# EIA FOR THE PROPOSED BOULDERS WIND FARM: WEST COAST SUB-REGION, WESTERN CAPE PROVINCE

## Agricultural Assessment Study: Soils and soil suitability and Agricultural economic assessment


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Prepared for:
**EOH Coastal & Environmental Services,**
**Cape Town**

On behalf of the applicants:

**Vredenburg Windfarm (Pty) Ltd**

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## EXECUTIVE SUMMARY

This report deals with the expected impact (from an agricultural perspective) of the proposed wind energy facility of Vredenburg Windfarm (Pty) Ltd. in the West Coast sub-region of the Western Cape Province. The project is known as the Boulders Wind Farm. The wind energy facility will consist of up to 45 wind turbines (with a contracted capacity of up to 140MW) which will be located on the following land portions in the Vredenburg area of the West Coast Region:

- Portion 2 of BOEBEZAKSKRAAL 40
- Portion 5 of BOEBEZAKSKRAAL 40
- Portion 3 of SCHUITJIES KLIP 22
- Portion 1 of HETSCHUITJE 21
- Portion 2 of FRANSVLEI 46

The first three land portions together are further referred to as Farm 1 (Heydenrich), while the last two land portions together form Farm 2 (Lombard).

The total area to be under consideration for the placement of the 45 turbines is approximately 2626 ha. It is important to note that during the scoping phase the following ten land parcels were identified as a project site to be investigated for the envisaged wind energy facility:
Boebezaks Kraal 2/40
Boebezaks Kraal 3/40
Boebezaks Kraal 5/40
Frans Vlei 2/46
Schuitjes Klip 3/22
Schuitjes Klip 1/22
Davids Fontyn 9/18
Davids Fontyn 7/18
Het Schuytje 1/21
Uitkomst RE/6/23

The total area covered during the scoping phase was approximately 5084 ha. Through the undertaking of the Scoping phase and a sensitivity analysis to consider all environmental and social impacts, a preferred development area was identified within the project site with an extent of 2626 ha that is analyzed in this report (referred to as the investigation area, i.e. the five Portions of land that are listed above).

The purpose of this report is to provide information with regard to the expected impact of the envisaged wind energy facility on agricultural activities on the site that is earmarked for the development. The expected impact of both the ''draft layout'' and the ''final layout'' of the turbines are evaluated from a farming perspective. The investigation therefore focused on the potential of the natural resource base as far as production possibilities are concerned, the impact that the placement of turbines and roads (and other associated infrastructure) will have on water and wind erosion, as well as the impact on the economics of current and potential

agricultural production practices. The soils and soil suitability assessment (refer to Section A) will serve as a base for the agricultural economic assessment (refer to Section B). The analyses of the impact (from an agricultural perspective) of the proposed wind energy facility is presented in Section C of this report.

The Vredenburg region is characterised by a relatively low and variable rainfall. This reality, when seen together with the relatively low capacity of the investigation area in terms of suitable soils for crop production, are the main contributing factors for the area to have a relative low suitability for the production of winter grain crops. The absence of lasting irrigation water sources totally limits the production of perennial crops. The site earmarked for the proposed wind energy facility is situated in the winter-grain production region, but the production will be risky due to:

- relatively low suitability of the soils and therefore, low output of crops
- relatively variable and lower winter-rain volumes, and
- the "price-cost-squeeze" relevant to winter-grain production in areas with relatively lower production potential.

Farming activities are practiced continuously on the two farms where the wind farm development is planned. It can therefore be deduced that the farming activities that are practiced are profitable for the farmers, probably due to good managerial skills as far as risk management is concerned. The impact of the project on the financial situation of the farms that are involved, will therefore be determined by, inter alia, the following aspects:

- Production possibilities and the profitability levels thereof.
- Loss of farming income due to the impact of the project, for example the negative effect of the loss of land on agricultural output.
- Possible gain in income for the farmers due to a profit-sharing/rent-income agreement with the wind-farm developer.

The financial calculations were done with a typical farming model as a point of departure. This is a normal procedure when agricultural potential is studied as the managerial productivity differs between farmers. The typical farming model was developed with the aid of the farmers involved and it was verified via the inputs of other industry experts.

The affected farms contained in the investigating area are currently used for agricultural purposes, including small-grain and livestock farming. A typical farm of 1200 ha is assumed for calculation purposes. The following farming strategy is assumed, given the relatively risky nature of the region for winter cropping:

- 400 ha of wheat per year
- 400 ha of oats/barley grazing per year
- 400 ha of fallow land per year
- 1200 ewes (Meat-type Merino's) on the farm of 1200ha.

This farming strategy is typical for the region. The two farms that are involved have a medium-low suitability for the production of winter grain. A scenario for the expected financial outcome of the assumed farming strategy was therefore developed.

The financial analyses showed relative low profit margins for the grain cropping production system that was assumed (refer to Tables 8.2 to 8.6). It is clear from the analyses that the assumed production situation will find it difficult to cover the expected yearly farming overhead costs (i.e. labour costs, regional taxes, depreciation of equipment and fixed improvements) in the long run.

The impact of the project is expected to be as follows:

- It can be seen as a permanent substitution of some of the agricultural land (due to the construction of the wind turbines) for the development of alternative energy.
- The magnitude of the impact of the alternative energy project at a national level is expected to be more positive than negative (i.e. the positive contribution towards electricity development is expected to be considerably more than the negative impact of the loss in agricultural output value).
- The duration of the project can be seen as long term (i.e. relative permanent)
- The loss of agricultural resources can, however, also be seen as reversible (i.e. should the project be terminated after 20 years the parcels of land directly affected will become ''free'' again for agricultural production purposes).

The **negative impacts** on farming will therefore mainly be the loss of agricultural land due to the construction of:

- The wind energy turbines
- Internal access roads
- On-site substation
- Construction laydown area
- Allowance for the loss of land due to the minor disturbance of cultivation practices around the wind turbines

The relevant areas affected by the development footprint were calculated as approximately 30 to 35 ha in extent for the two farms (i.e. approximately 1.1% of the total farm area). The footprint of the development is expected to cover the same area for both the turbine layouts that are investigated (i.e. for 45 turbines). The income in excess of the running costs to be incurred to generate that income therefore present the expected net loss of agricultural production value due to the envisaged wind energy facility. Farm overhead costs will not be influenced by the relative small loss of agricultural production practices. The financial analyses were therefore undertaken to the profit-level of **gross margin per ha** (i.e. the income in excess of the running costs to be incurred to generate that income). The yearly net loss of agricultural production value on Farms 1 and 2 will amount to approximately R5 835 (i.e. 0.9%), and R2 918 (i.e.

1.6%) respectively. According to Table 9.1, only R9 060 of the yearly gross margin (i.e. approximately 1.1%) will be lost on the two farms due to the project.

The installation of the wind turbines will therefore have ***an ignorable negative impact*** from an agricultural production point of view, irrespective of whether the ''draft layout'' or the ''final turbine layout'' are implemented. The proposed wind farm is planned near an existing (i.e. operational) wind energy facility on directly adjacent farms, known as the West Coast One Wind Energy Facility. When viewed from an agricultural production perspective, the increase in the wind energy facilities on the farms of the region should not have any additional negative impact than that stated in this report.
The soils of the planned installation area (Annexure 1, Table 4) have a medium-low to low suitability for crop production. The implication of the extremely low percentage of the farmland to be taken up by the development is that the negative impact on the total agricultural production value will be ***virtually zero.***

This yearly small loss in agricultural production value should, however, be weighed against, *inter alia*, the following:

> The yearly income that will be generated for the farmer due to the project. This capital injection should enable the farmer to continue farming under the mentioned risky production conditions and therefore keep workers employed and contribute to the national goal of food security. The expected income from the profit-sharing/rent-income agreement with the developer should serve as a stabilising factor as far as yearly income is concerned. Possible farming practices should therefore be able to continue in a more stable financial environment and the security in this regard of the farmer, his farm workers and their families should be furthered by the envisaged project. The **''no-go''** option will therefore be to the disadvantage of the farms and farm owners that are involved in the wind farm as far as the establishment of a more stabilised financial set-up is concerned.

Appropriate mitigation measures with regard to the conservation of the natural resource base should form an important part of the planning process, *inter alia* regarding the following aspects:

- Placing of turbines in areas that will have the minimum impact on agriculture (see section 10.5 and Table 10.4)

- Proper planning of service road layout so that roads follow the contours as far as possible (see Section 10.5)

- Avoiding of agriculturally sensitive areas (see Figures 3.1 and 3.2), in order to prevent the degradation thereof and to comply with mitigation measures suggested on layout areas (see Tables 7.1 and 7.2 of Section A below and Table 10.4 of Section 10.5 below).. In Annexure 1, Table 6 preventive actions to be taken to minimise degradation of lay-out sites are given. When the results of the June 2018 layout are compared with the November 2018 layout, no real difference between the two, is evident.

- Conservation of the topsoil during construction and the proper rehabilitation of the construction sites after construction.

- Protection of the vegetation and veld by means of the construction of proper service roads and the proper maintenance thereof over time.

- The construction of the project infrastructure should be synchronised, as far as possible with the seasonal pattern of farming activities in order to minimise the possible disturbance of the latter.

The proper execution of the mentioned planning principles, as far as the conservation of existing farming activities is concerned, should therefore lead to minor disturbance, if any, of agricultural production practices (including agricultural land) on the farms.

Based on the findings of this investigation, we are of the opinion that the proposed wind energy facility should have an ***ignorable, small negative impact*** on farming activities on the two farms where it is planned to be constructed, subject to the implementation of appropriate mitigation measures. The impact of the project will not result in a major loss of high potential agricultural land and will therefore not impact negatively on the strive towards food security for South Africa. The project should strengthen the continued financial viability of farming as it should reduce the risk in terms of the limitations experienced on the development site. Jobs should be maintained and thus lead to a more stable financial situation for the farmer and his farm workers.

Policy-makers have various goals for the development of South Africa. As far as this project is concerned, inter alia the following are relevant:

- The management and utilisation of natural agricultural resources (i.e. land and water) in such a way that the goal of food-security will not be jeopardised. This goal is 'looked after' by the Departments of Agriculture (National and Regional levels).

- To add new capacity to the national electricity grid, *inter alia*, via the utilisation of renewable energy sources, for example wind energy, and therefore reducing carbon emissions. This goal is the 'business' of the Department of Energy.

It seems that in this case (considering the Boulders Wind Farm) both these goals can be furthered via the utilisation of a relative ignorable portion of low potential agricultural land for the development of the proposed wind energy facility.

## DECLARATION OF INDEPENDENCE

I, Johann Laubscher, declare that I am an independent consultant, and that I am financially independent of the client and their consultants, and that all opinions expressed in this report are substantially my own.

