

BASIC ASSESSMENT REPORT

SOIL, LAND USE AND AGRICULTURAL POTENTIAL SURVEY:

PROPOSED VISSERSPAN SOLAR FACILITY PROJECT NO. 2, ON VISSERSPAN FARM NO. 40, TOKOLOGO LOCAL MUNICIPALITY, FREE STATE PROVINCE

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Declaration

I, Johan Hilgard van der Waals, declare that -

- 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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1. INTRODUCTION

1.1 TERMS OF REFERENCE

Terra Soil Science was appointed by EnviroAfrica cc to conduct a soil and agricultural potential survey/assessment of the proposed Visserspan Solar Facility Project No. 2 on the Farm Visserspan No. 40 in the Tokologo Local Municipality in the Free State Province.

1.2 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.

In the case where crop production is not possible due to soil or climatic constraints aspects such as grazing potential and carrying capacity is considered. Grazing capacity is mainly determined by vegetation characteristics of a site and would therefore have to be deduced from vegetation reports (that do address carrying capacity) or from dedicated discussions with farmers and land users. The combination of the above-mentioned factors will be used to assess the agricultural potential of the soils on the site.

1.3 LAND CAPABILITY BACKGROUND AND CLASSIFICATION

Land capability refers to the specific land use and agronomic practices that a given piece of land is capable of in the context of the original land capability categories published in the USA in the 1960's. The land capability concept is a bit broader than the "land suitability" approach expounded by the FAO (Food and Agriculture Organisation of the UN) where the latter aims to pronounce on the suitability of a specific area of land for a specific "land utilization type" (LUT). In the more recent South African case for "land capability" the then Department of Agriculture, Forestry and Fisheries (DAFF) established a requirement for the classification of land based on the criteria provided in **Table 1**. These categories are not significantly different from the original concept but have been amended for the South African context.

Land	Definition	Concernation Need	
Land Capability Class	Definition	Conservation Need	Use suitability
1	No or few limitations. Very high arable potential. Very low erosion hazard.	Good agronomic practice.	Annual cropping.
11	Slight limitations. High arable potential. Low erosion hazard.	Adequate run-off control.	Annual cropping with special tillage or ley (25%)
111	Moderate limitations. Some erosion hazards.	Special conservation practice and tillage methods.	Rotation of crops and ley (50 %).
IV	Severe limitations. Low arable potential. High erosion hazard.	Intensive conservation practice.	Long term leys (75 %)
V	Watercourse and land with wetness limitations.	Protection and control of water table.	Improved pastures or Wildlife
VI	Limitations preclude cultivation. Suitable for perennial vegetation.	Protection measures for establishment eg. Sod-seeding	Veld and/or afforestation
VII	Very severe limitations. Suitable only for natural vegetation.	Adequate management for natural vegetation.	Natural veld grazing and afforestation
VIII	Extremely severe limitations. Not suitable for grazing or afforestation.	Total protection from agriculture.	Wildlife

Table 1 Land capability classes for assessment of land

The assessment of land capability rests squarely on the assessment of soil properties for agricultural purposes as discussed in the previous section. These properties will therefore be used to determine the specific land capability class for the survey area.

2. LOCALITY OF THE SURVEY AREA

The 223 ha survey area lies between 28° 34' 59" S and 28° 36' 48" S and 25° 43' 32" E and 25° 45' 05" E approximately 7 kilometres north-north-west of the town of Dealesville in the Free State Province (**Figure 1**).



Figure 1 Location of the investigation site

3. METHOD OF SOIL AND AGRICULTURAL SURVEY

The survey was conducted in five phases.

3.1 PHASE 1: BROAD GEOLOGICAL SETTING

The broad geological setting of the investigation area was ascertained from the 1:250 000 Geological Map of South Africa, Council for Geoscience.

3.2 PHASE 2: 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) (Land Type Survey Staff, 1972 – 2006). 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 (The Soil Classification Working Group, 1991).

