REPORT

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SOIL IMPACT ASSESSMENT FOR THE PROPOSED GRID CONNECTION INFRASTRUCTURE FOR THE AGGENEYS 2 SOLAR PV FACILITY NEAR AGGENEYS, NORTHERN CAPE PROVINCE

By

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DECLARATION

I have over 30 years' experience in soil surveying, classification and interpretation. I have compiled over 150 soil survey reports, including numerous EIA and related studies. I have a PhD in soil science and am a member of the Soil Classification Working Group of South Africa.

I hereby declare that I am qualified to compile this report as a registered Natural Scientist (SACNASP Registration No. 400463/04) and that I am independent of any of the parties involved and that I have compiled an impartial report, based solely on all the information available.

D G Paterson
March 2019

CONTENTS **Page**

1. INTRODUCTION		**4**
2. TERMS OF REFERENCE		**5**
	2.1 Legislative and Policy Framework	**5**
3. SITE CHARACTERISTICS		**6**
	3.1 Location	**6**
	3.2 Terrain	**7**
	3.3 Climate	**9**
	3.4 Parent material	**9**
4. METHODOLOGY (Land Type Survey)		**9**
5. SOILS		**10**
	5.1 Site A Field Observations	**13**
	5.2 Erodibility	**14**
6. AGRICULTURAL POTENTIAL		**14**
	6.1 Recommendations	**14**
7. IMPACTS		**15**
	7.1 Cumulative impacts	**16**
	7.2 Limitations and Assumptions	**17**
8. CONCLUSION AND RECOMMENDATION		**19**
	8.1 Measures for inclusion in draft EMP	**19**
REFERENCES		**20**

1. INTRODUCTION

ARC-Institute for Soil, Climate and Water was contracted to provide soil and associated information for the proposed grid connection infrastructure for the Aggeneys 2 solar PV facility near Aggeneys in the Northern Cape Province.

This report specifically deals with the proposed construction of a collector substation and associated power line (up to 220 kV) including associated infrastructure for the Aggeneys 2 - 100MW solar photovoltaic (PV) facility on the farm Bloemhoek 61/rem, in the Northern Cape. The proposed powerline will extend from the PV project site to the Aggeneis Main Transmission Substation (MTS) located ~14km to the west. It must be noted that the Aggeneys 2 solar PV facility will not form part of this environmental authorisation process, but will form part of a separate environmental authorisation application.

The proposed grid connection infrastructure for Aggeneys 2 consists of the following:

- A single circuit power line with a capacity of up to 220 kV and a maximum height of up to 40 m. The servitude width would be up to a maximum of 47 m wide and two alternative corridors have been proposed for assessment as follows:
    - Alternative 1 – follows an existing 400kV power line, and eventually meets with and follows the N14, extending for approximately 15 km in length; and
    - Alternative 2 – follows the Loop 10 gravel road, and eventually meets with and follows the N14, extending for approximately 17 km in length.
- A new collector substation/ switching station including new feeder bays, busbars, protection equipment etc., with an area of approximately 1.25 ha, would be located at the eastern end of the power line;
- A gravel access road (to be tarred if required) to the substation, ~6 m wide and up to ~2 km long;
- New feeder bay/s at the exiting Aggeneys Main Transmission Substation (MTS).

2. TERMS OF REFERENCE

The purpose of the investigation is to contribute to the Basic Assessment process for the proposed grid connection infrastructure for Aggeneys 2. A Basic Assessment is being undertaken as the project is located within the Springbok Renewable Energy Development Zone 8. The objectives of the study are;

- To obtain all existing soil and related information,
- To produce a soil map of the specified area, and
- To assess broad agricultural potential and impacts.

2.1 Legislative and Policy Framework

In terms of the Subdivision of Agricultural Land Act (Act 70 of 1970), any application for change of land use must be approved by the Minister of Agriculture, while under the Conservation of Agricultural Resources Act (Act 43 of 1983) no degradation of natural land is permitted.

The following section summarises South African Environmental Legislation with regard to soil and agricultural issues:

- The law on ***Conservation of Agricultural Resources*** (Act 43 of 1983) states that the degradation of the agricultural potential of soil is illegal. The Act also requires the protection of land against soil erosion and the prevention of water logging and salinization of soils by means of suitable soil conservation works to be constructed and maintained. The utilisation of marshes, water sponges and watercourses are also addressed.