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Johann Laubscher

**Abridged CV**

Surname: Laubscher
First names: Johann
Date of Birth: 29 July 1945
University of Stellenbosch, South Africa. Ph D (Agric) 1987

**Key Experience**

I retired in 2006 as professor in Agricultural Economics at the University of Stellenbosch with 32 years' experience. My expertise covers various fields, *inter alia*, strategic planning and -management, financial viability analyses, agricultural enterprise budgeting and advice, business plans and environmental impact analyses (Agricultural economic perspective). I was involved, since 1990, in 18 projects in water resource planning, *inter alia* the Western Cape Systems Analysis (Estimation of the irrigation water demand) and the financial viability analysis of various envisaged irrigation schemes in the Olifants-, Doring- and Breede river basins.

I was involved, since 2011, in 15 projects that focussed on the impact of the development of alternative energy installations on farms on their agricultural production potential.

I trade under the name **Johann Laubscher**.

**DECLARATION OF INDEPENDENCE**

I, Freddie Ellis, declare that I am an independent consultant, and that I am financially independent of the client and their consultants, and that all opinions expressed in this report are substantially my own.

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Freddie Ellis
Pr. Sci. Nat. (registration Number 400158/08)

**Abridged CV**

Surname: Ellis
First names: Freddie
Date of Birth: 21 April 1947
University of Stellenbosch, South Africa. PhD Agric (Soil Science) 1988

I have been working as a soils consultant for more than 30 years and consult under my own name**.**

**Some of the activities are briefly listed below:**

| | |
|---|---|
| 1990 | **South Africa:** An agricultural evaluation of the Atlantis Corridor (approx. 75 000 ha) area |
| 2001 | **Namibia** Soil survey and land interpretation for irrigation development along the Lower Orange River near Koeskop and Daberas |
| 2001-2003 | **South Africa:** Western Cape Olifants/Doring River Irrigation Study. Responsible for field soil survey and classification and mapping of the soils. Soil suitability evaluations for irrigated crop production; recommendations for physical and chemical ameliorations measure. |
| 2001-2003+ | **South Africa:** Water quality information systems for integrated water resource management: The Riviersonderend-Berg River systems (funded by WRC) involved as a *Soil Science Team Member:* |
| 2008 | **Uganda:** Potential for afforestation of an area of approximately 24 000 ha at Sango Bay, Uganda. |
| 2009 | **South Africa:** Reconnaissance soil survey and land use plan for the Heidelberg farms (approx. 5 000 ha), University of Stellenbosch |

**Sundays River Valley**: More than 10 soil surveys of farms to be able to apply for approval for citrus growing from the Department of Agriculture on new unplanted land

Since 2009 I was also involved in more than 10 projects that focussed on the impact of the development of alternative energy installations on farms on their agricultural production potential, especially the soils aspect

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Figure 1 Map showing positions of soil profile sites described during 2014 and the present (November 2018) turbine positions

# ANNEXURE 4

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# ANNEXURE 5

TERMS OF REFERENCE FOR THE VREDENBURG WIND FARM RECEIVED FROM SAVANNAH ENVIRONMENTAL

# 1 INTRODUCTION

This report deals with the agricultural impacts of the proposed Boulders wind energy facility (WEF) of up to 45 turbines by Vredenburg Windfarm (Pty) Ltd on two farms in the Vredenburg area of the Western Cape Province, covering approximately 2626 ha. During the scoping phase the following ten land parcels were identified (known as the project site and covering approximately 5084 ha) to be investigated for the envisaged wind energy facility:

Boebezaks Kraal 2/40
Boebezaks Kraal 3/40
Boebezaks Kraal 5/40
Frans Vlei 2/46
Schuitjes Klip 3/22
Schuitjes Klip 1/22
Davids Fontyn 9/18
Davids Fontyn 7/18
Het Schuytje 1/21
Uitkomst RE/6/23

The emphasis of the scoping report was the identification of the potential impacts that the proposed WEF could have on the potential agricultural activities on the abovementioned farms located within the larger project site. All affected farms are currently used for agricultural purposes, including small-grain and livestock farming. During the Scoping phase and a sensitivity analysis to consider all environmental and social impacts, a preferred development area was identified within the project site with an extent of 2626 ha which contains 5 farm portions, namely:

- Portion 2 of BOEBEZAKSKRAAL No 40
- Portion 5 of BOEBEZAKSKRAAL No 40
- Portion 3 of SCHUITJES KLIP No 22
- Portion 1 of HET SCHUITJE No 21
- Portion 2 of FRANSVLEI No 46

The first three land portions together are further referred to as Farm 1 (Heydenrich), while the last two land portions together form Farm 2 (Lombard).

The purpose of this report is to provide information with regard to the expected impacts of the envisaged wind energy facility on agricultural activities on the site that is earmarked for the development of up to 45 wind turbines and associated infrastructure. The expected impact of both the ‘’draft layout’’ and the ‘’final layout’’ of the turbines are evaluated from a farming perspective. The investigation therefore focused on the potential of the natural resource base as far as production possibilities are concerned, the influence that the placement of turbines and roads will have on water and wind erosion, as well as impacts on the economics of current and potential agricultural production practices. The soils and soil suitability assessment (refer to Section A) will serve as a base for the agricultural economic perspective (refer to Section B). The analysis of the impact (from an agricultural perspective) of the proposed wind energy facility is presented in Section C of this report.

The Terms of Reference (TOR) for this Soil and Agricultural Potential Assessment (Impact Assessment Phase) was supplied by Savannah Environmental. Full generic details are given in **Annexure 5** and a brief summary of the EIA requirements, is given below**.**

## EIA Report Requirements

The purpose of the EIA Report is to elaborate on the issues and potential impacts identified during the scoping phase of the proposed project. This is achieved by site visits and research in the site-specific study area as well as a comprehensive assessment of the impacts identified during the scoping phase. The EIA report should be in line with the EIA Regulations of 2014, as amended on 07 April. The "**Guideline for involving economists in EIA processes: Edition 1. CSIR Report No ENV-S-C 2005 053 G''** (Van Zyl, H.W., de Wit, M.P. & Leiman, A. 2005), served as a valuable aid for the Impact analyses.

For the Agricultural impact evaluation, the following has also been applied:

Firstly, a soil survey was done during 2014 (previous application for Environmental Authorisation) by investigation of 45 soil profiles. Twenty-four of these profiles that occur on the present farm areas considered as part of the EIA phase for the Boulders Wind Farm were used in the soil-related parts described below:

- Compilation of a soil legend based on soil forms/families and other important soil properties;
- Evaluation of soil map legend based on units important for agricultural purposes, relevant to the area;
- Determine the agricultural suitability of the soils covering the lease area and suggest actions to minimise the possible impact on agriculture
- To assess the extent to which the current agricultural activities on the properties would be interrupted by the construction and operation of a wind energy facility and to propose appropriate mitigation measures (i.e. impact analyses);
- Investigation of the profitability levels of current and potential farming activities;
- Estimation of the loss in farming income for the duration of the lease period for the project (at least a 20-year period);

- Estimation of the income for the landowners due to a profit-sharing/rent-income agreement with the developer (20-year period);
- Undertake a comparison of such costs and what your conclusions are; and
- Reporting of the findings of the investigation.

The **negative impacts** on farming will mainly be the loss of agricultural land due to the construction of:

- The wind energy structures (mainly turbines)
- Internal and access Roads
- On-site Substation
- Construction Laydown Area
- Allowance for the loss of land due to the minor disturbance of cultivation practices around the wind turbines

These negative impacts should, however, be weighed against the **possible gain** in income for the farmer, and therefore by implication the possibility to invest in actions to increase the agricultural productivity of the farms. These actions become a possibility due to a profit-sharing/lease-income agreement with the wind energy developer over a period of at least 20 years.

# SECTION A

## SOIL AND SOIL SUITABILITY ASSESSMENT

### 2 GENERAL DECRIPTION AND LAND USE OF THE SURVEY AREA

Vredenburg Windfarm (Pty) Ltd proposes to construct a wind energy facility which would consist of up to 45 wind turbines (with a contracted capacity of up to 140MW) that would be located on the following land portions in the Vredenburg region of the Western Cape Province (see Fig 1):

- Portion 2 of BOEBEZAKSKRAAL No 40
- Portion 5 of BOEBEZAKSKRAAL No 40
- Portion 3 of SCHUITJES KLIP No 22
- Portion 1 of SCHUITJE No 21
- Portion 2 of FRANSVLEI No 46

Based on the contour map of the area the terrain can be described as level in places (mostly the northern farms e.g. Portion 3 of SCHUITJES KLIP No 22) to undulating. The highest points in the landscape and also with the steepest slopes (slopes up to 20 % and heights about 180 m above sea level) occur on the south eastern farm Portion 1 of SCHUITJE No 21.

The whole project site is underlain by very coarse-grained Cape Granites. Due to the resistance to weathering combined with a relatively low rainfall in the area the base rock is not deeply weathered and rock outcrops are common in the more erodible landscapes. Because of the resistant coarse quartz grains in the base rock the dominant sand grain of the soils are coarse. This is very obvious in the sandy colluviated topsoil layer especially on lower slope soils.

