BTE RENEWABLES (PTY) LTD

ESIZAYO EXPANSION
SOIL AND AGRICULTURAL POTENTIAL STUDY

06 APRIL 2022

DRAFT

ESIZAYO EXPANSION

SOIL AND AGRICULTURAL POTENTIAL STUDY

BTE RENEWABLES (PTY) LTD

DRAFT

PROJECT NO.: 41103063
DATE: APRIL 2022

WSP
BUILDING C, KNIGHTSBRIDGE
33 SLOANE STREET
BRYANSTON, 2191
SOUTH AFRICA

T: +27 11 361 1380
F: +086 606 7121
WSP.COM

QUALITY MANAGEMENT

ISSUE/REVISION	FIRST ISSUE	REVISION 1	REVISION 2	REVISION 3
Remarks	Draft			
Date	April 2022			
Prepared by	Karen King			
Signature				
Checked by	Ashley Strong			
Signature				
Authorised by	Karen King			
Signature				
Project number	41103063			
Report number	R01			
File reference	41103063-Soils Assessment-20220406.docx			

TABLE OF CONTENTS

APPENDIX

TABLES

FIGURES

1 INTRODUCTION

WSP in Africa (WSP), a wholly owned affiliate of WSP Global Inc., has been appointed by BTE Renewables (Pty) Ltd to undertake a Soil and Agricultural Potential Assessment for the proposed expansion of the Esizayo Wind Energy Facility (WEF) (herein referred to as the Project).

The Project lies approximately 30km Northwest of Laingsburg in the Western Cape, and falls within the Laingsburg Local Municipality, which is located within the Central Karoo District Municipality (see **Figure 1**).

The aim of this assessment is to provide descriptions of the soil forms and their distribution within the project area, and to determine the typical soil properties, as well as current land use, land capability and soil potential. A soils potential impact assessment was also carried out and associated mitigation measures recommended.

This report was prepared by Ms Karen King, a professional registered soil scientist (Pr.Sci.Nat, M.Sc.). Ms King has 16 years' work experience and specialises in agricultural studies, soil science and related risk assessments and management plans. Ms. King's Curriculum Vitae is included in Appendix A.

1.1 BACKGROUND

On 14 July 2017, BTE Renewables (Pty) Ltd (BTE) received an EA (DFFE Ref no: 14/12/16/3/3/2/967) for the Esizayo Wind Energy Facility (WEF) proposed to be constructed on the following portions:

- Portion 1 of Aanstoot Farm No 72;
- Annex Joseph's Kraal Farm No 84, and
- Aurora Farm No 285.

BTE now proposes to expand the existing authorised Esizayo WEF extent by adding three new land parcels as listed below:

- Portion 2 of Farm Aanstoot Farm 72 (2/72);
- Portion 1 of Farm Leeuwenfontein 71 (1/71), and
- Remainder of Farm Leeuwenfontein 71 (RE/71).

1.2 PROJECT DESCRIPTION

The Project entails the expansion of the existing Esizayo WEF extent through the addition of three (3) land parcels with a total development infrastructure footprint of approximately 200 ha. To enable the facility to supply a contracted capacity of up to 200 MW, the proposed development will incorporate the following infrastructure (**Figure 2**):

- Up to 23 wind turbines. Each turbine with a foundation of up to 25 m in diameter and up to 4m in depth, compacted hard standing areas of up to 4.5 ha each;
- Internal roads traversing a length of 30 km with a width of 9 m;
- 33 kV underground cables or overhead powerlines;
- 33 kV and/or 132 kV substations;
- Fence around the project development area;
- Site offices and maintenance buildings, including workshop areas for maintenance and storage; and
- Laydown areas.

1.3 PROPOSED PROJECT DEVELOPMENT ACTIVITIES

- The typical steps involved in the construction and operation of a wind energy facility is summarised below:
- Planning Phase
  - Step 1: Surveying of the development area and negotiation with affected landowners; and
  - Step 2: Final design and micro-siting of the infrastructure based on geotechnical, topographical conditions and potential environmental sensitivities.
- Construction Phase
  - Step 3: Vegetation clearing and construction of access roads/tracks (where required);
  - Step 4: Construction of tower structure foundations;
  - Step 5: Assembly and erection of infrastructure on site;
  - Step 6: Stringing of conductors; and
  - Step 6: Rehabilitation of disturbed areas and protection of erosion sensitive areas.
- Operation Phase
  - Step 7: Continued maintenance during operation.

1.3.1 CONSTRUCTION PHASE

Construction of the WEF is anticipated for a period of up to 24 months. The main activities associated with the construction phase of the wind energy project will include the following:

ESTABLISHMENT OF INTERNAL ROADS

Internal road access will be constructed onsite. These roads will be up to 9m in width. The length of the internal road network is approximately 30km.

SITE PREPARATION

Site preparation includes the clearance of vegetation and any bulk earthworks (including blasting if required) within the footprint of each construction area that may be required in terms of the facility design.

ESTABLISHMENT OF A LAYDOWN AREA ON SITE

Construction materials, machinery and equipment will be kept at relevant laydown and/or storage areas. The expansion project will use the authorised Esizayo project's construction laydown area. The laydown area will limit potential environmental impacts associated with the construction phase by limiting the extent of the activities to one designated area.

CONSTRUCT FOUNDATION

Concrete foundations will be constructed at each turbine location. Foundation holes will be mechanically excavated to a depth of 4m, depending on the local geology. Concrete will be at the authorised Esizayo project's cement batching plant.

CONSTRUCTION OF THE TURBINE

A large lifting crane will be brought onto site to lift each of the tower parts into place.

CONSTRUCT IPP SUBSTATION AND INVERTORS

Invertors will be installed to facilitate the connection between the wind turbines and the Eskom Grid. The turbines will be connected to the substation via underground or overhead cabling. The substation will be constructed with a maximum footprint of approximately 150m x 150m.

ESTABLISHMENT OF ANCILLARY INFRASTRUCTURE

The expansion project will use the authorised Esizayo project's Operations and Maintenance building, storage areas, office and a temporary laydown area for contractor's equipment.

UNDERTAKE SITE REHABILITATION

The site will be rehabilitated once the construction phase is complete and all construction equipment and machinery have been removed from site.

1.3.2 OPERATIONAL PHASE

The proposed WEF Expansion is anticipated to have a minimum life of 20 years. The facility will operate 7 days a week. While the project is self-sufficient, maintenance and monitoring activities will be required. Potable water requirements for permanent staff will be limited and provided by bottled water.

During the operational phase there will be little to no Project-related movement along the servitude as the only activities are limited to maintaining the servitude (including maintenance of access roads and cutting back or pruning of vegetation to ensure that vegetation does not affect the WEF), inspection of the WEF infrastructure and repairs when required. Limited impact is expected during operation since there will not be any intrusive work done outside of maintenance in the event that major damage occurs to site infrastructure.

