PROPOSED DEVELOPMENT OF THE MAYOGI PHOTO-VOLTAIC FACILITY NEAR HELPMEKAAR, EASTERN CAPE PROVINCE

DESKTOP GEOTECHNICAL REPORT

AUGUST 2023

REVISION 00

Prepared by:

JG AFRIKA (PTY) LTD

Pietermaritzburg
6 Pin Oak Avenue, Hilton
3201
Phone: 033 343 6700
Email: norrisj@jgafrika.com
Project Director: Jan Norris

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CARRIED OUT BY:

JG AFRIKA (PTY) LTD
Pietermaritzburg
6 Pin Oak Avenue
Hilton
Pietermaritzburg
3201

Tel.: +27 33 343 6700
Email: pmb@jgafrika.com

COMMISSIONED BY:

SIVEST SA (PTY) LTD
Johannesburg
12 Autumn Road
Rivonia
Johannesburg
2128

Tel.: +27 11 798 0637
Email: Phumelam@sivest.co.za

AUTHOR

P. Subrayen

CLIENT CONTACT PERSON

P. Madubela

SYNOPSIS

Desktop geotechnical investigation for the proposed Mayogi Photo-voltaic Facility

KEY WORDS:

Geology, Engineering Geology, Solar PV, Subsoils

QUALITY VERIFICATION

This report has been prepared under the controls established by a quality management system that meets the requirements of ISO 9001: 2015 which has been independently certified by DEKRA Certification.

Verification	Capacity	Name	Signature	Date
By Author	Engineering Geologist	P. Subrayen Pr.Sci.Nat.		15/08/2023
Checked By	Associate	K. Singh Pr.Sci.Nat.	pp	15/08/2023
Authorised By	Director	J. Norris Pr.Eng.		15/08/2023

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NATIONAL ENVIRONMENTAL MANAGEMENT ACT, 1998 (ACT NO. 107 OF 1998) AND ENVIRONMENTAL IMPACT REGULATIONS, 2014 (AS AMENDED) - REQUIREMENTS FOR SPECIALIST REPORTS (APPENDIX 6)

Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6	**Section of Report**
1. (1) A specialist report prepared in terms of these Regulations must contain- a) details of- i. the specialist who prepared the report; and ii. the expertise of that specialist to compile a specialist report including a curriculum vitae;	Verification Page
b) A declaration that the specialist is independent in a form as may be specified by the competent authority	Appendix C
c) An indication of the scope of, and the purpose for which, the report was prepared;	1
(cA) An indication of the quality and age of base data used for the specialist report;	4, 5, 6
(cB) A description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	N/A
d) The date and season of the site investigation and the relevance of the season to the outcome of the assessment;	N/A
e) A description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	1
f) Details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternatives.	Appendix A, Figure 1, 2, 3, 4, 5
g) An identification of any areas to be avoided, including buffers;	Appendix A, Figure 1, 2, 3, 4, 5
h) A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	Appendix A, Figure 1, 2, 3, 4, 5
i) A description of any assumptions made and any uncertainties or gaps in knowledge;	2
j) A description of the findings and potential implications of such findings on the impact of the proposed activity, (including identified alternatives on the environment) or activities;	3, 4, 5, 6, 7
k) Any mitigation measures for inclusion in the EMPr;	N/A
l) Any conditions for inclusion in the environmental authorisation;	N/A
m) Any monitoring requirements for inclusion in the EMPr or environmental authorisation;	N/A
n) A reasoned opinion- i. (as to) whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and ii. if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan;	N/A N/A
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	N/A

p) a summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	None
q) any other information requested by the competent authority.	N/A
2) Where a government notice *gazetted* by the Minister provides for any protocol or minimum information requirement to be applied to a specialist report, the requirements as indicated in such notice will apply.	N/A

PROPOSED DEVELOPMENT OF THE MAYOGI PHOTO-VOLTAIC FACILITY NEAR HELPMEKAAR, EASTERN CAPE PROVINCE

DESKTOP GEOTECHNICAL REPORT

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EXECUTIVE SUMMARY

This desktop level study presents the findings concluded for the proposed Mayogi Photo-voltaic (PV) Facility. The proposed study area receives a relatively moderate mean annual precipitation of 523mm, with the warmest month being December. The study area is predominantly underlain by Kirkwood Formation of the Uitenhage Group, which comprises reddish and greenish mudstone and sandstone while the south-western extremity is underlain by grey silty shale with sandstone of the Adolphspoort Formation of the Bokkeveld Group. Regional hydrogeological information indicates the presence of a “b2” type, fractured aquifer underlying the site, with median borehole yields in the range of 0.1l/s to 0.5l/s. The desktop study indicates no fatal flaws from a preliminary and geological and geotechnical assessment. The impact of the development from a geotechnical perspective will be restricted to the removal and displacement of soil, boulders and bedrock. The impact assessment matrix impact of the PV Facility was found to be “Negative low impact - The anticipated impact will have negligible negative effects and will require little to no mitigation”. The site, from a desktop level geotechnical study is considered suitable for the proposed development.

PROPOSED DEVELOPMENT OF THE MAYOGI PHOTO-VOLATIC FACILITY NEAR HELPMEKAAR, EASTERN CAPE PROVINCE

DESKTOP GEOTECHNICAL REPORT

1 INTRODUCTION

This geotechnical report presents the findings of a desktop study undertaken by JG Afrika (Pty) Ltd (JG Afrika), for the proposed construction of the Mayogi Photo-voltaic (PV) Facility near Helpmekaar in the Eastern Cape Province. It is understood that a desktop level geotechnical report is required as part of an environmental submission for an Environmental Impact Assessment (EIA) report being undertaken by SiVEST South Africa (Pty) Ltd (SiVEST). The proposed development is to be located approximately 10km north-west of Helpmekaar within the Sunday River Valley Local Municipality in the Eastern Cape Province and can be accessed via the R75 Highway.

In accordance with the information provided to JG Afrika the Mayogi PV Facility is to comprise of two (2 No.) 75MW solar PV plants referenced Mayogi PV 1 (located to the south-east) and Mayogi PV2 (located to the north-west) with each including the following infrastructure:

- **PV Panels**
  - Structure height:
    - Solar panels with a maximum height of 5m above the ground.
  - Structure orientation Fixed tilt or tracking:
    - Fixed tilt: north-facing at a defined angle of tilt.
    - Or panels will either be fixed to a single-axis horizontal tracking structure where the orientation of the panel varies according to the time of the day, as the sun moves from east to west; or tilted at a fixed angle equivalent to the latitude at which the site is located in order to capture the most sun.
    - Crystalline silicon or thin film technology (To be determined at later stage)
  - Dimensions of Panel:
    - Width (in m) of PV panels: 2.278m.
    - Height (in m) of PV panels: 1.134m.

