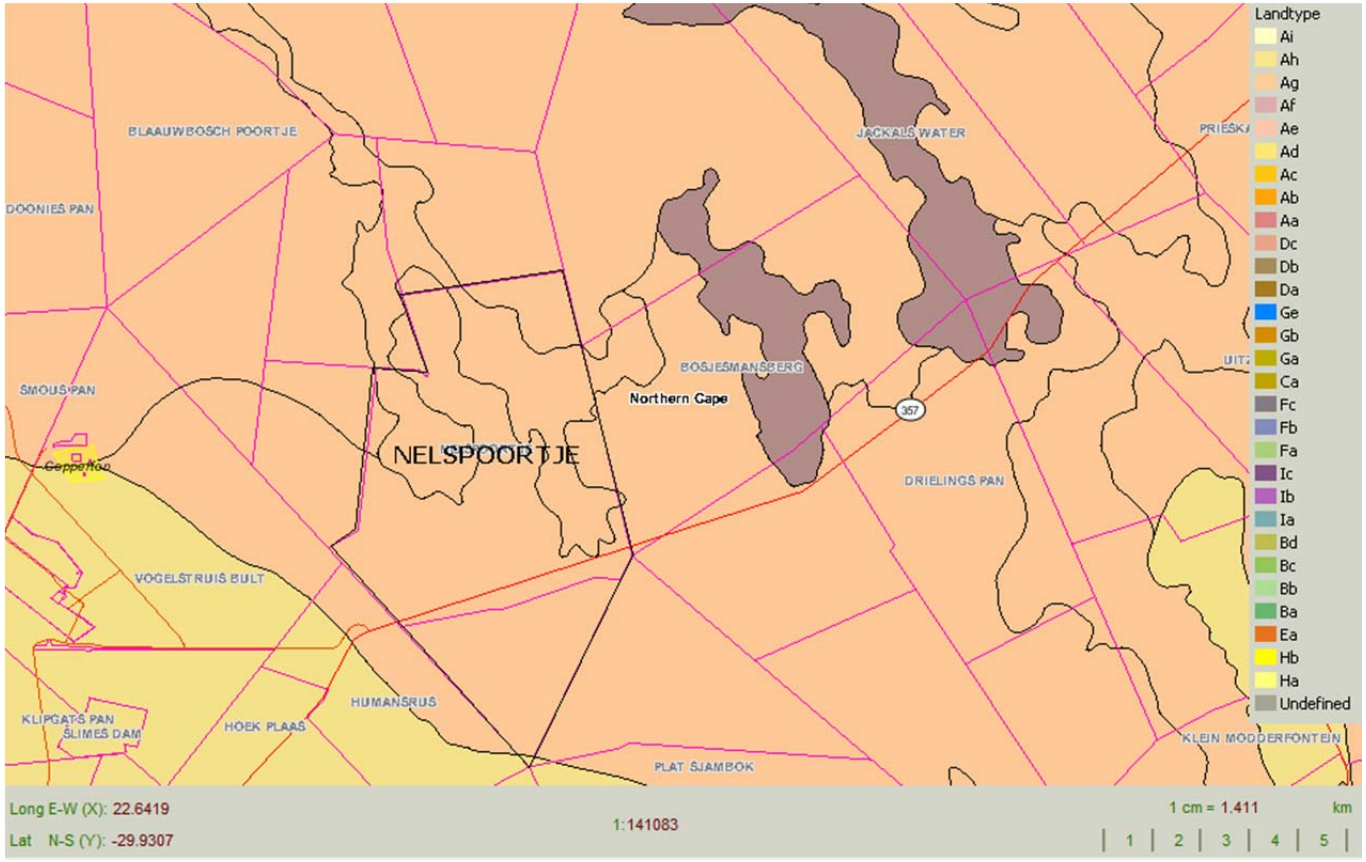
Appendix 6 Land types

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



Proposed Garob 1 Wind Energy Site

Farm Portion

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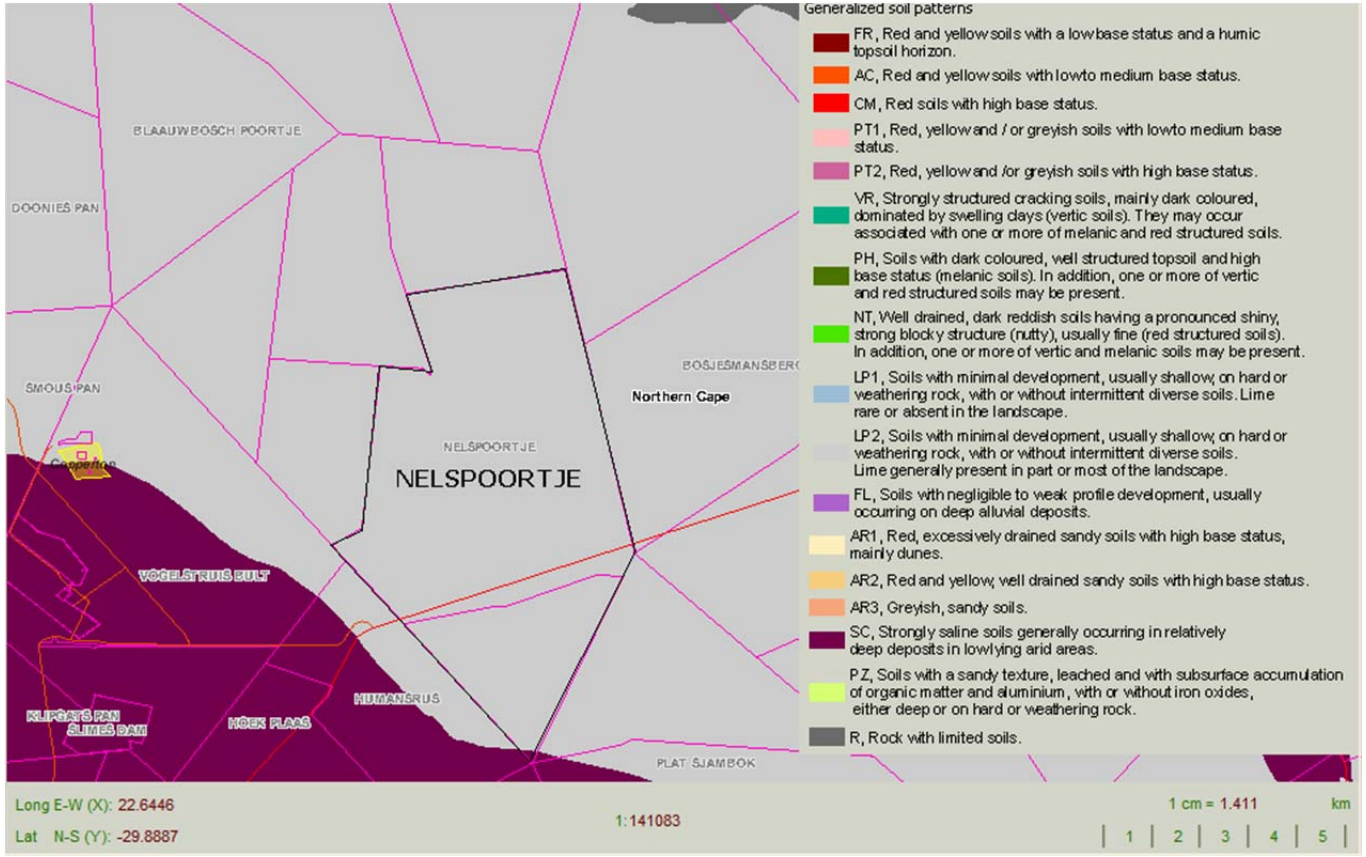
Appendix 7 Generalised soil patterns

