



BASIC ASSESSMENT REPORT

SOIL, LAND USE, LAND CAPABILITY AND AGRICULTURAL POTENTIAL SURVEY:

PROPOSED KOINGNAAS WIND ENERGY FACILITY: KOINGNAAS, NORTHERN CAPE PROVINCE

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DECLARATION

I, Johan Hilgard van der Waals, declare that I –

- I act as the independent specialist in this application
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 71 and is punishable in terms of Section 24F of the Act.

J.H. VAN DER WAALS
TERRA SOIL SCIENCE

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SOIL, LAND USE, LAND CAPABILITY AND AGRICULTURAL POTENTIAL SURVEY – KOINGNAAS WIND ENERGY FACILITY: KOINGNAAS, NORTHERN CAPE PROVINCE

1. TERMS OF REFERENCE

Terra Soil Science (TSS) was commissioned by Savannah Environmental (Pty) Ltd to undertake a BAR level soil, land use, land capability, and agricultural potential survey for the proposed Koingnaas Wind Energy Facility in the Northern Cape Province.

2. INTRODUCTION

2.1 Study Aim and Objectives

The study area has been proposed to serve as a locality for the construction of a wind energy facility and associated infrastructure for power generation purposes. This study aims to determine the possible impact that this development could have on the soils, land use, land capability and agricultural potential as well as to identify areas of high sensitivity regarding turbine placement.

The study has as objectives the identification and estimation of:

- » Soil form (SA taxonomic system) and soil depth for the area;
- » Soil potential linked to current land use and other possible uses and options;
- » Discussion of the agricultural potential in terms of the soils, water availability, surrounding developments and current status of land; and
- » Discussion of impacts (potential and actual) as a result of the development.

2.2 Agricultural Potential Background

The assessment of agricultural potential rests primarily on the identification of soils that are suited to crop production. In order to qualify as high potential soils they must have the following properties:

- » Deep profile (more than 600 mm) for adequate root development,
- » Deep profile and adequate clay content for the storing of sufficient water so that plants can weather short dry spells,
- » Adequate structure (loose enough and not dense) that allows for good root development,
- » Sufficient clay or organic matter to ensure retention and supply of plant nutrients,
- » Limited quantities of rock in the matrix that would otherwise limit tilling options and water holding capacity,
- » Adequate distribution of soils and size of high potential soil area to constitute a viable economic management unit, and

- » Good enough internal and external (out of profile) drainage if irrigation practices are considered. Drainage is imperative for the removal (leaching) of salts that accumulate in profiles during irrigation and fertilization.

In addition to soil characteristics, climatic characteristics need to be assessed to determine the agricultural potential of a site. The rainfall characteristics are of primary importance and in order to provide an adequate baseline for the viable production of crops rainfall quantities and distribution need to be sufficient and optimal. The combination of the above mentioned factors will be used to assess the agricultural potential of the soils on the site.

2.3 Survey Area Boundary

The survey area (proposed turbine placement) lies between 30° 13' 04" and 30° 13' 53" south and 17° 14' 45" and 17° 16' 18" east 3 km southwest of the settlement of Koinaas in the Northern Cape Province (**Figure 1**).

2.4 Survey Area Physical Features

The survey area lies close to the ocean on relatively flat terrain that has been significantly impacted by diamond mining activities. The altitude above mean sea level varies from 40 m in the west to 60 m in the northwest. The geology of the area consists of aeolian material overlying Tertiary and Quaternary marine sediments.

3. SOIL, LAND CAPABILITY, LAND USE SURVEY AND AGRICULTURAL POTENTIAL SURVEY

3.1 Method of Survey

The BAR level soil, land capability, land use and agricultural potential surveys were conducted in three phases.

3.1.1 Phase 1: Land Type Data

Land type data for the site was obtained from the Institute for Soil Climate and Water (ISCW) of the Agricultural Research Council (ARC). The land type data is presented at a scale of 1:250 000 and entails the division of land into land types, typical terrain cross sections for the land type and the presentation of dominant soil types for each of the identified terrain units (in the cross section). The soil data is classified according to the Binomial System (MacVicar et al., 1977). The soil data was interpreted and re-classified according to the Taxonomic System (MacVicar, C.N. et al. 1991).