- **Access Roads**
  - Width of internal roads:
    - Approximately 6m with an additional 2m drainage on each site if necessary.
  - Existing roads will be utilised as far as reasonably possible.

- Site Access: Existing access roads may need to be upgraded by approximately 450m x 6m.

- **On-site Substation**
  - Two substations are proposed with a maximum capacity of 33/132kV:
    - Maximum height of on-site substation: approximately 3 to 4 m.
    - The substation area is max. 1ha including a building for switching, measurement and control units, a high voltage transformer and high voltage overhead-lines connecting the transformer to the 132 kV grid line that is close to the site.
    - On-site, there will be around 15 to 20 container-sized transformer stations (12192*2896*2438 mm; W*H*D) that step up the low voltage coming from the inverters to 33 kV medium voltage.

- **Construction Camp**
  - 1 x Construction camp will be required.
  - Offices and other buildings with toilets including septic tank and infrastructure, will used during the construction phase.
    - Around 10 x 40ft containers, in total <0.1ha.

- **Temporary Infrastructure**
  - Temporary laydown area: up to approximately 2ha.

- **O&M Buildings**
  - 1 x O&M building will be utilized for plant supervision and storing of spare parts.
  - All auxiliary buildings to be developed include, but are not limited to: O&M building, site office, staff lockers, bathrooms, warehouses, etc (with septic tanks and all infrastructure) as follows:
    - Office (~250m²).
    - Storeroom (~200m²).
    - Staff lockers and changing room (~100m²).
    - Security control (~40m²).
    - Sanitation facilities with septic tank outside.
    - Conservancy Tank.
    - Borehole (if possible, somewhere on site).

- **On-site IPP Electrical Infrastructure**
  - The proposed project will include one on-site IPP substation.

- Planned size: 2ha
    - 1ha for Substation.
    - 1ha for battery storage.

- Substation area: One building that will include:
    - Office/control room (~50m²).
    - MV switchgear room (~100m²).
- Substation yard will include:
    - High voltage transformer and high voltage overhead-lines connecting the transformer to the existing Eskom 132 kV grid line via an approximately 200m long underground cable. This area will include construction laydown area, construction camp facilities and storage area, in the beginning.
- Medium voltage cabling will link PV facility to grid connection infrastructure.
- Internal underground lines of up to 33 kV (22kV or 33kV).
- *Cables will be laid underground wherever technically feasible, with overhead 33kV lines grouping PV areas to crossing valleys and ridges to get to the on-site substation.*

- **Fencing**
    - Type: proposed galvanized metal mesh.
    - Length: 16km.
    - Height: Up to 2m.

- **Proximity to Grid Connection**
    - Skilpad substation is adjacent to the site.

Starting point:

- PV Panel Array - To produce up to 75MW, the proposed facility will require numerous linked PV panels connected in series, which will form solar PV arrays that will comprise the PV facility.
- The PV array will be wired to central inverters. The inverter is a MPPT (Maximum Power Point Tracking) inverter that converts direct current (DC) electricity to alternating current (AC) electricity at grid frequency.

Connection to the grid:

- Connecting the array to the electrical grid requires transformation of the voltage from LV voltage to 33kV to 132kV. The normal components and dimensions of a distribution rated electrical substation will be required. Output voltage from the

inverter is LV AC and this is fed into step up transformers to 33kV. From the inverter transformer an RMU is uses to connect to the on-site substation.

- The on-site substation will be required on the site to step the voltage from 33kV up to 132kV. After which the power will be evacuated into the national grid.
- A switching substation (and associated infrastructure) will be positioned close to the Eskom substation.

- **Borehole and Storage Tanks**
  - Water will be either extracted from the borehole within the property or purchased from the neighbouring farm with access to the river.
  - Water from the borehole is used to irrigate the land. Meaning good flow rate is available.
  - 2.5/5/10 Kl storage tanks.
  - During construction and O&M – mostly above ground tanks; 2 or 3 with 5kl or 10kl volume, close to O&M buildings normally.

For PV Farm:

- Planned size project of 100- 150 MW PV (in total for both PVs)
- The plant will require an estimated amount per year.
  - During construction: 1.5 to 2 years. Estimated 40mL per year of Road construction and compaction.
  - Concrete batching for PV mounting structures foundation.
  - Dust suppressions of the internal roads.
  - Provision of portable water for staff needs (if it can be used).
  - During Operation and Maintenance: 15 to 25 years. Estimated 7 mL per year o Dust suppression of the internal roads.
  - PV panel washing .
  - Office building use (eg. Toilets and washbasins).

- **A Battery Energy Storage System (BESS)**
  - It will depend on future off takers requirements and the size may vary.
  - Provision of 1ha footprint will be kept on plan.
  - Redox flow or solid state battery electrolytes -Lithium technology to be catered for.

1.1 Scope of works

The investigation seeks to give a desktop evaluation of the proposed site focusing on the areas proposed for the construction of the above-mentioned PV Facility and associated infrastructure.

The objectives of the desktop investigation were to assess the geological and geotechnical conditions across the development area.

This involved a literature review and a review of topographic, geological and hydrogeological maps. Consideration was given to, but not limited to the following from a desktop level:

- The influence of topography on site suitability;
- The envisaged geological and geotechnical influences on the competency of foundations for the construction of structures;
- Tectonic influences on overall stability, namely the presence of faults, lineaments and preferred discontinuity orientations;
- Comments regarding likely founding conditions, geotechnical constraints, problem areas and overall site stability from a desktop level; and
- Recommendations regarding requirements for subsequent detailed geotechnical investigations.

The proposed PV Facility is to be located on one (1 No) farm portion (Farm Number 692).

1.2 Terms of Reference

The appointment to proceed with the investigation is based upon JG Afrika's cost estimate email referenced, "Quotation for a Desktop Geotechnical Report for the Proposed Mayogi PV Facility" dated 16th September 2022. JG Afrika received the appointment via a sub-consultancy agreement letter referenced, "18222 Mayogi PV Facility Sub Consultant Short Contract_JG Afrika_October 2022". A further cost-estimate considering the updated PV plant layout and report split was submitted to SiVEST in March 2023. In August 2023 SiVEST extended this appointment, via email, to include a report consolidation for the split report for submission as part of an EIA.

1.3 Specialist Credentials

Ms. Subrayen is a professionally registered and qualified engineering geologist, attaining a Honours of Science Degree in Engineering Geology, from the University of KwaZulu-Natal (UKZN).