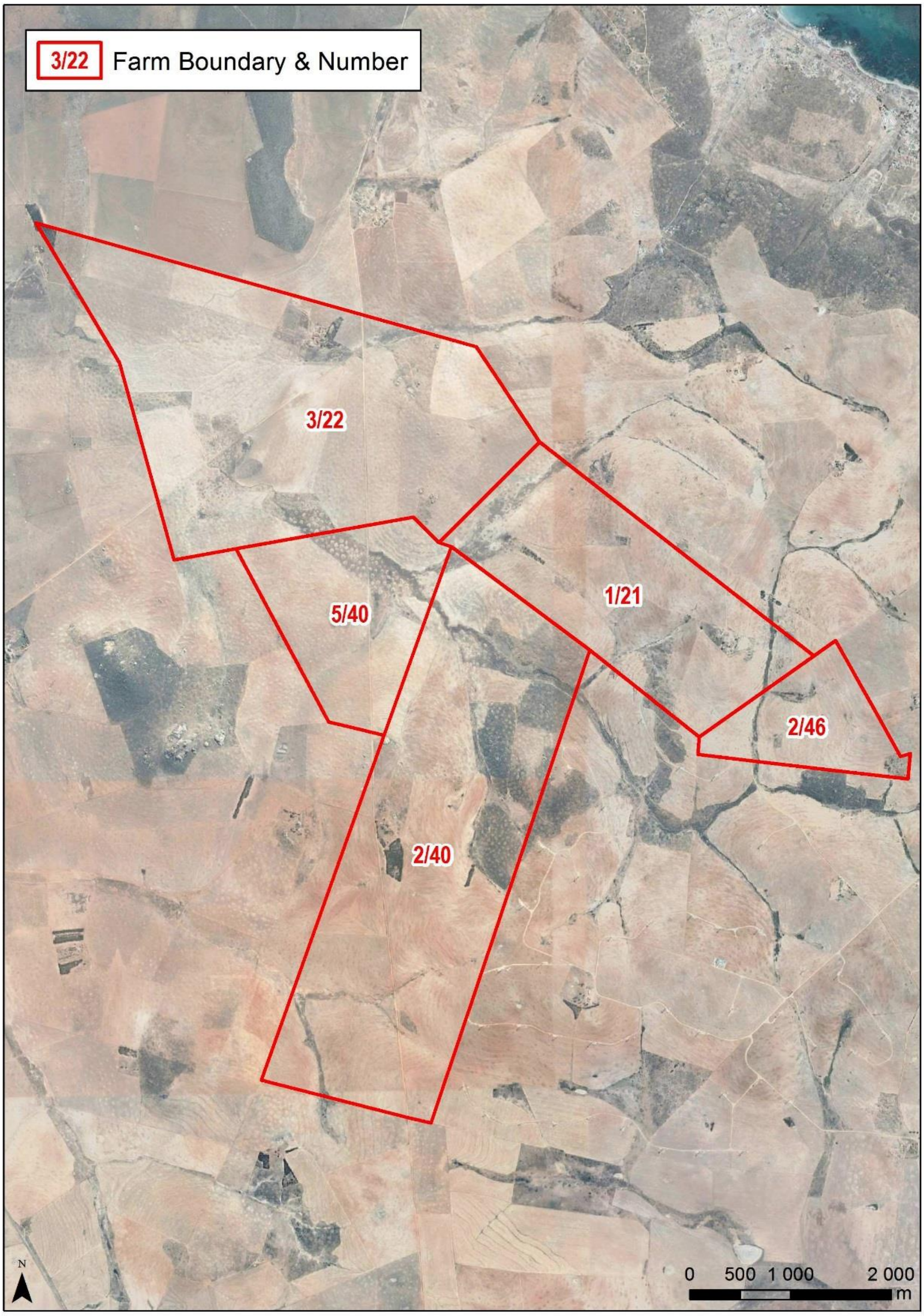


**Figure 1. Base map of farms with farm boundaries and farm numbers affected by the infrastructure layout.**

These are the farm properties considered as part of the EIA phase for the Boulders Wind Farm.

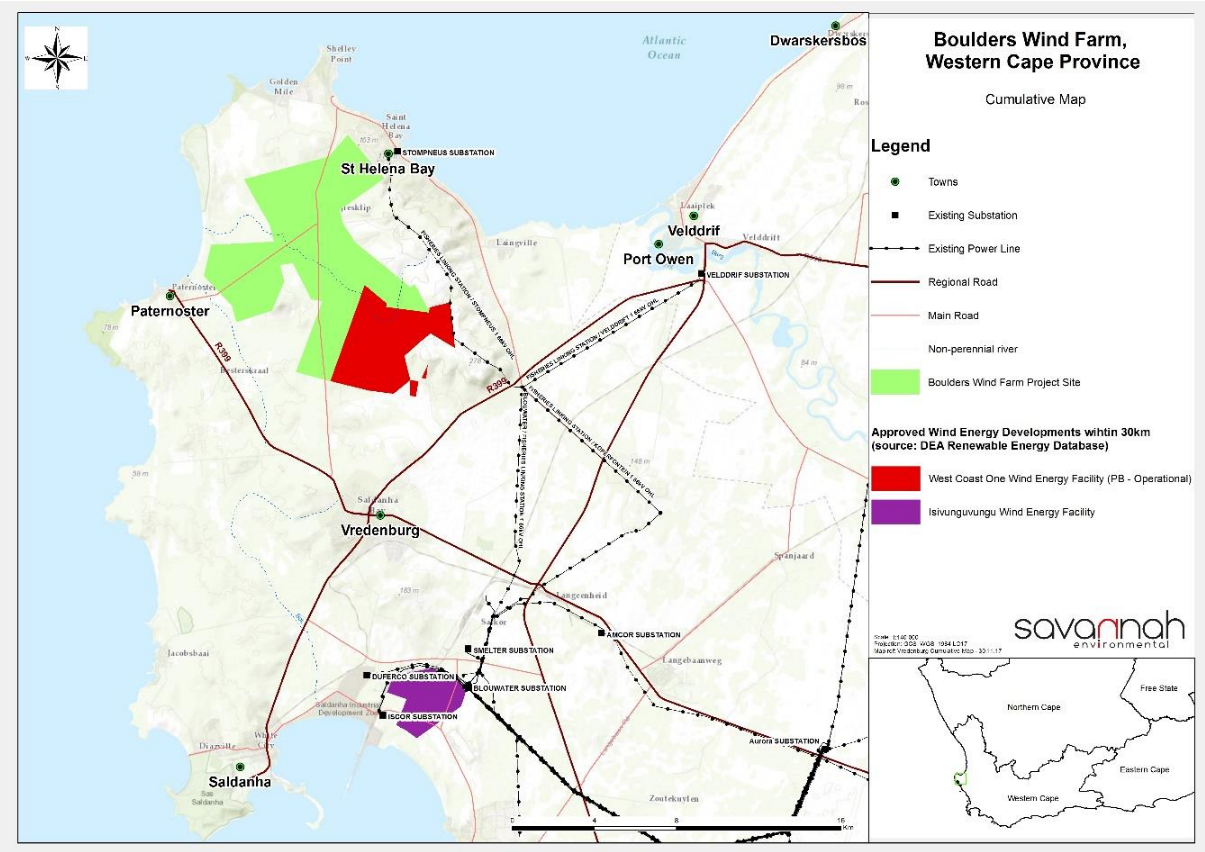


**Figure 2: Vredenburg cumulative map as supplied by Savannah**

On the highest crest and near mid-slope remnants of an older (probably Tertiary) land surface is evident in the form of the occurrence of red/yellow apedal soils with relict hard plinthite, usually on pre-weathered granite. Shallow deflation pans are also common in these landscapes. Some of the steeper mid-slopes have many exposed granite outcrops, illustrating incision since the Tertiary period, thereby creating a younger landscape with shallower soils.

Another very common micro-relief feature throughout the site is the abundant occurrence of mounds or “heuweltjies”. These are old termite mounds and cover between 20 % and 30 % of the land surface. Due to the termite activity the “heuweltjie” soils differ completely from the surrounding non-”heuweltjie” soils. They are normally calcareous and especially in the lower parts of the landscape hardpan carbonate horizon have developed. In eroded sections these hardpans are exposed at the surface.

The nearest weather stations to the site are at Langebaanweg and Vredenburg. In **Table 2.1** the climate statistics for these stations are list

**Table 2.1: Climate statistics for Langebaanweg and Vredenburg**

| Weather station | Langebaanweg | Vredenburg |
|---|---|---|
| Mean daily maximum temperature (°C) | 23.3 | 21.5 |
| Mean daily minimum temperature (°C) | 10.9 | 12.6 |
| Mean daily average (°C) | 17.1 | 17.1 |
| Mean monthly highest maximum temperature (°C) | 32.0 | 30.7 |
| Mean monthly lowest minimum temperature (°C) | 5.8 | 9.1 |
| Mean annual rainfall (mm/a) | 275 | 317 |
| Mean daily A-pan evaporation (mm/day) | 7.0 | 6.4 |

It could be expected that the rainfall in the site would be closer to that of Langebaanweg than Vredenburg but it will be cooler. If the mean annual rainfall of the site is compared to that of Malmesbury (522 mm/a) and farm Diemersdal, Durbanville (also known as the Koeberg grain producing area) (481 mm/a), two very good wheat production areas, one would expect that wheat production in the site would be riskier with a lower production potential.

Based on field observations there is no evidence of any irrigated crop production. This is probably due to the non-availability of irrigation water to irrigate sections of the site.

## 3 FIELD SOIL SURVEY

A soil investigation at each turbine position was done on 9 and 10 December 2014 by Dr. F. Ellis and Mr..BHA Schloms (Soil Scientist, Pr. Sci. Nat. Reg no 400059/10). (It must be noted that these turbine positions were based on a previous application for Environmental Authorisation but is however still considered to be sufficient for the Boulders Wind Farm due to the same properties being considered). During the survey the sites for soil pitting was selected to fall within a 50 m radius to positions where each of the 45 turbines were to be erected at that stage. Information of these investigation sites have been used for the present study as this is the best soil information available to date of the area.

Because of the occurrence of heuweltjies (micro-relief features caused by termites) throughout the site, it was decided that at most observation points a soil investigation between or in some cases where large heuweltjies occur also on a heuweltjie will be investigated.

During the field soil survey, the coordinates of soil pits were determined by handheld GPS (see **Annexure 1: Table 1**). The 26 soil profile pits applicable to this survey were investigated and the important soil properties (e.g. texture, colour, mottling, structure, coarse fragments, horizon depths, etc.) were described following standard procedures prescribed by the Institute for Soil, Climate and Water, Pretoria. Based on recognizable, as well as inferred properties, the soils were classified according to the South African soil classification system (Soil Classification Working Group, 1991) into soil forms and soil families.

This system is based on the recognition of diagnostic soil horizons and materials. Soil forms are defined in terms of the type and vertical sequence of diagnostic horizons or materials. For communication, soil forms are given locality names, e.g. Coega, and abbreviated to a two-letter symbol, e.g. Cg. Soil forms are subdivided into soil families using properties that are not used in the definition of diagnostic horizons or materials. Reference to a soil family is provided by combining the soil form abbreviation and a four-digit symbol, e.g. Cg 2000 is family number 2000 of the Coega form. All soil forms and families described during the field soil survey are listed alphabetically according the soil form name in **Annexure 1, Table 2**

In addition to the standard description the individual profiles were coded in detail according to a system used for detailed soil surveys in the fruit and wine industry in the Western Cape (Lambrechts *et al*., 1978; **Note**: In **Annexure 4** the symbols used during this survey are explained).

For this survey it was not necessary to subdivide soil families into soil types as no soil map was to be compiled.

In **Annexure 1**, **Table 3** the soil families that were defined are briefly described in terms of soil form, diagnostic horizons, family criteria, additional features and effective depth before and after amelioration of physical limitations.

During the field survey undertaken in 2014 additional information on properties that might play a role in the possible influence that additional roads and the excavation for placement of the turbines might have on the conditions of the land afterwards, were collected. These were a combined field estimate by both of the surveyors on wind and water erosion conditions at each turbine point (the lay-out of proposed roads was not available at the time and could therefore not be taken in consideration). The presence of contours at each site was also recorded.

In **Annexure 1 Table 5** Columns 2 and 4 the field data (representing the present condition) on water and wind erosion are given and in Column 6 the percentage slope determined at each turbine position (through consideration of the layout available in 2014). In Columns 3 and 5 numerical values were given to be able to use in an index formula (see Section 7 below).

## 4 SOIL LIMITATIONS

All the profiles investigated during the field survey may have one or more soil physical, morphological and/or chemical property that could negatively affect root development, plant growth and production potential and which may also influence water and wind erosion which will be used to try to quantify the impacts they might have on agriculture. These properties include *inter alia* the following:

### 4.1 Low clay content in top- and upper subsoil

All the soils of the site generally have a very low to low organic matter content and the clay content is generally less than 10 % while the majority have less than 5 % clay.

The ability of soils to retain water and plant nutrients for use by plants is determined mainly by the clay and organic matter content. With a clay content of less than 8 – 10 % the water storage capacity is already so low that it should be considered as a limitation for crop production. A low clay content is regarded as a limitation because such soils become very warm and dry out quickly. It is therefore difficult to maintain plant available water at an optimum level during warm summer months and when plants are young with a small leaf canopy.