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



Proposed Garob 1 Wind Energy Site

Farm Portion

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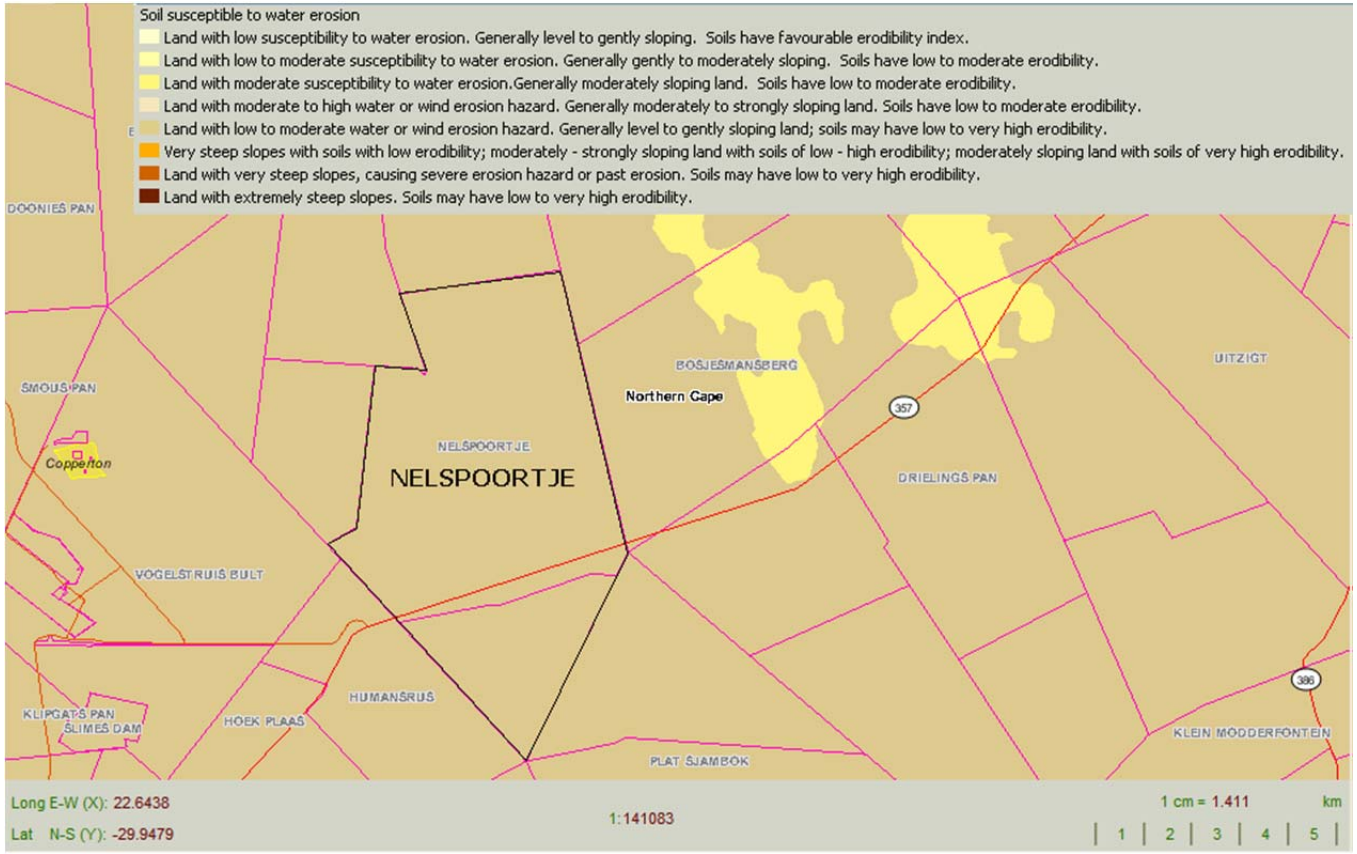
Appendix 8 Soil susceptibility to water erosion