- The ***Bill of Rights*** states that environmental rights exist primarily to ensure good health and well-being, and secondarily to protect the environment through reasonable legislation, ensuring the prevention of the degradation of resources.

- The Environmental right is furthered in the ***National Environmental Management Act*** (No. 107 of 1998), which prescribes three principals, namely the precautionary principle, the "polluter pays" principle and the preventive principle. It is stated in the above-mentioned act that the individual/group responsible for the degradation/pollution of natural resources is required to rehabilitate the polluted source.

- Soils and land capability are protected under the ***National Environmental Management Act*** (Act 107 of 1998), the ***Environmental Conservation Act*** (Act 73 of 1989) and the ***Conservation of Agricultural Resources Act*** (Act 43 of 1983).

- The ***National Veld and Forest Fire Bill*** of 10 July 1998 and the ***Fertiliser, Farm Feeds, Agricultural Remedies and Stock Remedies Act*** (Act 36 of 1947) can also be applicable in some cases.

- The ***National Environmental Management Act*** (Act 107 of 1998) requires that pollution and degradation of the environment be avoided, or, where they cannot be avoided, minimised and remedied.

3. SITE CHARACTERISTICS

3.1 Location

An area was investigated lying to the south-east of the town of Aggeneys on the Remaining Extent of the farm Bloemhoek 61. The broader study area lies between 29^{o} 14' and 29^{o} 22' S and between 18^{o} 52' and 19^{o} 00' E, as is shown by the black line in Figure 1. The position of the proposed Aggeneys 2 project site is shown by the green polygon on Figure 1, with the proposed grid alternative corridors to the existing Aggeneys Main Transmission Substation (MTS) to the west shown by the blue and red lines.