Operation of the WEF will involve the following activities, discussed below.

SERVITUDE MANAGEMENT AND ACCESS ROAD MAINTENANCE

Servitude and access road maintenance is aimed at eliminating hazards and facilitating continued access to the WEF. The objective is to prevent all forms of potential interruption of power supply due to overly tall vegetation/climbing plants or establishment of illegal structures within the right servitude. It is also to facilitate ease of access for maintenance activities on the WEF. During the operational phase of the project, the servitude will be maintained to ensure that the functions optimally and does not compromise the safety of persons within the vicinity of the WEF.

WIND ENERGY FACILITY MAINTENANCE AND OPERATIONS

BTE will develop comprehensive planned and emergency programmes through its technical operations during the operation and maintenance phase for the WEF. The maintenance activities will include:

— BTE's Maintenance Team will carry out periodic physical examination of the WEF and its safety, security and integrity.

— Defects that are identified will be reported for repair. Such defects may include defective conductors, flashed over insulators, defective dampers, vandalised components, amongst others.

  Maintenance / repairs will then be undertaken.

1.3.3 DECOMMISSIONING PHASE

Following the initial 20-year operational period of the wind facility, the continued economic viability will be investigated. If the facility is still deemed viable, the life of the facility will be extended. The facility will only be decommissioned once it is no longer economically viable. If a decision is made to completely decommission the facility, this will be subject to a separate authorisation and impact assessment process, all the components will be disassembled, reused and recycled or disposed of. The site would be returned to its current use (grazing).

1.4 STUDY LIMITATIONS

- The geotechnical study has not yet been completed, so it is not yet known whether any large excavations and stabilized backfill will be required. The impact and mitigation assessment has been undertaken assuming that this is not the case.
- Site access was difficult owing to the terrain, a lack of access roads and inclement weather.
- The site could not be traversed such that an even grid matrix of classification points could be set up. As a result, some extrapolation of findings was necessary.

