

Basic Assessment Report: Upgrading & Development of an Access Road from the N10/'Burgerville' District Road (2448) Turn-Off into the Farm Riet Fountain No. 39C and to the Switching Station and Main Transmission Substation on Sun Central Cluster 1 (300 MW) Solar PV Facility between De Aar & Hanover, Emthanjeni Local Municipality, Pixley Ka Seme District Municipality, Northern Cape Province, South Africa (2023).

Assessment of alternatives

Description of alternatives

3(1) A basic assessment report... must include –

(h) a full description of the process followed to reach the proposed preferred alternative within the site, including – (i) **details of all the alternatives** considered; and (iv) the **environmental attributes associated with the alternatives** focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects.

Appendix 1 (Basic Assessment Report) of the EIA Regulations, 2014 as amended

“The proponent should be encouraged to explore all possible alternatives, including the Best Practicable Environmental Option (BPEO). The BPEO can be defined as the option that provides the most benefit or causes the least damage to the environment as a whole, at a cost acceptable to society in the long term as well as in the short term” (DEAT, 2004).

All environmental impact assessments, which are to be utilised in informing an application for environmental authorisation, must identify and investigate the alternatives to the activity on the environment (Sections 24(4)(b)(i) and 24(4A) of NEMA, 1998) and include a description and comparative assessment of the advantages and disadvantages that the proposed activity and feasible and reasonable alternatives will have on the environment and on the community that may be affected by the activity. If, however, after having identified and investigated alternatives, no feasible and reasonable alternatives exist, no comparative assessment of alternatives, beyond the comparative assessment of the preferred alternative and the option of not implementing the activity (Sections 24(4)(b)(i) and 24(4A) of NEMA), is required during the assessment phase. In this instance, the EAP managing the application must provide the competent authority with detailed, written proof of the investigation(s) undertaken and motivation indicating that no reasonable or feasible alternatives, other than the preferred alternative and the no-go option, exist.

Details of all the alternatives considered

Types of Alternatives

In terms of the EIA Regulations, 2014 as amended, “alternatives” are generally considered to be different locations, activities and/or technologies that can meet the general purpose and requirements of a proposed activity:

- (1) The property on which or location where it is proposed to undertake the activity. This refers to both alternative properties as well as alternative sites on the same property, or in the case of linear developments, then alternative routes.

“A distinction should also be drawn between alternative locations that are geographically quite separate, and alternative locations that are in close proximity. In the case of the latter, alternative locations in the same geographic area are often referred to as alternative sites. This tends to be the more common

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application. In some cases it may not be possible to consider alternative locations as there may be constraints to the activity location” (DEAT, 2004).

(2) The design or layout of the activity. Design refers to different architectural and or engineering designs, whereas site layout involves the consideration of different spatial configurations of an activity on a particular site.

“Consideration of different designs for aesthetic purposes or different construction materials in an attempt to optimise local benefits and sustainability would constitute design alternatives. Generally, the design alternatives could be incorporated into the project proposal and so be part of the project description, and need not be evaluated as separate alternatives” (DEAT, 2004).

(3) The type of activity to be undertaken.

“These are sometimes referred to as project alternatives. Consideration of such alternatives requires a change in the nature of the proposed activity. An example is incineration of waste rather than disposal in a landfill, or the provision of public transport rather than increasing the capacity of roads. In view of the substantive differences in the nature of the proposed activities, it is likely that this category is most appropriate at a strategic decision-making level, such as in a Strategic Environmental Assessment (SEA)” (DEAT, 2004).

(4) The technology to be used. Technologies include different methods or processes that achieve the same goal, e.g., coal-fired power stations versus solar power plants.

(5) The no-go option, or option of not implementing the activity, is taken to be the existing rights on the property and this includes all the duty of care and other legal responsibilities that apply to the owner of the property (all the applicable permits must be in place for a land use to be an existing right).

Other types of alternatives, such as alternative operational aspects, other means for meeting a demand, alternative inputs, scheduling and timing, and scale and magnitude, are considered throughout the assessment process to address site-specific impacts when the need for mitigation is identified by, for example, the relevant specialist studies.

The key criteria when identifying and investigating alternatives are that they should be “feasible” and “reasonable”. The “feasibility” and “reasonability” of and the need for alternatives must be determined by considering, *inter alia*, the general purpose and requirements of the activity.

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Identification of Alternatives

Potentially ‘feasible’ and ‘reasonable’ alternatives were identified by considering whether the different types of alternatives could meet the general purpose and requirements of the proposed access road (**Table 1**),

Table 1: Purpose and Requirements of the proposed activity, specifically an access road.

Purpose	Requirements
Access to the Switching Station (Dx) and Main Transmission Substation (MTS) from the N10.	Hanover is accessed via the N1 from either Johannesburg or Cape Town, and deliveries from either East London or Gqeberha (formerly Port Elizabeth) would be via the N10. Consequently, the access road must intersect the N10 as heavy equipment will be transported to site using the left, north-bound lane of the N10 from Hanover.
	The access road must end at the Sun Central Cluster 1 Solar PV footprint.
	The access road must meet the minimum Eskom specifications to ensure the safe delivery of abnormal loads (e.g., 500 MVA transformers) to site, using a 270 tonne, 40 m to 60 m-long truck and trailer combination.
	As far as is practical, utilize existing road network.
	Maintain the same agricultural rural “sense of place.”
	Cause the least potential damage to river and/or wetland crossings.
	Structural integrity.

Alternative No. 1: Property and Location

- Purpose and Requirements


Two alternative routes (**Table 2**), which can meet the general purpose and requirements of an access road to the MTS, were identified and therefore constitute potentially feasible and reasonable alternatives that will need to undergo a comparative assessment to determine the Best Practicable Environmental Option.

- Methodology

Frank Sprung (Construction Manager) of SolarAfrica Energy investigated two alternative routes (**Table 2**) for the access road (SolarAfrica Sun Central – Access Road Study Rev 0.1 (Document Reference: SAE-PD-DA-Access Road Study 0.1 FS), prepared by Frank Sprung, dated 16th September 2022). Both alternative routes were driven and assessed for road condition, geometry and length of road that would require improvement..

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Table 2: Details of the route alternatives.

Alternative Route No. 1 - preferred route (White line)	Alternative Route No. 2 (Blue line)
	
<p>Access to site via gravel District Road 2448 from N10 (white line).</p>	<p>Access to site via gravel District Road 2451 from Hanover) blue line).</p>
<p>Start: 30°52'31.51"S & 24°13'25.90"E</p>	<p>Start: 31° 4'18.54"S & 24°26'37.65"E</p>
<p>Middle: 30°51'13.11"S & 24°16'58.88"E</p>	<p>Middle: 30°57'56.37"S & 24°23'35.44"E</p>
<p>End: 30°53'20.89"S & 24°18'53.47"E</p>	<p>End: 30°53'21.98"S & 24°18'53.85"E</p>
<p>Distance: 14.1 km</p>	<p>Distance: 25.7 km</p>

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<p>The preferred route can be divided into three sections:</p> <p>(1) the existing public 'Burgerville' District Road 2448 (± 5.2 km). This road is in good condition but would require subgrade and subbase reconstruction in several areas, where stormwater runoff needs to be improved. These are all low-lying areas where water ponding occurs and has softened the layer works to the point where deep rutting occurs due to wheel tracks from traffic on the roads.</p> <p>(2) existing private farm tracks ($\pm 6,25$ km) from where the formal district road known as road 2448 intersects the De Bad farm boundary onto the "old Hanover Road 3557", which has been deregistered and now forms part of the De Bad farm property. This part of the access road crosses the Brak River and continues along existing farm tracks until the fence line of the Sun Central Cluster 1 solar field (footprint).</p> <p>(3) a new road follows undisturbed ground from the where the farm track reaches the perimeter fence of Cluster 1 to the Switching Station and Main Transmission Substation ($\pm 2,65$ km). The portion of new road is required as Eskom needs unrestricted access to both substations, that is without traversing the fenced Sun Central Cluster 1 development footprint.</p>	<p>Alternative Route No. 2 can be divided into three sections:</p> <p>(1) Section A to B is 17.2 km long and still declared as an official road, however it is in a neglected state. It was found that stormwater drainage off the road is virtually non-existent, mainly due to excessive grading over the years resulting in the top layer often being lower than the surrounding verges. This results in ponding of water which has severely compromised the structural component of the road. Deep rutting is evident where vehicles dig their tyres into soft mud. The general geometry is acceptable. However, some inclines, corners, dips and peaks would need to be modified to comply with an ESKOM specification road. Significant repair would be required.</p> <p>(2) Section B to C is 6.7 km long and is no longer registered as an official road but formally known as road 3557. The use of this section of road would require special permission from adjoining farmers and wayleaves would have to be obtained. The road is no longer recognisable as a former road, as it is heavily overgrown with vegetation. It could be considered as a farm track and would require extensive rebuilding to bring it to an acceptable road specification.</p> <p>(3) Section C to D (a possible proposal to extend the road) is 1.8 km long through undisturbed ground and would be built just inside the farm boundary to the entrance of the MTS. There is a farm dam close by as well as a very sandy section, running through what could be a low-lying watershed area. This section also occurs within the 100 m buffer of a watercourse, which was delineated by the Aquatic specialist for Cluster 1.</p>
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- Criteria used to investigate alternatives

The alternative routes were investigated by taking such criteria into account as geotechnical aspects, design requirements, footprint, construction costs, accessibility, and safety.

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- Requirements (criteria) used to identify comparable sites

The access road has to be accessible from the N10 and should as far as is practical utilize an existing road network that can reach the Switching Station (Dx) and Main Transmission Substation (MTS) (**Table 2** above).