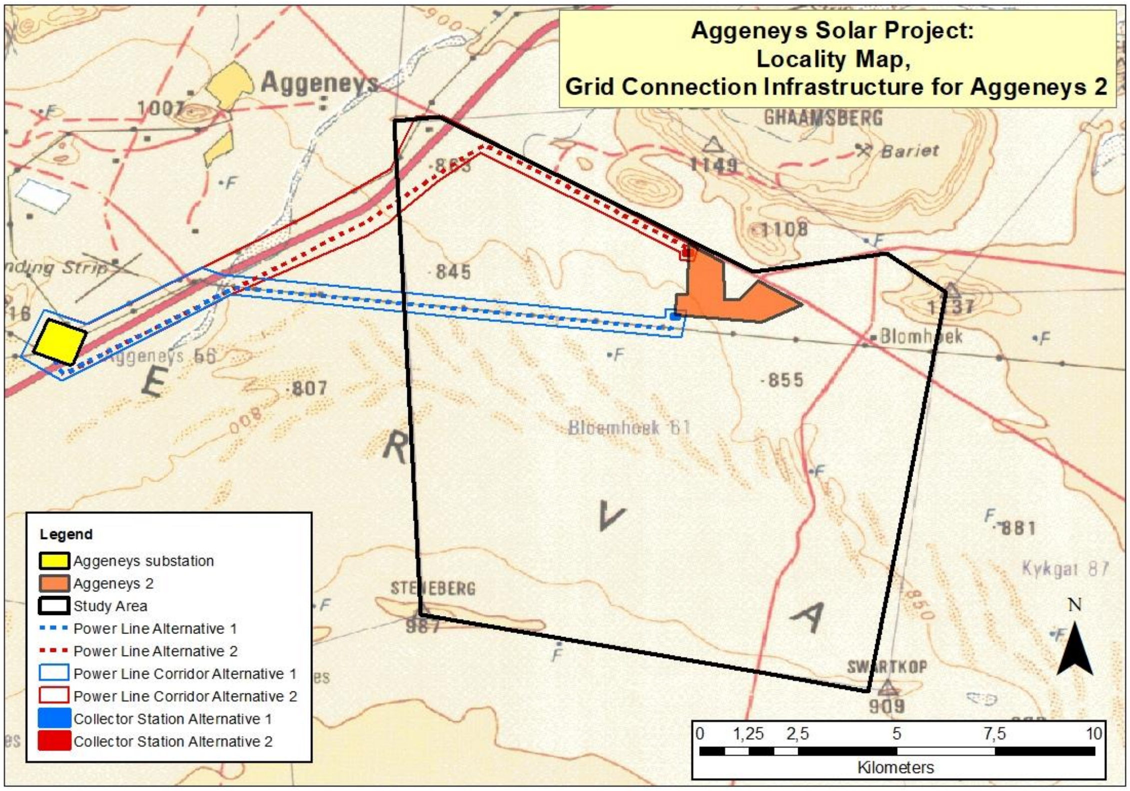

Figure 1 *Grid connection and associated infrastructure locality map*

3.2 Terrain

The broader study area (including the project site) consists of gently undulating topography, with slopes of less than 5% over most of the area, and with an altitude above sea level of between 850 and 1 000 m.

The current natural vegetation of the project site is very sparse natural shrub vegetation (see Figure 2). The site also includes a significant proportion of sand dunes along portions of the southern grid corridor, as well as to the south (see Figure 3).


Figure 2 *Natural vegetation in study area*

Figure 3 *Dune landscape in study area*

3.3 Climate

The climate of the area has a mostly all year rainfall distribution, but the annual average is very low, at around 75 mm per year, although this might be slightly higher in the higher parts of the landscape (Koch *et al.*, 1987).

Temperatures will be warm to very hot in summer, with daily maximums regularly exceeding 40°C, but cool to cold in winter, with almost no occurrence of frost.

3.4 Parent Material

The area is underlain by Quaternary sediments, mostly sandy (Geological Survey, 1984). As previously stated, dunes occur in places in the landscape.

4. METHODOLOGY (Land Type Survey)

Existing information was obtained from the map sheet 2918 Pofadder (Schloms & Ellis, 1987) from the national Land Type Survey, published at a 1:250 000 scale. A ***land type*** is defined as an area with a uniform terrain type, macroclimate and broad soil pattern. The soils are classified according to MacVicar *et al* (1977).

The grid corridors under investigation are covered by two land types, as shown on the map in Figure 4, namely:

- **Af21, Af26** (High base status, red soils, with dunes)

It should be clearly noted that, since the information contained in the land type survey is of a reconnaissance nature, only the general dominance of the soils in the landscape can be given, and not the actual areas of occurrence within a specific land type. Also, other soils that were not identified due to the scale of the survey may also occur.

A summary of the dominant soil characteristics of each land type is given in Table 1 below.

Column 6 shows the distribution of agricultural potential per soil class within each land type (see Section 5), with the dominant class shown in **bold**. These figures will always add up to 100%, so that the relative proportions of each potential class within every land type can be determined and easily compared with other land types.