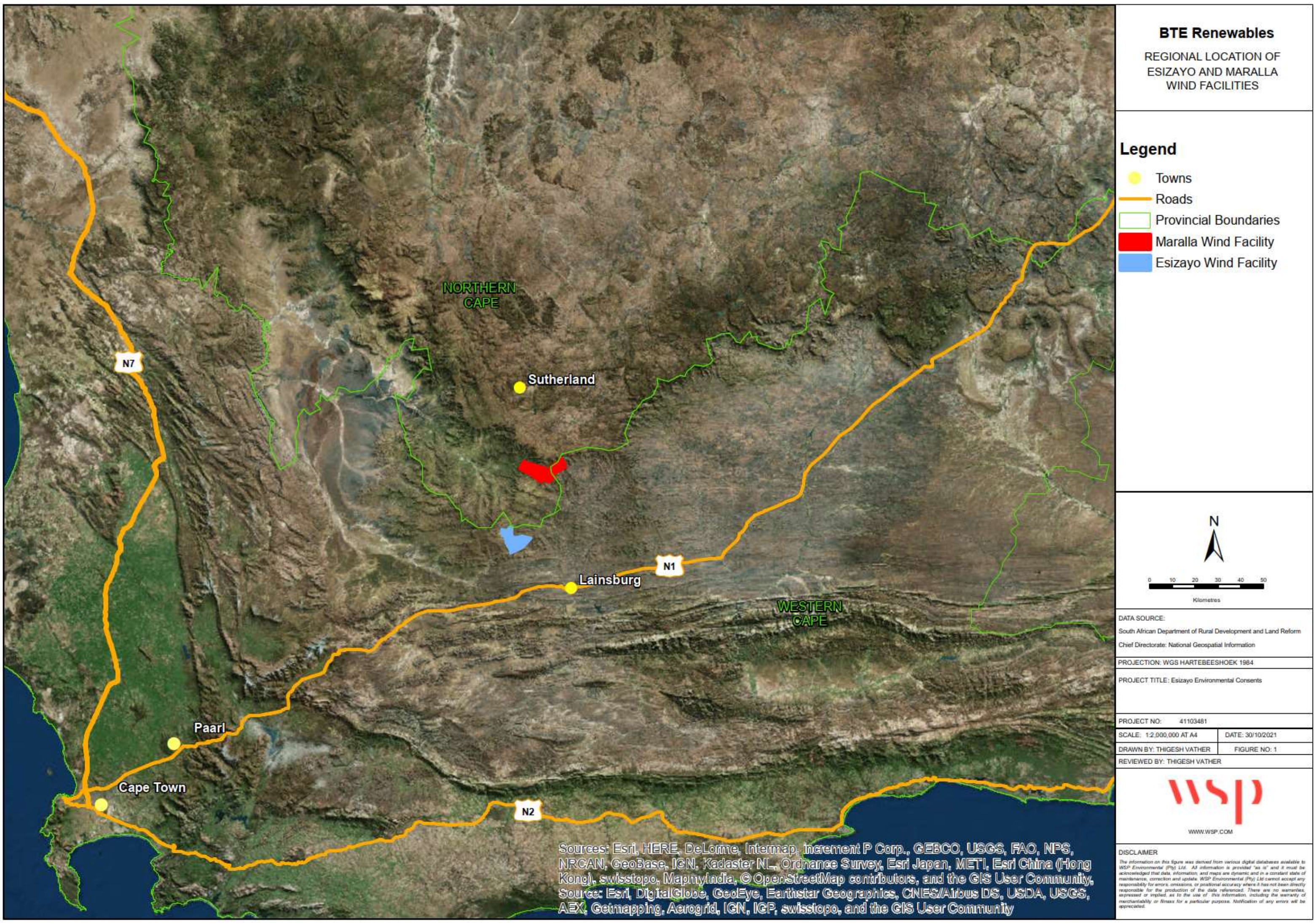

Figure 1: Esizayo Regional Site Setting

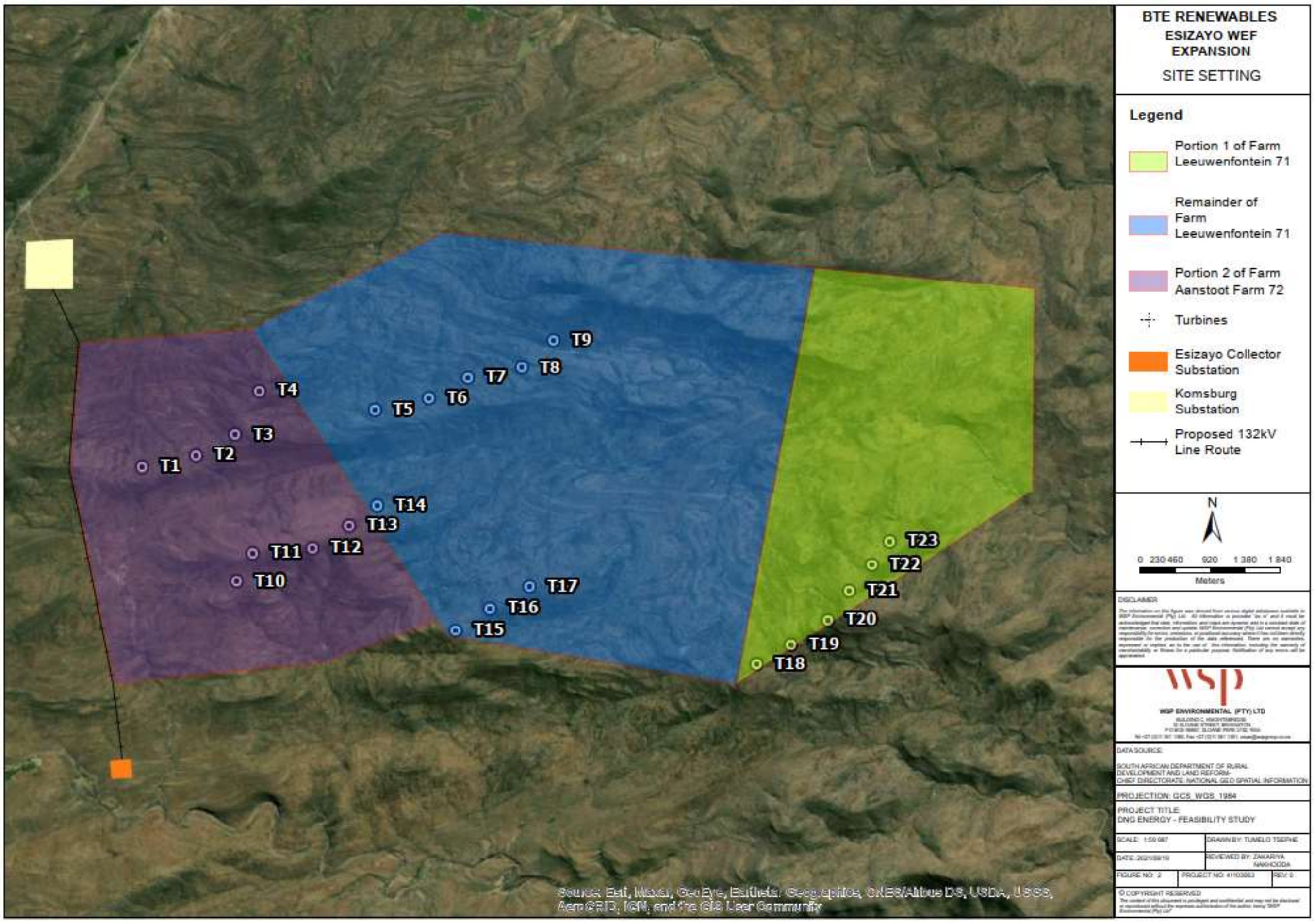

Figure 2: Esizayo Local Site Setting

2 RELEVANT LEGISLATION

The legislation that has direct implications for how soils are managed is the Conservation of Agricultural Resources (Act 43 of 1983) (CARA). Other environmental legislation such as the Environmental Conservation Act (Act 73 of 1989), the National Environmental Management Act (Act 107 of 1998) and the National Water Act (Act 36 of 1998) provide guidance on environmental activities and sets out the principles of Duty of Care, Pollution Control and Waste Management. The relevant sections of the CARA are discussed below.

2.1 CONSERVATION OF AGRICULTURAL RESOURCES ACT 43 OF 1983 ("THE CARA")

The purpose of the CARA is to provide for the control over the utilization of the natural agricultural resources of the Republic so as to promote the conservation of the soil, the water sources and the vegetation and the combating of weeds and invader plants. The Act states that control measures may be applied to (amongst others):

- The utilization and protection of land which is cultivated;
- The prevention or control of waterlogging or salination of land;
- The restoration or reclamation of eroded land or land which is otherwise disturbed or denuded.

The Act further states that different control measures may be prescribed in respect of different classes of land users or different areas or in such other respects as the Minister may determine.

- Any land user who refuses or fails to comply with any control measure which is binding on him, shall be guilty of an offence.

The implication of this for the project are that control measures will be required to manage and where possible mitigate the impacts of the project on soil and land capability.

3 BASELINE ENVIRONMENT

3.1 CLIMATE

The climate of the region is arid to semi-arid. Rainfall is low and occurs throughout the year but predominantly in the winter months between March and August. Mean annual precipitation is approximately 290mm, ranging from 180 – 410mm rainfall per year. The region experiences dry hot summers and the warmest month of the year is February which averages 23.4°C. The lowest average temperatures in the year occur in July, averaging approximately 9.3°C. The region experiences steady, strong winds between December and April; however, the winds calm between the months of June and October.

3.2 LAND COVER

Based on the Mucina and Rutherford (2006) natural vegetation classification map, the area is mostly Central Mountain Shale Renosterveld, with a minor contribution of Koedoesberge-Moordenaars Karoo. The Department of Agriculture, Forestry and Fisheries (DAFF) define the land use within the site as predominantly Shrubland and Low Fynbos (DAFF, 2012). During the site visit, the vegetation present was identified as mostly shrub-like vegetation.

3.3 GEOLOGY

The general geological description of the area is based on the 1:1 000 000 geological map for the Northern Cape Province, published by the Trigonometrical Survey Office in 1970 (Schifano *et.al.*,1970). The Site is nested in the Roggeveld Mountains range, in the Larger Cape Fold belt system. The site is located on the Beaufort Series which forms part of the Karoo system. The rock type for the series comprises of shale, mudstone, sandstone and limestone (Schifano *et al.,* 1970). During the site visit it was observed that shale and mudstone were the dominant rock type for the area.

3.4 TOPOGRAPHY

The topography of the area comprises mountainous hillslopes (part of the Roggeveld Mountain Range) with small patches of open rocky ground in between, and numerous watercourses and drainage channels. The hillslopes have an average gradient of 34.4 % and 1.1% on the open flat ground. The elevation of the area ranges from 984 m to 1 379 m above mean sea level (amsl).

4 METHODOLOGY

4.1 DESKTOP ASSESSMENT

A desktop assessment was undertaken for the site. This included assessing relevant past environmental reports, site characteristics using Geographic Information System (GIS) and aerial imagery, and soils databases.

4.2 SITE ASSESSMENT

A site visit was conducted during the summer season between the 27th and 29th March 2022. A free format soils classification survey of the study area was undertaken on foot, using a hand-held bucket auger to identify soil forms present at on site. Current activities at the site were also noted, and specific areas of land use were noted. A hand-held GPS was used to record the location of each point.