The Visserspan site falls into the **Ae46** land type as indicated in **Figure 2** (Land Type Survey Staff, 1972 – 2006). This land type is summarised below with a description of the dominant soils, land capability, land use and agricultural potential.

3.3 PHASE 3: TOPOGRAPHIC AND OTHER BIOPHYSICAL PARAMETERS

The topography of the site was elucidated through the generation of a digital elevation model (DEM) map for the site. From this data a topographic wetness index (TWI) map was generated.

3.4 PHASE 4: SATELLITE IMAGE INTERPRETATION

A dedicated satellite image (Google Earth) interpretation exercise was conducted to determine the current site conditions as well as the historical land uses. This was done through the accessing of Google Earth images from different periods in the past.

3.5 PHASE 5: SITE VISIT AND SOIL SURVEY

A high-level reconnaissance soil survey was conducted to ascertain soil variation across the land types. For the soil survey the area was traversed in a vehicle along public roads and soils were investigated at accessible spots as well as along road cuttings. Photographs were taken of the relevant site and soil characteristics.



Figure 2 Land type map for the investigation area

4. SURVEY RESULTS

4.1 PHASE 1: BROAD GEOLOGICAL SETTING

The broad geology patterns (1:250 000 Geological Map of South Africa, Council for Geoscience) of the survey area indicates the site to consist of dominantly aeolian sands with dolerite, calcrete and grey shales with interbedded siltstone

4.2 PHASE 2: LAND TYPE DATA

Land Type Ae46

<u>Land Type – General</u>: Ae land types denote landscapes where the dominant soils are red high base status (eutrophic and lime containing) in excess of 300 mm depth..

<u>Soils</u>: Soils are dominantly red coloured, eutrophic and lime containing, well-drained and of sandy to sandy loam texture. Light coloured sandy soils occur in depressions. Some of these soils have lighter colours due to the presence of lime and some are bleached due to occasional ponding of water.

Land capability and land use: The land use in this land type is extensive grazing due to climatic constraints. The land capability mimics the land use.

<u>Agricultural potential</u>: The agricultural potential in terms of dryland cropping is low due to lower than 500 mm pa rainfall (**Figure 3**) with grazing potential being dependent on rainfall and management.



Figure 3 Rainfall map of South Africa indicating the survey site

4.3 PHASE 3: TOPOGRAPHIC AND OTHER BIOPHYSICAL PARAMETERS

Contours of the entire site were used to generate a digital elevation model (DEM –**Figure 4**) and topographic wetness index (TWI – **Figure 5**). The contours indicate a relatively flat landscape with an easterly aspect. No drainage features are evident on the site.



Figure 4 Digital elevation model for the entire survey area



Figure 5 Topographic wetness index (TWI) for the entire survey area

4.4 PHASE 4: SATELLITE IMAGE INTERPRETATION

The satellite image of the Visserspan No. 2 site and surrounding area (with 5 m contours) is provided in **Figure 6**.



Figure 6 Satellite image of the Visserspan No. 2 site and surrounding area

An additional Google Earth image with a different surface colour is provided in **Figure 7**. This image is provided with an indication of the interpreted geological features. These features are discussed in more detail in section 4.5.



Figure 7 Google Earth image (2016/10/07) of the investigation site with geological features

4.5 PHASE 5: SITE VISIT AND SOIL SURVEY

The soils on the site are predominantly sandy surface horizons overlying calcrete and weathered dolerite. As such the soils vary from moderately deep sandy Hutton (orthic A / red apedal B / unspecified material – usually hard or weathering rock) forms to Glenrosa (orthic A / lithocutanic B) or Mispah (orthic A / hard rock) forms. The patterns are relatively easy to identify on satellite images with bleached and lime containing topsoils indicating shallower soils overlying calcrete.

There is a small section that shows evidence of historical tillage and crop production but that has now been abandoned. This aspect is considered to indicate a general low agricultural potential. The grazing potential can only be assessed based upon more detailed vegetation surveys (not part of this investigation).