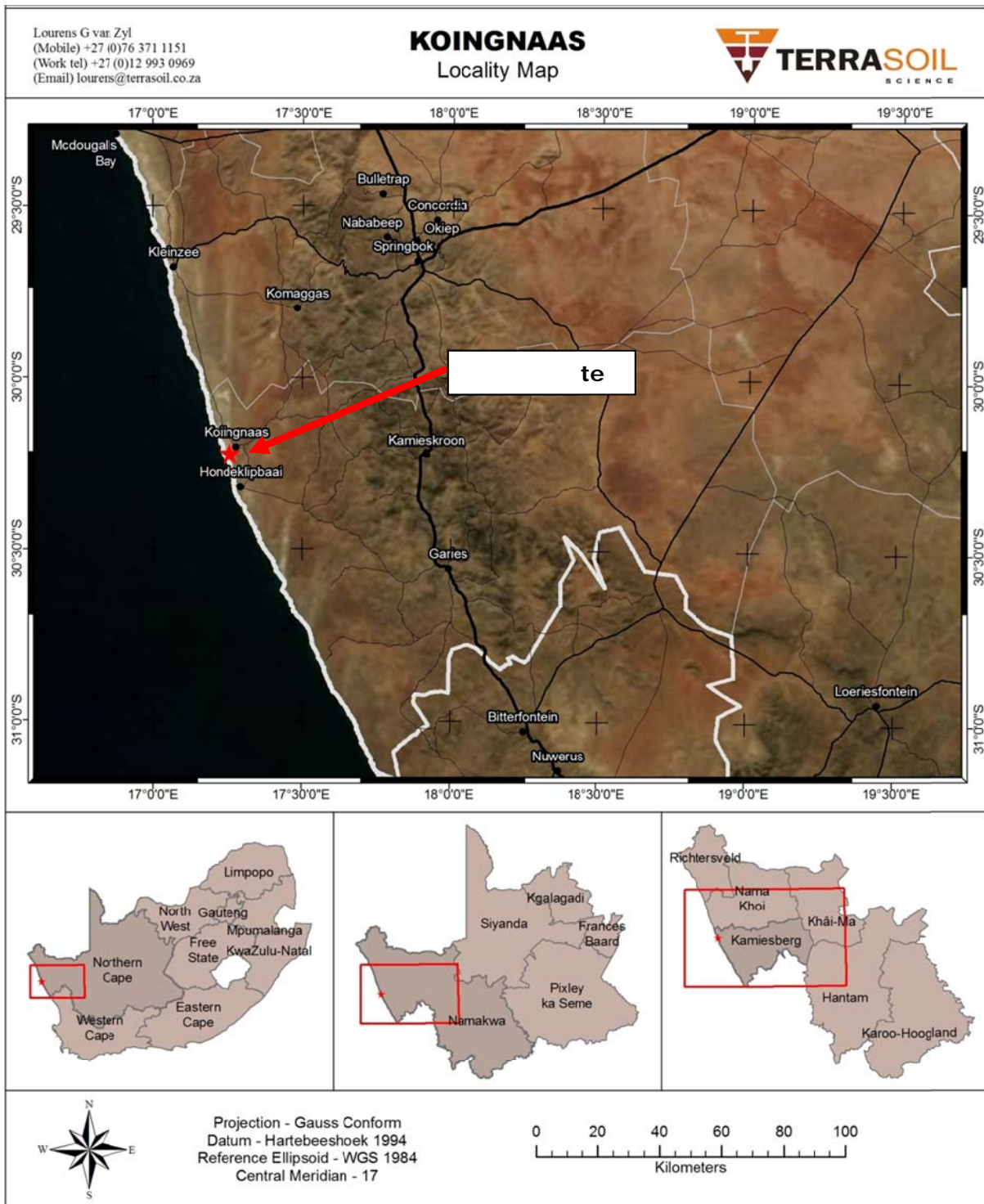


Figure 1 Locality of the survey site

3.1.2 Phase 2: Aerial Photograph Interpretation and Land Use Mapping

The most up to date aerial photographs of the site were obtained from Google Earth. The image was used to interpret aspects such as land use and land cover.

3.1.3 Phase 3: Site Visit and Soil Survey

A site visit was conducted on the 15th of August, 2011, during which a reconnaissance soil survey was conducted. The presence of open pits from mining facilitated the assessment of the soils in that clear soil profiles could be described, classified and photographed.

3.2 Survey Results

3.2.1 Phase 1: Land Type Data

Figure 2 presents the land type distribution for the site and surrounding area. The dominant land type found on the site is **Ai14** with the **Ah38** land type occurring immediately east from the site (Land Type Survey Staff, 1972 – 2006). A brief description of each land type is provided below.

Land Type Ai14

Soils: Yellow to bleached deep sandy soils with apedal structure. (Note: This classification is somewhat erroneous due to the recent recognition of gypsic soils in the SA Taxonomic System. Gypsic soils occur extensively in this land type on the site.)

Land capability and land use: Mainly wilderness and extensive grazing due to climatic constraints. Diamond mining occurs extensively in the unconsolidated material overlying the bedrock underneath.

Agricultural potential: Very low due to climate (rainfall – **Figure 3**) constraints.

Land Type Ah38

Soils: Red, yellow-brown and bleached deep sandy soils with apedal structure. Dorbank horizons occur throughout the landscape.

Land capability and land use: Mainly wilderness and extensive grazing due to climatic constraints.

Agricultural potential: Very low due to climate (rainfall – **Figure 3**) constraints.

3.2.2 Phase 2: Aerial Photograph Interpretation and Land Use/Capability Mapping

The aerial photograph interpretation of the site yielded two land uses namely mining and natural veld (**Figure 4**). Due to the correlation with soils and impacts on the site these areas are indicated on the soil map (**Figure 5**) provided later in the report.