Sandy soils are normally permeable with a very rapid hydraulic conductivity and are rapidly leached. It is therefore difficult to maintain the concentration of soluble plant nutrients at an acceptable level for optimal growth and development.

Another limitation of sandy topsoil with low organic matter content is their susceptibility to water and wind erosion; the latter especially when the surface is bare during warm, dry periods. Wind transported sand grains can also cause serious mechanical damage to young plants.

If water is available for irrigation, it is important that irrigation systems on these sandy soils are properly designed. The system should be capable to supplement water loss during periods with exceptionally high evapotranspiration. With regular soil water monitoring, above average irrigation management and other measures such as organic mulches, these limitations can largely be overcome. The same comments are applicable to fertilization, provided that the fertilizer is judiciously and correctly applied to limit potential impacts on adjacent land.

Another problem of sandy topsoil is that surface structures, e.g. ridges, are extremely unstable and need regular maintenance. Sandy ridges dry out very quickly and become extremely warm.

### 4.2 Subsoil hardpans

Dorbank hardpan is a diagnostic horizon in the Oudtshoorn soil form. Silica is the primary cementing agent in dorbank horizons although calcium carbonate may be present as a secondary cementing material. These pans vary in hardness from moderately to extremely hard, with the latter type the most common. The pans are mostly massive to weakly platy, with rare vertical cracks or weakness planes. These pans are a severe limitation for root penetration and are slowly permeable to water. The shallower the depth of the dorbank the more severe is the limitation.

Depending on the hardness and depth of the hardpan below the soil surface it is a common practice to break these pans during deep soil cultivation with a tine-implement (commonly referred to as a ripper; rip ploughing). Loose dorbank material is open and porous and generally a good medium for root development. In soils with moderately shallow hardpans, large quantities of medium-large to very large fragments of the disrupted hardpan material might be brought to the surface of the soil. These fragments might affect planting of crops and restrict traffic.

### 4.3 Dense, structured subsoil clay layer

A moderately to strongly structured layer without or with signs of wetness is present in the Kroonstad soil form. These structured layers usually have a fairly high clay content, somewhat swelling clays and/or high percentages of exchangeable sodium and/or magnesium ions.

Structured, clayey subsoil is usually dense with a low macro-porosity. With an increase in the degree of structural development, size and angularity of the structural units (peds), the greater the negative effect on root and water penetration. Water and wind erosion can be high on these soils, especially when topsoil clay contents are low and if the soils are lying on a slope.

This limitation can be improved through mechanical loosening of the subsoil clay layer and application of gypsum in cases where the clays are physically stable (low exchangeable sodium and magnesium saturation). When the clay is physically unstable very little can be done to improve the internal soil drainage and effective rooting depth.

### 4.4 Wetness

This refers to the presence of free water at varying depths in a soil profile.

In the site wetness occurs localised as a ***perched water table*** in the E horizon above a G horizon (e.g. Kroonstad soil form). Soil families with a "yellow" E horizon are less hydromorphic and have a more friable consistence than families with a "grey" E.

Wetness during active root respiration results in a low oxygen concentration with an increased carbon dioxide concentration. This causes reduction of iron oxides/hydroxides and leaching of the reduced iron. As the iron content decreases soil density increases and very large soil strengths can develop when the soil dries out. Other adverse effects of wetness are: (i) toxic concentrations of iron ($Fe^{2+}$), manganese ($Mn^{2+}$), sulfides, nitrites, ethylene and volatile organic acids can develop; (ii) various diseases can become epidemic under wet conditions. *Phytophthora* in particular can wipe out sensitive crops/plants, and (iii) as a result of limited volumes of non-wet soil that is available for root growth, plants have a restricted root system during the wet season.

### 4.5 Free carbonates and alkalinity

Due to the low rainfall in the site the soils are generally moderately to poorly leached with a high base saturation percentage and $pH_{KCl}$ values of > 6.0. As a result of the activity of termites the termite generated heuweltjies are calcareous with an alkaline pH. In non-sandy soils the base content may be so high that free carbonates [$CaCO_3$ or $CaMg(CO_3)_2$] precipitate as free salts as in the heuweltjie soils. These soils tend to be saline with $pH_{KCl}$ values in the region of 8.0.

As a result of the high pH values, the solubility of nutrients such as phosphorus, zinc, iron, copper and manganese, is very low and has a low availability to plants. The less crystalline and more powdery the carbonates, the more severely the solubility is affected.

The presence of free carbonates (and gypsum when present), however, improves the physical stability of soil material. The calcareous heuweltjie soils are therefore more friable and porous than the non-calcareous soils between the heuweltjies.

### 4.6 Salt affected soils (salinity)

As was pointed out in the preceding paragraphs the heuweltjie (e.g. Coega form soils) soils in the site are poorly leached and tend to be saline. Soils of the Kroonstad and Katspruit soil forms are also expected to be saline in the subsoil. The general salt profile of these soils is an increased soluble salt content with depth.

Rainfall and wind coming from the nearby sea bringing in Na-rich sea spray and an ancient landscape are factors that affect the salt content of the saline soils, it is further influenced by:

- Texture (more clayey more saline);
- Position on the heuweltjie; and
- Slope percentage.

### 4.7 Other limitations

Other soil properties that might be considered as a limitation for crop production within the site include the following:

- Bleached topsoil in the dry state (all soil types with bleached soil families).
- Coarse fragments in top or upper subsoil horizons

## 5 SOIL SUITABILITY FOR DRY-LAND CROP PRODUCTION

During the soil survey the individual soil pits were evaluated by the surveyors in terms of its suitability for the commercial production of annual (e.g. grain crops) and perennial pasture crops (e.g. lucerne). Annual crops included *inter alia* dry-land pastures and winter small grain (e.g. oats, wheat and barley). Although there is not at present water for irrigation purposes available for the area the soils were rated for both dry-land crop production and for irrigated crop production. The suitability rating ranges from 1 to 10, with 1 the lowest and 10 equal to the highest or best suitability. The suitability rating refers to vigour and potential production potential without considering product quality. Although fairly subjective, suitability ratings by experienced soil scientists with many years of field experience are a handy tool to group soil types into production potential classes and for land use recommendations. The ratings can be interpreted according to the guidelines in **Table 5.1**. Climate was not included in the evaluation of soil suitability.

**Table 5.1: Interpretation of suitability ratings**

| Rating | General suitability | |
|---|---|---|
| ≤2 | Very low | Not recommended (NR) |
| >2 - ≤3 | Low | |
| >3 - ≤4 | Low-medium | Marginally recommended (MR) |
| >4 - ≤5 | Medium | Conditionally recommended (CR) |
| >5 - ≤6 | Medium-high | Recommended (RE) |
| >6 - ≤8 | High | Highly recommended (HR) |
| >8 | Very high | |

The majority of soils in the site are very (<10 % clay) to extremely (≤5 % clay) sandy in the topsoil and upper subsoil. The inherent nutrient status and potential to retain nutrients will therefore be low. Although no chemical soil analyses are available, it is expected that the sandy soil between heuweltjies will have a lower $pH_{KCl}$ (acidic to slightly acidic) and non-saline. The heuweltjie soils are all calcareous with a high pH (>7.0) and most probably saline. Lower lying soils in concave terrain positions with signs of wetness (Kd 1) may have higher pH values and could potentially be saline.

# 6 SOIL SUITABILITY FOR IRRIGATED CROP PRODUCTION

Should irrigation water become available, crops such as supplementary irrigated winter annual crops (e.g. small grain, vegetables and legume pastures), and full irrigated summer crops (e.g. pastures, vegetables, wine grapes) could also be considered for the site.

For the economic viable production of deep rooted crops (e.g. lucerne and wine grapes) under irrigation, the physical effective depth limitations (*inter alia* dorbank horizons in Oudtshoorn form soil) should be mechanically loosened. For shallow rooted annual crops this should not be necessary.

Once loosened the predominantly saline heuweltjie soils could be leached to remove excessive salts. This should be done in conjunction with the judicious application of gypsum. This would also require the installation of artificial drainage to remove leached salts out of the system. The soil suitability for annual and perennial crops around each profile is given in **Annexure 1, Table 4.**

**It must be mentioned that soil suitability at each turbine site was not determined for the Boulders Wind Farm but that the suitability obtained above is expected to follow the same trend at most of the turbines and are therefore considered relevant to the proposed project. This information was used to define whether turbine positions would be acceptable for agriculture and what the impact of water and wind erosion on turbine lay-down areas, new roads and crossing existing contour structures could be.** (See Annexure 1, Table 6 and 10.5, Mitigation measures)

## 7 COMPARISONS OF PRESENT SOIL AND LAND CONDITIONS WITH CONDITIONS EXPECTED TO OCCUR AFTER TURBINES AND ROADS HAVE BEEN IMPLIMENTED (i.e. IMPACTS ON AGRICULTURE)

In an attempt to quantify the possible affect that the placement of roads and turbines might have on the inherent properties of the land (i.e. soils and terrain) that are currently under cultivation for annual crops, we came up with the calculation of three indexes.

The soil profile data given in Annexure 1, Table 4 were used for the evaluation. These indexes (water erosion, wind erosion and a combined index taking into account water erosion, wind erosion and soil suitability for annual crops, also called Total Agricultural Impact Index) can be used to determine the individual and total impact the placement of turbines might have on agriculture and at the same time help to determine the best way to limit the negative impact to a minimum**.**

**The indexes were calculated as follows:**

1. We used the numerical values for water and wind erosion (See columns 3 and 5 of Annexure 1, Table 5) as described in Section 3 above to represent the present condition.
2. We used (See columns 7 to 11 of Annexure 1, Table 5) the Scotney et al, 1987 criteria (See Annexure 2) to determine the negative influence of water and wind erosion on different soils and under different slopes.
3. Water erosion index (Column 12) was calculated using Field rating (Column 5) + Scotney water erosion class (Column 9).
4. Similarly wind erosion (Column 14) was calculated using Column 3 and 11.
5. In column 16 the Total Impact Assessment Index was calculated as: 10/annual suitability*(field water + Scotney water)* (Field wind + Scotney wind).