Ms. Subrayen holds the position of Engineering Geologist at JG Afrika's Durban branch. She has experience in the various fields of earth science and ground engineering, namely: engineering geology, geotechnical engineering, environmental geology and geohydrology.

1.4 Assessment Methodology

The investigation methodology included a literature review and a review of topographic, geological and hydrogeological maps. Consideration was given to the terrain, geology, hydrogeology and envisaged geotechnical constraints.

An Environmental Impact Assessment matrix was provided to JG Afrika by SiVEST via email in May 2023.

2 ASSUMPTIONS, LIMITATIONS, UNCERTAINTIES - DISCLAIMER

The interpretation of the overall geotechnical conditions across the site are based on observations and point information acquired from a desktop level. Subsurface and geotechnical conditions intermediate to these have been inferred by extrapolation, interpolation and professional judgement. The information and interpretations are given as a guideline only. There is no guarantee that the information given is totally representative of the entire area in every respect and no responsibility will be accepted for consequences arising out of the fact that actual conditions vary from those inferred.

3 TECHNICAL DESCRIPTION

3.1 Project Location

The proposed Mayogi PV Facility is to be located approximately 10km north-west of the town of Helpmekaar in the Eastern Cape province. The R75 main road provides access to the site buffers it's eastern boundary with the Schuilpaddop, Voetpadskloof and Citruslandgoed Game Farms located to the north-west, north-east and east respectively.

The location of the study area is indicated in Figure 1, **Appendix A**.

3.2 Topography and Land Use

The proposed development area is currently vacant with the exception of vegetation and trees. The topography varies minimally across the site with the elevation ranging from 235 meters above mean sea level (mamsl) in the south-west to 205 mamsl in the north-east. A slope category map depicting the topographic variation across the site is shown in Figure 3, **Appendix A**.

3.3 Climate

In accordance with the Köppen-Geiger climate classification the town of Helpmekaar is characterised by an oceanic climate with a "Cfb" classification and received an average annual precipitation of 523mm per annum. The average lowest rainfall is received in July (4mm) and the highest in January (99mm), which is a seasonal variation of 95mm.

The average maximum midday temperature for Helpmekaar ranges from 29.3°C in December to 19.7°C in June, which is a seasonal variation of 9.6°C.

The most sunshine days occur in July while the month of December has the least.

Table 3-1 overleaf summarizes the climatic conditions.

Table 3-1: Summary of Climatic Conditions, Helpmekaar, Eastern Cape (Source: www.weather atlas.com)

Months	Average Rainfall (mm)	Temperature (°C)		Average Sunshine Days
		Maximum	Minimum	
January	99	29.2	16	5.8
February	91	28.5	15.1	6.1
March	66	27.3	13.7	8.8
April	35	24.1	10.6	14.9
May	6	22.7	8.9	23.9
June	6	19.7	6.4	25.2
July	4	19.9	6.2	26.2
August	13	22.8	8.8	23.9
September	15	26.3	12	18.7
October	36	27.3	13.8	12.5
November	63	28.4	14.7	7.1
December	89	29.3	15.6	4.1

According to the regional contour map of climatic N-values for Southern Africa by Weinert (1980), the Weinert N-Value of the study is between 2 and 5 and is indicative of moderate climatic conditions. Weathering of rock material is predominantly by chemical processes.

3.4 Drainage

The proposed Mayogi PV Facility is to be located within the N40B quaternary catchment and is anticipated to receive a Mean Annual Precipitation (MAP) of 319mm per annum over an area of 1209.6m^2.

A tributary of the Kariega River is the only major surface drainage feature that occurs within the PV Facility boundary, specifically intersecting the eastern boundary of Mayogi PV Facility 2. Additionally, the Bezuidenhouts River, located to the south of the development area, is the other major surface drainage feature that flows in close proximity to the site.

It should be noted that both of the proposed OHL's that form part of the Mayogi PV 2 development will cross this drainage feature to reach the Skilpad substation.

3.5 Vegetation

Vegetation in the area is characterised by Xeric Succulent Thicket, of the Thicket Biome.

4 GEOLOGY

According to the 1: 250 000 scale geological map of Port Elizabeth (Map Reference 3324) (Council for Geoscience, 2000). The study area is predominantly underlain by reddish and greenish mudstone, sandstone (J-Kk) of the Kirkwood Formation while the south-western extremity being underlain by grey silty shale and siltstone with sandstone at the base (Da) of the Adolphspoort

Formation. No structural lineaments in the form of dykes or faults were identified during a review of geological maps and aerial photography.

A geological map is presented as Figure 4, **Appendix A**.

5 HYDROGEOLOGY

According to the 1: 500 000 scale hydrogeological map series of Port Elizabeth (Map Reference: 3122). The study area is underlain by a "b2" type fractured aquifer with median borehole yields anticipated to be low and in the range of 0.1l/s to 0.5l/s. Regional groundwater quality test results indicate an electrical conductivity of between 300mS/m to 1000mS/m.

A hydrogeological map is presented as Figure 5, **Appendix A**.

6 ENGINEERING GEOLOGY

The Kirkwood Formation of the Uitenhage Group predominantly underlies the site and comprises of argillaceous rocks (shale and mudstone) and sandstone. According to Brink (1979) the bedrock materials typically exhibit very soft to soft rock hardness and may, in some instances, display consistencies similar to an over-consolidated clay. Joints in bedrock are generally wide spaced, and while relatively impervious the intact mudstones and shales, specifically, can become unstable subsequent to the absorption of water. The residual soils are mainly clayey with high soil activity and can be problematic in terms of slope stability (for steeper slopes) and exhibit volumetric changes (during wetting and drying) (Brink, 1979). Higher up in the soil profile, the residual subsoils forming from the argillaceous rocks of the Kirkwood Formation tend to have a shattered and/ or slickensided soil structure and tend to be the most expansive with clay contents of up to 80%. Large volumetric swells and shrinkage upon desiccation are also common higher up in the soil profile (Brink, 1979). Based on the above mentioned factors the foundations of heavier structures should therefore be founded, at depth, within the bedrock materials. Additionally, the sediments of the Kirkwood Formation are considered to be poor construction materials.