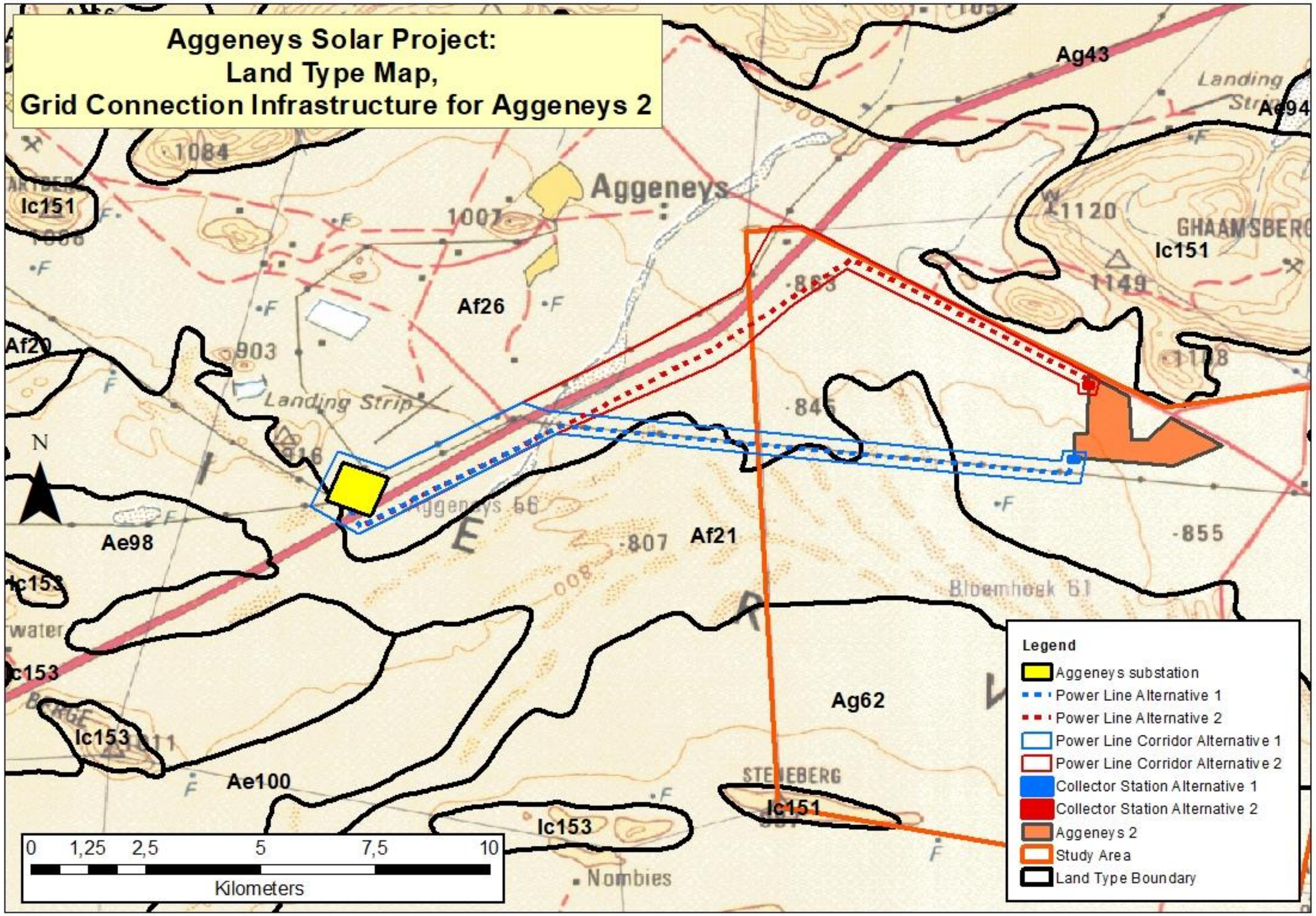

Figure 4 *Land types occurring, grid connection infrastructure for Aggeneys 2*

Table 1 Land types present within the grid corridors (with soils in order of dominance)

Land Type	Dominant soils	Depth (mm)	Percent of land type	Characteristics	Agric. Soil Potential* (%)
Af21	Hutton 31 Hutton 32/35	>1200 300-700	75% 16%	Red, sandy, structureless dune soils Red, sandy, structureless soils, on calcrete/dorbank	High: 0.0 Mod: 0.0 **Low: 100.0**
Af26	Hutton 30/31 Fernwood 21	>1200 >1200	63% 17%	Red, sandy, structureless soils, occasional dunes Grey, sandy, structureless soils	High: 0.0 Mod: 0.0 **Low: 100.0**

***Note** – this describes the **soil characteristics only**, and does not take into account any other limiting factors, such as climate.

5 SOILS

5.1 Field observations

The site was visited on 6th and 7th November 2018. The purpose of the field visit was to confirm by reconnaissance ground-truthing, the soils occurring in the area, as well as to carry out a visual evaluation of the landscape.

As evident from Figure 4, the proposed grid connection corridors lie largely within land type Af26, which consists largely of deep, sandy soils, as well as land type Af21 to the south, which has a large component of dune soils. However, the field investigation confirmed the presence of shallower soils along much of the two routes, with soils classified as belonging to the **Garies** (orthic topsoil on red apedal subsoil on cemented dorbank) and **Knersvlakte** (orthic topsoil on cemented dorbank) forms, with depths of between 450 and 900 mm. Some outcrops of gravel and dorbank were also observed at the surface, as shown in Figure 5. In the dune areas to the south, deeper (>1 200 mm) red sandy soils were encountered (Figure 3).