6. All three indexes were then individually grouped into classes (e.g. Low, Medium, etc.) that were used in **Table 7.1** (June 2018 placings) and **Table 7.2** (November 2018 placings) below

**Table 7.1 Impacts of placement of turbines (June 2018 placings) on agricultural land at profile sites described using indexes related to soil, soil suitability for annual crop production, water and wind erosion. This information was used for making the comments about the placing of nearby turbines and mitigation measures to be taken at and around (including new roads and erosion structures) turbines given in Annexure 1, Table 6**

| Soil profile number* | Water erosion index class | Wind erosion index class | Total agricultural impact assessment index class |
|---|---|---|---|
| 15 | Low | Medium | LOW |
| 16 | Low | Medium | LOW |
| 17 | High | Low | MEDIUN |
| 18 | Low | Medium | LOW |
| 19 | Medium | High | MEDIUM |
| 20 | Low | Low | LOW |
| 21 | Medium | Medium | MEDIUM |
| 22 | Very high | Low | VERY HIGH |
| 23 | Medium | Low | MEDIUM |
| 26 | Medium | Low | LOW |
| 27 | High | Medium | MEDIUM |
| 28 | High | High | HIGH |
| 29 | Medium | Medium | HIGH |
| 30 | Very high | Medium | VERY HIGH |
| 32 | High | Medium | MEDIUM |
| 33 | High | Medium | HIGH |
| 34 | High | Medium | MEDIUM |
| 36 | Very high | Medium | HIGH |
| 37 | High | Medium | HIGH |
| 38 | High | Low | MEDIUM |
| 39 | High | Medium | VERY HIGH |
| 40 | High | Low | MEDIUM |
| 41 | Medium | Medium | MEDIUM |
| 42 | High | Low | MEDIUM |
| 43 | High | Low | MEDIUM |
| 44 | Low | Low | LOW |
| 45 | High | Low | MEDIUM |

**Table 7.2: Impacts of placement of turbines (November 2018 placings) on agricultural land at profile sites described using indexes related to soil, soil suitability for annual crop production, water and wind erosion. This information was used for making the comments about the placing of nearby turbines and mitigation measures to be taken at and around (including new roads and erosion structures) turbines given in Annexure 1, Table 6**

| Soil profile number* | Water erosion index class | Wind erosion index class | Total agricultural impact assessment index class |
|---|---|---|---|
| 23 | Medium | Low | MEDIUM |
| 26 | Medium | Low | LOW |
| 29 | Medium | Medium | HIGH |
| 30 | Very high | Medium | VERY HIGH |
| 32 | High | Medium | MEDIUM |
| 33 | High | Medium | HIGH |
| 34 | High | Medium | MEDIUM |
| 36 | Very high | Medium | HIGH |
| 37 | High | Medium | HIGH |
| 38 | High | Low | MEDIUM |
| 39 | High | Medium | VERY HIGH |
| 40 | High | Low | MEDIUM |
| 41 | Medium | Medium | MEDIUM |
| 42 | High | Low | MEDIUM |
| 43 | High | Low | MEDIUM |
| 44 | Low | Low | LOW |
| 45 | High | Low | MEDIUM |

1

To sum up the main findings of the soil and erosion analyses given in Annexure 1, Table 4 (soil suitability) and in Tables 7.1 and 7.2 above for both the June 2018 and November 2018 placings (erosion and its impact on agriculture):

- Soil suitability is **low to medium** for both annual and perennial crops
- Wind erosion hazard is not seen as a limitation (Table 7.1 and 7.2) on the sites considered for turbine placings
- **Water erosion** is seen as the most important limitation (the areas identified to have a high to very high agricultural impact assessment index in Table 7.1 and 7.2) and this will have a major impact on the mitigation measures as suggested in Section 10.5 below where this information is applied to the given layout for both the June and November 2018 placings (see Figures 3.1 and 3.2)

# SECTION B

# AGRICULTURAL ECONOMIC ASSESSMENT

The proposed Boulders Wind Farm of Vredenburg Windfarm (Pty) Ltd. is located in the West Coast Region of the Western Cape Province. This region is characterised by a relatively low and variable winter rainfall. This factor, when seen together with the relatively low suitable soils (refer to Section A), limits crop production. The absence of lasting irrigation water sources totally limits the production of perennial crops. The site is situated in the winter-grain production region, but the production thereof will be risky due to:

- relatively low suitable soils and therefore, low output
- relatively variable and lower winter-rain volumes
- the “price-cost- squeeze” relevant to winter-grain production in areas with relatively lower production potential.

The agricultural economic assessment that follows is based on the findings of the soil suitability study (refer to Section A).

## 8 PRODUCTION POSSIBILITIES AND LIMITING FACTORS

Production possibilities are limited for winter grain and winter grazing crops for animal feedstuff. Both cattle and sheep are possible livestock enterprises to be practised in combination with winter grain production systems.

The profitability of winter grain production is mainly determined by the following aspects:

- The producer price level. This can be seen as a ‘given’, due to the fact that individual producers have little/no influence as far as price determination of produce are concerned.
- The output level of the different grain kinds. Output levels are influenced by controllable factors (mainly of a managerial kind, *inter alia* effective and efficient production practices) as well as un-controllable factors (mainly fluctuating climatic conditions and soil suitability). The relative low suitability of the area (i.e. low to medium low suitable soils and relative low and variable winter rain volumes) that is earmarked for the proposed development (refer to Annexure 1, Table 4) will therefore have a negative impact on the expected output levels of the winter grain kinds that can be considered for production.
- The level of success as far as risk management is concerned. The production of wheat (monoculture) is relatively cost intensive and therefore risky, given fluctuating climatic conditions. Risk levels can, however, be lowered via the implementation of crop rotation systems, a general practice in the grain producing regions of the Western Cape Province. The inclusion of grazing crops like barley and oats in a crop rotation system therefore enlarge the animal factor and usually leads to more

stable income levels for the farm in the long run. This strategy is a normal practice in the region and the calculations with regard to the farming potential of the affected areas (i.e. Farms 1 and 2, refer to Table 8.1) will therefore be based thereon.

The suitability of the soils for winter grain cropping is based on the soil investigation as presented in Section A above. A 'medium-low' suitability situation is assumed for each of the two farms involved (refer to Tables 8.1(a) and (b)). The farm land to be taken up with the ''draft layout'' (June 2018 placings) of the wind turbines is presented in Table 8.1(a), while the impact on farm land used for the ''final layout'' (November 2018 placings) is presented in Table 8.1(b).

**Table 8.1(a): Perspective of the areas (''draft layout'' of turbines) of the two farms involved and the actual affected area**

| ITEM | FARM 1 | FARM 2 | TOTAL |
|---|---|---|---|
| Farm area (ha) | 2036 | 590 | 2626 |
| Suiability for winter grain cropping | Medium-low | Medium-low | Medium-low |
| Number of turbines | 31 | 14 | 45 |
| Footprint and crane working area (ha)* | 5.9 | 2.7 | 8.6 |
| Area lost due to cultivation disturbance (ha)** | 1.4 | 0.6 | 2.0 |
| Service roads (ha)*** | 12.7 | 5.3 | 18.0 |
| Sub-station | | | 1.0 |
| **TOTAL AFFECTED AREA (ha)** | 19.9 | 8.6 | 29.5 |
| **% of farm area affected** | 1.0% | 1.5% | 1.1% |
| **Farm 1**: Pierre Heydenrych (Land pieces 3/22; 5/40 and 2/40) | | | |
| **Farm 2**: Nico Lombard (Land pieces 2/46 and 1/21) | | | |
| * Area of 1900 m2 per turbine | | | |
| ** At 436 m2 per turbine | | | |
| *** Total area of service and access roads (including draining construction on both sides) on the affected areas of the farmland. | | | |

**Table 8.1(b): Perspective of the areas (''final layout'' of turbines) of the two farms involved and the actual affected area**

| ITEM | FARM 1 | FARM 2 | TOTAL |
|---|---|---|---|
| Farm area (ha) | 2036 | 590 | 2626 |
| Suiability for winter grain cropping | Medium-low | Medium-low | Medium-low |
| Number of turbines | 27 | 18 | 45 |
| Footprint and crane working area (ha)* | 5.1 | 3.4 | 8.6 |
| Area lost due to cultivation disturbance (ha)** | 1.2 | 0.8 | 2.0 |
| Service roads (ha)*** | 12.7 | 5.3 | 18.0 |
| Sub-station | | | 1.0 |
| **TOTAL AFFECTED AREA (ha)** | 19.0 | 9.5 | 29.5 |
| **% of farm area affected** | 0.9% | 1.6% | 1.1% |
| **Farm 1**: Pierre Heydenrych (Land pieces 3/22; 5/40 and 2/40)<br>**Farm 2**: Nico Lombard (Land pieces 2/46 and 1/21) | | | |

* Area of 1900 m2 per turbine

** At 436 m2 per turbine

*** Total area of service and access roads (including draining construction on both sides) on the affected areas of the farmland.

It is clear that the impact on farming activities of the two turbine layouts is expected to be the same. Approximately 30 ha of farmland (i.e. 1.1% of the farmland) will be used for both layouts of the wind energy project.

The financial calculations, to illustrate the expected impact of the wind energy project on farming activities, were done with a typical farming model as a point of departure. This is a normal procedure when agricultural potential is studied as the managerial productivity differs between farmers. The typical farming model was developed with the aid of the farmers involved and it was verified via the inputs of other industry experts. Valuable inputs in this regard were obtained from the Agricultural economic Section of Overberg Agri (Edms) Bpk., Moorreesburg. It is assumed that the results of the financial evaluation of the typical farming situations will serve as a plausible source of information for the evaluation of the agricultural potential of the two farms that are earmarked for the proposed wind energy facility. It is further assumed that the managerial inputs on the farming areas will be optimal.

The farms are currently used for agricultural purposes, including small-grain, cattle and sheep farming. A typical farm of 1200ha is assumed for calculation purposes. The following farming strategy is assumed, given the relative risky nature of the region for winter cropping:

- 400 ha of wheat per year
- 400 ha of oats/barley grazing per year
- 400 ha of fallow land per year
- 1200 ewes (Meat-type Merino's) on the farm of 1200ha

This farming strategy is typical for the region. A Scenario is developed for the expected financial outcome from farming, namely a medium-low suitability situation for winter grain to suit Farm 1 as well as Farm 2.

**Table 8.2: Expected profitability of wheat production on Farms 1 and 2, Vredenburg, 2017/18***

| **Wheat Rotation: Medium-low to low production potential** | |
|---|---|
| | **Wheat Rotation** |
| | **Rand/ha** |
| **Gross Production value from crop** | |
| Producers price (R/ton) | 3170 |
| Output (ton/ha) | 2 |
| **TOTAL** | **6340** |
| | |
| **Directly allocatable costs** | |
| Seed | 791 |
| Fertilizer | 2188 |
| Lime and gypsum | 181 |
| Herbicides | 589 |
| Insecticides | 143 |
| Disease control | 408 |
| Insurance | 43 |
| Marketing costs | 155 |
| Seasonal labour | 7 |
| Contract work | 27 |
| Soil analyses | 49 |
| Cultivation cost: | 0 |
| Fuel | 320 |
| Repairs | 526 |
| Other allocatable costs | 284 |
| **Total** | **5710** |
| **Gross Margin(GM)** | **R 630** |
| Source: Overberg Agri (Edms) Bpk., Moorreesburg, 2017. | |

*The contribution of Mr Wynand Heunis, farm financial modelling expert, Overberg Agri (Edms) Bpk., Moorreesburg, December 2016, is hereby acknowledged.