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



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Farm Portion

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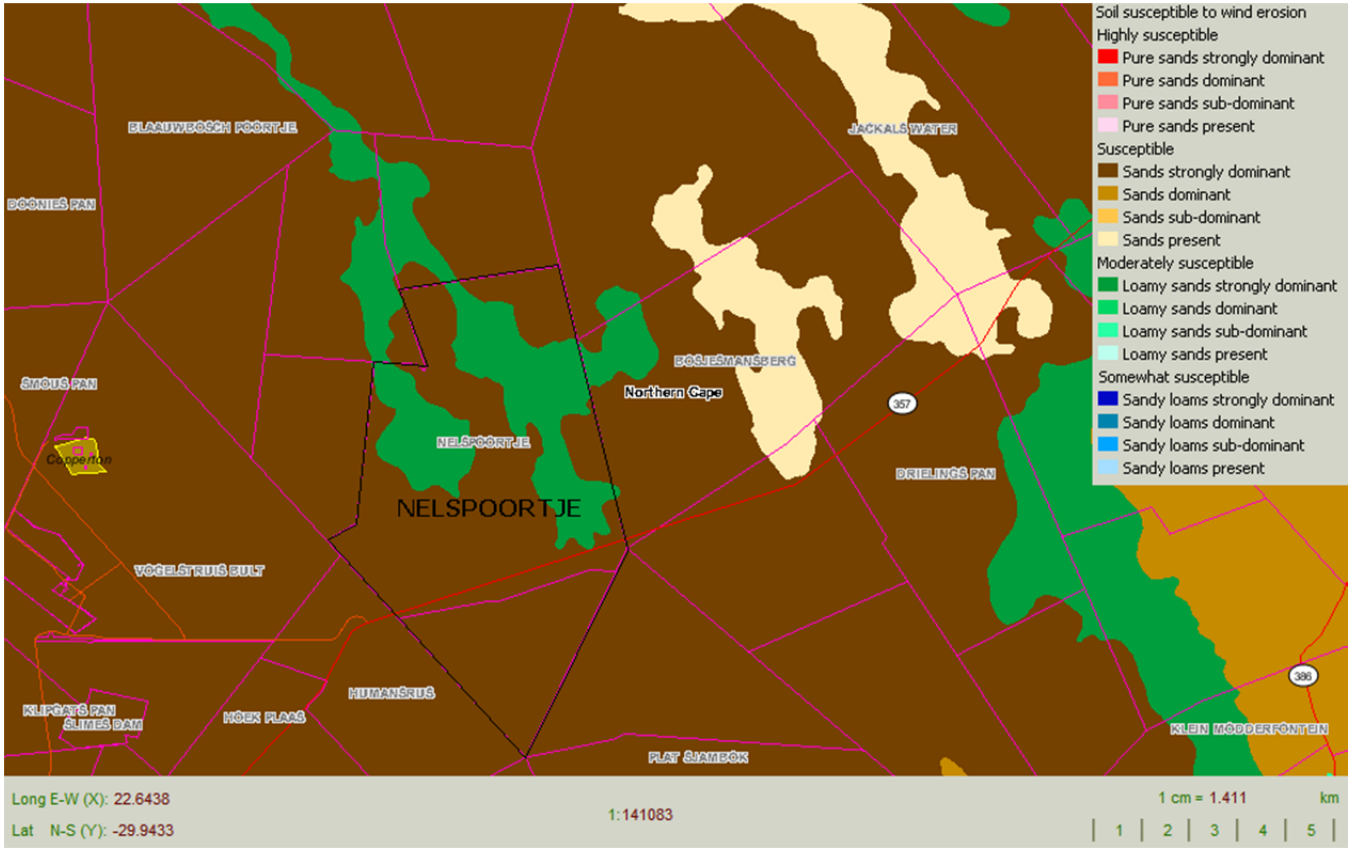
Appendix 9 Soil susceptibility to wind erosion

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



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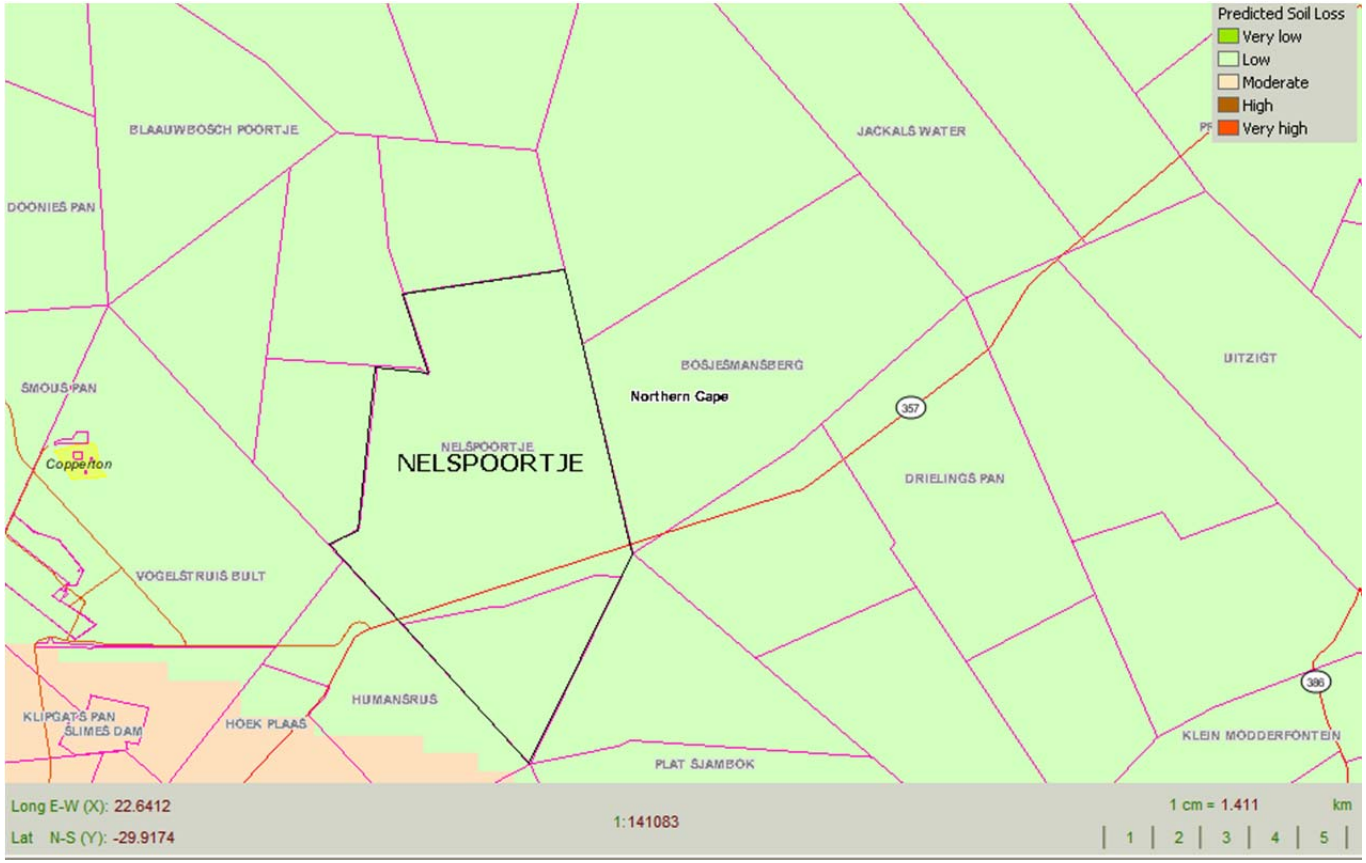
Appendix 10 Predicted soil loss