1

3.2.3 Phase 3: Site Visit and Soil Survey

The soil survey yielded that the site is dominated by sandy surface horizons (sand dunes) overlying a gypsic layer that is hardened over almost the entire survey site. Such hard gypsic horizons are formally classified and “petrogypsic”. The proposed soil forms that occur on the site are Sendelingsdrift (Orthic A-horizon / Neocarbonate B-horizon / Gypsic Horizon), Koingnaas (Orthic A-horizon / Soft Carbonate B-horizon / Gypsic Horizon) and Swakopmund

Orthic A-horizon / Gypsic Horizon). The gypsic horizon is divided at a lower level (family level) into the soft and the hardened versions.

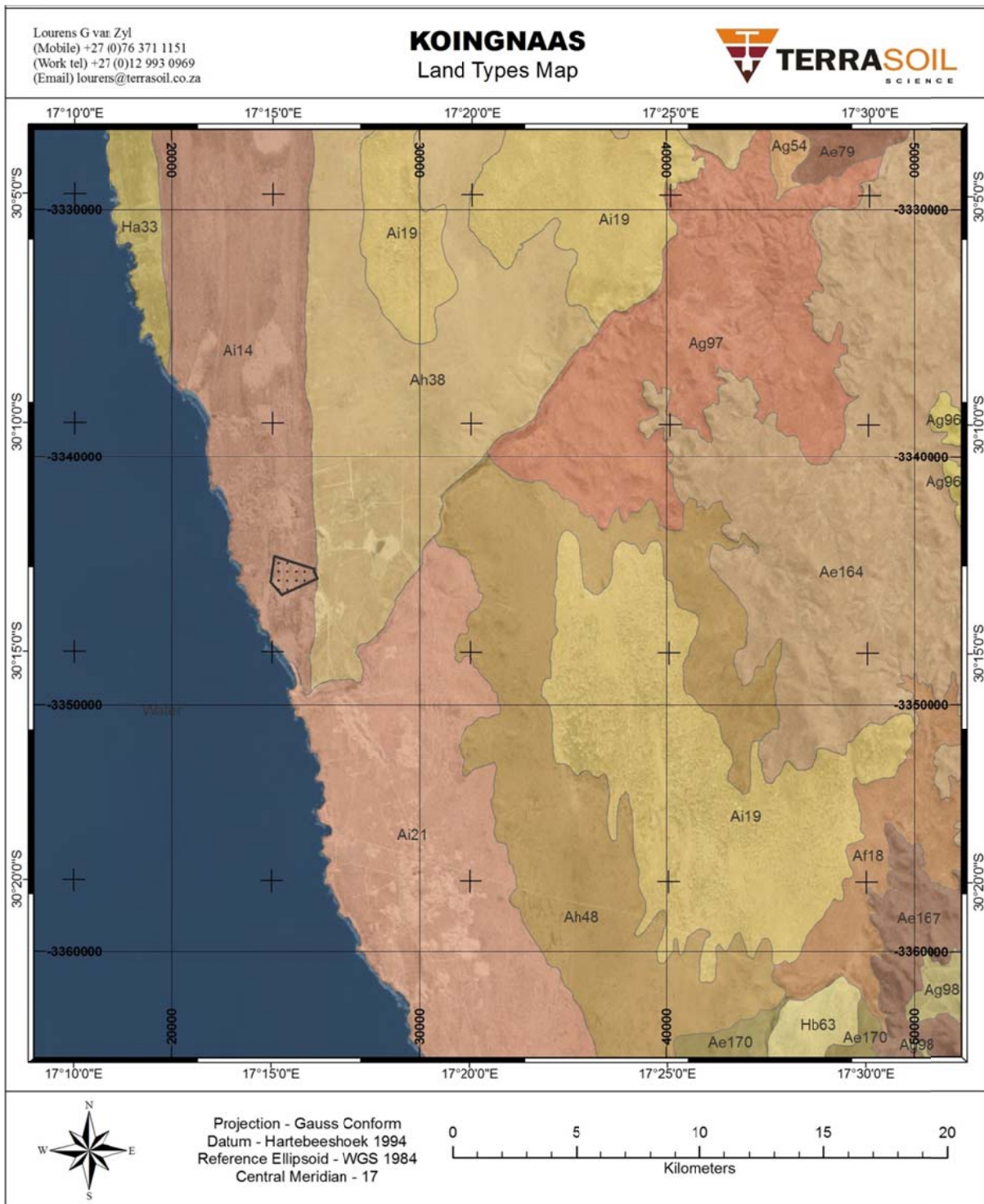


Figure 2 Land type map of the survey site

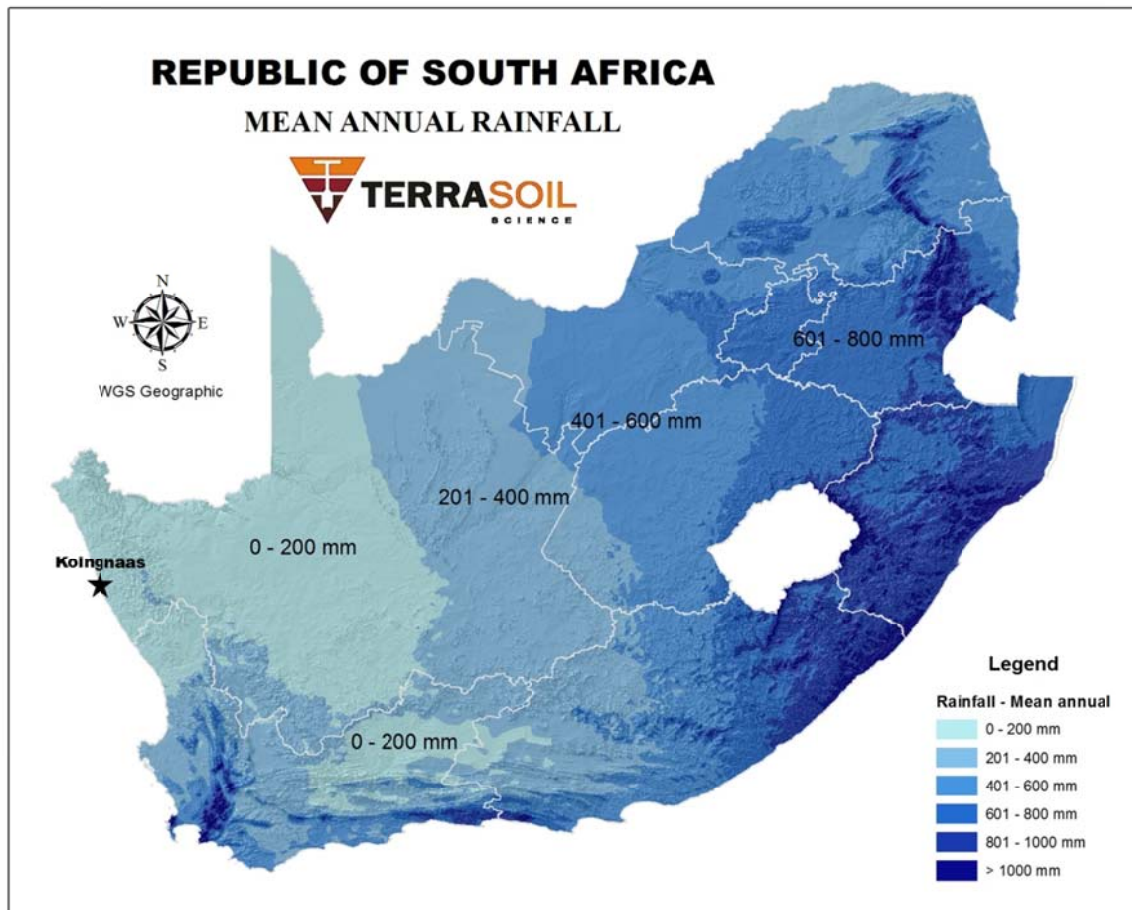


Figure 3 Rainfall map of South Africa indicating the survey site

The open mining pits on the site provided an ideal opportunity to photograph and describe a number of these profiles with the one main problem though that the surface horizons exhibited a varying degree of disturbance due to the mining activities. **Figure 5** indicates the distribution of these soils on the survey site. **Figures 6 to 16** indicate the different profiles as well as the setting within which they occur. The land cover in this area is mainly coastal vegetation with an undulating soil surface (**Figure 17** and **18**). Immediately outside of the survey area to the east the soils change in colour and surface characteristics and here soils with Dorbank horizons dominate (**Figures 19** and **20**).