Alternative No. 2: Design and Layout

- Reasoned explanation why an alternative was not found to be reasonable or feasible

No alternative design for delivering 1 x 500mVA 400kV/132kV transformer to the MTS other than the minimum ESKOM Standard (typical structural road design) for access roads for extra heavy loads into ESKOM facilities (**Figure 1**)

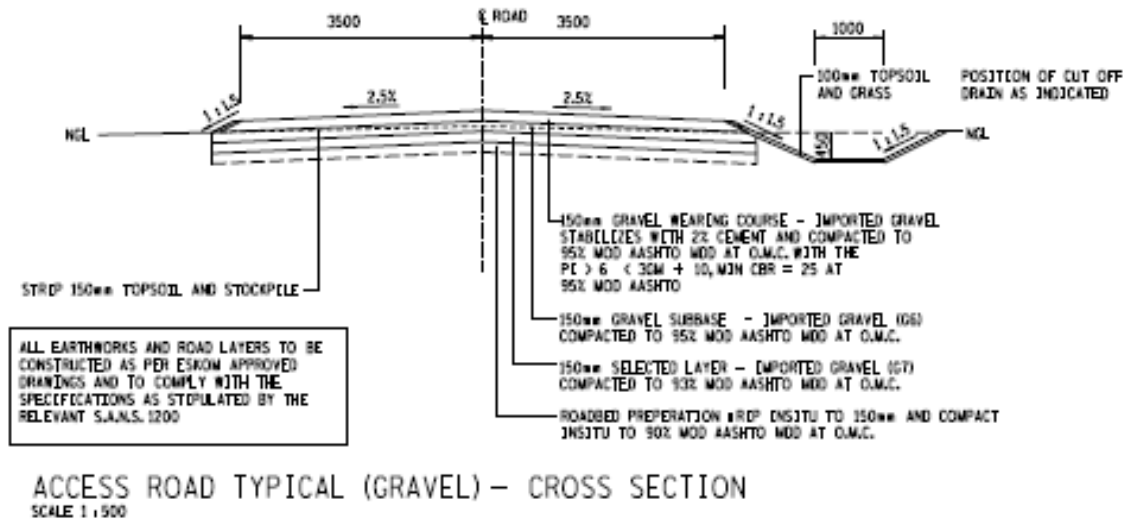


Figure 1. The minimum ESKOM Standard for access roads for extra heavy loads into ESKOM facilities (taken from ESKOM Typical Access Road Cross Section Drawing).

Parameters of the required road geometry must include for longitudinal slope, lateral slope, turning circle radii, concave and convex longitudinal radii and road clearance for the trailer delivering the MTS 500mVA transformer.

Alternative No. 3: Type of Activity

- Reasoned explanation why an alternative was not found to be reasonable or feasible

No alternative activities exist.

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Alternative No. 4: Technology

- Reasoned explanation why an alternative was not found to be reasonable or feasible

No alternative technology for delivering 1 x 500mVA 400kV/132kV transformer to the MTS other than that prescribed by Goldhofer THP/SL45 2-File-20-Axle trailer; Payload 255 tonnes, including trailer 370 tonnes, 18 tonnes per axle line, 2.3 tonnes per wheel, Ground Bearing Pressure 1.9 tonnes per m², turning circle approximately 24 m radius, and total length of trailer and 3 horses is 73 m.

Alternative No. 5: No-go Option

The option of not implementing the activity is used as the benchmark against which all impacts associated with the proposed development were assessed. In this case, the no-go option would be to use the existing road network in its current state of disrepair, making it impossible to deliver the heavy equipment to site.

Conclusion

Two alternative routes and the no-go option were identified for further assessment.

Other criteria that will be considered during the comparative assessment to determine which potentially reasonable and feasible alternative is the Best Practicable Environmental Option, include need and desirability, opportunity costs, the need to avoid negative impact altogether, the need to minimise unavoidable negative impacts, the need to maximise benefits, and the need for equitable distributional consequences. The (development) alternatives must be socially, environmentally, and economically sustainable. They must also aim to address the key significant impacts of the proposed development by maximizing benefits and avoiding or minimising the negative impacts.

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Identification (and assessment) of impacts and risks for each alternative

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(h) a full description of the process followed to reach the proposed preferred alternative within the site, including – (v) **the impacts and risks identified for each alternative, including the nature, significance, consequence, extent, duration and probability of the impacts, including the degree to which these impacts - (aa) can be reversed; (bb) may cause irreplaceable loss of resources; and (cc) can be avoided, managed or mitigated;** (vii) **positive and negative impacts that the proposed activity and alternatives will have on the environment and on the community that may be affected focusing on the geographical, physical, biological, social, economic, heritage and cultural aspects;** (viii) **the possible mitigation measures that could be applied and level of residual risk.**

Appendix 1 (Basic Assessment Report) of the EIA Regulations, 2014 as amended

Assessment of Site Alternatives

Receiving Environment: Terrestrial & Avian fauna

Description of potential impacts:

Impact-Consequence	Change	Source*	Impact No.
<p>Loss of fauna.</p> <ul style="list-style-type: none"> • Bird mortalities due to vehicle collisions or collisions with infrastructure, such as fences - the loss of threatened (Red Data) species may result in a loss of biodiversity and ecosystem resilience to climate change (direct), and the loss of threatened keystone species may alter the functioning of an ecosystem (direct). • Disturbance to breeding or destruction of bird nesting sites and roosts - decrease in avifauna population (directly) due to loss of offspring/breeding pairs for generation (indirectly). • Disturbance (including of nesting SCC) due to noise, such as machinery movements and maintenance operations, causing active mammals and birds to temporarily evade or emigrate from the area - forced redistribution out of home ranges or territories can cause 	quantity	Matrix	1

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stress and conflict, leading to injury or death of individuals (indirect), and decrease in avifauna population due to loss of offspring/breeding pairs for generation.			
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*The source of information used in identifying the impact is either the Leipold Matrix (Matrix), Interested and Affected Parties (I&APs) and/or Specialist studies (Specialist)

Any assumptions, uncertainties & limitations, or gaps in knowledge with predicting the impacts

- The Animal Species theme for both Alternative Routes is High owing to the presence of certain birds (Screening Assessment Reports).
- Both Alternative Routes fall within an Important Bird Area (IBA) called Platberg-Karoo Conservancy (unprotected) (bgisviewer.sanbi.org, 2015). The study area occurs in the Platberg-Karoo Conservancy (SA037) Important Bird and Biodiversity Area (IBA). The Platberg-Karoo Conservancy IBA covers c. 1240 000 ha and is in the Northern Cape Province with a protected status of "Unprotected". A total of 289 bird species have been recorded in the IBA during SABAP2 (Avifauna Final EIA Report, 2022).
- IBA trigger species are the Globally threatened Blue Crane, Ludwig's Bustard, Kori Bustard, Secretary bird, Martial Eagle, Blue Korhaan, Black Harrier and Denham's Bustard. Regionally threatened species are Black Stork, Lanner Falcon, Tawny Eagle, Karoo Korhaan and Verreaux's Eagle (BirdLife website, 2015).
- Eighty-four (84) bird species were observed within and around the Combined Project Area out of an expected total of 104 species, based on previous surveys, the SABAP Pentad analysis and habitat suitability, based Probability of Occurrences. Seventeen (17) priority species are expected to occur within and surrounding the study area. Thirteen (13) of the seventeen (17) expected priority species were confirmed within the Project Area of Influence (PAOI) (Phases 1 – 3), including some of the IBA trigger species such as **Blue Crane, Ludwig's Bustard, Kori Bustard, Secretary bird, Martial Eagle, Lanner Falcon, Tawny Eagle, Karoo Korhaan and Verreaux's Eagle** (Avifauna Final EIA Report, 2022).
- The most significant breeding habitat recorded during the survey were the active Verreaux's Eagle and Tawny Eagle nests. The nesting site is at this stage the highest sensitivity found within proximity of the study area. A portion of the preferred Alternative Route No. 1, specifically existing farm tracks that will be rebuilt to Eskom specification, are within the 1 km buffer of the Verreaux Eagle's nest (Avifauna Final EIA Report, 2022).
- Verreaux's Eagles breed with one partner for their entire life, and only replace a partner in the event of death. **Mating takes place all year round and egg-laying season is between April and July** (Verreaux's Eagle - SANBI, 2014).
- Average monthly rainfall peaks from **October to May**, whereas average monthly run-off peaks from December to April (Hydrology Assessment, 2023)

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Assessment without mitigation:

Legend					
Criteria		Reversibility, Irreplaceability, & Mitigatory Potential		Significance (Impact Magnitude & Impact Importance)	
Abbreviation	Description	Abbreviation	Description	Abbreviation	Description
H	High	L	Low	0	Non-significant
M	Medium	M	Moderate	1	Significant
L	Low	H	High		
-I/R	Negative Impact/Risk				
+I/R	Positive Impact/Risk				

Alternative Route No. 1 (preferred)

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
1	L	L	L	-I	L	M	0	H	M	1
Reversibility		H		Irreplaceability		H		Mitigatory Potential		H

Alternative Route No. 2

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
1	L	M	L	-I	M	M	1	M	M	1
Reversibility		H		Irreplaceability		H		Mitigatory Potential		H

Any aspects which were conditional to the findings of the assessment (to be included as conditions of authorisation):

- None

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References (legal, scientific, social, or other criteria) used for the assessment and mitigations:

- Screening Assessment Reports.
- BirdLife website (<https://www.birdlife.org.za/iba-directory/platberg-karoo-conservancy> - page last updated Friday 13th February 2015)
- Avifauna Final EIA Report prepared by Enviro-Insight CC (Sam Laurence and A.E. van Wyk) dated October 2022
- [Verreaux's Eagle - SANBI](#) article prepared by Mandisa Kondlo and Thato Moeketsane of Walter Sisulu National Botanical Garden on September 2014.
- "Hydrological Assessment for additional listed activities and water uses relating to the development of the Sun Central Cluster 1 300 MW Solar PV facility (previously known as Phase 1) in the Northern Cape", Version – Final 1, prepared by Hendrik Botha and dated 09 January 2023 (GCS Ref – 22 - 1054).

Mitigations:

Impact Management Outcome(s):

- Ensure the protection of Aves.
- Ensure least impact on breeding, e.g., bird roosts and nests are not disturbed.

Targets:

- Minimal bird injuries & mortalities recorded.
- Least impact on breeding, e.g., bird roosts and nests are not disturbed.
- No unnecessarily loud noise that is a nuisance to wildlife.

Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
1	Consideration of Alternatives	Bird mortalities due to vehicle collisions or collisions with	Ensure the protection of Aves.	Minimal bird injuries & mortalities recorded	Fences must be set back no more than 2 metres from the shoulder of the access road and	Holder, Engineer, Contractor	Planning & Design Phase, and Construction Phase	Injuries & mortalities to be monitored by SEO.