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



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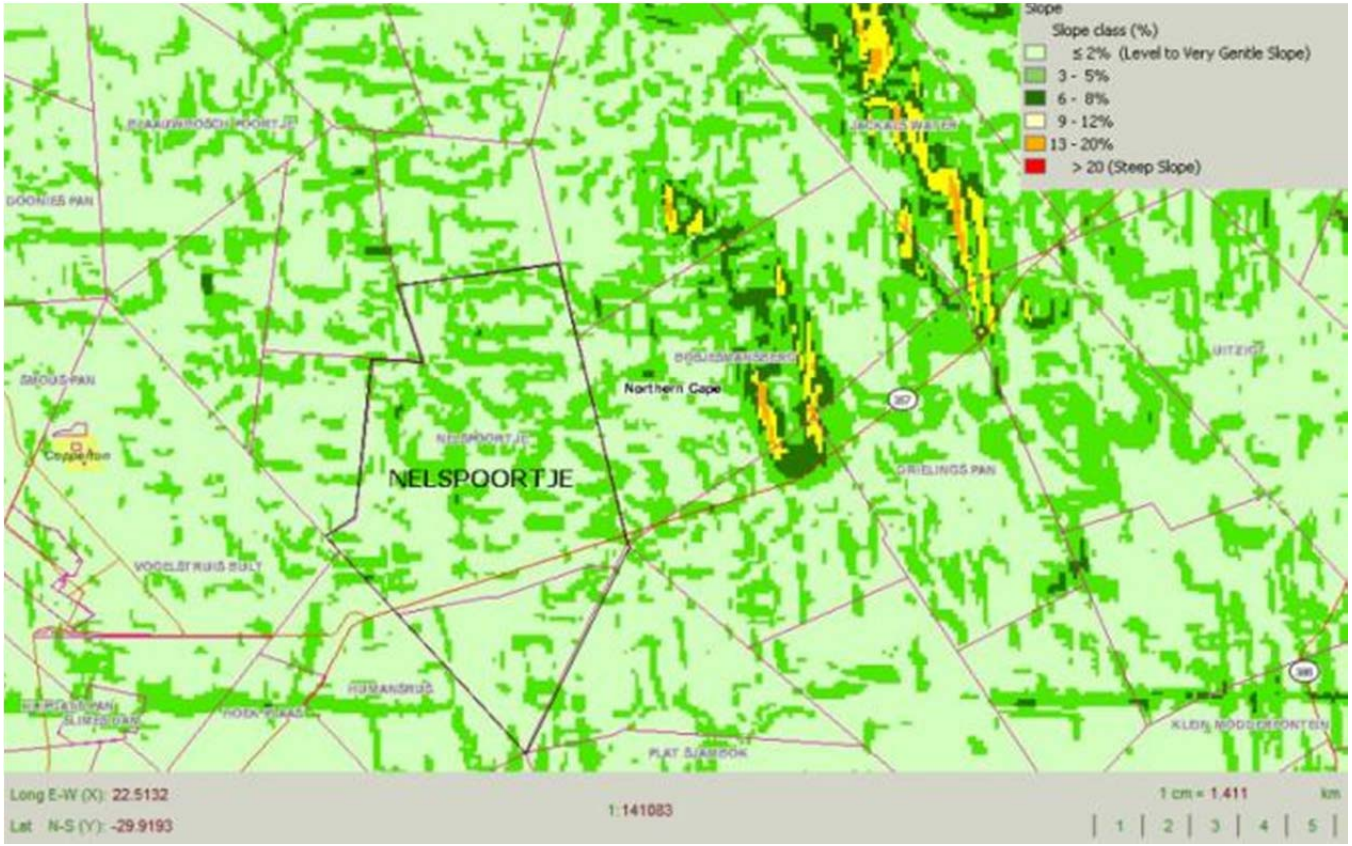
Appendix 11 Slope