The south-western extremity of the study area is predominated by the Adolphspoort Formation of the Bokkeveld Group. Mainly argillaceous in nature the rock units of the Adolphspoort Formation comprise of mudrocks, shales and siltstone which typically exhibit a soft rock hardness (Brink, 1979). Often, layers of soft clay known as clay gouge, may be present in between bedding planes (Brink, 1979). The bedrock material will likely undergo slaking and degradation upon exposure to the elements. Weathering results in the occurrence of residual soils varying anywhere from 1m thick to 15m thick. These subsoils tend to be clayey or silty, are laminated and exhibit firm to stiff consistencies. The residuum is considered to be a weak founding stratum and is non expansive. Laboratory testing confirms a reduction in the shear strength of the material upon exposure to water (Brink, 1979). Based on these factors foundations of heavier structures should be constructed below the residual soils on bedrock materials. According to Brink (1979) the rock units of the Bokkeveld Group are considered to be poor construction materials but have previously been use in roadworks.

The study area receives a mean annual rainfall of approximately 523mm per annum. According to Weinert (1980) weathering of bedrock material, predominantly through chemical processes, is common resulting in the presence of a thicker residual soil profile which is likely active. Heavier structures will therefore have to be founded within competent bedrock horizons across the development area.

7 GEOTECHNICAL APPRAISAL

If underlain by residual mudstone, siltstone or shale subsoils the soil activity may be influenced by the presence of expansive soil conditions while the sandstones will likely be granular or gravelly and will not be significantly expansive. Volumetric changes upon exposure to, and, absorption of water are also common for these materials. Shale and mudrock residuum and bedrock horizons are likely to undergo desiccation on drying and slaking and degradation upon exposure to the elements. Based on Weinert (1980) and Brink (1979) deeper residual subsoil profiles may be encountered across the development area.

Competent founding conditions can be anticipated within the mudrock, siltstone, shale and sandstone horizons. Additionally, the mudstone, siltstone and shale subsoil and bedrock materials may not be suitable material for use during construction. These factors will however have to be assessed during the invasive geotechnical investigation.

8 GEOTECHNICAL IMPACT ASSESSMENT

From a preliminary geological and geotechnical assessment, no fatal flaws have been identified.

8.1 Impact of the Project on the Geological Environment

The impact of the development from a geotechnical perspective will be restricted to the removal and displacement of soil, boulders and bedrock referred to in this report as “subsoils”. The levelling of areas to create building platforms will also result in the displacement and exposure of subsoils. These impacts will have a negative visual impact on the environment, which in some cases can be remediated.

The potential impact of the development on the terrain and geological environment, will be the increased potential for soil erosion, caused by construction activities and the removal of vegetation. Areas of concentrated surface flow conditions can be anticipated at the PV Facility, resulting in gradual erosion of unconsolidated soil, during the operational life of the development. This can result in the creation of preferential drainage features, unless remediated through proper engineering design (i.e stormwater drainage).

Based on the impact assessment matrix undertaken for this project, from a geotechnical perspective the impact of the Mayogi PV Facility was found to be “Negative low impact - The anticipated impact will have negligible negative effects and will require little to no mitigation.” The assessment impact assessment matrix is presented overleaf as Table 8-1.

Table 8-1: Geotechnical Impact Assessment Matrix

Mayogi PV Facility																					
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	I	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase																					
Removal of subsoils (soil, rock)	Displacement of natural earth material and overlying vegetation. 1) Increase in soil and wind erosion due to clearing of vegetation. 2) Construction and earthmoving vehicles may displace soil during operations. 3) Creation of drainage paths along access tracks. 4) Potential oil spillages from heavy plant. 5) Excessive dust.	1	3	3	2	2	2	22	-	Low Impact	Identify protected areas prior to construction. 1) Construction of temporary berms and drainage channels to divert surface water. 2) Minimize earthworks and fills. 3) Use existing road network and access tracks. 4) Rehabilitation of affected areas (such as re-grassing, mechanical stabilization). 5) Correct engineering design and construction of gravel roads and water crossings. 6) Correct construction methods for foundation installations. 7) Vehicle repairs to be undertaken in designated areas. 8) Control stormwater flow. 9) Dust suppression	1	2	2	1	4	2	20	-	Low Impact
Operational Phase																					
Removal of subsoils (soil, rock)	Displacement of natural earth material. 1) Increase in soil erosion due to concentrated flow received off PV Panels. 2) Potential oil spillages from maintenance vehicles. 3) Sedimentation of non-perennial features caused by soil erosion.	1	2	2	2	3	2	20	-	Low Impact	1) Use of existing roads and tracks. 2) Rehabilitation of affected areas (such as erosion control mats). 3) Correct engineering design and construction of roads and water crossings. 4) Vehicle repairs to be undertaken in designated areas. 5) Maintenance of stormwater system.	1	2	2	2	3	2	20	-	Low Impact
Decommissioning Phase																					
Removal of subsoils (soil, rock)	Decommissioning of the structure will disturb the geological environment. 1) Increase in soil and wind erosion due to clearance of structures. 2) Construction and earthmoving vehicles will displace the soil. 3) Creation of drainage paths. 4) Potential oil spillages from vehicles. 5) Excessive sediments in non-perennial features.	2	4	3	1	1	3	33	-	Moderate Impact	1) Use of temporary berms and drainage channels to divert surface water during flooding. 2) Minimise earthworks and demolish footprints. 3) Use of existing roads and tracks. 4) Rehabilitation of affected areas (such as re-grassing). 5) Develop a chemical spill response plan. 6) Develop dust and demolition fly suppression plan. 7) Vehicle repairs to be undertaken in designated areas. 8) Reinstate channelized drainage features.	1	3	4	2	2	2	24	-	Low Impact
Cumulative																					
Removal of subsoils (soil, rock)	None							0			None							0		

9 GEOTECHNICAL COMPARATIVE ASSESSMENT OF ALTERNATIVES

Design and layout alternatives for each PV plant (Mayogi PV1 and Mayogi PV2) were considered and assessed as part of this geotechnical report. These include alternatives for the substations including the O&M buildings and laydown areas and the overhead powerlines (OHL's) which connect the proposed new 33/132kV substations to the existing Skilpad Substation.

For ease of reference the comparative assessments of alternatives for each PV plant are provided below and shown in Figure 2, **Appendix A.**

9.1 Mayogi PV 1

- **Overhead Powerline, Substation and O&M Buildings and Laydown Area Option 1**
  - The Overhead powerline route that is being considered for the link between Substation Option 1 and the existing Skilpad substation is approximately 0.58km in length. The proposed OHL route will exit from the south-eastern boundary of the proposed new substation and enter the Skilpad substation from it's north-western boundary;
  - Option 1 of the proposed substation O&M buildings and laydown area cover an area of approximately 4ha and are located to the north-west of the Skilpad substation.

- **Overhead Powerline, Substation and O&M Buildings and Laydown Area Option 2**
  - The Overhead powerline route that is being considered for the link between Substation Option 2 and the existing Skilpad substation is approximately 0.20km in length. The proposed OHL route will exit from the north-eastern boundary of the proposed new substation and enter the Skilpad substation from it's south-western boundary;
  - Option 2 of the proposed substation O&M buildings and laydown area cover an area of approximately 3ha and is located to the south-west of the Skilpad substation.