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		infrastructure, such as fences.			side/cut-off drain to limit any chance of vulnerable species foraging on verge side vegetation and causing subsequent fence collisions and/or entanglement.			Compliance to be verified by ECO and IEA.
1	Consideration of Alternatives	Disturbance to breeding or destruction of bird roosts.	Ensure least impact on breeding, e.g., bird roosts and nests are not disturbed.	Construction in watercourse crossings between May and August.	As far as possible, limit construction within sensitive flood plains, watercourses and associated buffers to May, June, July, and August to avoid breeding periods of Avian species.	Holder, Engineer, Contractor.	Construction Phase	Compliance to be verified by ECO and IEA.
1	Consideration of Alternatives	Disturbance to breeding or destruction of bird roosts.	Ensure least impact on breeding, e.g., bird roosts and nests are not disturbed.	No active construction within 1.5 km buffer from April to July, and preferably August.	If work is to be undertaken in the vicinity of nests or roosts of species of conservation concern the scheduling of work must be planned outside of the breeding season of the nesting bird;	Contractor	Continuous during construction phase	SEO to monitor 1.5 km buffer. Compliance to be verified by ECO and IEA.

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					construction of that portion of the preferred Alternative Route No. 1 that is within the 1.5 km buffer of the Verreaux Eagle's nest must be completed outside its breeding season, which is from April to July, and preferably August as well.			
1	Consideration of Alternatives	Bird mortalities due to vehicle collisions or collisions with infrastructure, such as fences.	Ensure the protection of Aves.	Minimal bird injuries & mortalities recorded	Drivers must adhere to the speed limit (30 km/hr).	Contractor	Continuous during construction phase	Injuries & mortalities to be monitored by SEO. Compliance to be verified by ECO and IEA.
1	Consideration of Alternatives	Bird mortalities due to vehicle collisions or collisions with infrastructure,	Ensure the protection of Aves.	Minimal bird injuries & mortalities recorded	Drivers must be vigilant, that is on the lookout for animals and birds, and slow down when approaching animals or birds.	Contractor	Continuous during construction phase	Injuries & mortalities to be monitored by SEO. Compliance to be

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		such as fences.			This is to be included in the induction.			verified by ECO and IEA.
1	Consideration of Alternatives	Bird mortalities due to vehicle collisions or collisions with infrastructure, such as fences.	Ensure the protection of Aves.	A kept record of bird injuries & mortalities.	A log should be kept detailing all fauna-related incidences or mortalities that occur on site, including roadkill, fence collisions etc. during construction.	Contractor	Continuous during construction.	Injuries & mortalities to be monitored by SEO. Compliance to be verified by ECO and IEA.
1	Consideration of Alternatives	Disturbance to breeding or destruction of bird roosts.	Ensure least impact on breeding, e.g., bird roosts and nests are not disturbed.	No unnecessarily loud noise that is a nuisance to wildlife.	Construction plant, machinery and equipment must be regularly serviced and well maintained to reduce noise levels.	Contractor	Continuous during construction.	Compliance to be verified by ECO and IEA.
1	Consideration of Alternatives	Disturbance to breeding or destruction of bird roosts.	Ensure least impact on breeding, e.g., bird roosts and nests are not disturbed.	No unnecessarily loud noise that is a nuisance to wildlife.	Keep noise levels as low as practically possible when working, e.g., no unnecessary shouting, loud music or revving of engines.	Contractor	Continuous during construction.	Compliance to be verified by ECO and IEA.

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
1	Consideration of Alternatives	Disturbance to breeding or destruction of bird roosts.	Ensure least impact on breeding, e.g., bird roosts and nests are not disturbed.	No activities or construction creep observed beyond the fenced road servitude.	Except for the designated staging area and construction camp, all other construction activities are restricted to within the fenced road servitude.	Engineer, Contractor	Continuous during construction.	Compliance to be verified by ECO and IEA.
1	Consideration of Alternatives	Bird mortalities due to vehicle collisions or collisions with infrastructure, such as fences.	Ensure the protection of Aves.	No observed snares or poaching incidents.	Poaching is strictly forbidden.	Contractor	Continuous during construction.	Compliance to be verified by ECO and IEA.

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Assessment with mitigation:

Alternative Route No. 1 (preferred)

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
1	L	L	L	-I	L	L	0	L	M	0

Alternative Route No. 2

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
1	L	M	L	-I	M	L	0	L	M	0

Alternative No. 3 – No-Go Option

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
1	L	L	L	neutral	L	L	0	L	L	0

Residual Risk (feeds back into “Mitigations”):

- Sedentary or burrowing fauna, as well as ground nesting birds, may occupy the development site after their observed absence during the basic assessment process.
- Although the development footprint is small relative to animal home ranges and territories, sound can travel further, beyond the boundaries of the footprint.
- Poaching by the contractor’s staff.
- Although sedentary animals pose a higher risk of harm than active animals, both types of animals are susceptible to harm when construction vehicles are driven at speed.

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Receiving Environment: Ground and Surface Water

Description of potential impacts:

Impact-Consequence	Change	Source*	Impact No.
<p>Natural resource depletion. Construction will require the abstraction of water from boreholes for dust suppression, road stabilisation, mixing concrete and potable usage. Natural Resource depletion (of groundwater reserve), declining groundwater abstraction yields - less water in the underground aquifer means less water for other water users, including for reasonable domestic use and livestock watering (direct).</p>	<p>quantity</p>	<p>Matrix</p>	<p>2</p>

*The source of information used in identifying the impact is either the Leipold Matrix (Matrix), Interested and Affected Parties (I&APs) and/or Specialist studies (Specialist).

Any assumptions, uncertainties & limitations, or gaps in knowledge with predicting the impacts

- The Karoo is a dry plateau, experiencing periodic droughts which negatively affects the surrounding farming areas (Emathanjeni Local Municipality Final Integrated Development Plan 2021/2022). The average rainfall is 320 mm yr⁻¹. Mean Annual Evaporation exceeds Mean Annual Participation by about 85%. The greater evaporative losses mean that non-perennial streams and rivers will only flow during flood events (Hydrological Assessment Report, January 2023). Consequently, De Aar is dependent on groundwater for agriculture and drinking water (District Municipality’s Climate Change Response Plan). Not surprisingly, both Alternative Routes are located within a Strategic Water Source Area, meaning the groundwater capture zone (recharge area) must be protected to ensure the ongoing integrity of aquifers (quantity and quality).
- The largest risk of geohydrology is therefore the proposed groundwater abstraction activities. As groundwater is a very important resource for locals in the area, care should be taken not to overproduce from boreholes chosen for this project, and there is a limited impact on existing livestock/domestic watering already implemented (Geohydrological Assessment Report, 20th December 2022).
- *Alternative Route No. 1 (preferred)*
 - Demand
 - It is estimated that approximately 211 m³/day of groundwater will be required during construction of the 14.1 km-long access road. Water use during construction includes:
 - Road Stabilisation (118 m³/day),
 - Concrete mixing (watercourse crossings and MTS) (25 m³/day),
 - Domestic use for workers (drinking, washing hands, and sanitation) (2,25 m³/day), and
 - Dust suppression (spraying once per day and using a soil binding agent) (65,8 m³/day).
 - The estimated demand* (211 m³/day) exceeds the available groundwater yields (197.85 m³/8hr day) from two selected boreholes, creating a potential deficit of 13,15 m³/day. Water saving strategies will need to be implemented on site to ensure sufficient water during the construction of the access road.

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* The estimated demand was calculated using available data and assumptions where no data was provided, such findings may change at any time should any further information be made available.

Yield

- The pump test data generated from BH13 in sub-catchment/HRU 4 indicates a total abstraction of 191.23 m³/8hr day, and the pump test data from Solar Borehole No. 5 in sub-catchment/HRU 5 indicates a total abstraction of 6.62 m³/day. Consequently, cumulative water demand during construction of the access road should not exceed 197.85 m³/8hr day, unless there is another borehole to supplement water usage for other projects (limited to the surplus groundwater reserve in the respective sub-catchments; HRU4 and HRU5) or SAE staggers other construction projects, e.g., MTS, Dx and solar field, to reduce the total water demand on BH13 and Solar BH5 at any one time.
- BH13 is in HRU4. So, assuming there is no Base Flow and Basic Human Needs are met by Existing Groundwater Abstraction, then there is a surplus amount of 98 450.63 m³/yr (269.73 m³/day) available, after the allocation of the proposed PU (which is the sustainable yield; 191,23 m³/day). Therefore, it is estimated that there is enough groundwater available on a sub-catchment level to sustain the proposed 8-hour abstraction from the designated boreholes and the sub-catchments they fall in (Geohydrological Assessment Report, 20th December 2022).
- Solar BH No. 5 is in HRU5. So, assuming there is no Existing Use, Basic Human Needs and Base Flow, then there is a surplus amount of 416 010.85 m³/yr (1 139.76 m³/day) available, after the allocation of the proposed PU (which is the sustainable yield; 6.62 m³/day). Therefore, it is estimated that there is enough groundwater available on a sub-catchment level to sustain the proposed 8-hour abstraction from the designated boreholes and the sub-catchments they fall in (Geohydrological Assessment Report, 20th December 2022).
- **Alternative Route No. 2**
 - Demand**
 - It is estimated that approximately 362.25 m³/day of groundwater will be required during construction of the 25.7 km-long access road. Water use during construction includes:
 - Road Stabilisation (215 m³/day),
 - Concrete mixing (watercourse crossings and MTS) (25 m³/day),
 - Domestic use for workers (drinking, washing hands, and sanitation) (2,25 m³/day), and
 - Dust suppression (spraying once per day and using a soil binding agent) (120 m³/day).
 - The estimated demand* (362.25 m³/day) exceeds the available groundwater yields (197.85 m³/8hr day), creating a potential deficit of 164,4 m³/day.

* The estimated demand was calculated using available data and assumptions where no data was provided, such findings may change at any time should any further information be made available.
 - The longer Alternative Route 2 would require an additional estimated 151.25 m³ of groundwater per day, putting unnecessarily additional pressure on the regional aquifers within this Strategic Water Source Area.
- It is not necessary to consider the impact of climate change forecasts (2050) on the reduced availability of groundwater reserves as the 8-week access road project will be undertaken as soon as possible (once all the authorisations have been received).