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



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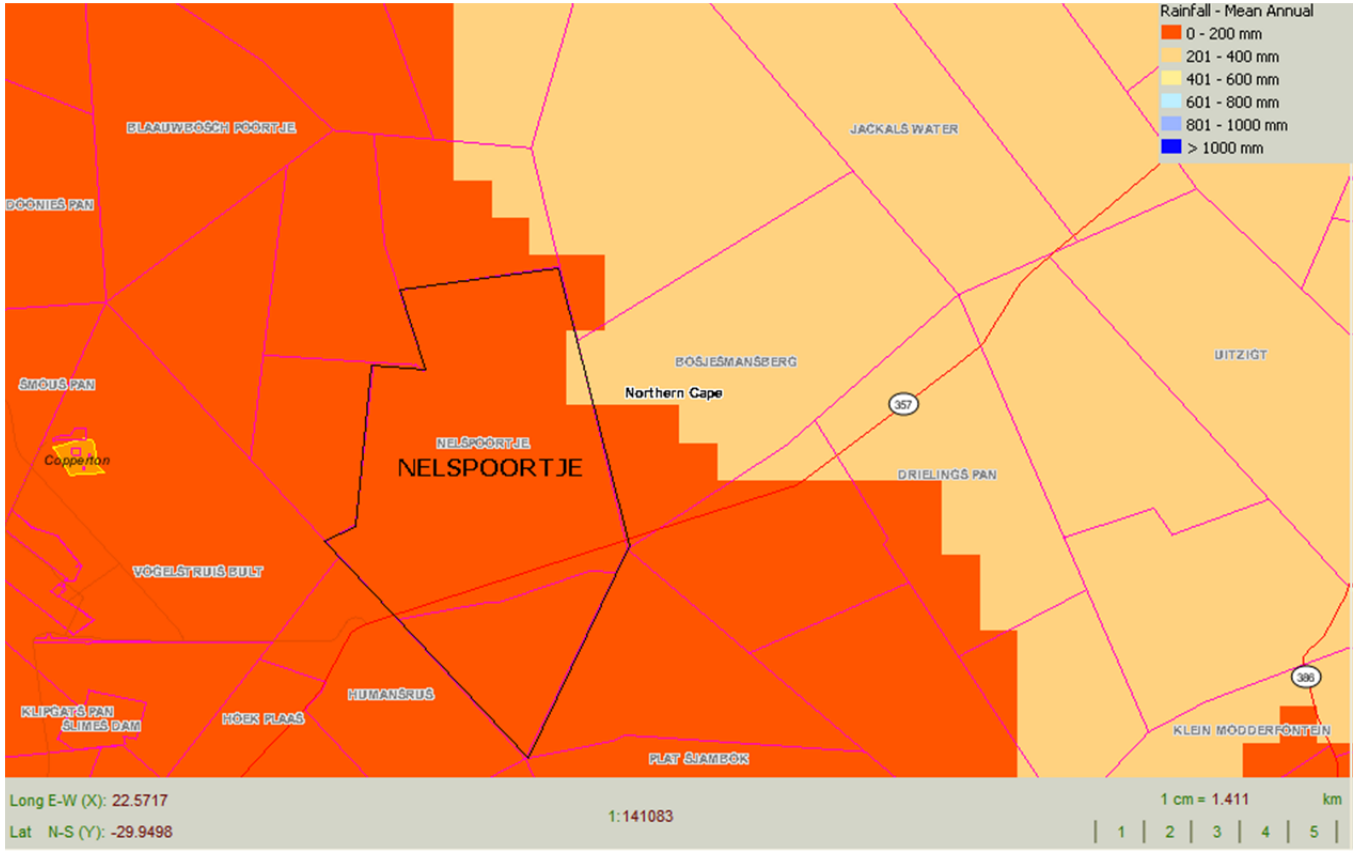
Appendix 12 Mean annual rainfall

Source: Department of Agriculture, Fisheries & Forestry – www.agis.agric.za



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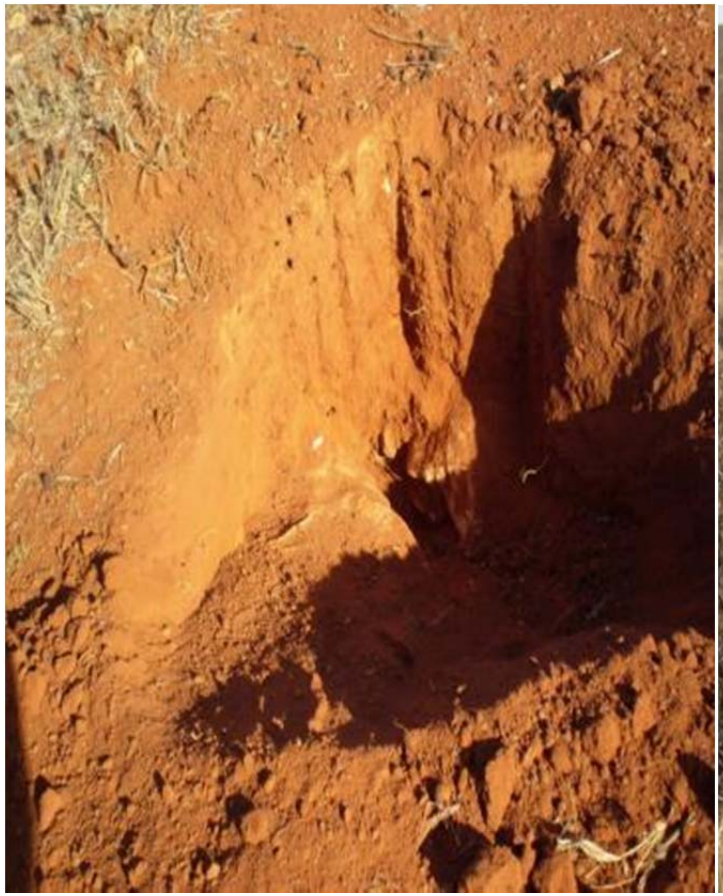
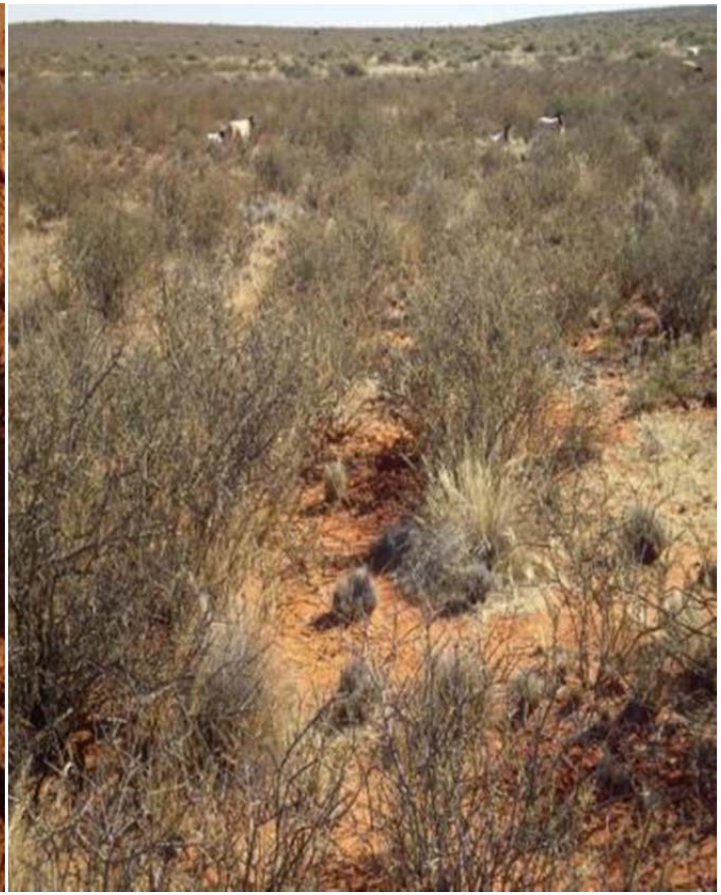
Appendix 13 Photographs of the Plooysburg soil-form and associated vegetation