Figure 5 *Cemented dorbank layer exposed in soil profile*

5.2 Erodibility

The soils present along the proposed grid corridors are not considered susceptible to erosion by water. However, if the vegetation cover is disturbed (for example by overgrazing or construction activities) and considering the sandy nature of the topsoils, as well as the dry climate, there is a significant possibility of removal of some or all of the topsoil by wind action.

This can be mitigated by ensuring that the minimum area is disturbed, and that rehabilitation of surface vegetation is carried out as soon as possible.

6. AGRICULTURAL POTENTIAL

As can be seen from the information contained in Table 1, there are no high potential soils present within the project site and the soils are of generally low potential at best. This is due mainly to a combination of the restricted depth in places (observed during the field visit) and the sandy texture which will lead to rapid water infiltration and the soils drying out.

In addition, the low rainfall in the area (Section 3.3) means that there is in any case little potential for rain-fed arable agriculture in the area. Arable production would therefore be possible only by irrigation, and no indications of any irrigated areas, within and surrounding the project site, can be identified through Google Earth.

In general, the soils that do occur within the project site are suited for extensive grazing at best and furthermore the grazing capacity of the area is very low, at around 26-40 ha/large stock unit (ARC-ISCW, 2004).

6.1 Recommendations

The prevailing potential of the soils for rain-fed cultivation throughout most of the area, as well as the use of irrigation activities for cultivation, is low. Considering the land types and soils located within the project site and the current land-use activities, it is recommended that no further detailed soil investigation is required for the proposed grid connection infrastructure for Aggeneys 2.

7. IMPACTS

Two impacts have been identified to be associated with the development of grid connection infrastructure for Aggeneys 2 from a soils perspective; these impacts include:

***Impact 1* (Table 2)**: In most environmental investigations, the major impact on the natural resources of the site would be the loss of potential agricultural land due to the specified development. However, in this instance, there is no evidence of any cultivation in the vicinity, this impact would be of extremely limited significance and would be local in extent, if at all.

***Impact 2* (Table 3)**: In this area, the sandy soils, coupled with the dry climate, means that a possible impact would be the increased risk of wind erosion of the topsoil when vegetation cover is removed or disturbed. This would be especially relevant for the construction of access roads, the Collector Substation/ Switching Station, the power line and other associated infrastructure.

The significance of the impacts on the grid corridors can be summarised as follows:

Table 2 Loss of agricultural land

Nature: Loss of potentially productive agricultural land *(both construction and operation phase)*		
	Without mitigation	**With mitigation**
Extent	Low (1)	Low (1)
Duration	Long-term (4)	Long-term (4)
Magnitude	Low (4)	Minor (2)
Probability	Probable (3)	Improbable (2)
Significance (E+D+M)x P	**Low (27)**	**Low (14)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Yes	
Mitigation: The main mitigation measures would be: • To minimise the footprint of construction as much as possible.		
Cumulative impacts: likely to be low, as all soil-related aspects will be confined to the site, and the prevailing agricultural potential in the area is low.		
Residual Risks: likely to be low, since the implementation of the appropriate mitigation measures will enable more or less complete rehabilitation during and after the life of the project.		

Table 3: Soil erosion

Nature: Increased soil erosion hazard by wind *(construction and operation phase)*		
	Without mitigation	**With mitigation**
Extent	Medium (3)	Low (1)
Duration	Permanent (5)	Short-term (2)
Magnitude	High (8)	Minor (2)
Probability	Highly probable (4)	Improbable (2)
Significance (E+D+M) x P	**High (64)**	**Low (10)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	High
Irreplaceable loss of resources?	Very possible	No
Can impacts be mitigated?	Yes	Yes
Mitigation: The main mitigation measures would be: • To minimise the footprint of construction as much as possible. • Where soil is removed/disturbed, ensure it is stored for rehabilitation and re-vegetated as soon as possible. • Implement all appropriate soil conservation measures, including contouring, culverts etc. (for road construction), geotextiles and slope stabilisation (for all infrastructure).		
Cumulative impacts: likely to be high, as wind erosion can carry soil particles for a considerable distance, depending on wind strength and direction, as well as soil texture.		
Residual Risks: if mitigation is not carried out, long-term wind erosion, with results such as loss of valuable topsoil, may occur.		