4.3 SOIL CLASSIFICATION

The soils identified in the field were classified by form in accordance with the South African soil taxonomic system (Soil Classification Working Group, 1991). All South African soil forms fall within 12 soil types; Duplex (marked accumulation of clay in the B horizon), Humic (intensely weathered, low base status, exceptional humus accumulation), Vertic (swelling, cracking, high activity clay), Melanic (dark, structured, high base status), Silicic (Silica precipitates as a dorbank horizon), Calcic (accumulation of limestone as a horizon), Organic (peaty soils where water inhibits organic breakdown), Podzolic (humic layer forms beneath an Ae or E), Plinthic (fluctuating water table causes iron re-precipitation as ferricrete), Oxidic (iron oxides weather and colour soils), Hydromorphic (reduced lower horizons) and Inceptic (young soils - accumulation of unconsolidated material, rocky B or disturbed) soils.

4.4 SOIL CAPABILITY ASSESSMENT

The area's soils capability was assessed and mapped, based on the results of the classification study. The South African land capability classification system by Scotney *et al*. (1987) was used to identify and map soil capability (**Table 1**). This system is useful in that it is able to quickly provide an overview of the agricultural capability and limitations of the soils in question and is useful for soil capability comparisons. A shortcoming of this system, however, is that it is very agriculturally focussed, offering little information about the soil potential for alternative uses. For this reason an alternative soil capability assessment tool developed in-house by WSP and informed by the IEMA Land and Soils in EIA Guide (IEMA, 2021) was also applied to the site (**Table 2**). A key aspect of this method is that input is gathered in an interdisciplinary manner. As the proposed use of the land for this study is WEF turbines, the geotechnical expert working on the project was consulted. The outcomes of this tool, however, cannot be used in the place of a geotechnical or structural investigation.

Table 1: Land Capability Classification System (Scotney *et al.*, 2014)

Land Capability Group	Land Capability Class	Increased intensity of use									Limitations
Arable	I	W	F	LG	MG	IG	LC	MC	IC	VIC	No or few limitations. Very high arable potential. Very low erosion hazard
	II	W	F	LG	MG	IG	LC	MC	IC	-	Slight limitations. High arable potential. Low erosion hazard
	III	W	F	LG	MG	IG	LC	MC	-	-	Moderate limitations. Some erosion hazards
	IV	W	F	LG	MG	IG	LC	-	-	-	Severe limitations. Low arable potential. High erosion hazard.
Grazing	V	W	-	LG	MG	-	-	-	-	-	Water course and land with wetness limitations
	VI	W	F	LG	MG	-	-	-	-	-	Limitations preclude cultivation. Suitable for perennial vegetation
	VII	W	F	LG	-	-	-	-	-	-	Very severe limitations. Suitable only for natural vegetation
Wildlife	VIII	W	-	-	-	-	-	-	-	-	Extremely severe limitations. Not suitable for grazing or afforestation.

W - Wildlife
MG – Moderate grazing
MC - Moderate cultivation
F - Forestry
IG - Intensive grazing
IC - Intensive cultivation.
LG - Light grazing
LC - Light cultivation
VIC – Very intensive cultivation

Table 2: Alternative Land Capability Classification System

PROPOSED USE		(ENTER USE HERE)	COMMENTS
Limitations		(enter use-specific limitations here)	(explain capability class decision here)
Capability Class		**Limitations To Proposed Use**	
1	Very good	None or Marginal	
2	Good	Slight	
3	Fair	Moderate	
4	Poor	Considerable, Long-Term	
5	Very Poor	Severe, Long-term, Irreversible	

4.5 IMPACT ASSESSMENT METHODOLOGY

The potential impacts of the development on the site soils were assessed based on the system outlined in **Table 3**. This system proved appropriate for some of the potential impacts, but not all, so the alternative impact assessment system outlined in **Table 4** was also applied to some of the potential impacts. This system enables the specialist to better regulate the magnitude of the impact by introducing a 'Consequence' factor. This factor is multiplied by the Magnitude criterion such that the specialist can alter the impact that the Magnitude value has on the impact rating outcome. This is necessary in cases where the remainder of the criteria are fixed and the magnitude of the impact is high, but the impact thereof is either inconsequential or dire.

4.5.1 ASSESSMENT OF IMPACTS

The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation. The key objectives of the impact assessment methodology are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed project, and to propose a significance ranking. Issues / aspects will be reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and resources and receptors to provide a detailed discussion of impacts. The assessment considers direct[1], indirect[2], secondary[3] as well as cumulative[4] impacts. A standard risk assessment methodology is used for the ranking of the identified environmental impacts pre-and post-mitigation (i.e. residual impact). The significance of environmental aspects is determined and ranked by considering the criteria[5] presented in **Table 3.**

Table 3: Impact Assessment Criteria and Scoring System

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$				
IMPACT SIGNIFICANCE RATING					

[1] Impacts that arise directly from activities that form an integral part of the Project.
[2] Impacts that arise indirectly from activities not explicitly forming part of the Project.
[3] Secondary or induced impacts caused by a change in the Project environment.
[4] Impacts are those impacts arising from the combination of multiple impacts from existing projects, the Project and/or future projects.
[5] The definitions given are for guidance only, and not all the definitions will apply to all the environmental receptors and resources being assessed. Impact significance was assessed with and without mitigation measures in place.

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Total Score	0 – 30		31 to 60		61 – 100
Environmental Significance Rating (Negative (-))	**Low (-)**		**Moderate (-)**		**High (-)**
Environmental Significance Rating (Positive (+))	**Low (+)**		**Moderate (+)**		**High (+)**

Table 4: Alternative Impact Assessment Criteria and Scoring System

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes
Magnitude Consequence (C) The extent to which the magnitude of the impact matters in the project context	Very low: Negligible consequence	Low: Slight consequence	Medium: Notable consequence	High: Significant consequence	Very High: Severe consequence
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of environmental receptor to rehabilitate or restore after the activity has caused change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + MxC) \times P]$ $Significance = (Extent + Duration + Reversibility + (Magnitude\ x\ Consequence)) \times Probability$				
IMPACT SIGNIFICANCE RATING					
Total Score	0 – 30		31 to 60		61 – 100
Environmental Significance Rating (Negative (-))	**Low (-)**		**Moderate (-)**		**High (-)**
Environmental Significance Rating (Positive (+))	**Low (+)**		**Moderate (+)**		**High (+)**

4.5.2 IMPACT MITIGATION

The impact significance without mitigation measures were assessed with the design controls in place. Impacts without mitigation measures in place are not representative of the proposed development's actual extent of impact and are included to facilitate understanding of how and why mitigation measures were identified. The residual impact is what remains following the application of mitigation and management measures and is thus the final level of impact associated with the development. Residual impacts also serve as the focus of management and monitoring activities during project implementation to verify that actual impacts are the same as those predicted in this report.