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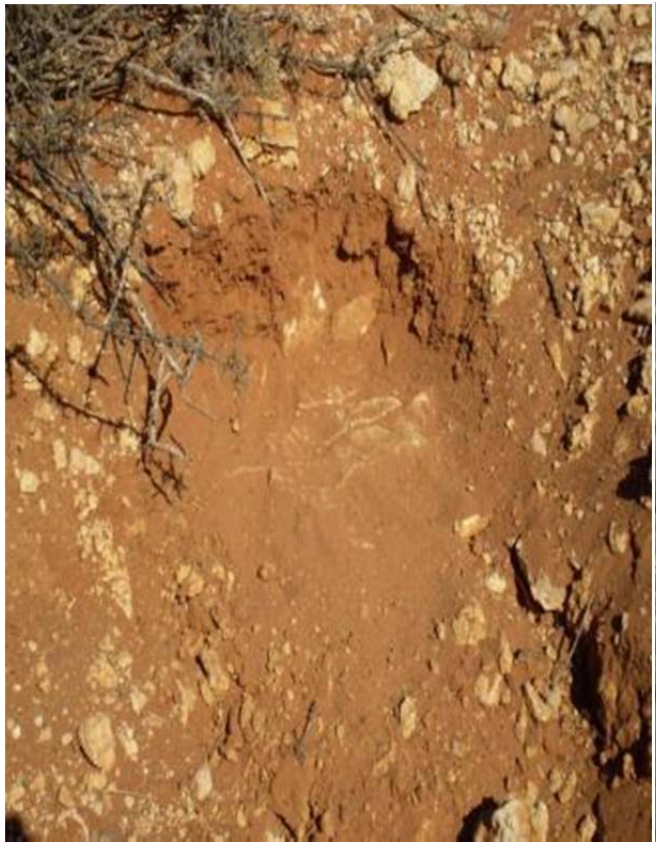
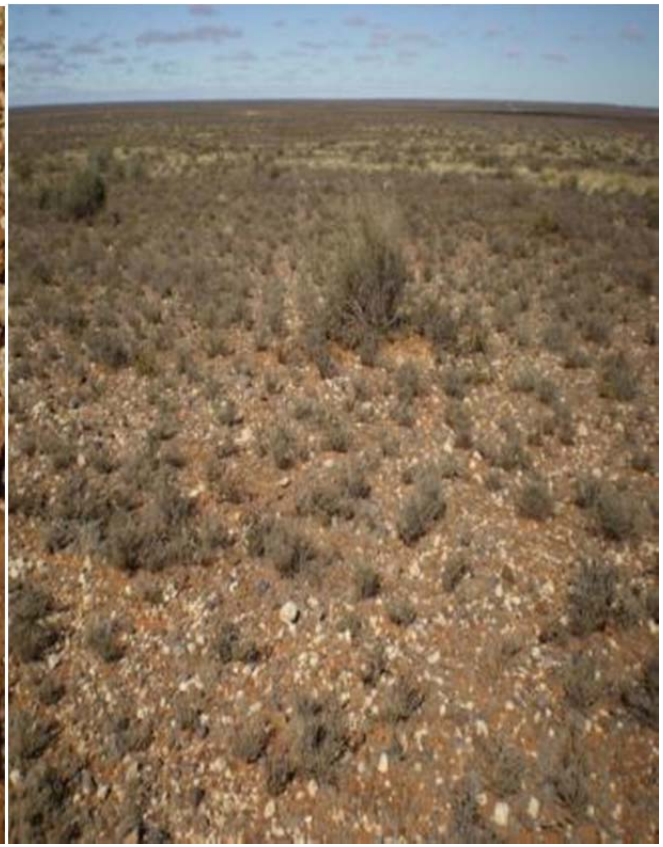
Appendix 14 Photographs of the Coega soil form and associated vegetation





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Appendix 15 Photographs of the Mispah soil form and associated vegetation