**Table 8.3: Expected costs of fallow land cultivation practices, Farms 1 and 2, Vredenburg, 2017/18**

| | Fallow Land |
|---|---|
| | **Rand/ha** |
| **Gross Production value from crop** | |
| Producers price (R/ton) | 0 |
| Output (ton/ha) | 0 |
| **TOTAL** | **0** |
| | |
| **Directly allocatable costs** | |
| Cultivation cost: | |
| Fuel | 639 |
| Repairs | 684 |
| Other allocatable costs | 208 |
| **Total** | **1362** |
| **Gross Margin(GM)** | **-R 1 362** |
| Source: Overberg Agri (Edms) Bpk., Moorreesburg, 2017. | |

**Table 8.4: Expected costs of grazing crop production practices, Farms 1 and 2, Vredenburg, 2017/18**

| | Oats and Barley Grazing |
|---|---|
| **Gross Production value from crops** | **Rand/ha** |
| Producers price (R/ton) | 0 |
| Output (ton/ha) | 0 |
| **TOTAL** | **0** |
| | |
| **Directly allocatable costs** | |
| Seed | 394 |
| Fertilizer | 461 |
| Lime and gypsum | 209 |
| Herbicides | 191 |
| Disease control | 32 |
| Seasonal labour | 17 |
| Soil analyses | 56 |
| Cultivation cost: | 0 |
| Fuel | 314 |
| Repairs | 410 |
| Other allocatable costs | 170 |
| **Total** | **2006** |
| **Gross Margin(GM)** | **-R 2 006** |
| Source: Overberg Agri (Edms) Bpk., Moorreesburg, 2017. | |
| . | |

**Table 8.5: Expected profitability of the meat type Merino sheep production practices, Farms 1 and 2, Vredenburg, 2017/18**

| | Merino: Meat-wool Type |
|---|---|
| **Gross Production value** | **Rand/ewe** |
| Meat sales | 1477 |
| Wool sales | 565 |
| **TOTAL** | **2042** |
| | |
| **Directly allocatable costs** | |
| Concentrates | 534 |
| Grazing | 0 |
| Lick blocks | 65 |
| Veterinary & medicine | 98 |
| Seasonal labour | 34 |
| Marketing costs | 45 |
| Contract work | 0 |
| Fuel & repairs | 28 |
| Other | 19 |
| **Total** | **822** |
| | |
| **Gross Margin(GM)** | **R 1 220** |
| **Key Assumptions:** | |
| * Lambing %: 120 | |
| *Weaning %: 100 | |
| Source: Overberg Agri (Edms) Bpk., Moorreesburg, 2017. | |

**Table 8.6: Expected profitability of the assumed production strategy for Farms 1 and 2, Vredenburg, 2017/18**

| Item | Units | GM/unit (Rand) | Total GM(Rand) |
|---|---|---|---|
| Wheat(ha) | 400 | R 630 | 251 946 |
| Fallow land (ha) | 400 | -R 1 362 | -544 991 |
| Oats/barley grazing (ha) | 400 | -R 2 006 | -802 208 |
| Meat type Merino sheep (ewes) | 1200 | R 1 220 | 1 463 430 |
| **TOTAL GROSS MARGIN** | | | **R 368 177** |
| | | | |
| **GROSS MARGIN/ha FARM** | | | **R 307** |

It is therefore clear that this production situation will **find it difficult** to cover the expected farming overheads (i.e. labour costs, regional taxes, depreciation of equipment and fixed improvements) of R 1209/ha per year in the long run. It should also be noted that **no**

**allowance** was made in the cost structure for the remuneration to capital employed and managerial inputs.

The main limiting factors for profitable farming on the two farms that are earmarked for the proposed wind farm are therefore:

- the relative low suitability of the soils and climate for dry-land crop production systems in general, and
- the non-availability of irrigation water for an economically acceptable crop-production scale.

## 9 ESTIMATED LOSS OF AGRICULTURAL PRODUCTION DUE TO THE WIND FARM PROJECT

Farming activities are practiced on a continuous basis on the two farms where the wind-farm is planned. It can therefore be deduced that the farming activities that are practiced are profitable for the farmers, probably due to good managerial skills as far as risk management is concerned. The impact of the project on the financial situation of the farms that are involved, will therefore be determined by, *inter alia*, the following aspects:

- Production possibilities and the profitability levels thereof
- Loss of farming income due to the impact of the project, for example the negative effect of the loss of land on agricultural output.
- Possible gain in income for the farmers due to a profit-sharing/rent-income agreement with the wind-farm developer.

The loss of farming income will be determined by, *inter alia*, the following aspects:

- Number of turbines to be constructed, the size of the foot-print and the area to be taken up by the service roads, permanent crane location and supporting buildings will determine the area of land-loss and therefore the loss of income from farming.
- The placing-strategy (i.e. positioning) of the turbines.
- Expropriation of farmland, if applicable.
- Appropriate mitigation measures, like the conservation of the top-soil, the proper rehabilitation of the construction sites, the sensible placing of the turbines and service roads and the synchronization of construction with the off-season of farming activities.

The total footprint (i.e. the wind turbines and construction- and service platforms and service roads), according to information supplied by Vredenburg Windfarm (Pty) Ltd., for up to 45 turbines is approximately 30 to 35 ha (i.e. about 1.1%) of approximately 2626 ha of farmland that is earmarked for the envisaged wind farm at Vredenburg (refer to Tables 8.1(a) and (b) and also to Table 9.1). The expected loss in farming income is expected to be the same for both the layouts for the turbines, thus only the expected financial impact of the ''final layout'' is presented in Table 9.1.

**Table 9.1: Expected loss in farming income on the two farms that are earmarked for the envisaged wind farm, Vredenburg, 2017/18**

| ITEM | FARM 1 | FARM 2 | TOTAL |
|---|---|---|---|
| Farm area (ha) | **2036** | **590** | **2626** |
| Suiability for winter grain cropping | **Medium-low** | **Medium-low** | **Medium-low** |
| Number of turbines | **27** | **18** | **45** |
| Footprint and crane working area (ha)* | **5.1** | **3.4** | **8.6** |
| Area lost due to cultivation disturbance (ha)** | **1.2** | **0.8** | **2.0** |
| Service roads (ha)*** | **12.7** | **5.3** | **18.0** |
| Sub-station | | | **1** |
| **TOTAL AFFECTED AREA (ha)** | **19.0** | **9.5** | **29.5** |
| **% of farm area affected** | **0.9%** | **1.6%** | **1.1%** |
| Expected gross margin/ha farm (Rand) | **R 307** | **R 307** | **R 307** |
| Expected gross margin of farm (Rand) | **R 625 052** | **R 181 130** | **R 806 182** |
| **EXPECTED LOSS IN GROSS MARGIN PER FARM (Rand)**** | **R 5 835** | **R 2 918** | **R 9 060** |
| **% of total Gross margin of farm lost** | **0.9%** | **1.6%** | **1.1%** |
| **Farm 1**: Pierre Heydenrych (Land pieces 3/22; 5/40 and 2/40)<br>**Farm 2**: Nico Lombard (Land pieces 2/46 and 1/21) | | | |

* Area of 1900 m2 per turbine

** At 436 m2 per turbine

*** Total area of service and access roads (including draining construction on both sides of road) on the affected areas of the farmland.

**** Loss in Gross margin per year due to loss of production on affected land areas.

It is also foreseen that the service roads will be used as farm roads and/or firebreaks, while as much as possible of the existing farm roads will also be used in the layout.

No expropriation of farmland will take place according to the developer. Lease agreements under the Subdivision of Agricultural land Act (Act 70 of 1970) will be concluded with the farmers involved in the development. It is further assumed that appropriate mitigation measures, like the conservation of the top-soil, the proper rehabilitation of the construction sites and the proper construction of service roads (i.e. to prevent erosion, see Section A and paragraph 10.5) will be implemented.

The loss of farming income due to the project will therefore be determined mainly by the future loss of productive land due to areas to be taken up by the footprints of the wind energy facility and the service roads. The relevant areas in this regard were calculated as approximately 30 to 35 ha.

The income in excess of the running costs to be incurred to generate that income therefore present the expected net loss of agricultural production value due to the envisaged energy project.  Farm overhead costs will not be influenced by the relative small loss of agricultural production practices.  The financial analyses were therefore performed to the profit-level of ***gross margin per ha*** (i.e. the income in excess of the running costs to be incurred to generate that income).  According to Table 9.1, only R9 060 of the yearly gross margin (i.e. about 1.1%) will in total be lost on the two farms due to the project.  The implication of this extremely low percentage of the farmland to be taken up by the development is that the negative effect on total agricultural production value should be ***virtually zero.***

This yearly loss in agricultural production value must, however, be weighed against, *inter alia*, the following:

> The yearly income that will be generated for the farmer due to the project.  This capital injection should enable the farmer to continue farming under the mentioned risky production conditions and therefore keep workers employed and should therefore contribute to the national goal of food security.

The negative effect of the envisaged project on the total agricultural production of the two farms is therefore ***virtually ignorable.***

# SECTION C

## IMPACT ASSESSMENT: AGRICULTURAL PERSPECTIVE

### 10 PROJECT ACTIVITIES THAT MAY IMPACT ON PRESENT AND FUTURE AGRICULTURAL PRODUCTION ACTIVITIES

#### 10.1 GENERAL

This section describes the potential impacts of the envisaged wind farm project on the future agricultural production potential of the two farming units. The impacts can either be positive or negative on the existence (i.e. existing role, contribution or function) of an entity (i.e. the farms). For example, the construction of the proposed wind farm would impact negatively on the natural resource base of the farms in the Vredenburg region should it take up a large portion of the farmland that can be used for the production of winter grain crops. On the other hand, the remuneration that the farmers will receive for the use of their property could serve as a valuable 'injection' to enable the farmers to continue farming under the mentioned risky production conditions and therefore keep workers employed which should contribute to the national goal of food security.

#### 10.2 FARM ECONOMIC IMPACT IDENTIFICATION

The negative impacts on farming will therefore be the loss of agricultural land and therefore production value (farming income) due to the construction of:

- The wind energy turbines
- Internal and access roads
- Electrical substation
- Construction laydown area
- Allowance for the loss of land due to the minor disturbance of cultivation practices around the wind turbines

Approximately 30 to 35 ha of agricultural land will be lost for either of the two layouts for the turbines in this regard. The reasons for this are quite obvious:

- The land area per turbine is the same for both layouts
- The land area for the roads and other constructions should be the same for both lay-outs.

The impact analyses (farming perspective) that follows should thus apply to either of the two alternative turbine layouts.

The ***on-farm impact*** of the proposed wind energy development facility is therefore situated in:

- The yearly net loss of agricultural production value of approximately R9 060 (i.e. 1.1%) in total on the two farm units.

- The income that will be generated for the farmers due to the project. This capital 'injection' should enable them to continue farming under the mentioned risky production conditions and therefore keep workers employed which should contribute to the national goal of food security.

The impacts associated with the ***"no-go" option*** is the following:

- Farming activities will continue as in the past. The estimated net yearly loss of future agricultural production value that is associated with the development of the wind energy facility which amounts to R9 060 will ***not*** be realized.

- The opportunity to generate capital for possible farming developments and enhancements by leasing a portion of land for the proposed wind energy development facility will ***not*** be realized.