This assessment is based on the comparative assessment criteria is given in Table 9-1, with the complete assessment presented in Table 9-2.

Table 9-1: Comparative Assessment Criteria

PREFERRED	The alternative will result in a low impact / reduce the impact / result in a positive impact
FAVOURABLE	The impact will be relatively insignificant
LEAST PREFERRED	The alternative will result in a high impact / increase the impact
NO PREFERENCE	The alternative will result in equal impacts

Table 9-2: Geotechnical Comparative Assessment of Alternatives (Mayogi PV1)

Alternative	Preference	Reasons (incl. potential issues)
Substation Alternatives		
Substation Option 1	**FAVOURABLE**	• This substation area is underlain by the Kirkwood Formation. • Substation option 1 lies on shallow to moderately dipping slopes (generally between 4.68% and 14.05%) with earthworks likely to be required to create a level platform. • There are no existing gravel roads allowing access to this substation option.
Substation Option 2	**PREFERRED**	• This substation option is underlain by the Kirkwood Formation and is anticipated to have similar geotechnical characteristics to the subsoils underlying substation option 1 . • Substation option 2 is to be located on shallow slopes (generally <4.68%) with minimal earthworks being required to create a level platform. • Substation option 2 is located close to an existing gravel road and access point. It is ideal in terms of serviceability.
Construction Laydown Area Site Alternatives		
Laydown Area Option 1	**NO PREFERENCE**	• Both of the laydown areas are underlain by the Kirkwood Formation and the subsoils can be anticipated to have similar geotechnical characteristics. • Slopes in both areas are shallow (generally <4.68%) with minor earthworks anticipated to create a level platforms for construction. • Laydown area option 2 is located close to an existing gravel road and access point. It is ideal in terms of serviceability.
Laydown Area Option 2	**PREFERRED**	
OHL Alternatives		
OHL Option 1	**FAVOURABLE**	• This OHL route is underlain by the Kirkwood Formation. • OHL option 1 generally traverses shallow to moderately dipping slopes generally between 4.68% and 14.05%. There is likely to be, unstable transported soils, with potential slope stability issues and serviceability constraints.
OHL Option 2	**PREFERRED**	• This OHL route is underlain by the Kirkwood Formation and the subsoils can be anticipated to have similar geotechnical characteristics to those underlying OHL option 1. • OHL option 2 generally traverses shallow dipping slopes (generally <4.68%) and will be shorter in distance from the proposed substation to the Skilpad substation.

9.2 Mayogi PV 2

- **Overhead Powerline, Substation and O&M Buildings and Laydown Area Option 1**
  - The Overhead powerline route that is being considered for the link between Substation Option 1 and the existing Skilpad substation is approximately 1.89km in length. The proposed OHL route will exit from the south-eastern boundary of the proposed new substation and enter the Skilpad substation from it's north-western boundary;
  - Option 1 of the proposed substation O&M buildings and laydown area cover an area of approximately 4ha and are located to the north-west of the Skilpad substation.

- **Overhead Powerline, Substation and O&M Buildings and Laydown Area Option 2**
  - The Overhead powerline route that is being considered for the link between Substation Option 2 and the existing Skilpad substation is approximately 2.17km in length. The proposed OHL route will exit from the south-eastern boundary of the proposed new substation and enter the Skilpad substation from it's south-western boundary;
  - Option 2 of the proposed substation O&M buildings and laydown area cover an area of approximately 4ha and is located to the north-west of the Skilpad substation.

As above this assessment is based on the comparative assessment criteria listed in Table 9-1, with the complete assessment presented in Table 9-3 below.

Table 9-3: Geotechnical Comparative Assessment of Alternatives (Mayogi PV2)

Alternative	Preference	Reasons (incl. potential issues)
Substation Alternatives		
Substation Option 1	**FAVOURABLE**	• This substation area is underlain by the Kirkwood Formation. • Substation option 1 lies on shallow to moderately dipping slopes (generally between 4.68% and 14.05%) with earthworks likely to be required to create a level platform. • Substation option 1 is located close to an existing gravel road however further access may be required and potential road upgrades are likely.
Substation Option 2	**PREFERRED**	• This substation option is underlain by the Kirkwood Formation and is anticipated to have similar geotechnical characteristics to the subsoils underlying substation option 1. • Substation option 2 is to be located on shallow slopes (generally <4.68%) with minimal earthworks being required to create a level platform. • Substation option 2 is located close to an existing gravel road. It is ideal in terms of serviceability.

Alternative	Preference	Reasons (incl. potential issues)
Construction Laydown Area Site Alternatives		
Laydown Area Option 1	**NO PREFERENCE**	• Both of the laydown areas are underlain by the Kirkwood Formation and the subsoils can be anticipated to have similar geotechnical characteristics. • Slopes in both areas are shallow (generally <4.68%) with minor earthworks anticipated to create a level platforms for construction. • Both laydown areas are located close to existing gravel roads and are ideal in terms of serviceability.
Laydown Area Option 2	**PREFERRED**	
OHL Alternatives		
OHL Option 1	**FAVOURABLE**	• This OHL route is underlain by the Kirkwood Formation. • This OHL route crosses a drainage feature. • OHL option 1 generally traverses shallow to moderately dipping slopes generally between 4.68% and 14.05%. There is likely to be, unstable transported soils, with potential slope stability issues and serviceability constraints.
OHL Option 2	**PREFERRED**	• This OHL route is underlain by the Kirkwood Formation and the subsoils can be anticipated to have similar geotechnical characteristics to those underlying OHL option 1. • This OHL route crosses a drainage feature. • OHL option 2 generally traverses shallow dipping slopes (generally <4.68%). Accessibility to the entry point of the substation is easier due to the presence of an existing gravel road.

No fatal geotechnical constraints were identified that would render the proposed substation alternatives, construction laydown areas or OHL routes for each of the PV plants unsuitable. Preferences are given in the tables above for informative purposes.

Construction activities on steeply inclined slopes will require additional earthworks, longer access routes in comparison to lower topographic areas. Additionally, slope stability issues can arise in steeply inclined terrain which will require retention structures and advanced foundations. None of the alternatives are considered fatally flawed provided the recommendations presented in this report are adhered to.

10 CONCLUSIONS AND RECOMMENDATIONS

The foregoing report presents the findings concluded from a desktop study undertaken for the proposed Mayogi PV Facility and associated infrastructure.