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Assessment without mitigation:

Legend					
Criteria		Reversibility, Irreplaceability, & Mitigatory Potential		Significance (Impact Magnitude & Impact Importance)	
Abbreviation	Description	Abbreviation	Description	Abbreviation	Description
H	High	L	Low	0	Non-significant
M	Medium	M	Moderate	1	Significant
L	Low	H	High		
-I/R	Negative Impact/Risk				
+I/R	Positive Impact/Risk				

Alternative Route No. 1 (preferred)

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
2	L	L	L	neutral	L	M	0	L	M	0
Reversibility		H		Irreplaceability		H		Mitigatory Potential		H

Alternative Route No. 2

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
2	L	L	L	neutral	L	M	0	M	M	1
Reversibility		H		Irreplaceability		H		Mitigatory Potential		H

Any aspects which were conditional to the findings of the assessment (to be included as conditions of authorisation):

- None

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References (legal, scientific, social, or other criteria) used for the assessment and mitigations:

- Emathanjeni Local Municipality Final Integrated Development Plan 2021/2022.
- “Hydrological Assessment for additional listed activities and water uses relating to the development of the Sun Central Cluster 1 300 MW Solar PV facility (previously known as Phase 1) in the Northern Cape”, Version – Final 1, prepared by Hendrik Botha and dated 09 January 2023 (GCS Ref – 22 - 1054).
- District Municipality’s Climate Change Response Plan
- Geohydrological Assessment Report Version – Final Rev 3/4 prepared by GCS Water and Environmental Consultants dated 20th December 2022 (GCS Project Number: 22-0401).

Mitigations:

Impact Management Outcome(s):

- Maintain the integrity of the groundwater reserve(s).

Targets:

- Avoid over production and declining abstraction yields from project boreholes.
- Avoid declining abstraction yields from boreholes belonging to other water users (within the zone of influence).
- Avoid abstracting more groundwater than is available (e.g., the estimated surplus) on a sub-catchment level.
- Minimise water usage.

Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
2	Consideration of Alternatives	Natural Resource depletion (of groundwater reserve),	Maintain the integrity of the groundwater reserve(s).	Avoid over production and declining abstraction	Abstraction may not exceed the sustainable abstraction yield at the recommended	Holder, Contractor	Continuously during construction.	SEO to monitor borehole abstraction.

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
		declining groundwater abstraction yields.		yields from project boreholes. Monitoring records.	pumping rate of 8 hrs per day for BH13, that is 6,64 l/s @ 8hrs (or 191.23 m3/8hr day).			Compliance to be verified by ECO and IEA.
2	Consideration of Alternatives	Natural Resource depletion (of groundwater reserve), declining groundwater abstraction yields.	Maintain the integrity of the groundwater reserve(s).	Avoid over production and declining abstraction yields from project boreholes. Monitoring records.	Abstraction may not exceed the sustainable abstraction yield at the recommended pumping rate of 8 hrs per day for Solar BH5, that is 0,23 l/s @ 8hrs (or 6.62 m3/8hr day).	Holder, Contractor	Continuously during construction.	SEO to monitor borehole abstraction. Compliance to be verified by ECO and IEA.
2	Consideration of Alternatives	Natural Resource depletion (of groundwater reserve), declining groundwater abstraction yields.	Maintain the integrity of the groundwater reserve(s).	Minimise water usage. Minutes of meetings.	Continually investigate and implement water-saving strategies and technologies or alternatives, including design to ensure sufficient groundwater during the construction of the access road.	Holder, Engineer, Contractor	Continuously during construction.	Compliance to be verified by ECO and IEA.
2	Consideration of Alternatives	Natural Resource depletion (of groundwater reserve), declining	Maintain the integrity of the groundwater reserve(s).	Avoid abstracting more groundwater than is available	If the adopted water saving strategies and technologies are insufficient to curb demand, then SAE should use	Holder, Landowner, Engineer, Contractor	Continuously during construction.	Compliance to be verified by ECO and IEA.

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
		groundwater abstraction yields.		(e.g., the estimated surplus) on a sub-catchment level.	another borehole to supplement water usage for this and/or other projects (limited to the surplus groundwater reserve in the respective sub-catchments; HRU4 and HRU5 and subject to additional authorisation(s) if applicable) and/or SAE staggers other construction projects, e.g., MTS, Dx and solar field, to reduce the total water demand on BH13 and Solar BH5 at any one time.			
2	Consideration of Alternatives	Natural Resource depletion (of groundwater reserve), declining groundwater abstraction yields.	Maintain the integrity of the groundwater reserve(s).	Avoid declining abstraction yields from boreholes belonging to other water users (within the zone of influence).	Undertake water level monitoring of boreholes within a 1.5 km radius of the pumping borehole. If a decline in water levels is noted in all boreholes, because of pumping, the abstraction rate should be lowered to	Holder, Contractor	Continuously during construction.	SEO to monitor water levels. Compliance to be verified by ECO and IEA.

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
				Monitoring records.	prevent aquifer depletion.			
2	Consideration of Alternatives	Natural Resource depletion (of groundwater reserve), declining groundwater abstraction yields.	Maintain the integrity of the groundwater reserve(s).	Avoid declining abstraction yields from boreholes belonging to other water users (within the zone of influence). Monitoring records.	Conduct multi borehole water level logging, to ensure that no cumulative dewatering impacts are taking place for boreholes which may be in the same contact zones.	Holder, Contractor	Continuously during construction	SEO to monitor water levels. Compliance to be verified by ECO and IEA.
2	Consideration of Alternatives	Natural Resource depletion (of groundwater reserve), declining groundwater abstraction yields.	Maintain the integrity of the groundwater reserve(s).	Avoid declining abstraction yields from boreholes belonging to other water users (within the zone of influence). Monitoring records.	Implement the surface and groundwater monitoring protocol during construction.	Holder, Contractor	Continuously during construction	SEO is to monitor abstraction and water levels. Compliance to be verified by ECO and IEA.

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Assessment with mitigation:

Alternative Route No. 1 (preferred)

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
2	L	L	L	neutral	L	L	0	L	M	0

Alternative Route No. 2

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
2	L	L	L	neutral	L	L	0	M	M	1

Alternative No. 3 – No-Go Option

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
2	L	L	L	neutral	L	L	0	L	L	0

Residual Risk (feeds back into “Mitigations”):

- None.

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Receiving Environment: Atmosphere

Description of potential impacts:

Impact-Consequence	Change	Source*	Impact No.
<p>Dust pollution. PM10 and Total Suspended Particulate (TSP) emitted from vehicle entrainment during construction activities. Impact: Air pollution or reduced air quality due to increased ambient PM10 concentrations and dust fallout</p> <ul style="list-style-type: none"> - Airborne dust from gravel roads (a type of PM10) can cause eye, nose and throat irritations (direct). - Dust settling on and smothering plants will reduce photosynthetic capacity and plant vigour, making them less resistant to diseases and pest infestations (indirect). - Dust settling on and smothering solar panels will reduce their efficiency, causing a decline in electrical power output, lost income for the operator and increase the payback period (indirect). 	quality	Matrix	3

*The source of information used in identifying the impact is either the Leipold Matrix (Matrix), Interested and Affected Parties (I&APs) and/or Specialist studies (Specialist).

Any assumptions, uncertainties & limitations, or gaps in knowledge with predicting the impacts

- The study area is not within an Air Quality Priority Area. According to the Emathanjeni Local Municipality Final Integrated Development Plan 2021 – 2022, the air quality within this municipality is in good condition compared to the other urban areas, but dust pollution does occur in the Karoo to some extent due to low variable rainfall and sparse vegetation.
- The predicted dust fallout is low and well below the limit value for acceptable dust fallout in non-residential areas. Consequently, the significance of the impact of dust fallout resulting during construction of the Access Road is also low. This assessment considers the current dust control measures, e.g., spraying the Access Road once a day with water. It is however recommended that these are expanded to reduce the emission and ensure that the significance of the impact remains low (Air Quality Impact Assessment, January 2023).
- For the uncontrolled scenario the predicted ambient PM10 concentrations exceed the annual average and 24-hour NAAQS for PM10 up to 1 500 m from the Access Road. For the controlled scenario the predicted ambient PM10 concentrations are below the annual average NAAQS for PM10 but exceed the 24-hour NAAQS for PM10 up to 300 m from the Access Road. Sensitive receptors have been noted within these zones. The significance of the impact of construction activities on air quality is therefore medium. This assessment considers the dust control measures of watering once per day. These however need to be expanded to reduce the emission and lower the impact significance to low with mitigation (Air Quality Impact Assessment, January 2023).

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Assessment without mitigation:

Legend					
Criteria		Reversibility, Irreplaceability, & Mitigatory Potential		Significance (Impact Magnitude & Impact Importance)	
Abbreviation	Description	Abbreviation	Description	Abbreviation	Description
H	High	L	Low	0	Non-significant
M	Medium	M	Moderate	1	Significant
L	Low	H	High		
-I/R	Negative Impact/Risk				
+I/R	Positive Impact/Risk				

Alternative Route No. 1 (preferred)

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
3	L	L	L	-I	L	M	0	M	M	1
Reversibility		H		Irreplaceability		H		Mitigatory Potential		H

Alternative Route No. 2

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
3	L	M	L	-I	M	M	1	M	M	1
Reversibility		H		Irreplaceability		H		Mitigatory Potential		H

Any aspects which were conditional to the findings of the assessment (to be included as conditions of authorisation):

- None

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References (legal, scientific, social, or other criteria) used for the assessment and mitigations:

- Emathanjeni Local Municipality Final Integrated Development Plan 2021 – 2022
- Air Quality Impact Assessment for the Proposed Development of the Sun Central Cluster 300 MW Solar PV Facility between De Aar & Hanover, Emthanjeni Local Municipality, Pixley Ka Seme District Municipality, Northern Cape Province”, Version – Final, prepared by Mark Zunckel of uMoya-NILU and dated January 2023 (Report number: uMN192-22).

Mitigations:

Impact Management Outcome(s):

- Minimise dust generation.

Targets:

- Avoid exceeding NAAQS annual ambient PM10 concentrations (40 µg/m3) and 24-hour ambient PM10 concentrations (75 µg/m3).
- Avoid exceeding the National Dust Standard for non-residential (1 200 mg/m2/day) and residential (600 mg/m2/day) areas.

Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
3	Consideration of Alternatives	Air pollution or reduced air quality due to increased ambient PM10 concentrations and dust fallout.	Minimise dust generation.	No observed speeding. Speed signs. Record of fines.	Reduce speed to 30 km/hr. Enforce speed control through speed limit road signage and fines.	Contractor	Continuous during Construction.	Compliance to be verified by ECO and IEA.
3	Consideration of Alternatives	Air pollution or reduced air quality due to	Minimise dust generation.	No observed construction creep.	Avoid the unnecessary clearance of	Contractor	Continuous during Construction.	Compliance to be verified by

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
		increased ambient PM10 concentrations and dust fallout.			indigenous vegetation by restricting construction activities within the road servitude to the existing footprints and/or road design specifications (8 m wide plus 3 m for side/cut-off drain), as well as designated (30 m-long & 3 m-wide) passing lanes.			ECO and IEA.
3	Consideration of Alternatives	Air pollution or reduced air quality due to increased ambient PM10 concentrations and dust fallout.	Minimise dust generation.	Records < 1 200 mg/m ² /day	Effective implementation of the National Dust Control Regulations to ensure that the dust fallout does not exceed the acceptable limits.	Contractor	Continuous during Construction.	Compliance to be verified by ECO and IEA.
3	Consideration of Alternatives	Air pollution or reduced air quality due to increased ambient PM10 concentrations and dust fallout.	Minimise dust generation.	Records and monitoring units.	Implement a dust monitoring programme for the access road and construction sites, including the installation of dust monitoring units.	Contractor	Continuous during Construction.	Specialist to monitor dust. Compliance to be verified by ECO and IEA.

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
3	Consideration of Alternatives	Air pollution or reduced air quality due to increased ambient PM10 concentrations and dust fallout.	Minimise dust generation.	Record of wind speeds. No high-risk activities during windy conditions (unless effectively mitigated).	The contractor should take into consideration predicted wind speeds from the local weather station when planning construction-related activities with a high risk of generating dust, such as adding cement to the road.	Contractor	Continuous during Construction.	SEO to monitor wind speeds. Compliance to be verified by ECO and IEA.
3	Consideration of Alternatives	Air pollution or reduced air quality due to increased ambient PM10 concentrations and dust fallout.	Minimise dust generation.	Observed spraying of road in combination with a soil binding agent.	Implement dust control measures on gravel access roads, including watering, but only in combination with an environmentally friendly (organic) soil binding agent/dust suppressant (to reduce wasteful water consumption).	Contractor	Continuous during Construction.	Compliance to be verified by ECO and IEA.
3	Consideration of Alternatives	Air pollution or reduced air quality due to increased ambient PM10	Minimise dust generation.	Spraying records correlate with traffic, e.g.,	Increase frequency of road wetting during times of high expected traffic loads.	Contractor	Continuous during Construction.	SEO to estimate expected traffic.

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
		concentrations and dust fallout.		expected traffic or delivery records.				Compliance to be verified by ECO and IEA.
3	Consideration of Alternatives	Air pollution or reduced air quality due to increased ambient PM10 concentrations and dust fallout.	Minimise dust generation.	Spraying records.	Keep a record of spraying roads with water including frequency, duration, volumes, as well as length and width of road sprayed.	Contractor	Continuous during Construction.	SEO to monitor spraying. Compliance to be verified by ECO and IEA.
3	Consideration of Alternatives	Air pollution or reduced air quality due to increased ambient PM10 concentrations and dust fallout.	Minimise dust generation.	Observed good drainage. Schedule of Road Maintenance Activities.	Implement and maintain good drainage on all (permanent or temporary) gravel roads within the road servitude, including a schedule of maintenance activities to reduce potholes and rough areas that could increase dust generation.	Contractor	Continuous during Construction.	Compliance to be verified by ECO and IEA.

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Assessment with mitigation:

Alternative Route No. 1 (preferred)

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
3	L	L	L	-I	L	L	0	L	M	0

Alternative Route No. 2

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
3	L	M	L	-I	M	L	0	L	M	0

Alternative No. 3 – No-Go Option

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
3	L	L	L	neutral	L	L	0	L	L	0

Residual Risk (feeds back into “Mitigations”):

- None.

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Receiving Environment: Aquatic Ecosystem

Description of potential impacts:

Impact-Consequence	Change	Source*	Impact No.
Fragmentation of aquatic (and riparian) habitat. Roads cause fragmentation of aquatic and terrestrial landscapes - Fragmentation reduces connectivity, interrupts ecological process pathways such as surface water and subterranean flows, as well as local migration patterns of aquatic species effectively isolating fragmented patches (or "islands") (direct). This can result in species extinction and biodiversity loss due to decreased colonization and population size (indirect).	fragmentation	Matrix	4

*The source of information used in identifying the impact is either the Leopold Matrix (Matrix), Interested and Affected Parties (I&APs) and/or Specialist studies (Specialist)

Any assumptions, uncertainties & limitations, or gaps in knowledge with predicting the impacts

- Both Alternative Routes are located within a Strategic Water Source Area.
- The project area contains National Freshwater Ecosystem Priority Areas (NFEPA) “Wetlands and Estuaries” and “Rivers”, including the floodplain areas of the Brak River and its tributaries (non-perennial drainage streams). Both Alternative Routes will infringe on these ecologically sensitive zones.
- The Aquatic Biodiversity theme for both Alternative Routes is Very High because the study area is within a Strategic Water Source Area, National Freshwater Ecosystem Priority Area (NFEPA) “Wetlands and Estuaries” and “Rivers” and FEPA quaternary catchments (Screening Assessment Reports). This was confirmed during the site sensitivity verification.
- The Brak River and a tributary (unnamed FEPA drainage line D62D – 05610 SQ bounding the Sun Central 1 development) are the only recognised water courses impacted by Alternative Route No. 1 (Hydrology Assessment, 2023)
- The Terrestrial Biodiversity theme for both Alternative Routes is Very High because both road alignments intersect a Critical Biodiversity Area 1 (CBA1), a Critical Biodiversity Area 2 (CBA2), an Ecological Support Area (ESA) and NFEPA sub-catchments. Alternative Route No. 2 is further located in a National Protected Area Expansion Strategy (NPAES).
- The study area falls within a CBA1 because the Brak River has been identified as having FEPA River Ecosystem Type status according to the Freshwater Ecosystem Protected Areas (FEPA) map for the area (Phase 1 Aquatic Report October 2017) and all FEPA prioritised rivers and wetlands have a minimum category of CBA1. All FEPA prioritised wetland clusters have minimum category of CBA2, and natural non-FEPA wetlands and larger rivers have minimum category of ESA (Avifauna Final EIA Report prepared by Sam Laurence of Enviro-Insight cc, dated October 2022).

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Assessment without mitigation:

Legend					
Criteria		Reversibility, Irreplaceability, & Mitigatory Potential		Significance (Impact Magnitude & Impact Importance)	
Abbreviation	Description	Abbreviation	Description	Abbreviation	Description
H	High	L	Low	0	Non-significant
M	Medium	M	Moderate	1	Significant
L	Low	H	High		
-I/R	Negative Impact/Risk				
+I/R	Positive Impact/Risk				

Alternative Route No. 1 (preferred)

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
4	M	M	H	-I	H	M	1	H	M	1
Reversibility		H		Irreplaceability		H		Mitigatory Potential		H

Alternative Route No. 2

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
4	M	M	H	-I	H	M	1	H	M	1
Reversibility		H		Irreplaceability		H		Mitigatory Potential		H

Any aspects which were conditional to the findings of the assessment (to be included as conditions of authorisation):

- None.

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References (legal, scientific, social, or other criteria) used for the assessment and mitigations:

- Screening Assessment Reports
- “Hydrological Assessment for additional listed activities and water uses relating to the development of the Sun Central Cluster 1 300 MW Solar PV facility (previously known as Phase 1) in the Northern Cape”, Version – Final 1, prepared by Hendrik Botha and dated 09 January 2023 (GCS Ref – 22 - 1054).
- Avifauna Final EIA Report prepared by Sam Laurence of Enviro-Insight cc, dated October 2022

Mitigations:

Impact Management Outcome(s):

- Preserve aquatic ecosystem structure and function as well as riparian habitat.
- Maintain the provision of supporting ecological processes along ecological process pathways, e.g., spatially explicit corridors, such as watercourses.

Targets:

- Avoid fragmentation of surface water and groundwater pathways (and associated habitats).

Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
4	Consideration of Alternatives	Fragmentation of aquatic (and riparian) habitat.	Maintain the provision of supporting ecological processes along ecological process pathways, e.g., spatially explicit	Avoid fragmentation of surface water and groundwater pathways (and associated habitats).	The final design will be determined during the detailed design stage and shall be subject to compliance with the following requirements or outcomes: • Ensure that any dedicated stream	Applicant, Engineer	Planning and Design phase	Compliance to be verified by ECO and IEA.

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
			corridors, such as watercourses.		<p>crossings use road crossing designs, such as box culverts or concrete drifts with rock fill, which spread the surface water into a broadly distributed sheet whilst maintaining unrestricted subterranean flow.</p> <ul style="list-style-type: none"> • Road crossing designs, such as box culverts or concrete drifts with rock fill, should be sized to accommodate at least 1:100 yr flood events. • Road crossings and stormwater outlets associated with any watercourse crossing should be designed in such a way so as not to cause erosion of the bed or banks 			

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
					by incorporating such stabilisation mechanisms as terracing, boulder and rock placement, minor gabion basket work construction, reno mattresses and/or rock pitching, especially at the downstream side to dissipate energy and reduce scour. <ul style="list-style-type: none"> • Pipe culvert road crossings are prohibited. • Road crossing designs, such as box culverts or concrete drifts with rock fill, shall spread the surface water into a broadly distributed sheet whilst maintaining unrestricted subterranean flow, across the width of 			

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
					the active channel(s).			
4	Consideration of Alternatives	Fragmentation of aquatic (and riparian) habitat.	Maintain the provision of supporting ecological processes along ecological process pathways, e.g., spatially explicit corridors, such as watercourses.	Avoid fragmentation of surface water and groundwater pathways (and associated habitats).	Avoid or minimise any restriction to subsurface water flow by constructing the surface of the road crossings at or above (not below) natural ground level (NGL) and, where applicable, retaining the in-situ topsoil with vegetation root mass (or mat). In the case of building road crossings above NGL, and if the natural vegetation is cleared, then ensure that the grader does not penetrate the abovementioned root mat and maintains a flat surface. Topsoil removed from other infrastructure	Applicant, Engineer	Planning and Design phase	Compliance to be verified by ECO and IEA.

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
					placement sites can be added below the road surface to protect the vegetative binding below.			