## 10.3 IMPACT ASSESSMENT METHODOLOGY

The impacts associated with the two alternative layouts for the proposed wind energy facility and the "no-go" option were analysed and assessed with the emphases on the natural resources soil and terrain and the agricultural production potential thereof.

The significance of each potential impact (Department of Environmental Affairs and Development Planning. 2010 and Van Zyl, H.W., de Wit, M.P. & Leiman, A. 2005), with and without the implementation of the proposed mitigation measures, can be assessed based on the following variables (evaluation components):

- **Extent** (spatial scale);
- **Magnitude (positive or negative)**;
- **Duration** (time scale);
- **Probability** of occurrence;
- **Irreplaceable** loss of resources; and
- **Reversibility** of the impact.

## 10.4 IMPACT ASSESSMENT

The impacts associated with the proposed development for the wind energy facility and the "no-go" option were analysed and assessed with the emphases on the natural resources soil and terrain and *agricultural production potential*. The significance rating of the unmitigated and mitigated scenarios for each impact-group was calculated and rated as indicated in **Tables 10.1 to 10.3** below.

**Table 10.1 Summary of the significance of impacts of turbine placings (with and without mitigation) on agricultural land for either of the two turbine lay-outs when taking the natural resources of soil, terrain and climate into consideration.**

| | | |
|---|---|---|
| Nature: To evaluate the placing of turbines and the lay-out thereof (mainly on turbine footprints and new roads anticipated) on existing agricultural land given the natural resource (soil, terrain and climate) circumstances unique to the area. **Water erosion was determined as the most important factor in the area**. Evaluation included suggested mitigation measures against water erosion for lay-down areas and water run-off lanes along new roads planned. Assessment also focused on areas where roads will cross existing contours. | | |
| | **Without mitigation** | **With mitigation** |
| Extent (local) | High (3) | Low (1) |
| Duration | Permanent (5) | Medium-term (3) |
| Magnitude | Moderate negative (6) | Low negative (4) |
| Probability | Definite (5) | Probable (3) |
| Significance | High (70) | Low (24) |
| Status (positive or negative) | Negative | Negative |
| Reversibility | Low | Low |
| Irreplaceable loss of resources | Yes | Yes |
| Can impact be mitigated? | Yes | Yes |
| Mitigation: Stabilizing of lay-down areas, water run-off lanes along roads and where contours are crossed, appropriate structures to be implemented to make sure they are still functioning well and to prevent any further activity that may be responsible for new water erosion to take place. Details of mitigation measures to take into consideration per turbine placing are given in Annexure 1, Tables 6.1 and 6.2 | | |

**Table 10.2** **Summary of the significance of impacts of the Boulders wind energy project (with and without mitigation) on *agricultural production potential* for either of the two turbine layouts (i.e. the on-farm impacts)**

| Nature: | | |
|---|---|---|
| | **Without mitigation** | **With mitigation** |
| Extent (local) | Low (i.e. site specific) (1) | Low (i.e. site specific) (1) |
| Duration | Long term (4) | Long term (4) |
| Magnitude | Very low negative (0) | Very low negative(0) |
| Probability | High (4) | High (4) |
| Significance | Low (20) | Low (20) |
| Status (positive or negative) | Negative | Positive |
| Reversibility | Low | Low |
| Irreplaceable loss of resources | Yes | Yes |
| Can impact be mitigated? | Yes (see Table 10.1) | Yes (see Table 10.1) |
| Mitigation: See Table 10.1 . | | |

**Table 10.3** **Summary of the significance of the ''no-go" option of the Boulders wind energy project on *agricultural production potential* (i.e. on farm impacts)***

| Nature: | | |
|---|---|---|
| | **Without mitigation** | **With mitigation** |
| Extent (local) | Low (i.e. site specific) (1) | Not applicable |
| Duration | Long term (4) | Not applicable |
| Magnitude | Very low (1) | Not applicable |
| Probability | High (4) | Not applicable |
| Significance | Low (24) | Not applicable |
| Status (positive or negative) | Negative | Not applicable |
| Reversibility | Low | Not applicable |
| Irreplaceable loss of resources | Yes | Not applicable |
| Can impact be mitigated? | Not applicable | Not applicable |
| Mitigation: Not applicable. | | |

* i.e. The non-realization of the opportunity to generate additional farming income via the yearly lease agreement payments.

The impact of the project (i.e. for either of the two turbine layouts) is thus expected to be as follows:

- The impact of water erosion along new lay-out areas on the soil is seen as high if not mitigated properly. With mitigation the impact will be low.
- The development can be seen as a permanent substitution of a very small portion (only approximately 1.1%) of the agricultural land for the construction of the wind turbines for the development of alternative energy.

- The loss of agricultural resources can, however, also be seen as reversible (i.e. should the project be terminated after, say, 20 years the land will become ''free'' again for agricultural production purposes).

**COMPARISON OF OVERALL IMPACT RATINGS OF THE ''DRAFT LAYOUT' VERSUS THE ''FINAL LAYOUT' (IN RESPONSE TO SPECIALIST RECOMMENDATIONS)**

*Soil and Soil suitability Assessment Overall Significance (Draft Layout):* ***LOW***

*Soil and Soil suitability Assessment Overall Significance (Final Layout):* ***LOW***

*Impact Assessment: Agricultural Perspective with mitigation Overall Significance (Draft Layout)* ***LOW***

*Impact Assessment: Agricultural Perspective with mitigation Overall Significance (Final Layout)* ***LOW***

*Farm economic Impact Assessment Overall Significance (Draft Layout):* **VERY LOW**

*Farm economic Impact Assessment Overall Significance (Final Layout):* **VERY LOW**

The expected loss in farmland as well as the expected loss in farm gross margin is expected not to exceed 1.1% per year, thus ***virtually ignorable*** **for either of the two turbine layouts**. The proposed wind farm development is planned near an existing (i.e. operational) wind energy facility on adjacent farms (known as the West Coast One Wind Energy Facility). When viewed from an agricultural production perspective, the increase in the wind energy facilities on the farms of the region, due to the planned project, should not have any additional negative impact than that stated in this report.

The expected income from the profit-sharing/rent-income agreement with the wind energy developer will serve as a stabilising factor as far as yearly income is concerned. Possible farming practices will therefore be able to continue in a more stable financial environment and the security in this regard of the farmer, his farm workers and their families should be furthered by the envisaged project. The **''no-go''** option will therefore be disadvantageous for the two farms that are involved in the wind farm development as far as the establishment of a more stabilised farm-financial set-up is concerned.

The installation of the wind turbines will therefore have a **minor negative impact** from an agricultural production point of view (including food security of the country). The soils of the planned installation area (refer to Annexure 1, Table 4) has a medium-low to low suitability for crop production.

An agriculturally sensitivity map (for either of the two turbine layouts) where the layout infrastructure is also indicated, was prepared and indicated in Figures 3.1 and 3.2 below. According to this layout all turbines are placed on present cultivated agricultural land having a low-medium soil suitability and on terrain where slopes are not too steep (< 12 % slope). No turbine seems to be placed in the areas indicated as agriculturally sensitive (mainly steam beds).

Also, considering the fact that the facility will mainly make use of existing roads this will result in acceptable loss and will not lead to any impacts of a high significance.

This analysis indicates that the proposed development should have a significant positive effect on the economic sustainability of the relevant farms as farming businesses which in turn will provide the opportunity for the landowner to enhance the farming activities being undertaken. Cognition should be taken of appropriate mitigation measures during construction (refer to Section 10.5).

It must also be noted that the comments received during the Scoping Phase Public Participation Process undertaken by Savannah Environmental have been reviewed by the specialists and the issues raised do not affect the outcome of this specialist report.

## 10.5 MITIGATION MEASURES

According to Section 10.4 the development will have minor negative impacts on the current farming activities as well as on possible future farming developments if the correct mitigation measures are followed, as follows:

- The placing strategy for the turbines should have a small negative effect on the total agricultural production value of the farms that it can be seen as ***virtually ignorable.***
- Appropriate mitigation measures with regard to the conservation of the natural resource base should form an important part of the planning process. (See Annexure 1, Table 6)
- Avoiding of sensitive areas, if applicable (i.e. wetlands, slopes and existing soil conservation works, see in order to prevent the degradation thereof (see Fig. 4)
- Conservation of the top-soil during construction and the proper rehabilitation of the construction sites after construction
- Protection of the vegetation and veld by means of the construction of proper service roads and the proper maintenance thereof over time

Measures to include in the draft Environmental Management Programme are detailed in Table 10.4 below and applies to either of the two turbine layouts.

### Table 10.4: Environmental Management Table for Agriculture

**Obfective:** To minimize the impact of the wind farm on agricultural land
**Project component/s:** Construction of all components that are planned on the soil surface
**Potential Impact:** Permanent loss of agricultural land if not managed properly
**Activity/risk source:** After construction less, agricultural land remains and normal farming will be influenced (positive and negative) but uncontrolled water erosion can be responsible for permanent loss of land.
**Mitigation:**
**Target/Objective:** To minimize any negative influence on agriculture by identifying the possible problems and to control them to a minimum by recommending proper mitigation measures

| Mitigation: Action/control | Responsibility | Timeframe |
| --- | --- | --- |
| Appropriate mitigation measures to control and avoid erosion (i.e. stabilizing lay-down areas, water run-off lanes along roads and where existing contours area crossed, proper structures be developed and implemented that will ensure proper functioning of the contours).<br>Conservation of the top-soil during construction and the proper rehabilitation of the construction sites after construction.<br>**Note: Moving of turbines to comply with the above actions is not seen necessary** | Construction team | During construction phase<br>The construction of the project infrastructure should be synchronised, as far as possible with the seasonal pattern of farming activities in order to minimise the possible disturbance of the latter. |

**Performance Indicator:** Lay-out according to plan submitted, proper handling of topsoil during construction and erosion structures that are put in place
**Monitoring:** It is recommended that a responsible soil conservation officer from the Department of Agriculture be involved to make sure that erosion control is done according to the correct procedures on a regular basis during and after construction
Mechanisms for monitoring compliance; the key monitoring actions required to check whether the objectives are being achieved, taking into consideration responsibility, frequency, methods and reporting

The proper execution of the mentioned planning principles, as far as the conservation of existing farming activities is concerned, should therefore lead to ***the minor disturbance***, if any, of agricultural production practices on the farms.