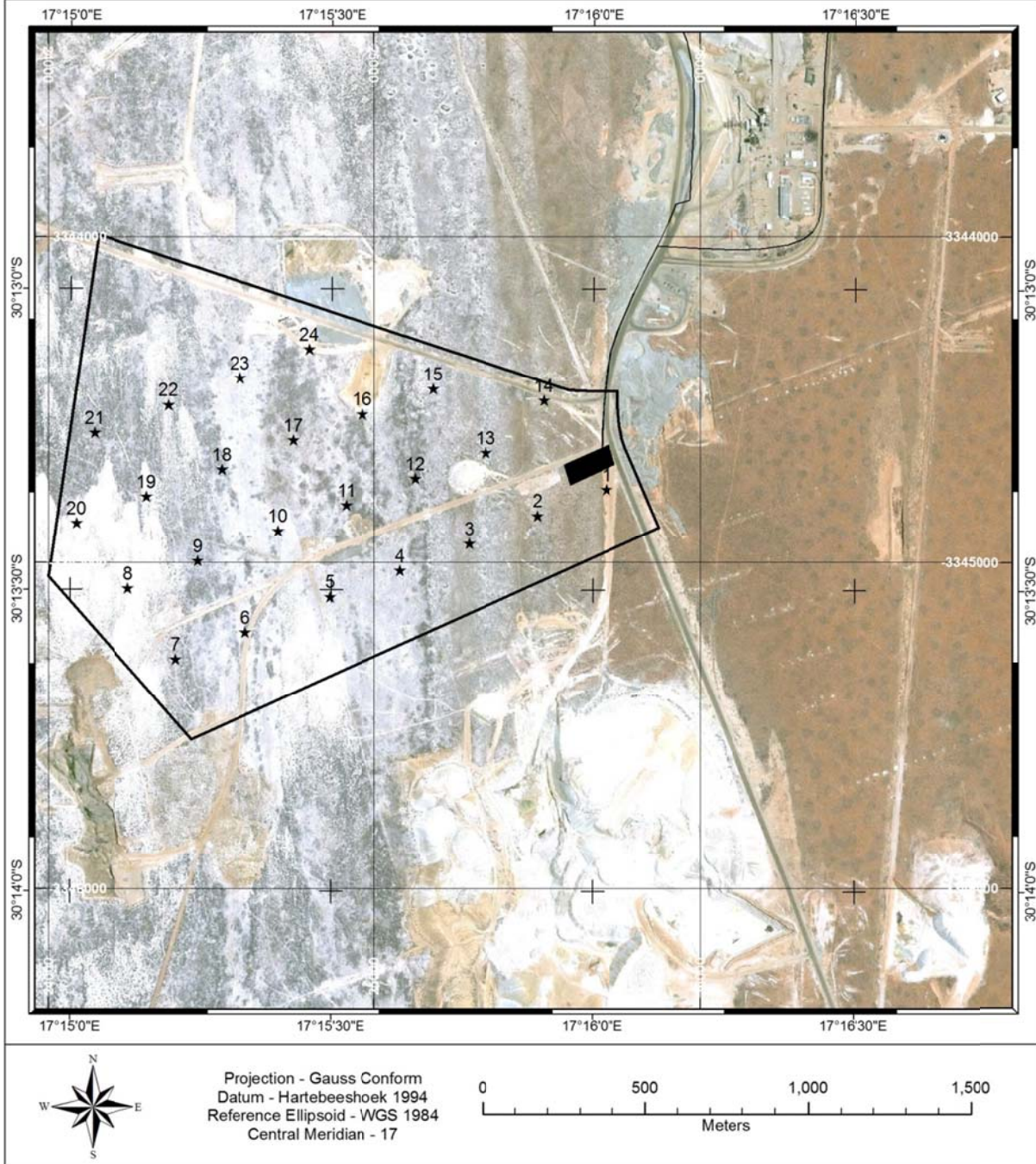


Figure 4 Satellite image of the site indicating mining and natural veld

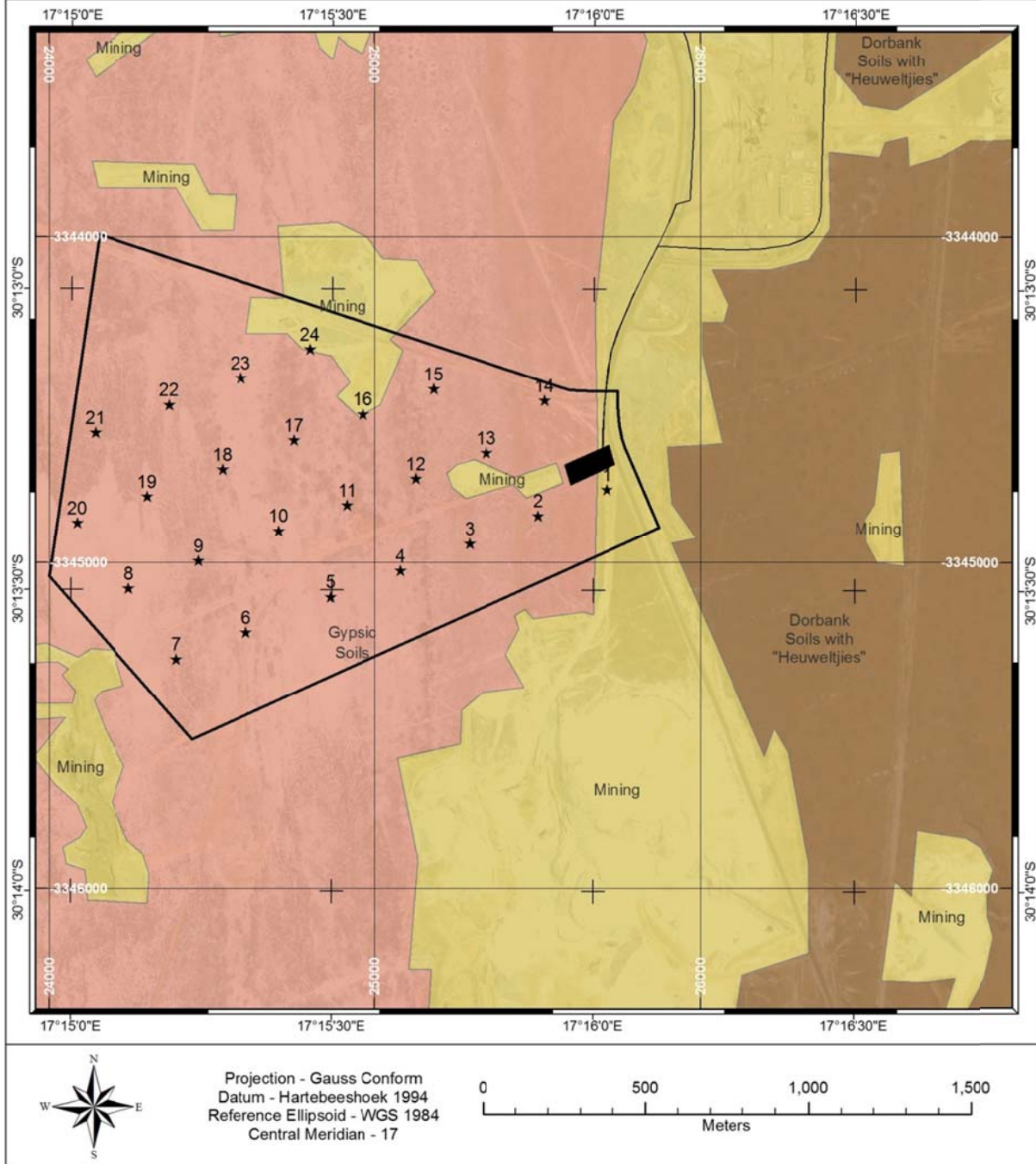


Figure 2 Generalised soil map of the survey site



Figure 3 Open pit in the mining area



Figure 7 Open pit in the mining area



Figure 8 Exposed profile in the pit



Figure 9 Layered aeolian and marine sediments in pit



Figure 10 Layered aeolian and marine sediments in pit



Figure 11 Gypsum (white material) horizon in soil profile



Figure 12 Gypsum (white material) horizon in soil profile in pit



Figure 13 Gypsum (white material) horizon in soil profile in pit



Figure 14 Gypsum (white material) horizon in soil profile in pit



Figure 15 Gypsum (white material) horizon in soil profile in pit



Figure 16 Gypsum (white material) horizon in soil profile in pit



Figure 17 Typical undulating landscape within the survey area



Figure 18 Typical undulating landscape within the survey area with mining activities in the background



Figure 19 Exposed profile with a dorbank on the eastern side of the survey area



Figure 20 Typical landscape on the eastern edge of the survey area

4. INTERPRETATION OF SOIL, LAND CAPABILITY AND LAND USE SURVEY RESULTS

The interpretation of the land use and land capability results yielded a number of aspects that are of importance to the project.

4.1 Agricultural Potential

The agricultural potential of the site is very low due to climatic constraints (as discussed earlier).

4.2 Overall Soil Impacts

In the context of the impacts of the mining activities the additional impacts of the wind energy infrastructure will be negligible. Due to the sandy nature of the topsoils rehabilitation of construction sites will have to be done but this will have to tie in with rehabilitation approaches followed by the mine.

5. ASSESMENT OF IMPACT

5.1 Assessment Criteria

The following assessment criteria (**Table 1**) will be used for the impact assessment.

Table 1 Impact Assessment Criteria