Assessment with mitigation:

Alternative Route No. 1 (preferred)

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
4	L	L	H	neutral	H	L	0	L	M	0

Alternative Route No. 2

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
4	L	M	H	neutral	H	L	0	L	M	0

Alternative No. 3 – No-Go Option

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
4	L	L	L	neutral	L	L	0	L	L	0

Residual Risk (feeds back into “Mitigations”):

- Despite the mitigations to avoid significant suspended sediment in the river, strong flows or a flash flood during summer would render any river diversion works futile.

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Receiving Environment: Economical

Description of potential impacts:

Impact-Consequence	Change	Source*	Impact No.
Greater repair and rebuilding costs. Haulage of imported materials incur a cost relating to distance travelled and time - financial feasibility of project.	NA	Matrix	5
The No-Go option would have an indirect but significant negative socio-economic impact as the MTS, Sun Central Cluster 1 Solar PV Facility, and other future facilities (1 GW in total) cannot be built without the improved access road. These Solar PV Facilities, will make a significant contribution to our country's power deficit when supply falls behind demand, meeting basic needs and equity that the no-go option cannot achieve.	NA	Matrix	

*The source of information used in identifying the impact is either the Leipold Matrix (Matrix), Interested and Affected Parties (I&APs) and/or Specialist studies (Specialist)

Any assumptions, uncertainties & limitations, or gaps in knowledge with predicting the impacts

- Alternative Route No. 2 is in a worse state of disrepair, requiring more significant repair and rebuilding (25.7 km) compared with the preferred Alternative Route No. 1 (14.1 km) (SolarAfrica Sun Central – Access Road Study Rev 0.1 (Document Reference: SAE-PD-DA-Access Road Study 0.1 FS).
- Road material or aggregate will be purchased from a licensed commercial source.
- South Africa’s electricity infrastructure has been degrading in the past decades, with both scheduled and unscheduled power outages on the increase. Simply put, South Africa cannot make enough electricity to supply its people and economy. Apart from load shedding, creating an awareness of and implementing power saving initiatives to reduce demand, no alternative exists other than “to rapidly expand our energy generation capacity” (President Cyril Ramaphosa: 2021 State of the Nation Address, 2021 <https://www.gov.za/speeches/president-cyril-ramaphosa-2021-state-nation-address-11-feb-2021-0000>).

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Assessment without mitigation:

Legend					
Criteria		Reversibility, Irreplaceability, & Mitigatory Potential		Significance (Impact Magnitude & Impact Importance)	
Abbreviation	Description	Abbreviation	Description	Abbreviation	Description
H	High	L	Low	0	Non-significant
M	Medium	M	Moderate	1	Significant
L	Low	H	High		
-I/R	Negative Impact/Risk				
+I/R	Positive Impact/Risk				

Alternative Route No. 1 (preferred)

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
5	L	L	L	-I	L	L	0	L	M	0
Reversibility		L		Irreplaceability		L		Mitigatory Potential		L

Alternative Route No. 2

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
5	M	M	L	-I	M	M	1	M	M	1
Reversibility		L		Irreplaceability		L		Mitigatory Potential		L

Any aspects which were conditional to the findings of the assessment (to be included as conditions of authorisation):

- Road material or aggregate will be purchased from a licensed commercial source.

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References (legal, scientific, social, or other criteria) used for the assessment and mitigations:

- SolarAfrica Sun Central – Access Road Study Rev 0.1 (Document Reference: SAE-PD-DA-Access Road Study 0.1 FS)

Mitigations:

No mitigation possible as long as the distances for the Preferred Alternative Route No. 1 and Alternative Route No. 2 remain the same, and as long as road material or aggregate is imported from a licensed commercial source.

Assessment with mitigation:

Alternative Route No. 1 (preferred)

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
5	L	L	L	neutral	L	L	0	L	M	0

Alternative Route No. 2

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
5	M	M	L	-I	M	M	1	M	M	1

Alternative No. 3 – No-Go Option

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
5	H	M	M	-I	H	H	1	H	H	1

Residual Risk (feeds back into “Mitigations”):

- None.

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Receiving Environment: Social (well-being)

Description of potential impacts:

Impact-Consequence	Change	Source*	Impact No.
Potential congestion and delays on the road network in Hanover town - disruptions and delays to residents and local farmers in the area due to increase traffic volumes, resulting in longer time periods for transportation of goods.	NA	Matrix	6
Dust and Noise pollution due to construction activities in Hanover town - a nuisance to residents and a decrease in sense of place due to dust and noise generated by construction activities and congestion.	NA	Matrix	
The No-Go option would have an indirect but significant negative socio-economic impact as the MTS, Sun Central Cluster 1 Solar PV Facility, and other future facilities (1 GW in total) cannot be built without the improved access road. These Solar PV Facilities, will make a significant contribution to our country's power deficit when supply falls behind demand, meeting basic needs and equity that the no-go option cannot achieve.	NA	Matrix	

*The source of information used in identifying the impact is either the Leipold Matrix (Matrix), Interested and Affected Parties (I&APs) and/or Specialist studies (Specialist)

Any assumptions, uncertainties & limitations, or gaps in knowledge with predicting the impacts

- Construction activities for rebuilding and building an access road along Alternative Route No. 1 (preferred) will take place in a rural agricultural environment, whereas Alternative Route No. 2 will also take place in an urban environment, specifically Hanover Town (SolarAfrica Sun Central – Access Road Study Rev 0.1 (Document Reference: SAE-PD-DA-Access Road Study 0.1 FS).
- Both Alternative Routes would require approval from National (SANRAL) and District Road authorities, as well as impact road users such as farmers and residents. However, (1) a section of Alternative Route No. 2 would require special permission from adjoining farmers and wayleaves would have to be obtained, and (2) the district road 2451, which forms part of Alternative Route No. 2 cannot be accessed directly off the N10 national road. Several possibilities were sought, but without intensely modifying sections of the road network within Hanover town itself, it is not possible to access the district road 2451 as the delivery of abnormal loads would be obstructed by geometric, height and width limitations along the route (SolarAfrica Sun Central – Access Road Study Rev 0.1 (Document Reference: SAE-PD-DA-Access Road Study 0.1 FS).
- South Africa’s electricity infrastructure has been degrading in the past decades, with both scheduled and unscheduled power outages on the increase. Simply put, South Africa cannot make enough electricity to supply its people and economy. Apart from load shedding, creating an awareness of and implementing power saving initiatives to reduce demand, no alternative exists other than “to rapidly expand our energy

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generation capacity” (President Cyril Ramaphosa: 2021 State of the Nation Address, 2021 <https://www.gov.za/speeches/president-cyril-ramaphosa-2021-state-nation-address-11-feb-2021-0000>).

Assessment without mitigation:

Legend					
Criteria		Reversibility, Irreplaceability, & Mitigatory Potential		Significance (Impact Magnitude & Impact Importance)	
Abbreviation	Description	Abbreviation	Description	Abbreviation	Description
H	High	L	Low	0	Non-significant
M	Medium	M	Moderate	1	Significant
L	Low	H	High		
-I/R	Negative Impact/Risk				
+I/R	Positive Impact/Risk				

Alternative Route No. 1 (preferred)

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
6	L	L	L	-I	L	M	0	M	M	1
Reversibility		H		Irreplaceability		H		Mitigatory Potential		H

Alternative Route No. 2

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
6	M	M	L	-I	M	M	1	H	M	1
Reversibility		H		Irreplaceability		H		Mitigatory Potential		H

Any aspects which were conditional to the findings of the assessment (to be included as conditions of authorisation):

- None.

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References (legal, scientific, social, or other criteria) used for the assessment and mitigations:

- SolarAfrica Sun Central – Access Road Study Rev 0.1 (Document Reference: SAE-PD-DA-Access Road Study 0.1 FS).

Mitigations:

Impact Management Outcome(s):

- Least disturbance to traffic and well-being.

Targets:

- Minimal congestion and delays to residents and farmers.
- Dust/noise is not a nuisance.

Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
6	Consideration of Alternatives	Potential congestion and delays on the road network.	Least disturbance to traffic and well-being.	Minimal congestion and delays. Schedule of peak construction periods compared with peak traffic periods.	Stagger and schedule peak construction periods with an expected increase in vehicle movement outside of the peak traffic periods.	Contractor	Continuous during construction	Compliance to be verified by ECO and IEA.
6	Consideration of Alternatives	Potential congestion and delays on the road network.	Least disturbance to traffic and well-being.	Minimal congestion and delays Passing lanes are present.	Ensure adequate passing lanes for local farmers and residents.	Contractor	Continuous during construction	Compliance to be verified by ECO and IEA.

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
6	Consideration of Alternatives	Potential congestion and delays on the road network.	Least disturbance to traffic and well-being.	Minimal congestion and delays. "Stop and Gos" are present.	Implement "Stop and Gos"	Contractor	Continuous during construction	Compliance to be verified by ECO and IEA.
6	Consideration of Alternatives	Dust and Noise pollution	Least disturbance to traffic and well-being.	Dust/noise is not a nuisance. Dust control measures are evident.	Implement dust control measures (see Receiving Environment: Atmosphere).	Contractor	Continuous during construction	Compliance to be verified by ECO and IEA.

Assessment with mitigation:

Alternative Route No. 1 (preferred)

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
6	L	L	L	-I	L	M	0	L	M	0

Alternative Route No. 2

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
6	L	M	L	-I	M	L	0	M	M	1

Alternative No. 3 – No-Go Option

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
6	H	M	M	-I	H	H	1	H	H	1

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Residual Risk (feeds back into "Mitigations"):

- None.