5. AGRICULTURAL POTENTIAL

5.1 AGRICULTURAL POTENTIAL OF THE SITE

The agricultural potential of the site is considered to be low due to variable and shallow depth soils as well as the average rainfall that is below 500 mm pa.

5.2 LAND CAPABILITY CLASSIFICATION

The land capability of the landscape is very much determined through the current land use (**Figure 7**). The entire site is classified as VII land capability (as discussed in section 1.3 and **Table 1**).

6. ASSESSMENT OF IMPACT

6.1 ASSESSMENT CRITERIA

The following assessment criteria (Table 2) will be used for the impact assessment.

CATEGORY			DESCRIPTION OF DEFINITION		
Direct,	indirect	and	In relation to an activity, means the impact of an activity that		
cumulative impacts			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 (S	Scale)		The area over which the impact will be expressed - ranging		
• 1/2	/3/4/5		from local (1) to regional (5).		

Table 2 Impact Assessment Criteria

CATEGORY	DESCRIPTION OF DEFINITION		
Duration	Indicates what the lifetime of the impact will be.		
• 1	 Very short term: 0 – 1 years 		
• 2	• Short-term: 2 – 5 years		
• 3	 Medium-term: 5 – 15 years 		
• 4	 Long-term: > 15 years 		
• 5	Permanent		
Magnitude	This is quantified on a scale from 0-10, where 0 is small and		
• 2	will have no effect on the environment, 2 is minor and will		
• 4	not result in an impact on processes, 4 is low and will cause		
• 6	a slight impact on processes, 6 is moderate and will result		
• 8	in processes continuing but in a modified way, 8 is high		
• 10	(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	Describes the likelihood of an impact actually occurring.		
• 1	Very Improbable		
• 2	Improbable		
• 3	Probable		
• 4	Highly probable		
• 5	Definite		
Significance	The significance of an impact is determined through a		
	synthesis of <u>all</u> of the above aspects.		
	$S = (E + D + M)^*P$		
	S = Significance weighting		
	E = Extent		
	D = Duration		
	M = Magnitude		
Status	Described as either positive, negative or neutral		
Positive			
Negative			
Neutral			
Other	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		

6.2 LIST OF ACTIVITIES FOR THE SITE

Table 3 lists the anticipated activities for the site. The last two columns in the table list the anticipated forms of soil degradation and geographical distribution of the impacts.

6.3 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 9**. <u>Note</u>: The impacts listed below indicate that no mitigation is possible. It is important to note that any soil impact in the form of drastic physical disturbance (as with construction activities) is a permanent one and no mitigation is possible. The mitigation that can be applied is the restriction of off-site effects due to developments through adequate implementation of environmental management measures (discussed later in the report).

Activity	Form of		Geographical	Comment
	Degradatio	n	Extent	(Section
				described)
Construction Phase				
Construction of solar panels and	Physical		Two dimensional	Impact small due
stands	degradation			to localised nature
	(surface)			(Section 6.3.1)
Construction of buildings and other	Physical		Two dimensional	(Section 6.3.2)
infrastructure	degradation			
	(compound)			
Construction of roads	Physical		Two dimensional	(Section 6.3.3)
	degradation			
	(compound)			
Construction and Operational Pha	ase Related Eff	ects		
Vehicle operation on site	Physical	and	Mainly point and	(Section 6.3.4)
	chemical		one dimensional	
	degradation			
	(hydrocarbon			
	spills)			
Dust generation	Physical		Two dimensional	(Section 6.3.5)
	degradation			

Table 3 List of activities and their associated forms of soil degradation

6.3.1 Construction of Solar Panels and Stands

Table 4 presents the impact criteria and a description with respect to soils, land capability and land use for the construction of solar panels and stands.