CATEGORY	DESCRIPTION OF DEFINITION
Direct, indirect and cumulative impacts	In relation to an activity, means the impact of an activity that in itself may not be significant but may become significant when added to the existing and potential impacts eventuating from similar or diverse activities or undertakings in the area.
Nature	A description of the cause of the effect, what will be affected and how it will be affected.
Extent (Scale) <ul style="list-style-type: none"> • 1 • 2 • 3 • 4 • 5 	The area over which the impact will be expressed – ranging from local (1) to regional (5).
Duration <ul style="list-style-type: none"> • 1 • 2 • 3 • 4 • 5 	Indicates what the lifetime of the impact will be. <ul style="list-style-type: none"> • Very short term: 0 – 1 years • Short-term: 2 – 5 years • Medium-term: 5 – 15 years • Long-term: > 15 years • Permanent
Magnitude <ul style="list-style-type: none"> • 2 • 4 • 6 • 8 • 10 	This is quantified on a scale from 0-10, where 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
Probability <ul style="list-style-type: none"> • 1 • 2 • 3 • 4 • 5 	Describes the likelihood of an impact actually occurring. <ul style="list-style-type: none"> • Very Improbable • Improbable • Probable • Highly probable • Definite
Significance	The significance of an impact is determined through a synthesis of <u>all</u> of the above aspects.

CATEGORY	DESCRIPTION OF DEFINITION
	$S = (E + D + M) * P$ S = Significance weighting E = Extent D = Duration M = Magnitude
Status <ul style="list-style-type: none"> • Positive • Negative • Neutral 	Described as either positive, negative or neutral
Other	<ul style="list-style-type: none"> • Degree to which the impact can be reversed • Degree to which the impact may cause irreplaceable loss of resources • Degree to which the impact can be mitigated

5.2 List of Activities for the Site

Table 2 lists the anticipated activities for the site. The centre two columns in the table list the anticipated forms of soil degradation and geographical distribution of the impacts.