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Receiving Environment: Heritage and Culture

Description of potential impacts:

Impact-Consequence	Change	Source*	Impact No.
Loss of heritage resources. Earthmoving activities could damage or destroy artefacts or fossils - The loss of a heritage resources undermines the understanding of previous generations that is vital to creating a sense of unity, belonging, and even pride among South Africans (direct).	NA	Matrix	7

*The source of information used in identifying the impact is either the Leipold Matrix (Matrix), Interested and Affected Parties (I&APs) and/or Specialist studies (Specialist)

Any assumptions, uncertainties & limitations, or gaps in knowledge with predicting the impacts

- The Archaeological and Cultural Heritage theme for Alternative Route No. 2 is High because the beginning of the access road (in Hanover) is within 2 km of a Grade II Heritage site, and within 150 m of a Grade IIIa Heritage site (Screening Assessment Report).
- The Archaeological and Cultural Heritage theme for Alternative Route No. 1 is Low according to the Screening Assessment Reports. However, previous archaeological and heritage assessments (2017 & 2021) for Phase 1 (now referred to as Sun Central Cluster 1) recorded a fairly large number of cultural heritage (archaeological & historical) resources of varying extent and significance in the area. These include scatters of open-air surface Stone Age sites, rock engravings, later agro-pastoralist stone-walled sites, as well as historical Anglo-Boer War (18990-1902) sites. These findings are clear evidence of the intrinsic heritage value of the area, but none of the cultural heritage resources identified and recorded during these assessments were Grade I or II sites (National or Provincial Heritage Sites). Nonetheless, some of the sites recorded in 2017 and 2021 are located in relative close proximity to, but outside the access road servitude and pipeline corridors (A Heritage Scoping Report Impact Assessment prepared by APelser Archaeological Consulting cc (APAC) dated February 2023).
- The palaeosensitivity of the 'broader' project area has been provisionally rated as Very High by the DFFE Screening Tool. However, previous palaeontological site visits to the same area indicate that this region is generally of LOW palaeosensitivity, despite being underlain at depth by potentially fossiliferous continental sediments of the Adelaide Subgroup (Beaufort Group, Karoo Supergroup) of Middle Permian age, as well as small, reworked blocks of petrified wood and low diversity trace fossil assemblages of low scientific interest being recorded from older alluvial deposits and bedrocks in the area. No High Sensitivity fossil sites have been recorded within any of the Soventix Phase 1 to Phase 3 solar project areas (including all associated infrastructure such as grid connections, substations, access roads, etc.). The low overall palaeosensitivity is probably largely due to rarity of well-preserved fossil remains within the bedrocks concerned, the generally very poor levels of bedrock exposure (especially in flat-lying regions), extensive baking of the sedimentary bedrocks by dolerite intrusions in the region as well as the generally low sensitivity of the superficial deposits in the region. The construction phase of the proposed additional infrastructure is very unlikely

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to cause significant negative impacts on local palaeontological heritage resources (Palaeontological Heritage Comment prepared by John E. Almond (PhD) of Natura Viva cc and dated January 2023).

Assessment without mitigation:

Legend					
Criteria		Reversibility, Irreplaceability, & Mitigatory Potential		Significance (Impact Magnitude & Impact Importance)	
Abbreviation	Description	Abbreviation	Description	Abbreviation	Description
H	High	L	Low	0	Non-significant
M	Medium	M	Moderate	1	Significant
L	Low	H	High		
-I/R	Negative Impact/Risk				
+I/R	Positive Impact/Risk				

Alternative Site No. 1 (preferred)

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
7	L	L	L	neutral	L	L	0	M	H	1
Reversibility		L		Irreplaceability		L		Mitigatory Potential		H

Alternative Site No. 2

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
7	L	M	L	-I	M	L	0	M	H	1
Reversibility		L		Irreplaceability		L		Mitigatory Potential		H

Any aspects which were conditional to the findings of the assessment (to be included as conditions of authorisation):

- None.

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References (legal, scientific, social, or other criteria) used for the assessment and mitigations:

- Screening Assessment Reports
- *A Heritage Scoping Report Impact Assessment related to the Development of the Sun Central Cluster 1, 300 MW, Solar PV Facility additional activities on various Farm Portions between De Aar & Hanover, Emthanjeni Local Municipality, Pixley Ka Seme District Municipality, Northern Cape Province, South Africa (Report: APAC023/12) prepared by APeiser Archaeological Consulting cc (APAC) dated February 2023*
- Palaeontological Heritage Comment, Access Road Basic Assessment and Transmission Line Part 2 Amendment for the Sun Central Cluster 1 between De Aar & Hanover, Pixley Ka Seme District Municipality, Northern Cape Province, prepared by John E. Almond (PhD) of Natura Viva cc, and dated January 2023.
- National Heritage Resources Act, 1999 (Act No. 25 of 1999)
 - *Structures*
 - No person may alter or demolish any structure or part of a structure, which is older than 60 years without a permit issued by the HRA (Section 34(1) of NHRA).
 - *Archaeological Sites and Remains*
 - In terms of Section 35(3) of the NHRA, any person who discovers archaeological or palaeontological objects or material or a meteorite during development or an agricultural activity must **immediately report the find** to the HRA.
 - In terms of Section 35(4) of the NHRA, **no person may without a permit** issued by the HRA destroy, damage, excavate, alter, deface, or otherwise disturb any archaeological or palaeontological site or any meteorite, or remove from its original position any archaeological, or palaeontological material or object or any meteorite.
 - *Graves*
 - In terms of Section 36(6) any person who during development discovers the location of a grave **must immediately cease such activity and report the discovery** to the HRA. The HRA must then, in co-operation with the SAPS, carry out an investigation.
 - In terms of Section 36(3) of the NHRA, **no person may, without a permit** issued by HRA, destroy, damage, alter, exhume, or remove from its original position or otherwise disturb the grave of a victim of conflict, any burial ground or part thereof which contains such graves, or any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority (Section 36(3) of NHRA).

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Mitigations:

Impact Management Outcome(s):

- Protection and preservation of heritage resources.

Targets:

- No unnecessary damage or destruction of heritage resources.
- Adequate supervision when clearing and grubbing, stripping topsoil, and excavating.
- Construction has ceased at the site of a discovery.
- Site of discovery has been cordoned off.
- A written response from the South African Heritage Resources Agency (SAHRA) and where applicable, the local police (SAPS).
- Permits issued by SAHRA.

Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
7	Consideration of Alternatives	Damage or destruction of heritage resources.	Protection and preservation of heritage resources.	Supervision No unnecessary damage or destruction of heritage resources.	The bulk of archaeological remains are normally located beneath or near the soil surface, so please be especially vigilant when clearing and grubbing, and excavating.	Contractor, SEO	During clearing and grubbing operations and excavations.	Compliance to be monitored by the SEO and verified by ECO and IEA.
7	Consideration of Alternatives	Damage or destruction of heritage resources.	Protection and preservation of heritage resources.	Supervision Adequate supervision when clearing and grubbing, stripping	The SEO shall supervise all clearing and grubbing, as well as	Contractor, SEO	During clearing and grubbing operations and excavations.	Compliance to be monitored by the SEO and verified

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
				topsoil, and excavating.	excavation activities: (1) Examples of cultural or archaeological objects include inter alia (a) Stone Age open-air surface scatters (e.g., cores, waste-flakes, more formal tools such as blades, scrapers and broken points), and (b) stone cairns. (2) Examples of palaeontological objects (fossils) include inter alia (a) Rare vertebrate bones and teeth, (b) petrified wood and other plant material, (c) Trace fossils within Beaufort Group sediments, (d) Fossil mammal bones, teeth, horn			by ECO and IEA.

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
					cores, freshwater molluscs, plant material in Late Caenozoic alluvium and pan deposits, and (d) Blocks of reworked silicified wood within surface gravels and older alluvium.			
7	Consideration of Alternatives	Damage or destruction of heritage resources.	Protection and preservation of heritage resources.	Construction has ceased at a site of discovery.	If any evidence of archaeological sites or artefacts (e.g., remnants of stone-made structures or artefacts, indigenous ceramics, bones, stone cairns, ostrich eggshell fragments, charcoal, and ash concentrations), fossils or other categories of heritage resources are found or uncovered by	Contractor, SEO, ECO.	Upon a chance find.	Compliance to be monitored by the SEO and verified by ECO and IEA.

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
					<p>construction staff during construction:</p> <ol style="list-style-type: none"> 1. IMMEDIATELY cease the construction activity, 2. notify the ECO, and 3. don't tamper with the finds. 			
7	Consideration of Alternatives	Damage or destruction of heritage resources.	Protection and preservation of heritage resources.	Site of discovery has been cordoned off.	The site of discovery must be cordoned off and demarcated a no-go area with security tape / fence / sand bags if necessary. Access to construction staff shall be prohibited until further notice by the ECO.	Contractor, SEO, ECO.	Upon a chance find.	Compliance to be monitored by the SEO and verified by ECO and IEA.
7	Consideration of Alternatives	Damage or destruction of heritage resources.	Protection and preservation of heritage resources.	Letter of Appointment. Report of findings.	A professional archaeologist or palaeontologist, depending on the nature of the finds, must be contracted as soon as possible	Holder, Contractor, SEO, ECO, Heritage Specialist	Upon a chance find.	Compliance to be verified by ECO and IEA.

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
					to inspect the heritage resource and assess the significance of the findings and advise on further actions.			
7	Consideration of Alternatives	Damage or destruction of heritage resources.	Protection and preservation of heritage resources.	A written response from the SAPS.	In the case of unmarked human burials, the ECO shall also alert the local police.	ECO.	Upon a chance find.	Compliance to be verified by ECO and IEA.
7	Consideration of Alternatives	Damage or destruction of heritage resources.	Protection and preservation of heritage resources.	Chance Fossil Finds Protocol is implemented.	If any substantial fossil remains (e.g., vertebrate bones, teeth) are exposed by surface clearance or excavations during the construction phase of the development, the Chance Fossils Finds Protocol must be fully implemented.	Holder, Contractor, SEO, ECO, Heritage Specialist	Upon a chance find.	Compliance to be verified by ECO and IEA.
7	Consideration of Alternatives	Damage or destruction of heritage resources.	Protection and preservation of heritage resources.	Permits issued by SAHRA.	If the newly discovered heritage resources prove to be of archaeological or paleontological significance, a Phase 2 rescue	Applicant, Heritage Specialist.	Prior to a Phase 2 rescue operation.	Compliance to be verified by ECO and IEA.

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Impact No.	Mgt Category No.	Identified Impacts and Risks	Impact Management Outcomes	Targets & Indicators	Management Actions & Mitigation Measures	Responsibility	Timeframe / Frequency	Monitoring
					operation may be required subject to permits issued by SAHRA.			
7	Consideration of Alternatives	Damage or destruction of heritage resources.	Protection and preservation of heritage resources.	Site of discovery has been cordoned off. Written permission to resume.	Ensure the heritage site remains safeguarded until clearance is given by the Heritage Specialist and/or SAHRA for work to resume.	Contractor, SEO.	Upon a chance find.	Compliance to be verified by ECO and IEA.