The main impact would be for the excavation for the foundations of the supporting structures for the power line, the Collector Substation/ Switching Station, and connecting infrastructure and any required parallel service road, where wind erosion could also be a problem.

7.1 Cumulative Impacts

The likelihood of cumulative impacts for wind erosion may be significant, if not mitigated. This is because concurrent developments are proposed close to the grid corridors investigated in this report; this is summarised in Table 4 below.

When considering the other renewable energy developments within the surrounding area, it is assumed that the impact of erosion and appropriate mitigation measures at a site-specific level for each of the facilities (as well as any grid connection infrastructure that may be required) has been considered and the mitigation measures recommended are sufficient for the management and mitigation of erosion. Therefore, considering that the impact of erosion at each facility will be low in extent, subject to the implementation of the recommended mitigation measures, and managed for each facility separately, the cumulative impact for erosion is considered to be low. Under these circumstances, the loss associated with erosion is therefore considered to be acceptable, without detrimental consequences.

If there is large scale development of renewable energy facilities in the area, any failure to prevent wind erosion of topsoil on one project could lead to that material being deposited on any or all neighbouring properties.

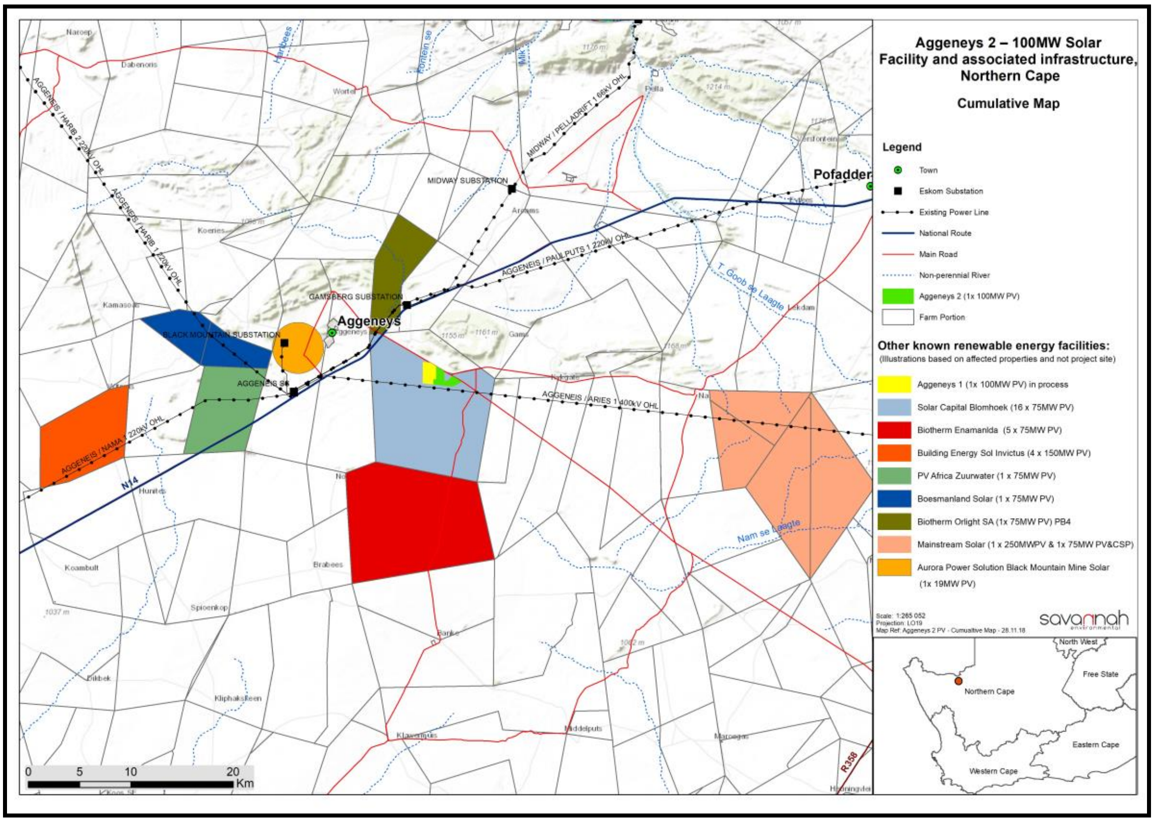

Figure 6 Map showing Renewable Energy projects in the vicinity of Aggeneys 2 (Courtesy of Savannah Environmental, 2019)

7.2 Assumptions and Limitations

The main limitation regarding soil information has been addressed with the field visit, which has confirmed soil conditions prevalent in the area, as well as carrying out a visual inspection.