Table 2 List of activities and their associated forms of soil degradation

Activity	Form of Degradation	Geographical Extent	Comment (Section described)
Construction Phase			
Construction of turbines (foundations)	Physical degradation (compound)	Two dimensional	Impact small in low sensitivity areas due to localised nature (Section 5.4.1)
Construction of buildings and other infrastructure	Physical degradation (compound)	Two dimensional	(Section 5.4.2)
Construction of roads	Physical degradation (compound)	Two dimensional	(Section 5.4.3)
Construction of power lines	Physical degradation (compound)	Two dimensional	(Section 5.4.4)
Construction and Operational Phase Related Effects			
Vehicle operation on site	Physical and chemical degradation (hydrocarbon spills)	Mainly point and one dimensional	(Section 5.4.5)
Dust generation	Physical degradation	Two dimensional	(Section 5.4.6)

5.3 Assessment of the Impacts of Activities

Many of the impacts are generic and their impacts will remain similar for most areas on the site. The generic activity will therefore be assessed. The impacts associated with the different activities have been assessed below for each activity. These impacts have been summarized in **Table 11**.

5.3.1 Construction of Facility

Table 3 presents the impact criteria and a description with respect to soils, land capability and land use for the construction of the turbines with foundations.

Table 3 Construction of turbine foundations

Criteria	Description
Cumulative Impact	The cumulative impact of this activity will be relatively small as the turbines are spread out and have small footprints.
Nature	This activity entails the construction of turbines (with a foundation) with the associated disturbance of soils and existing land use.
Extent	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed
Duration	5 – Permanent (unless removed)
Magnitude	2
Probability	4 (highly probable due to inevitable changes in land use)
Significance of impact	$S = (1 + 5 + 2) * 4 = 32$ (moderate)
Status	Negative
Mitigation	None possible. Limit footprint to the immediate development area

5.3.2 Construction of Buildings and Other Infrastructure

Table 4 presents the impact criteria and a description with respect to soils, land capability and land use for the construction of buildings and other infrastructure.

Table 4 Construction of buildings and other infrastructure

Criteria	Description
Cumulative Impact	The cumulative impact of this activity will be small as it is limited in extent on land with very low agricultural potential.
Nature	This activity entails the construction of buildings and other infrastructure with the associated disturbance of soils and existing land use.
Extent	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed
Duration	5 – Permanent (unless removed)
Magnitude	2
Probability	4 (highly probable due to inevitable changes in land use)
Significance of impact	$S = (1 + 5 + 2) * 4 = 32$ (moderate)
Status	Negative
Mitigation	None possible. Limit footprint to the immediate development area

5.3.3 Construction of Roads

Table 5 presents the impact criteria and a description with respect to soils, land capability and land use for the construction of roads.

Table 5 Construction of roads

Criteria	Description
Cumulative Impact	The cumulative impact of this activity will be small as it is linear and limited in geographical extent.
Nature	This activity entails the construction of roads with the associated disturbance of soils and existing land use.
Extent	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed along the road
Duration	5 – Permanent (unless removed)
Magnitude	4
Probability	4 (highly probable due to inevitable changes in land use)
Significance of impact	$S = (1 + 5 + 4) * 4 = 40$ (moderate)
Status	Negative
Mitigation	None possible. Limit footprint to the immediate development area and keep to existing roads as far as possible

5.3.4 Construction of Power Lines

Table 6 presents the impact criteria and a description with respect to soils, land capability and land use for the construction of power lines.

Table 6 Construction of power lines

Criteria	Description
Cumulative Impact	The cumulative impact of this activity will be small as it is linear and limited in geographical extent. Impacts are only associated with pylon foundations and not the line.
Nature	This activity entails the construction of power lines with the associated disturbance of soils and existing land use at each pylon point.
Extent	1 - Site: The impact is two dimensional but then limited to the immediate area of the pylon footprint.
Duration	5 – Permanent (unless removed)
Magnitude	2
Probability	2 (highly probable due to inevitable changes in land use)
Significance of impact	$S = (1 + 5 + 2) * 2 = 16$ (low)
Status	Negative
Mitigation	None possible. Limit footprint to the immediate development area and keep to existing roads as far as possible for placement of power line.

5.3.5 Vehicle Operation on Site

It is assumed that vehicle movement will be restricted to the construction site and established roads. Vehicle impacts in this sense are restricted to spillages of lubricants and petroleum products. **Table 7** presents the impact criteria and a description with respect to soils, land capability and land use for the operation of vehicles on the site.

Table 7 Assessment of impact of vehicle operation on site

Criteria	Description
Cumulative Impact	The cumulative impact of this activity will be small if managed.
Nature	This activity entails the operation of vehicles on site and their associated impacts in terms of spillages of lubricants and petroleum products
Extent	1 - Site: The impact is two dimensional but then limited to the immediate area that is being developed
Duration	2 – Short-term
Magnitude	2
Probability	4 (2 with prevention and mitigation)
Significance of impact	$S = (1 + 2 + 2) * 4 = 20$ (10 with prevention and mitigation) (low)
Status	Negative
Mitigation	Maintain vehicles, prevent and address spillages timeously

5.3.6 Dust Generation

Generated dust can impact large areas depending on environmental and climatic conditions.

Table 8 presents the impact criteria and a description with respect to soils, land capability and land use for dust generation on the site.