Assessment with mitigation:

Alternative Route No. 1 (preferred)

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
7	L	L	L	neutral	L	L	0	L	H	0

Alternative Route No. 2

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
7	L	M	L	neutral	M	L	0	L	H	0

Alternative No. 3 – No-Go Option

Impact	Intensity	Spatial	Duration	Status	Nature	Prob.	MAGNITUDE	Accept.	Prob.	IMPORTANCE
7	L	L	L	neutral	L	L	0	L	L	0

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Residual Risk (feeds back into "Mitigations"):

- Previous archaeological and heritage assessments for Cluster 1 (preferred Alternative Route No. 1) recorded a fairly large number of cultural heritage (archaeological & historical) resources of varying extent and significance in the area. These include scatters of open-air surface Stone Age sites, rock engravings, later agro-pastoralist stone-walled sites, as well as historical Anglo-Boer War (1899-1902) sites. These findings are clear evidence of the intrinsic heritage value of the area (A Heritage Scoping Report Impact Assessment prepared by APelser Archaeological Consulting cc (APAC) dated February 2023).
- The potential for rare, largely unpredictable fossil sites of High Palaeosensitivity within the Permian bedrocks or associated with older alluvial and pan deposits hidden in the subsurface cannot be entirely discounted. Consequently, **a Chance Fossil Finds Protocol shall be included within the EMP** in case any fossiliferous deposits are exposed by surface clearance or excavations during the construction phase of the development (Palaeontological Heritage Comment prepared by John E. Almond (PhD) of Natura Viva cc and dated January 2023).

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Site Selection Matrix

3(1) A basic assessment report... must include –

(h) a full description of the process followed to reach the proposed preferred alternative within the site, including - (ix) **the outcome of the site selection matrix;**

Appendix 1 (Basic Assessment Report) of the EIA Regulations, 2014 as amended

Table 3. Site Selection Matrix before mitigation.

Aspect	Legal system	Biological				Physical			Geographic		Economical			Social					Heritage & Culture
		Terrestrial fauna	Terrestrial flora	Aquatic fauna	Aquatic flora	Soil and Rock	G/Surface water	Atmosphere	Terrestrial Ecosystem	Aquatic Ecosystem	Project costs	Time saving	Other costs	Health & safety	Public services	Visual aesthetics	Visual aesthetics	Well-being	
Impact		1				2	3		4	5								6	7
A1		Red				Green	Red		Red	Green								Red	Red
A2		Red				Red	Red		Red	Red								Red	Red
No-Go		Green				Green	Green		Green	Red								Green	Green

Legend: Aspect – aspect or attribute of the receiving environment, **Impact** – any change to the environment: **1.** Loss of Avifauna, **2.** Depletion of Groundwater Reserves, **3.** Dust Pollution, **4.** Fragmentation of Aquatic Corridors, **5.** Greater Repair & Rebuilding Costs, **6.** Disruptions and Delays to Residents, **7.** Damage or Destruction of Heritage Resources, **A1** – Alternative Route No. 1 (preferred), **A2** - Alternative Route No. 2, **No-Go** – No-Go option.

	Significant negative impact/risk		Non-significant impact/risk		Significant positive impact/risk
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Table 4. Site Selection Matrix after mitigation.

Aspect	Legal system	Biological				Physical			Geographic		Economical			Social					Heritage & Culture
		Terrestrial fauna	Terrestrial flora	Aquatic fauna	Aquatic flora	Soil and Rock	G/Surface water	Atmosphere	Terrestrial Ecosystem	Aquatic Ecosystem	Project costs	Time saving	Other costs	Health & safety	Public services	Visual aesthetics	Visual aesthetics	Well-being	
Impact		1				2	3		4	5								6	7
A1		Green				Green	Green		Green	Green								Green	Green
A2		Green				Red	Green		Green	Red								Red	Green
No-Go		Green				Green	Green		Green	Red								Red	Green

Legend: Aspect – aspect or attribute of the receiving environment, **Impact** – any change to the environment: **1.** Loss of Avifauna, **2.** Depletion of Groundwater Reserves, **3.** Dust Pollution, **4.** Fragmentation of Aquatic Corridors, **5.** Greater Repair & Rebuilding Costs, **6.** Disruptions and Delays to Residents, **7.** Damage or Destruction of Heritage Resources, **A1** – Alternative Route No. 1 (preferred), **A2** - Alternative Route No. 2, **No-Go** – No-Go option.

	Significant negative impact/risk		Non-significant impact/risk		Significant positive impact/risk
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Outcome of Site Selection Matrix

An impact and risk assessment of the preferred alternative relative to a second alternative and the no-go option was undertaken. It is the EAP's opinion (for the reasons given below) that the proposed development of the preferred Alternative Route No. 1 is the **best practicable environmental option** and should be subjected to a Basic Assessment to comprehensively determine the feasibility of the project and mitigate impacts relating to its development.

Alternative Route No. 1 (preferred) is \pm 14.1 km long, starts at the N10/Burgerville District Road intersection, traverses along part of the District Road and then enters private properties belonging to a single landowner with whom the Applicant (SAE) has a legal Agreement for the development and operation of Sun Central Cluster 1 Solar PV Facility, including the Switching Station (Dx) and Main Transmission Substation (MTS), where the road ends. The last \pm 2,65 km follows undisturbed ground from the where the farm track reaches the perimeter fence of Cluster 1 to the Switching Station and Main Transmission Substation.

Alternative Route No. 2 is 25.7 km long, starts at the N10/District Road 2451 intersection in Hanover Town, traverses along part of the District Road and then enters private properties belonging to multiple landowners before entering the landowner's property with whom the Applicant (SAE) has a legal Agreement for the development and operation of Sun Central Cluster 1 Solar PV Facility, including the Switching Station (Dx) and Main Transmission Substation (MTS), where the road ends. The last \pm 1,8 km follows undisturbed ground from the where the farm track reaches the farm boundary and perimeter fence of Cluster 1 to the Switching Station and Main Transmission Substation.

Impact 1. Construction related impacts on Avifauna, such as mortalities and disturbance to breeding, are potentially significant because both routes are in an IBA with recorded Globally and Regionally threatened species. Furthermore, a portion of the preferred Alternative Route No. 1 is within the 1 km buffer of a known Verreaux Eagle's nest, and Alternative Route No. 2 covers a greater geographical area. None-the-less it is possible to mitigate these impacts to the extent that they are non-significant on both routes.

Impact 2. Although there is sufficient surplus groundwater available in both sub catchments (HRU4 and HRU5) to provide construction water for both alternative routes and mitigations will ensure that abstraction yields and ecological reserves are not exceeded, Alternative Route No. 2 remains significant (after mitigation) because the estimated additional demand of 151 250 litres/day is believed to be a wasteful use of a regionally scarce resource compared with the shorter preferred Alternative Route No. 1.

Impact 3. Dust emissions during road construction are generally socially unacceptable and therefore potentially significant. However, the greater geographical extent associated with the longer (25.7 km) Alternative Route No. 2 does make it *more* significant compared with the shorter (14.1 km) preferred Alternative Route No. 1. Whilst dust pollution can be mitigated to non-significant levels for both alternative routes, spraying water along the length of Alternative Route No. 2 will incur greater financial and ecological (water usage) costs compared with the preferred Alternative Route No. 1.

Impact 4. Both alternative routes intersect sensitive aquatic environments including a Strategic Water Source Area, NFEPA Rivers and Wetlands, as well as CBAs and an ESA (the Biodiversity Features identified with CBA1 include *inter alia* NFEPA River and Wetland ecosystems). Consequently, the potential fragmentation of these sensitive aquatic environments caused by both alignments is considered significant. However, it is possible through proper engineering designs to maintain the continuity of ecological process

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pathways, specifically uninterrupted or unobstructed surface, and subterranean flows, thereby reducing the rating for both alternative routes to non-significant.

Impact 5. Alternative Route No. 2 (25.7 km) will incur a *more* significant financial cost for repairing and rebuilding an access road, compared with the preferred Alternative Route No. 1 (14.1 km) because it is in a worse state of disrepair and 82% longer. It was found that access to the MTS through Hanover along the 2451 District Road would require extensive engineering and construction. An effective 25.7 km of road would require rebuilding, improving and in sections approval with road authorities and local farmers.

Impact 6. The social (well-being) impact of Alternative Route No. 2 is *more* significant than the preferred Alternative Route No. 1 because the former requires intensely modifying sections of the road network within Hanover town itself. Whilst mitigation potential for both Alternative Routes is High, the impact of Alternative Route No. 2 remains significant owing to the higher expected average daily traffic (ADT) in Hanover town compared with the more rural and agricultural setting of the preferred Alternative Route No. 1. The No-Go option would have a significant negative social impact as the MTS and associated Solar PV Facility (and other facilities) cannot be built without the improved access road, thereby denying South Africans of basic needs and equity that are dependent on a consistent and reliable supply of green energy.

Impact 7. Both routes are of a low palaeological sensitivity. The proximity of Alternative Route No. 1 to several cultural heritage (archaeological & historical) resources that were recorded during previous archaeological and heritage assessments (2017, 2021 & 2022), as well as Alternative Route No. 2 to a Grade II and Grade IIIa Heritage site does pose a significant risk. However, these risks can be easily and adequately mitigated.

In conclusion, unlike both alternative sites, the No-Go option poses no ecological threat before mitigation.

However, South Africa's electricity infrastructure has been degrading in the past decades, with both scheduled and unscheduled power outages on the increase. Simply put, South Africa cannot make enough electricity to supply its people and economy. Apart from load shedding, creating an awareness of and implementing power saving initiatives to reduce demand, no alternative exists other than "to rapidly expand our energy generation capacity" (President Cyril Ramaphosa: 2021 State of the Nation Address, 2021 <https://www.gov.za/speeches/president-cyril-ramaphosa-2021-state-nation-address-11-feb-2021-0000>).

Consequently, the No-Go option would have an indirect but significant negative socio-economic impact as the MTS, Sun Central Cluster 1 Solar PV Facility, and other future facilities (1 GW in total) cannot be built without the improved access road. These Solar PV Facilities, will make a significant contribution to our country's power deficit when supply falls behind demand, meeting basic needs and equity that the no-go option cannot achieve.

A high mitigatory potential of the identified impacts at both alternative routes means that the access road can be constructed without any significant negative impacts on the natural and socio-economical environments. Alternative Route No. 1 (preferred) is, however, the most favourable option as it will place a lower demand on the groundwater aquifer, incur lower project (repair and rebuilding) costs and cause less disruption to the social well-being of local farmers and residents (**Table 4** above).