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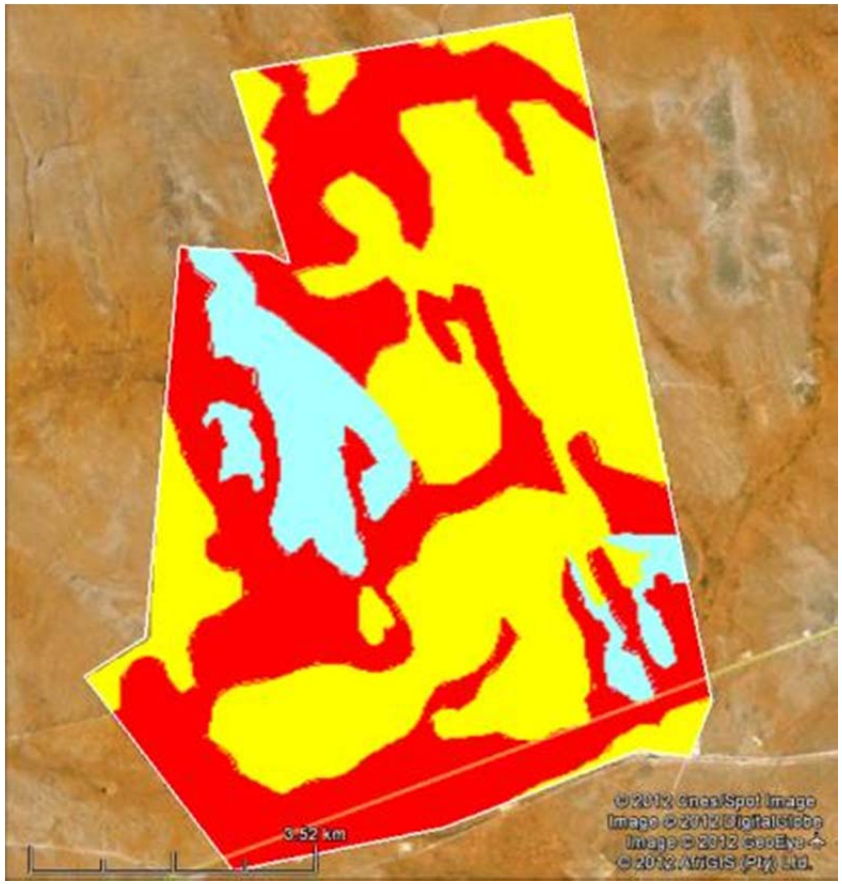
Appendix 16 Soil map of the site



Garob Wind Energy Site - Prieska

Coega Soil Form

Plooysburg Soil Form

Mispha Soil Form

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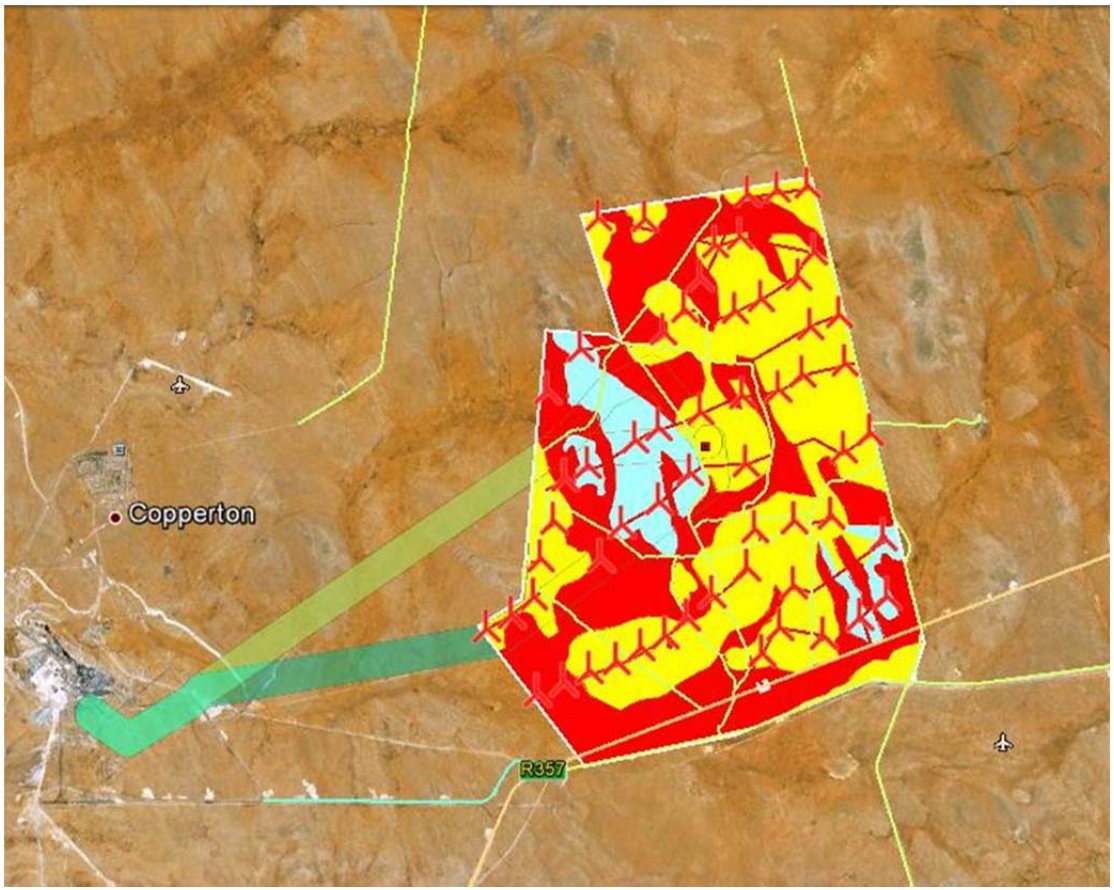
Appendix 17 Soil sample information of the Garob 1 site