Table 8 Assessment of impact of dust generation on site

Criteria	Description
Cumulative Impact	The cumulative impact of this activity will be small if managed but can have widespread impacts if ignored.
Nature	This activity entails the operation of vehicles on site and their associated dust generation
Extent	2 - Local: The impact is diffuse (depending on environmental and climatic conditions) and will probably be limited to within 3 – 5 km of the site
Duration	2 – Short-term
Magnitude	2
Probability	4 (2 with mitigation and adequate management)
Significance of impact	$S = (2 + 2 + 2) * 4 = 24$ (12 with mitigation and adequate management) (low)
Status	Negative
Mitigation	Limit vehicle movement to absolute minimum, construct proper roads for access

Table 11 Summary of the impact of the development on agricultural potential and land capability

Nature of Impact	<i>Loss of agricultural potential and land capability owing to the development</i>	
	<i>Without mitigation</i>	<i>With mitigation</i>
Extent	Low (1) – Site	Low (1) – Site
Duration	Permanent (5)	Permanent (5)
Magnitude	Low (2)	Low (2)
Probability	Highly probable (4)	Highly probable (4)
Significance *	32 (Low)	32 (Low)
Status (positive or negative)	Negative	Negative
Reversibility	Medium	Medium
Irreplaceable loss of resources?	No	No
Can impacts be mitigated?	Direct impacts cannot be mitigated but indirect impacts can be minimised and avoided through adequate planning of layout	
<i>Mitigation:</i> The loss of land is a long term loss and there are no mitigation measures that can be put in place to combat this loss. Mitigation is restricted to the limitation of the extent of the impact to the immediate area of impact and minimisation of off-site impacts		
<i>Cumulative impacts:</i> Soil erosion may arise due to altered surface water runoff. Adequate management and erosion control measures should be implemented.		
<i>Residual Impacts:</i> The loss of land is a long term loss. This loss extends to the post-construction phase. The agricultural potential is variable though and negative impacts can be limited through adequate planning for this within the layout.		

5.4 Environmental Management Plan

Tables 12 to 14 provide the critical aspects for inclusion in the EMP.

Table 12 Measures for erosion mitigation and control

Objective: Erosion control and mitigation		
Project components	Soil stabilisation, construction of impoundments and erosion mitigation structures	
Potential Impact	Large scale erosion and sediment generation	
Activity / risk source	Poor planning of rainfall surface runoff and storm water management	
Mitigation: Target / Objective	Prevention of eroded materials and silt rich water running off the site	
Mitigation: Action/control		
	Responsibility	Timeframe
Plan and implement adequate erosion control measures	Construction team and engineer	Throughout project
Performance indicator		
	Assessment of storm water structures and erosion mitigation measures. Measurement of actual erosion and sediment generation.	
Monitoring	Monitor and measure sediment generation and erosion damage	

Table 13 Measures for limiting vehicle operation impacts on site (spillages)

Objective: Erosion control and mitigation		
Project components	Maintenance of vehicles and planning of vehicle service areas	
Potential Impact	Oil, fuel and other hydrocarbon pollution	
Activity / risk source	Poor maintenance of vehicles and poor control over service areas	
Mitigation: Target / Objective	Adequate maintenance and control over service areas	
Mitigation: Action/control		
	Responsibility	Timeframe
Service vehicles adequately	Construction team and engineer	Throughout project
Maintenance of service areas, regular cleanup	Construction team and engineer	Throughout project
Performance indicator		
	Assessment number and extent of spillages on a regular basis.	
Monitoring	Monitor construction and service sites	

Table 14 Measures for limiting dust generation on site

Objective: Dust generation suppression		
Project components	Limit and address dust generation on site linked to construction activities	
Potential Impact	Large scale dust generation on site	
Activity / risk source	Inadequate dust control measures, excessive vehicle movement on unpaved roads	
Mitigation: Target / Objective	Minimise generation of dust	
Mitigation: Action/control		
	Responsibility	Timeframe
Implement dust control strategy including dust suppressants and tarring of roads	Construction team and engineer	Throughout project
Limit vehicle movement on unpaved areas to the absolute minimum	Construction team and engineer	Throughout project
Performance indicator		
	Assessment of dust generated on site	
Monitoring		
	Monitor construction site and surrounds	

6. CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the proposed development of a wind energy facility on the site will have no negative impacts on agricultural activities. The impacts on soils are small in comparison to historical mining impacts. The impacts should be limited to the immediate construction sites and rehabilitation measures should be implemented in line with those to be implemented by the mine.

Regarding the construction of turbines and associated infrastructure the following recommendations are made:

1. Limit physical impacts to as small a footprint as possible;
2. Site management has to be implemented with the appointment of a suitable environmental control officer (ECO) to oversee the process, address problems and recommend and implement corrective measures;
3. Implement site specific erosion and water control measures to prevent excessive surface runoff from the site (turbines and roads);
4. Plan the road and site layout in such a way as to make maximal use of existing roads to keep natural units as intact as possible; and
5. Prevent dust generation and vehicle associated pollution and spillages.

The impacts on the site need to be viewed in relation to the opencast mining of coal in areas of high potential soils – such as the Eastern Highveld. With this comparison in mind the impact of a wind energy facility is negligible compared to the damaging impacts of coal mining – for a

similar energy output. Therefore, in perspective, the impacts of the proposed facility can be motivated as necessary in decreasing the impacts in areas where agriculture potential plays a more significant role.

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