The mitigation measures chosen are based on the mitigation sequence/hierarchy which allows for consideration of five (5) different levels, which include avoid/prevent, minimise, rehabilitate/restore, offset and no-go in that order. The idea is that when project impacts are considered, the first option should be to avoid or prevent the impacts from occurring in the first place if possible, however, this is not always feasible. If this is not attainable, the impacts can be allowed, however they must be minimised as far as possible by considering reducing the footprint of the development for example so that little damage is encountered. If impacts are unavoidable, the next goal is to rehabilitate or restore the areas impacted back to their original form after project completion. Offsets are then considered if all the other measures described above fail to remedy high/significant residual negative impacts. If no offsets can be achieved on a potential impact, which results in full destruction of any ecosystem for example, the no-go option is considered so that another activity or location is considered in place of the original plan. The mitigation sequence/hierarchy is shown in **Figure 3**.

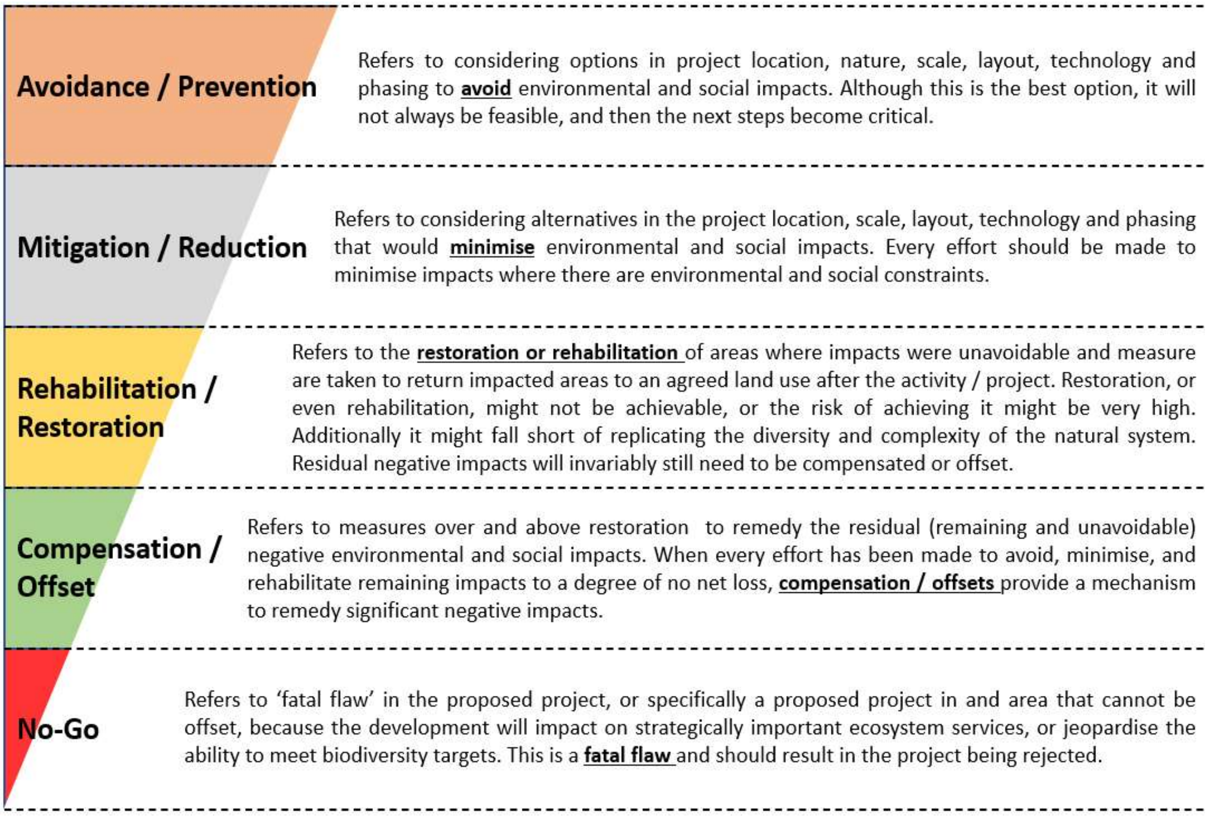

Figure 3: Mitigation Hierarchy

5 RESULTS AND DISCUSSION

5.1 DESKTOP ASSESSMENT

Based on the information included in the land type maps of South Africa (AGIS, 2007) the soils in the region are mostly classified as the Glenrosa and/or Mispah forms with lime generally present in the landscape and miscellaneous land classes, rocky areas with miscellaneous soils.

5.2 SOIL FORM IDENTIFICATION AND CLASSIFICATION

As identified in the desktop assessment; the two soil forms that dominate the site - as described by the South Africa taxonomic system - are the Glenrosa and Mispah soil forms. As these soil forms only vary by depth, they have been categorised together (see **Table 3** and **Figure 4**).

5.2.1 MISPAH

The Mispah soil form is characterised by an Orthic A horizon over a yellow-brown apedal B horizon over hard rock. As seen at the study site – a thin red or yellow-brown apedal horizon exists, with very low organic matter.

5.2.1 GLENROSA

The Glenrosa soil form is characterised by an Orthic A horizon overlying a lithocutanic B horizon that merges into the underlying weathering rock. These soils are deeper than Mispah soils but are still shallow, stony soils.

The soil forms identified are shown in **Table 5** and illustrated in **Figure 5**.

5.3 CURRENT LAND USE

The site is part of a farm that is currently largely unused. Very low intensity grazing occurs, but no grazing was noted during the site visit. Attempts to cultivate a few, small portions of the site have been abandoned. The site is covered by tufts of natural grasses and areas of bare rock and shallow soil. A tortoise was identified during the site visit. Photographs of the site can be seen in Appendix B.

Table 5: Soil Forms identified within the project area

Soil Type	In-field Observations	Photographs
Mispah	Thin Orthic A horizon over hard rock	  

Soil Type	In-field Observations	Photographs
Glenrosa	Thin Orthic A horizon over shallow lithocutanic subsoil	