Criteria	Description		
Cumulative	The cumulative impact of this activity will be small as it is constructed on land with		
Impact	low agricultural potential.		
Nature	This activity entails the construction of so	lar panels and stands with the associated	
	disturbance of soils and existing land use	2.	
	Without Mitigation With Mitigation		
Extent	1 - Site: The impact is two dimensional	1 - Site: The impact is two dimensional	
	but then limited to the immediate area	but then limited to the immediate area	
	that is being developed	that is being developed	
Duration	5 – Permanent (unless removed) 5 – Permanent (unless removed)		
Magnitude	2 2		
Probability	4 (highly probable due to inevitable	4 (highly probable due to inevitable	
	changes in land use)	changes in land use)	
Significance	S = (1 + 5 + 2)*4 = 32 (low)	S = (1 + 5 + 2)*4 = 32 (low)	
of impact			
Status	Negative Negative		
Mitigation	None possible. Limit footprint to the	None possible. Limit footprint to the	
	immediate development area	immediate development area	

Table 4 Construction of solar panels and stands

5.3.2 Construction of Buildings and Other Infrastructure

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

Criteria	Description		
Cumulative	The cumulative impact of this activity will be small as it is constructed on land with		
Impact	low agricultural potential.		
Nature	This activity entails the construction of b	uildings and other infrastructure with the	
	associated disturbance of soils and existi	ng land use.	
	Without Mitigation	With Mitigation	
Extent	1 - Site: The impact is two dimensional	1 - Site: The impact is two dimensional	
	but then limited to the immediate area	but then limited to the immediate area	
	that is being developed that is being developed		
Duration	5 – Permanent (unless removed)	5 – Permanent (unless removed)	
Magnitude	2	2	
Probability	4 (highly probable due to inevitable	4 (highly probable due to inevitable	
	changes in land use)	changes in land use)	
Significance	$S = (1 + 5 + 2)^{*}4 = 32$	S = (1 + 5 + 2)*4 = 32 (low)	
of impact			
Status	Negative Negative		
Mitigation	None possible. Limit footprint to the	None possible. Limit footprint to the	
	immediate development area	immediate development area	

Table 5 Construction of buildings and other infrastructure

6.3.3 Construction of Roads

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

Criteria	Description		
Cumulative	The cumulative impact of this activity will be small as it is linear and limited in		
Impact	geographical extent.		
Nature	This activity entails the construction of I	oads with the associated disturbance of	
	soils and existing land use.		
	Without Mitigation	With Mitigation	
Extent	1 - Site: The impact is two dimensional	1 - Site: The impact is two dimensional	
	but then limited to the immediate area	but then limited to the immediate area	
	that is being developed along the road	that is being developed along the road	
Duration	5 – Permanent (unless removed)	5 – Permanent (unless removed)	
Magnitude	2	2	
Probability	4 (highly probable due to inevitable	4 (highly probable due to inevitable	
	changes in land use)	changes in land use)	
Significance	S = (1 + 5 + 2)*4 = 32 (low)	S = (1 + 5 + 2)*4 = 32 (low)	
of impact			
Status	Negative	Negative	
Mitigation	None possible. Limit footprint to the	None possible. Limit footprint to the	
	immediate development area and keep	immediate development area and keep	
	to existing roads as far as possible	to existing roads as far as possible	

Table 6 Construction of roads

6.3.4 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.

Criteria	Description		
Cumulative	The cumulative impact of this activity will be small if managed.		
Impact			
Nature	This activity entails the operation of vehi	cles on site and their associated impacts	
	in terms of spillages of lubricants and pet	roleum products	
	Without Mitigation	With Mitigation	
Extent	1 - Site: The impact is two dimensional	1 - Site: The impact is two dimensional	
	but then limited to the immediate area	but then limited to the immediate area	
	that is being developed	that is being developed	
Duration	2 – Short-term	2 – Short-term	
Magnitude	2	2	
Probability	4 2 (with prevention and mitigation)		
Significance	$S = (1 + 2 + 2)^* 4 = 20$	$S = (1 + 2 + 2)^2 = 10$ (with prevention	
of impact		and mitigation)	
Status	Negative Negative		
Mitigation	Maintain vehicles, prevent and address	Maintain vehicles, prevent and address	
	spillages	spillages	

6.3.5 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. For the sake of this assessment contributions of dust generation other than the activities on the site have been ignored.