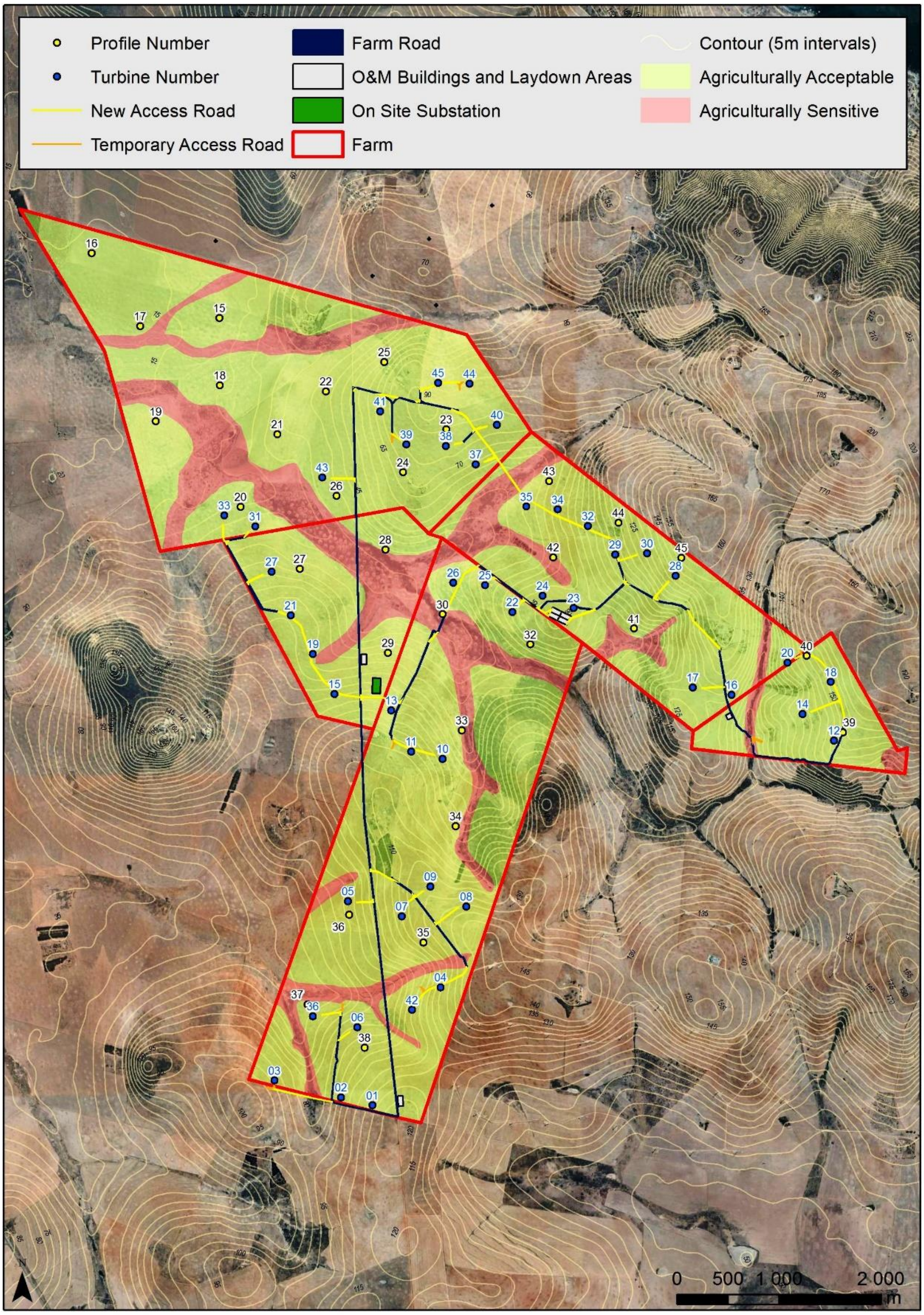


**Figure 3.1 Map showing the infrastructure layout and agriculturally acceptability and sensitivity (June 2018 layout)**

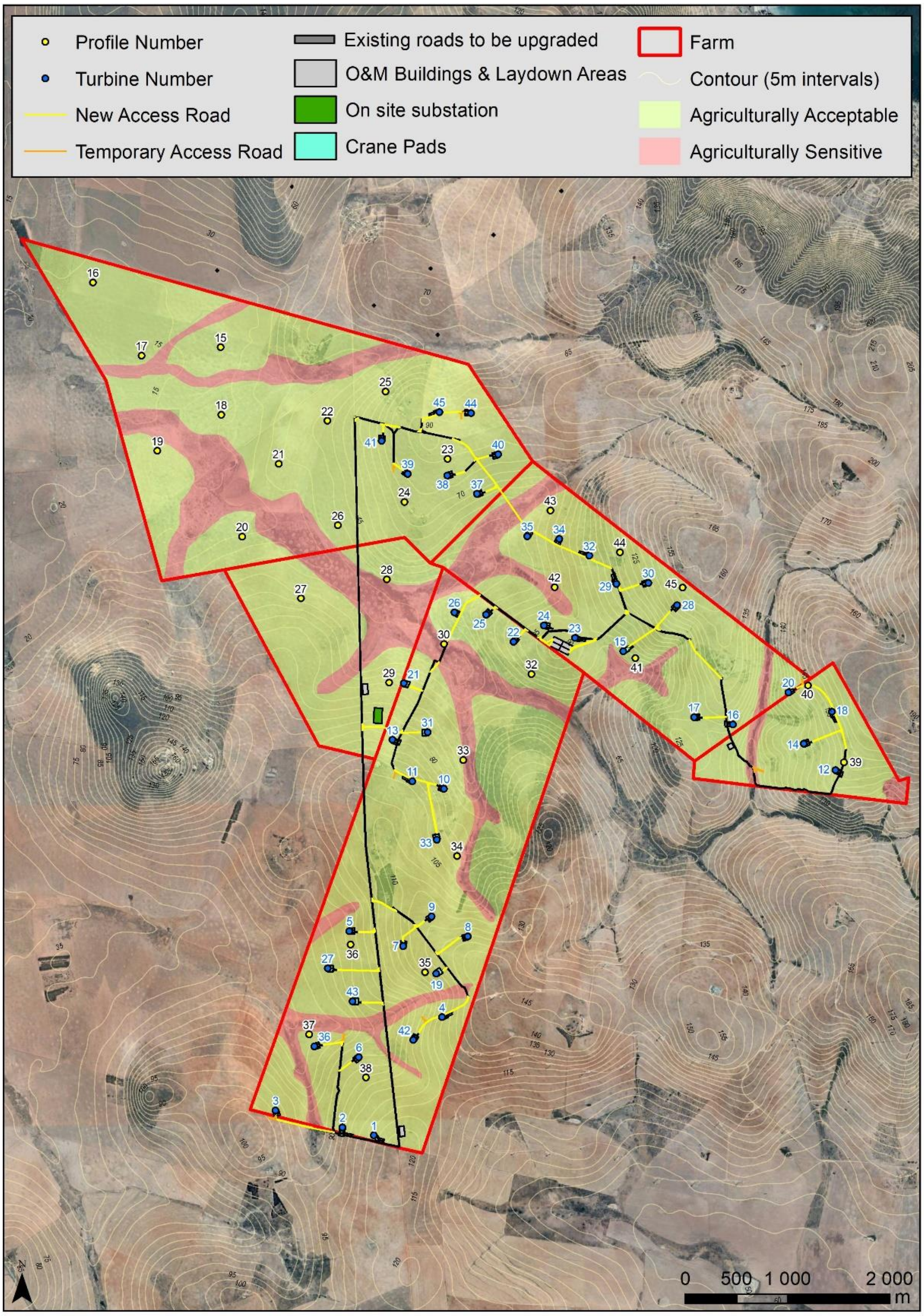


**Figure 3.2 Map showing the infrastructure layout and agriculturally acceptability and sensitivity (November 2018 layout)**

## 11 CONCLUSIONS

This report is in line with the DAFF guidelines and requirements, as well as any requirements under CARA. Regarding CARA requirements we can mention that turbines are not planned to be placed on slopes exceeding 12 %.

The investigation area in the Vredenburg region of the Western Cape Province is characterised by a relatively low and variable rainfall. This reality, when seen together with the relative low suitable soils of the investigation area is the main contributing factors for the area to have a relative low suitability for the production of winter grain crops. The absence of lasting irrigation water sources totally limits the production of perennial crops.

The relevant farms are currently used for agricultural purposes, including small-grain and livestock farming. Farming activities are practiced on a continuous basis on the two farm units where the wind farm development is planned. Farming will continue after the wind farm is constructed. It can therefore be deduced that the farming activities that are practiced are profitable for the farmers, probably due to good managerial skills as far as risk management is concerned. The impact of the project on the financial situation of the farms that are involved, will therefore be determined by, *inter alia*, the following aspects:

- Production possibilities and the profitability levels thereof
- Loss of farming income due to the impact of the project, for example the negative effect of the loss of land on agricultural output.
- Possible gain in income for the farmers due to a profit-sharing/rent-income agreement with the wind-farm developer.

The financial analyses showed relative low profit margins for the grain cropping production system that was assumed (refer to Tables 8.2 to 8.6) for the relevant farms. It is clear from the analyses that the assumed production situation will find it difficult to be profitable in the long run (i.e. to cover the expected yearly farming overhead costs like labour costs managerial expenses, regional taxes, depreciation of equipment and fixed improvements).

The **negative impacts** on farming will therefore mainly be the loss of agricultural land due to the construction of:

- The wind energy turbines
- Internal access roads
- Electrical substation
- Construction laydown area
- Loss of soil due to soil erosion, if not mitigated well

The relevant areas in this regard were calculated as approximately 30 to 35 ha in total for the two farms (i.e. approximately 1.1% of the total farm area). The yearly net loss of agricultural production value on farms 1 and 2 is expected to amount to approximately R5 835 (i.e. 0.9%%), and R2 918 (i.e. 1.6%) respectively. According to Table 9.1, only R9 060 of the yearly gross margin (i.e. approximately 1.1%) will be lost on the farms due to the project. The implication of this extremely low percentage of the farmland to be taken up by the development is that the negative impact on total agricultural production value should be ***virtually zero (i.e. an ignorable negative impact).*** This yearly small loss in agricultural production value must, however, be weighed against, *inter alia*, the following:

> The yearly income that will be generated for the farmer due to the project. This capital injection should enable the farmer to continue farming under the mentioned risky production conditions and therefore keep workers employed which should contribute to the national goal of food security. The expected income from the profit-sharing/rent-income agreement with the wind energy developer should therefore serve as a stabilising factor as far as yearly income is concerned. Possible farming practices should therefore be able to continue in a more stable financial environment and the security in this regard of the farmer, his farm workers and their families should be furthered by the envisaged project.

The **''no-go''** option will therefore be to the disadvantage of the farms that are involved in the alternative energy development as far as the establishment of a more stabilized financial set-up is concerned.

The proposed wind farm development is planned near to an existing (i.e. operational) wind energy facility on adjacent farms (known as the West Coast One Wind Energy Facility). When viewed from an agricultural production perspective, the increase in the wind energy facilities on the farms of the region, due to the planned project, should not have any additional negative impact than that stated in this report.

Based on the findings of this investigation, we are of the opinion that the proposed wind energy facility should have an ***ignorable, small negative impact*** on farming activities on the two farms where it is planned to be constructed, subject to the implementation of appropriate mitigation measures. The impact of the project will not result in a major loss of high potential agricultural land and will therefore not impact negatively on the strive towards food security for South Africa. The project should strengthen the continued financial viability of farming as it should reduce the risk in terms of the limitations experienced on the development site. Jobs should be maintained and thus lead to a more stable financial situation for the farmer and his farm workers.

The project should however, finally be authorised from an agricultural perspective by a responsible State Institution (i.e. National Department of Agriculture)

## 12 REFERENCES

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