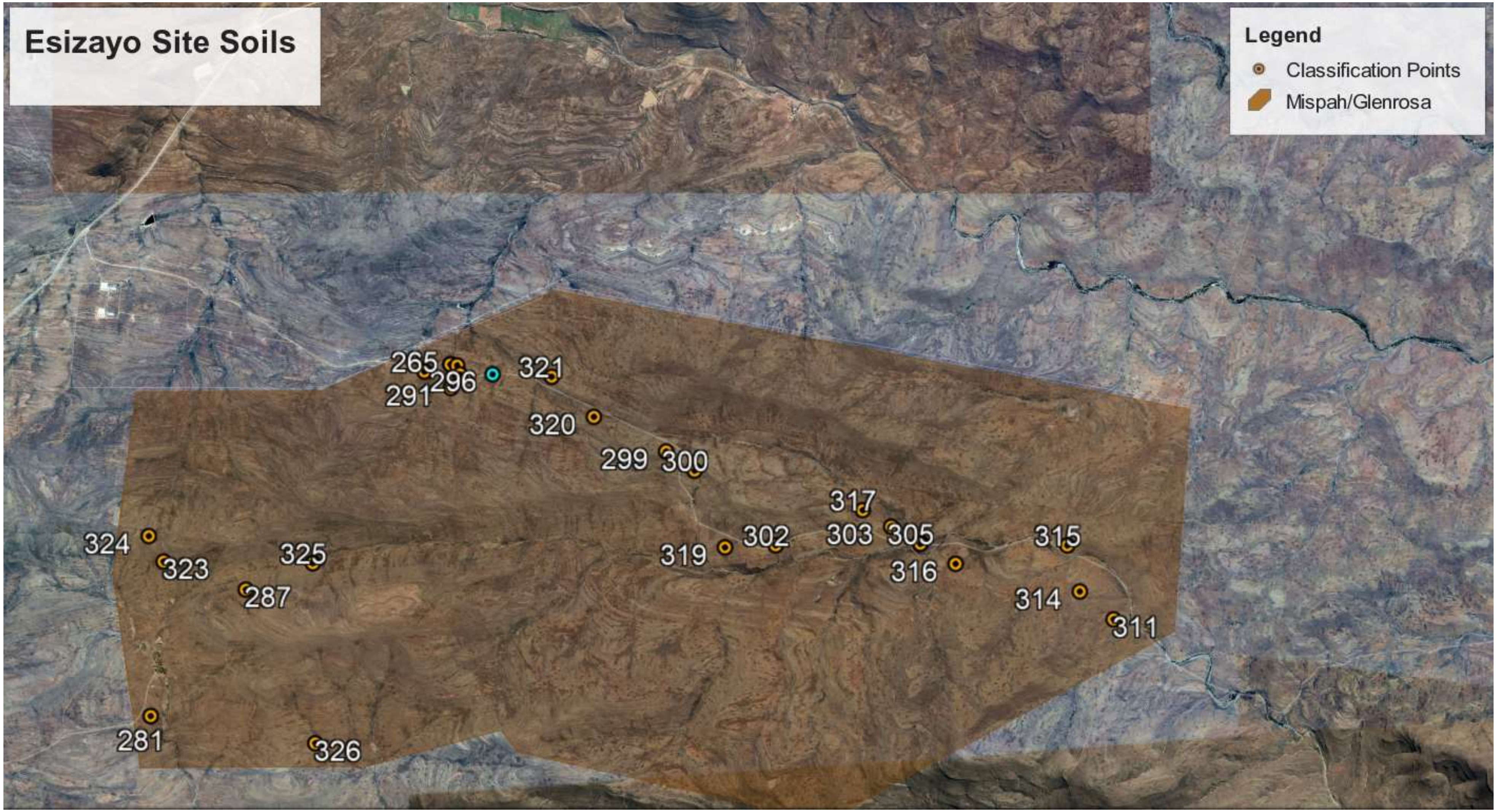

Figure 4: Map depicting dominant soil forms in the focus area

5.4 SOIL CAPABILITY ANALYSIS

Land capability is the inherent capacity of land to be productive under sustained use and specific management methods. The land capability of an area is the combination of the inherent soil properties and the climatic conditions as well as other landscape properties, such as slope and drainage patterns that may have resulted in the development of wetlands, as an example.

Using the South African soil classification guidelines (Scotney *et al.,* 1987), the land capability of the Mispah and Glenrosa soils was established as Land Capability Group 'Grazing' and Land Capability Class VIII, as they have 'Very severe limitations and are suitable only for natural vegetation,' and can be used for (in order of increased intensity of use) 'Wildlife, Forestry and Light Grazing' (**Table 1**, Scotney *et al.*, 1987).

Using the Alternative Capability Assessment system, the Capability Class for Agriculture remains 'Very Poor' with 'Severe, Long-Term, and Irreversible' Limitations (see **Table 6**). These limitations include a lack of depth and organic matter. Using this system the capability class for WEF turbines is 'Good' with 'Slight limitations to the proposed use' (see **Table 7**). The soils identified are not shrink-swell clays, not organic soils and are not poorly graded. Please note that this assessment system is based on an in-field classification assessment by a registered soil scientist using a hand-held auger only, so is indicative and cannot take the place of a geotechnical or engineering study. A geotechnical study of the area is currently underway and has confirmed many of the findings of the soils investigation, including that a lack of soil/shallow bedrock is not a problem for turbine foundations. As some clay-silts were logged by the geotechnical team, and the plasticity and linear shrinkage thereof have not yet been measured, the capability class remains 'Good' and not 'Very good'.

Table 6: Alternative Capability Assessment - Agriculture

PROPOSED USE		AGRICULTURE	COMMENTS
Limitations		Lack of depth, subsoil wetness, shrink-swell clays, lack of organic matter, stoniness	Shallow to very shallow, stony Mispahs and Glenrosas. Thin, infertile A-horizon. No signs of wetness, no shrink-swell clays.
Capability Class		Limitations To Proposed Use	
1	Very good	None or Marginal	
2	Good	Slight	
3	Fair	Moderate	
4	Poor	Considerable, Long-Term	
5	Very Poor	Severe, Long-term, Irreversible	

Table 7: Alternative Capability Assessment - Turbines

PROPOSED USE		TURBINE FOUNDATION	COMMENTS
Limitations		Shrink-swell clays, poorly graded soils, organic soils	Shallow to very shallow, stony Mispahs and Glenrosas. Thin, infertile A-horizon. No signs of wetness, no shrink-swell clays. Not poorly graded, but minimal soil present
Capability Class		Limitations To Proposed Use	
1	Very good	None or Marginal	
2	Good	Slight	
3	Fair	Moderate	
4	Poor	Considerable, Long-Term	
5	Very Poor	Severe, Long-term, Irreversible	

There are no areas on site that need to be buffered or avoided.

5.5 IMPACT ASSESSMENT

The following potential soil-related impacts were identified as applicable in respect of the proposed project.

- Erosion and Sedimentation
- Change in Surface Profile
- Change in Land Use
- Soil Contamination

The assessment of impact significance considers pre-mitigation as well as implemented of post-mitigation scenarios. The potential impacts associated with the construction and operation of the site have been assessed and discussed in the following sections, along with identification of recommended mitigation measures. The soil protection strategies identified are, in part, taken from the International Finance Corporation (World Bank) Environmental, Health and Safety Guidelines for Mining, 2007 (IFC, 2007). These guidelines are applicable to projects outside of the mining sphere and can be used to guide proposed construction activities at the site.