It is assumed that, for accurate determination of any cumulative impacts, there will be an optimal level of co-operation between representatives of all projects planned in the vicinity in the future. This will ensure that important environmental information is not withheld, that could lead to increased impact levels, such as wind erosion.

The cumulative impacts are summarised in Table 4 below.

Table 4 Cumulative Impact

Nature: Cumulative impact of the Proposed Development in terms of wind erosion		
	Overall impact of the proposed project considered in isolation[1]	**Cumulative impact of the project and other projects in the area**[2]
Extent	Low (1)	Low (2)
Duration	Short-term (2)	Short-term (2)
Magnitude	Minor (2)	Minor (2)
Probability	Improbable (2)	Improbable (2)
Significance (E+D+M)x P	**Low (10)**	**Low (12)**
Status (positive/negative)	Negative	Negative
Reversibility	High	High
Loss of resources?	No	No
Can impacts be mitigated?	Yes	
Confidence in findings: High.		
Mitigation: The main mitigation measures would be: • To minimise the footprint of construction as much as possible. • Where soil is removed/disturbed, ensure it is stored for rehabilitation and re-vegetated as soon as possible. • Implement all appropriate soil conservation measures, including contouring, culverts etc. (for road construction), geotextiles and slope stabilisation (for all infrastructure). • Ensure that equal responsibility and co-operation is accepted if more than one facility will be using the same access road, or if the possibility exists of sediment transfer (by wind or water) from one site to another		
Residual Risks: Significant risk of accelerated soil erosion by wind if mitigation measures of each grid connection corridor are not applied correctly.		

[1] It is assumed that the appropriate mitigation measures have been implemented.
[2] It is assumed that the appropriate mitigation measures have been implemented.

8 CONCLUSION AND RECOMMENDATIONS

The main recommendation is that care should be taken within all aspects of the construction phase to ensure that erosion is managed and mitigated appropriately. The project site is a dry area, with fragile vegetation and sandy topsoils and will be susceptible to uncontrolled topsoil removal by wind. The long-term effects of ignoring this aspect could be severe, both for the project and for the surrounding environment.

8.1 Measures for inclusion in the draft Environmental Management Programme

OBJECTIVE: Conservation, as far as possible, of the existing soil resource, both on site and in adjoining areas.

Project component/s	Construction of all infrastructure where topsoil will be disturbed
Potential Impact	Loss of topsoil leading to wind erosion
Activity/risk source	Construction activities
Mitigation: Target/Objective	To retain all topsoil with a stable soil surface

Mitigation: Action/control	Responsibility	Timeframe
• Storage of all topsoil that is disturbed (maximum height 2 m; maximum length of time before re-use 18 months)	Construction Engineer	Construction
• Immediate replacement of topsoil after the undertaking of construction activities within an area	Construction Engineer	Construction
• Soil conservation measures must be put in place to ensure soil stabilisation	Construction Engineer	Post-Construction

Performance Indicator	No indications of visible topsoil loss
Monitoring	Visual inspection every 6 months (minimum) of all areas where disturbance has taken place (for the duration of the project) If soil loss is suspected, acceleration of soil conservation and rehabilitation measures must be implemented (as specified above)

Considering the findings of the report and the current soils environment within which the grid connection infrastructure for Aggeneys 2 is proposed, it is the opinion of the specialist that the proposed activities should be authorised, subject to the implementation of the recommended mitigation measures. Regarding the two alternatives (Alternatives 1 and 2 as shown on Figure 1), the northern alternative (Alternative 2) would be preferred, due to the lesser occurrence of dunes, which could lead to increased level of wind erosion, especially in the long term.

Otherwise, the activities proposed are considered to be acceptable from a soils perspectives considering the characteristics and potential of the soils present within the project site.

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