Soil Sample	Soil Form (MacVicar *et al*, 1991)	Soil Form (MacVicar *et al*, 1977)	Effective Depth (mm)	Limiting Layer*	Latitude	Longitude
1	Plooysburg	Hutton	200	HPC	-29.95778	22.40939
2	Coega	Mispah	30	HPC	-29.95544	22.40541
3	Coega	Mispah	30	HPC	-29.94854	22.39410
4	Plooysburg	Hutton	450	HPC	-29.94564	22.38978
5	Coega	Mispah	30	HPC	-29.94094	22.38311
6	Coega	Mispah	30	HPC	-29.92672	22.38459
7	Plooysburg	Hutton	600	HPC	-29.91831	22.38714
8	Mispah	Mispah	30	R	-29.90922	22.39464
9	Plooysburg	Hutton	400	HPC	-29.90150	22.39764
10	Mispah	Mispah	30	R	-29.89408	22.40609
11	Plooysburg	Hutton	350	HPC	-29.88884	22.41053
12	Coega	Mispah	30	HPC	-29.88540	22.41466
13	Plooysburg	Hutton	350	HPC	-29.88099	22.41549
14	Plooysburg	Hutton	350	HPC	-29.89836	22.41515
15	Coega	Mispah	30	HPC	-29.90207	22.41387
16	Plooysburg	Hutton	450	HPC	-29.90881	22.40576
17	Mispah	Mispah	30	R	-29.92286	22.41117
18	Plooysburg	Hutton	400	HPC	-29.93113	22.41000
19	Mispah	Mispah	30	R	-29.93527	22.40670
20	Plooysburg	Hutton	550	HPC	-29.93555	22.40128
21	Mispah	Mispah	30	R	-29.93251	22.39844
22	Plooysburg	Hutton	450	HPC	-29.93107	22.39238
23	Mispah	Mispah	30	R	-29.94092	22.40766
24	Plooysburg	Hutton	300	HPC	-29.94395	22.40894
25	Coega	Mispah	30	HPC	-29.94809	22.41227
26	Coega	Mispah	30	HPC	-29.94561	22.41816
27	Coega	Mispah	30	HPC	-29.93774	22.41450
28	Coega	Mispah	30	HPC	-29.92066	22.42500
29	Coega	Mispah	30	HPC	-29.90635	22.42436
30	Plooysburg	Hutton	350	HPC	-29.90634	22.41737
31	Coega	Mispah	30	HPC	-29.93070	22.43199
32	Plooysburg	Hutton	400	HPC	-29.92478	22.43707
33	Coega	Mispah	30	HPC	-29.92079	22.44517

* HBC = Hardpan Carbonate, R = Rock

Appendix 18 Soil map, access roads and proposed position of wind turbines



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Coega Soil Form

Plooysburg Soil Form

Mispha Soil Form

Roads

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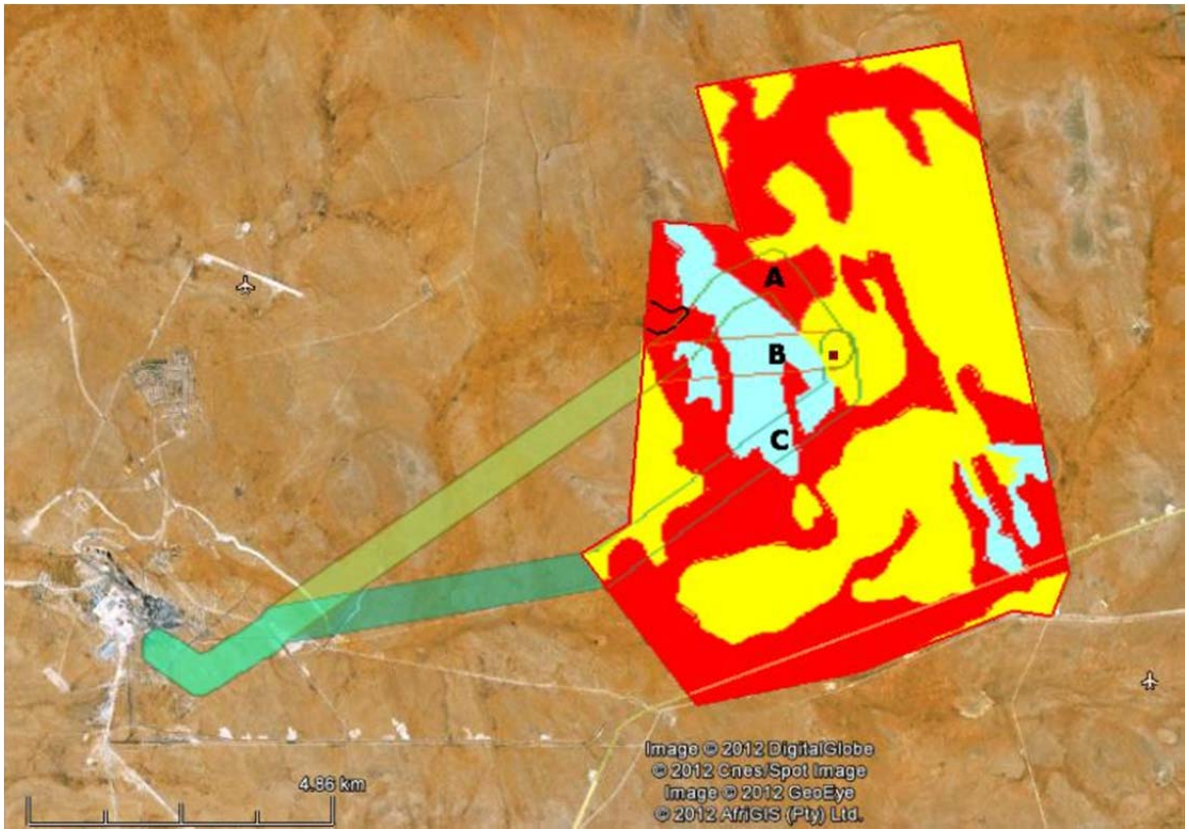
Appendix 19 Proposed power lines super-imposed over the soil map and NO GO watercourse



Garob Wind Energy Site - Prieska

Coega Soil Form

Plooysburg Soil Form

Mispha Soil Form

WATERCOURSES & LANDS

FARM PORTIONS

Proposed Power Lines

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Appendix 20 No Go watercourse

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WATERCOURSES & LANDS

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Appendix 21 Recruitment of vegetation after disturbance

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