5.5.1 CONSTRUCTION PHASE

Construction of the WEF is anticipated for a period of up to 24 months. This phase refers to the period when the internal roads are established, the site is prepared, a laydown area is established, foundations are constructed and the turbines are erected (concrete foundations will be constructed at each turbine location and mechanically excavated to a depth of 4m, depending on the local geology), the substation is constructed, inverters are installed and ancillary infrastructure installed. Further to this, site rehabilitation will be undertaken post-construction. This phase has the largest direct impact on soils and land capability.

This phase also includes site preparation prior to construction activities, involving vehicular movement (transportation of construction materials) and the removal of vegetation within the development footprint and associated disturbances to soil, and access to the site. Site preparation will lead to exposure of loose soils, as well as movement of construction equipment and personnel within the project area.

The following potential impacts on soils and land capability were considered within the project area.

IMPACT 1: EROSION AND SEDIMENTATION

Clearing of vegetation, movement of vehicles, mobile plant and equipment, as well as earthworks required for establishment of the turbines is very likely to result in increased loose material being exposed. As mentioned, the soil that is present is apedal, so devoid of macrostructure, making erosion more likely than it would be on well-structured soils. Having said this, much of the soil surface is bare currently and erosion does already occur continually. As there are watercourses crossing the site, the potential impact of sedimentation is linked to that of erosion. Although the magnitude and extent of erosion and sedimentation are likely to be limited if the recommended mitigation measures are properly implemented, some erosion is likely when clearing an area and erosion and sedimentation are not easily reversible. Mitigation should focus on limiting vegetation removal as far as possible, as the vegetative cover binds the soil particles. Earthworks and vehicle movement should be limited to demarcated areas and the duration of the construction activities should be limited where possible. Where soil stripping is required, this should be undertaken in the dry season and silt fences erected if unexpected weather washes loose soil into the watercourses. A construction phase Storm Water Management Plan should be adhered to.

Potential Impact: **Erosion and Sedimentation**	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Confidence**
Without Mitigation	*3*	*2*	*5*	*5*	*5*	***75***	***High***	(-)	High
With Mitigation	*1*	*1*	*3*	*2*	*3*	***21***	***Low***	(-)	Med

Mitigation and Management Measures

- Limit earthworks and vehicle movement to demarcated paths and areas.
- Limit the duration of construction activities where possible, especially those involving earthwork / excavations.
- Access roads associated with the development should have gradients or surface treatment to limit erosion, and road drainage systems should be accounted for.
- Removal of vegetation must be limited as far as possible and exposed surfaces and should be re-vegetated or stabilised as soon as is practically possible.
- A storm water management plan should be designed for the site and adhered-to.
- Soil stripping should be undertaken in the dry season where necessary, and silt fences erected if unexpected weather washes loose soil into the relatively nearby watercourse.

IMPACT 2: CHANGE IN SURFACE PROFILE

Earthworks required for establishment of the WEF turbines and associated infrastructure, as well as establishment of access tracks, will result in the change of surface profile within the project area.

A change in the surface profile is typically inevitable with earthworks, is long-term or permanent in duration, definite and cannot be easily mitigated against. Having said this, the physical extent of the earthworks will not be extensive, and the site comprises rock and shallow, stony soils overlying rock. Even though the extent of the impact is small, within the context of the impact assessment rating methodology the calculated significance with mitigation is a 'moderate' negative. Despite this, it is the specialist's opinion that the significance of this change in surface profile in the context of this project is 'low'. For this reason an alternative impact assessment system was also applied to this potential impact.

Potential Impact: <u>Change in surface profile</u>	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Without Mitigation	5	1	5	5	4	64	High	(-)	Low
With Mitigation	4	1	3	4	3	36	Moderate	(-)	Low
Mitigation and Management Measures									
— Opting for turbine positions where a smaller profile change is necessary — When the site is rehabilitated, the surface profile thereof can be altered to more closely resemble its current profile through earthworks.									

As seen below, the alternative system shows pre- and post-mitigation significance as a negative 'low'. This is as a result of the magnitude of the change in surface profile being considered very low as the processes underway at the site do not provide important community functions currently. The area appears to be home to at least one tortoise, but it is believed that the introductions of the WEF turbines and associated will not affect the soil in such a way that this will affect the tortoise habitat. Direct effects of the introduction of the WEF turbines and associated infrastructure on fauna were not considered within this study, however.

Potential Impact Using Alternative System: <u>Change in surface profile</u>	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Consequence	Confidence
Without Mitigation	5	1	5	5	4	44	Moderate	0	Med
With Mitigation	4	1	3	4	3	24	Low	0	Med

IMPACT 3: CHANGE IN LAND USE

Clearance of vegetation on site and establishment of infrastructure will result in a change of land use within the project area, which will continue through construction and operation. The land currently houses tufts of natural grass, bare rock and bare soil. The proposed project will result in a change in land use to host WEF turbines and associated infrastructure, so there will be a change, even though the land is hardly used currently. The degree of alteration is very high (i.e. complete change in land use), the change will definitely take place and will be irreversible for the duration of the project life (i.e. the impact will take place in the construction phase but will remain as long as the project infrastructure is in place).

Even though the extent is small, within the context of the impact assessment rating methodology the calculated significance is a 'moderate' negative. With implementation of mitigation measures that include limited disturbance and removal of vegetation, the impact remains 'moderate', even though the current land use can be recovered without excessive rehabilitation. It is however the specialist's opinion that the significance of this change in land use is low, as the current land use is very limited. For this reason, an alternative impact assessment system was also applied to this potential impact.

Potential Impact: **Change in land use**	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Confidence**
Without Mitigation	2	1	1	4	5	**40**	**Moderate**	(-)	Low
With Mitigation	1	1	1	4	5	**35**	**Moderate**	(-)	Low
Mitigation and Management Measures									
— Limit earthworks and vehicle movement to demarcated paths and areas. — Limit removal of vegetation to demarcated areas only. — Rehabilitate disturbed areas around the turbines as soon as practicable following disturbance thereof.									

As seen below, the alternative system shows pre- and post-mitigation significance as a negative 'low'. This is as a result of the magnitude of the change in the land use being considered negligible as the site currently houses areas of bare rock and soil and tufts of natural grass, and has a very limited grazing capacity.

Potential Impact: **Change in land use**	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Consequence**	**Confidence**
Without Mitigation	2	1	1	4	5	**30**	**Low**	0	Med
With Mitigation	1	1	1	4	5	**30**	**Low**	0	Med

IMPACT 4: SOIL CONTAMINATION

Movement of vehicles and equipment on site could result in leaks, spills of hazardous materials, such as fuels, oils and chemicals. Contaminated soil is expensive to rehabilitate and contamination entering the soils of the project area infiltrate into the ground as well as migrate into onsite watercourses and from site during rainfall events. With the correct implementation of mitigation measures, the probability, extent and duration of the impact can be reduced, thereby reducing the potential impact from a 'high' negative to 'low'.