Criteria	Description		
Cumulative	The cumulative impact of this activity will be small if managed but can have		
Impact	widespread impacts if ignored.		
Nature	This activity entails the operation of ve	hicles on site and their associated dust	
	generation		
	Without Mitigation	With Mitigation	
Extent	2 - Local: The impact is diffuse	2 - Local: The impact is diffuse	
	(depending on environmental and	(depending on environmental and	
	climatic conditions) and will probably be climatic conditions) and will proba		
	limited to within $3 - 5$ km of the site limited to within $3 - 5$ km of the		
Duration	2 – Short-term	2 – Short-term	
Magnitude	2	2	
Probability	4	2 (with mitigation and adequate	
		management)	
Significance	$S = (2 + 2 + 2)^* 4 = 24$	$S = (2 + 2 + 2)^2 = 12$ (with mitigation	
of impact		and adequate management)	
Status	Negative	Negative	
Mitigation	Limit vehicle movement to absolute	Limit vehicle movement to absolute	
	minimum, implement dust suppression	n minimum, implement dust suppression	
	strategies	strategies	

Table 8 Assessment of impact of dust generation on site

Table 9 Summary of the impact of the development on agricultural potential and land capability

Nature of Impact	Loss of agricultural potential and land capability owing to the development		
	Without mitigation	With mitigation	
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	No	No	
resources?			
Can impacts be mitigated?	No	No	

Mitigation:

The loss of agricultural land is a long-term loss and there are no mitigation measures that can be put in place to combat this loss.

Cumulative impacts:

Soil erosion may arise owing to increased surface water runoff. Adequate management and erosion control measures should be implemented.

Residual Impacts:

The loss of agricultural land is a long-term loss. This loss extends to the post-construction phase. The agricultural potential is very low though.

6.4 ENVIRONMENTAL MANAGEMENT PLAN

Tables 10 to 12 provide the critical aspects for inclusion in the EMP.

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 /	Prevention of eroded materials and silt rich water running off the site				
Objective					
Mitigation: Action/control		Responsibility	Timeframe		
Plan and implement adequate erosion control		Construction team and	Throughout project		
measures		engineer			
Performance	Assessment of storm water structures and erosion mitigation measures.				
indicator	Measurement of actual erosion and sediment generation.				
Monitoring	Monitor and measure sediment generation and erosion damage				

 Table 10 Measures for erosion mitigation and control

Table 11 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 /	Adequate maintenance and control over service areas				
Objective					
Mitigation: Action/control		Responsibility	Timeframe		
Service vehicles adequately		Construction team and	Throughout project		
		engineer			
Maintenance of service areas, regular cleanup		Construction team and	Throughout project		
		engineer			
Performance	Assessment number and extent of spillages on a regular basis.				
indicator					
Monitoring	Monitor construction and service sites				

Table 12 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 /	Minimise generation of dust				
Objective					
Mitigation: Action/control		Responsibility	Timeframe		
Implement dust control strategies suitable for		Construction team and	Throughout project		
the site conditions		engineer			
Limit vehicle movement on unpaved areas to		Construction team and	Throughout project		
the absolute minimum		engineer			
Performance	Assessment of dust generated on site				
indicator					
Monitoring	Monitor construction site and surrounds				

7. CONCLUSIONS AND RECOMMENDATIONS

It is concluded that the proposed development of a photovoltaic facility on the site will not have large impacts due to the low agricultural potential of the site as well as the rainfall that is below 500 mm pa.

Even though the soils on the site are not considered to be highly sensitive to erosion such prevention measures should be put in place due to the general slope of the site. The main impacts that have to be managed on the site during the construction activities are:

- 1. Erosion must be controlled through adequate mitigation and control structures.
- 2. Impacts from vehicles, such as spillages of oil and hydrocarbons, should be prevented and mitigated.
- 3. Dust generation on site should be mitigated and minimised as the dust can negatively affect the quality of grazing as well as livestock production.

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 solar 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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