Potential Impact: **Soil Contamination**	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Confidence**
Without Mitigation	3	3	3	5	5	**70**	**High**	(-)	High
With Mitigation	3	1	3	2	2	**18**	**Low**	(-)	Med
Mitigation and Management Measures									
— On-site vehicles should be well-maintained, — Drip trays should be placed under stationary vehicles / plant; — On-site pollutants/hazardous materials should be contained in a bunded area and on an impermeable surface; — Ensure proper control of dangerous substances entering the site; — Adequate disposal facilities should be provided, and — A non-polluting environment should be enforced.									

5.5.2 OPERATION PHASE

This phase refers to the period of operation of the WEF turbines (i.e. following commissioning through project life). As indicated above, the identified impacts to soil take place during the construction phase but some of the impacts can still be felt throughout the operation phase. The main potential impact to focus on during the operation phase is Erosion and Sedimentation.

IMPACT 1: EROSION AND SEDIMENTATION

Although the site is likely to only be directly affected during the operational phase by occasional maintenance, ongoing erosion and consequent sedimentation throughout the operational phase of the project should be monitored and mitigated against. As mentioned, the soil is apedal, so devoid of macrostructure, making erosion more likely than it would be on well-structured soils, especially once disturbed during the construction phase. As there are watercourses crossing the site, the potential impact of sedimentation is linked to that of erosion.

Mitigation should focus on erosion and sedimentation monitoring and management.

Potential Impact: Erosion and Sedimentation	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Without Mitigation	2	2	5	5	5	70	High	(-)	High
With Mitigation	1	1	3	2	2	14	Low	(-)	Med
Mitigation and Management Measures									
— The site should be monitored for signs of erosion continually and an erosion management plan should be put in place.									

5.5.3 DECOMMISSIONING PHASE

As mentioned, no plans to decommission the site are underway currently and decommissioning of the infrastructure will require a separate authorization. Having said this, the decommissioning phase will be similar to the construction phase as large vehicles will be on site and earth will be moved. Erosion and Sedimentation, and Soil Contamination are the most likely negative impacts. The potential impact can again be reduced from a negative 'High' to 'Low' if mitigation measures are properly implemented and progress monitored.

Mitigation should focus again on limiting earthworks and vehicle movement to demarcated paths and areas, and dry conditions where possible, as well as limiting the duration of the decommissioning activities where possible.

IMPACT 1: EROSION AND SEDIMENTATION

Potential Impact: Erosion and Sedimentation	Magnitude	Extent	Reversibility	Duration	Probability	Significance		Character	Confidence
Without Mitigation	3	2	5	5	5	75	High	(-)	High
With Mitigation	1	1	3	2	3	21	Low	(-)	Med
Mitigation and Management Measures									
— Limit earthworks and vehicle movement to demarcated paths and areas. — Limit the duration of deconstruction activities where possible. — Access roads associated with decommissioning should have gradients or surface treatment to limit erosion, and road drainage systems should be accounted for. — A decommissioning-specific storm water management plan should be designed for the site and adhered-to.									

IMPACT 2: SOIL CONTAMINATION

Movement of vehicles and plant / equipment on site could result in leaks, spills of hazardous materials, such as fuels, oils and chemicals. Contaminated soil is expensive to rehabilitate and contamination entering the soils of the project area infiltrate into the ground as well as enter the onsite watercourses and migrate from site during rainfall events. With the correct implementation of mitigation measures, the probability, extent and duration of the impact can be reduced, thereby reducing the potential impact from a 'high' negative to 'low'.

Potential Impact: **Soil Contamination**	**Magnitude**	**Extent**	**Reversibility**	**Duration**	**Probability**	**Significance**		**Character**	**Confidence**
Without Mitigation	3	3	3	5	5	**70**	**High**	(-)	High
With Mitigation	3	1	3	2	2	**18**	**Low**	(-)	Med
Mitigation and Management Measures									

- On-site vehicles should be well-maintained,
- Drip trays should be placed under stationary vehicles / plant;
- On-site pollutants/hazardous materials should be contained in a bunded area and on an impermeable surface;
- Ensure proper control of dangerous substances entering the site;
- Adequate disposal facilities should be provided, and
- A non-polluting environment should be enforced.

5.5.4 CUMULATIVE IMPACTS

The general area for which the proposed development is planned is very extensive (non-intensive) farmland. Only the potential impacts of erosion and sedimentation and contamination are likely to cumulatively add to those of surrounding farmland, and only if mitigation and monitoring requirements are not undertaken adequately.

5.5.5 MONITORING REQUIREMENTS

The site should be monitored for signs of erosion and for spills that could lead to contamination of the environment throughout all three of the abovementioned phases. Signs of erosion and soil contamination are usually relatively obvious so can be monitored visually.

6 CONCLUSIONS

The proposed development area is currently largely unused and houses areas of bare rock and soil and tufts of natural grass. The soils identified at the site were shallow, stony Mispahs and Glenrosas and the agricultural capability of the site was deemed to be Class VII; Grazing, and is suitable only for Wildlife, Forestry and Light Grazing, owing to its lack of depth, stoniness and A horizon. Using an alternative capability assessment method, no soils-related impediments to establishing WEF turbines were identified.

All potential impacts were deemed to be low post-mitigation. It is thus recommended that mitigation measures are implemented and plans adhered to, and that Erosion and Sedimentation, and Contamination are monitored and managed throughout all phases.

No soils-related fatal flaws are evident for the proposed project – so the 'no-go' scenario is not necessary. There are no areas on site that need to be buffered or avoided from a soils perspective. It is the specialist's opinion that the potential risk to the soils environment as a result of the proposed development is acceptable and no soils-specific conditions need to be added to the authorisation as a result of this study. It is highly recommended that mitigation and monitoring be undertaken, management measures be strictly implemented and that a Storm Water Management Plan be devised for the site and adhered to.

7 REFERENCES

- ARC – Institute for Soil, Climate and Water. 2006. *Land Types of South Africa*. Pretoria.
- Fey, M. 2012. *Soils of South Africa*. Cambridge University Press, Granger Bay, Cape Town, South Africa.
- IEMA. 2021. Land and Soils in EIA Guide. IEMA, London, UK.
- Mamo, M and P. Hain. Erosion Control Measures. Plant and Soil Sciences eLibrary. 2016.
- Soil Classification Working Group. 1991. *Soil Classification – Taxonomic System for South Africa*. Memoirs on the Agricultural Natural Resources of South Africa No. 15. Department of Agricultural Development, Pretoria.
- Scotney, D.M, F Ellis, R. W. Nott, T.P. Taylor, B.J., Van Niekerk, E. Vester and P.C. Wood. 1987. A system of soil and land capability classification for agriculture in the SATBVC states. Dept. Agric. Pretoria.

APPENDIX

A

SPECIALIST CV

APPENDIX

APPENDIX

B SITE PHOTOGRAPHS

APPENDIX

APPENDIX