No fatal flaws from a geotechnical perspective were identified during this desktop study. Conclusions presented in this report will have to be more accurately confirmed during the detailed geotechnical investigation phase. The PV Facility was found to be “Negative low impact - The

anticipated impact will have negligible negative effects and will require little to no mitigation." The site from a desktop level geotechnical study is considered suitable for the proposed development.

It recommended that a detailed geotechnical investigation be undertaken during the detailed design phase of the project. The detailed geotechnical investigation must entail the following:

- The profiling and sampling of exploratory trial pits to determine founding conditions for the substations and powerline infrastructure;
- Thermal resistivity and electrical resistivity geophysical testing for electrical design and ground earthing requirements; and
- Groundwater sampling of existing boreholes to establish a baseline of the groundwater quality for construction purposes.

10.1 Impact Statement

No fatal flaws from a geotechnical perspective were identified during this desktop study. Conclusions presented in this report will have to be more accurately confirmed during the detailed geotechnical investigation phase. The Mayogi PV Facility was found to be "Negative low impact - The anticipated impact will have negligible negative effects and will require little to no mitigation." The site from a desktop level geotechnical study is considered to be suitable for the proposed development.

11 SELECTED BIBLIOGRAPHY

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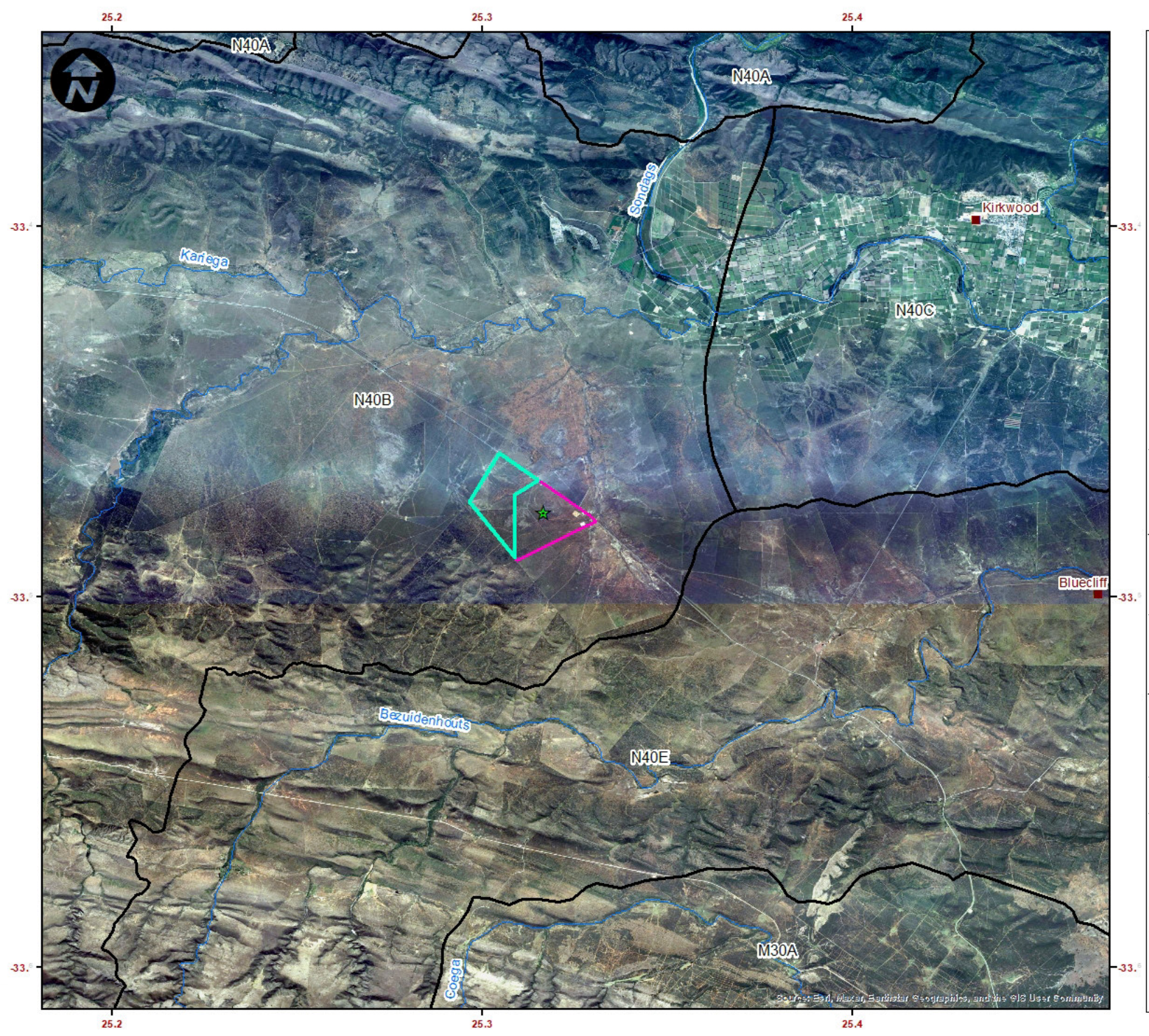
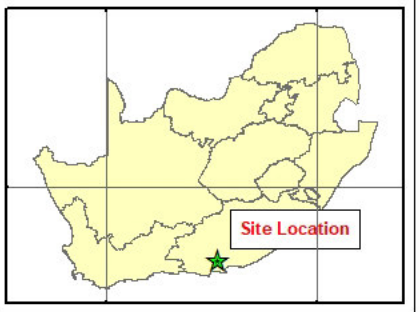
Appendix A: Figures





Legend

- Site Location
- Towns
- Mayogi PV2 Boundary
- Mayogi PV1 Boundary
- Quaternary
- Rivers

SCALE:

3 1.5 0 3 Kilometers

PROJECT: Mayogi Photo Volatic (PV) Facility & Associated Infrastructure

TITLE: Figure 1 - Locality Map

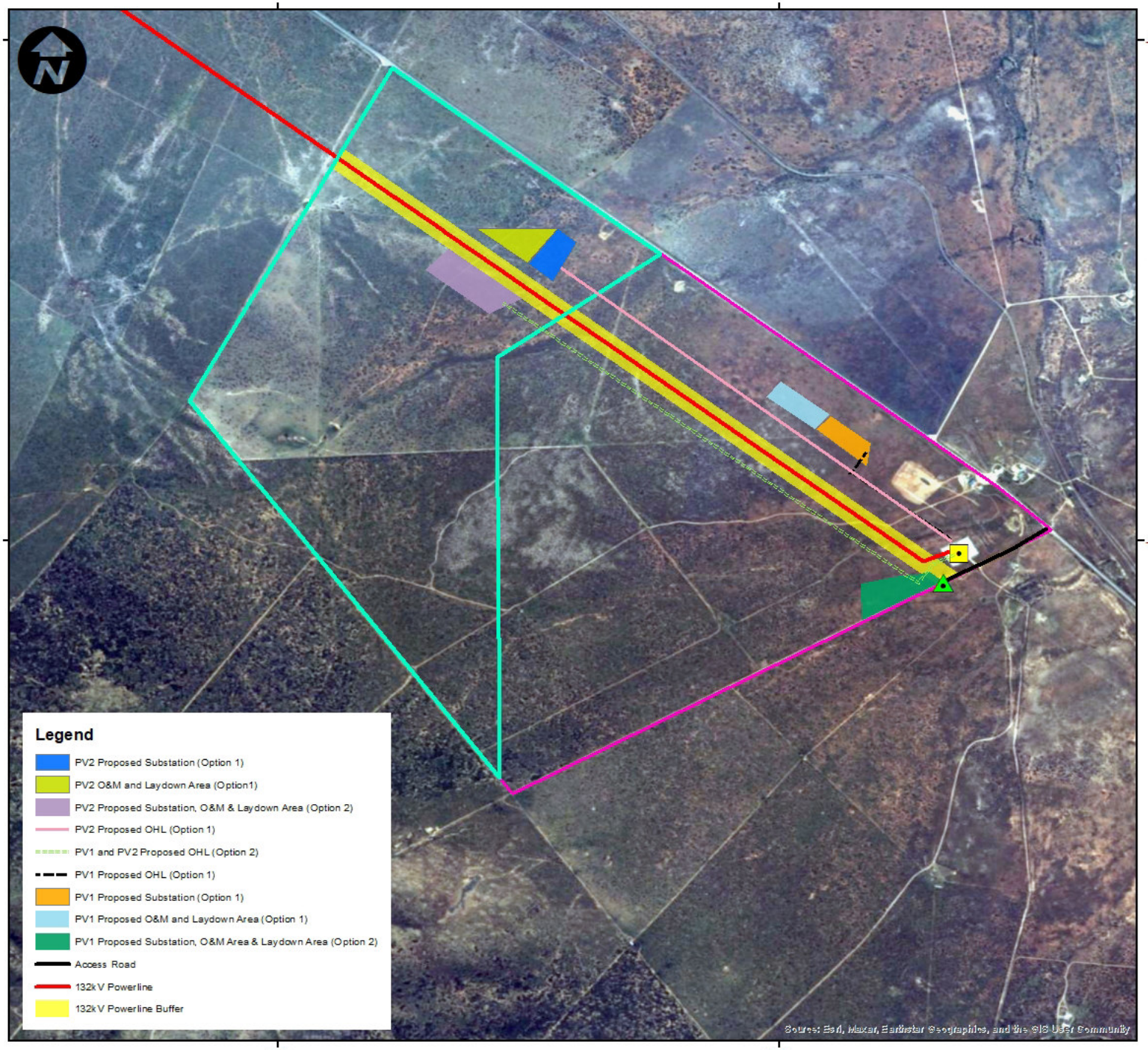
CLIENT: SiVest

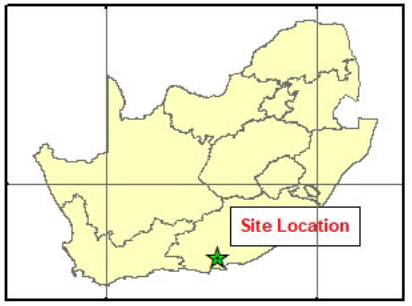
REFERENCE: WGS 84

5797_Mayogi PV Facility_JN

Scale:		A4
Drawn:	P. Subrayen	N/A
Checked:	K. Singh	N/A
Approved:	J. Norris	N/A

JG AFRIKA
6 Pin Oak Avenue
Hilton
3201
Tel: +27 33 343 6700
Email: subrayenp@jgafrika.com





Legend

- Site Location
- Mayogi PV2 Boundary
- Mayogi PV1 Boundary
- Site Access
- Skilpad Substation

SCALE:

0.4 0.2 0 0.4 Kilometers

PROJECT: **Mayogi Photo Volatic (PV) Facility & Associated Infrastructure**

TITLE: **Figure 2 - Site Plan**

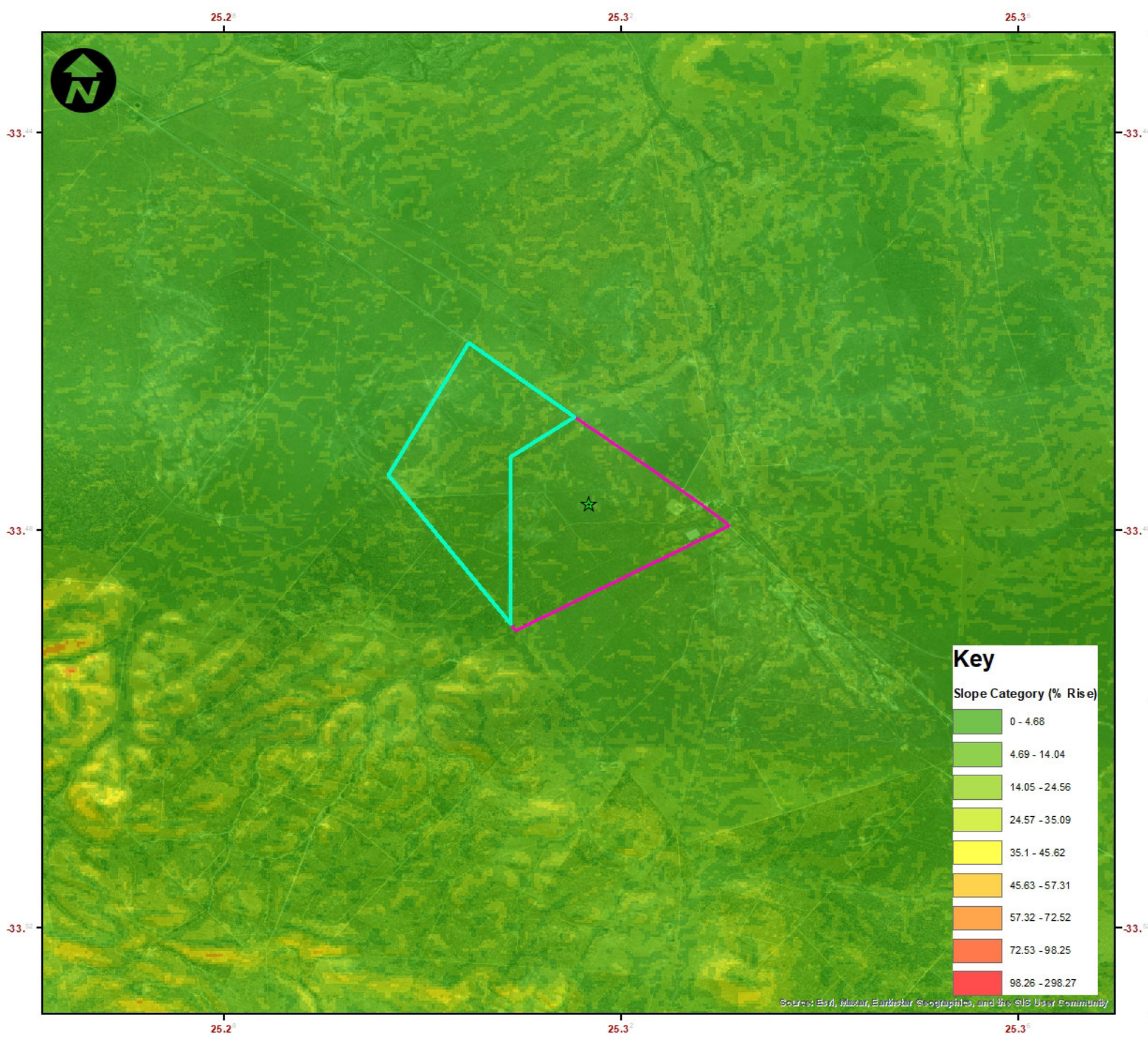
CLIENT: **SiVest**

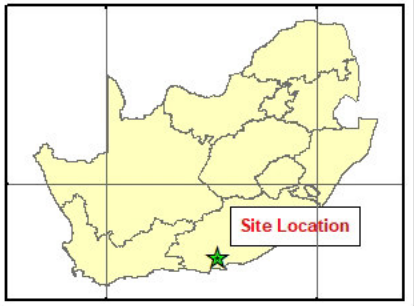
REFERENCE: WGS 84

5797_Mayogi PV Facility_JN

Scale:		A4
Drawn:	P. Subrayen	N/A
Checked:	K. Singh	N/A
Approved:	J. Norris	N/A

JG AFRIKA
6 Pin Oak Avenue
Hilton
3201
Tel: +27 33 343 6700
Email: subrayenp@jgafrika.com





Legend

- Site Location
- Mayogi PV2 Boundary
- Mayogi PV1 Boundary

SCALE:

1 0.5 0 1 Kilometers

PROJECT: **Mayogi Photo Volatic (PV) Facility & Associated Infrastructure**

TITLE: **Figure 3 - Slope Category Map**

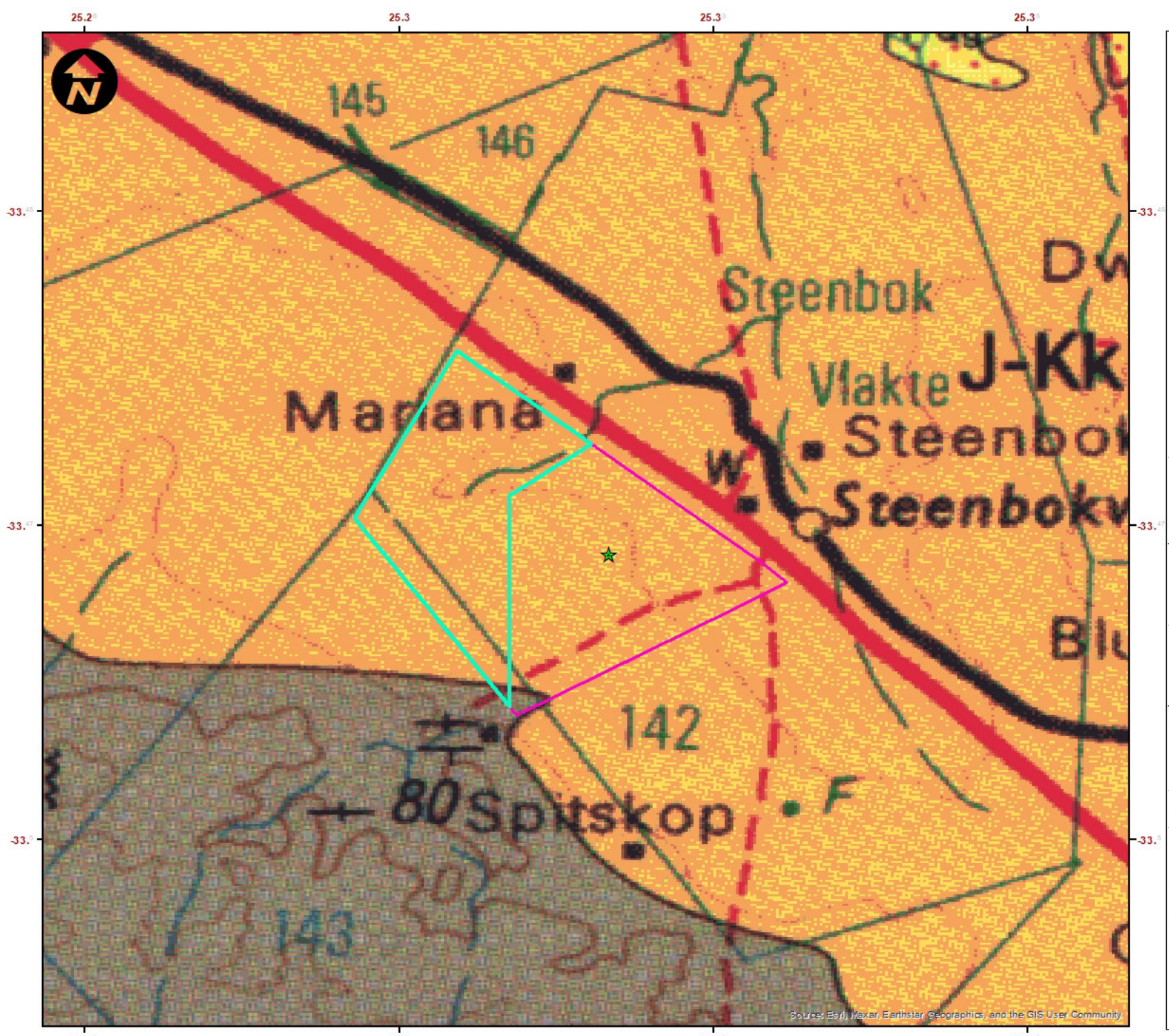
CLIENT: **SiVest**

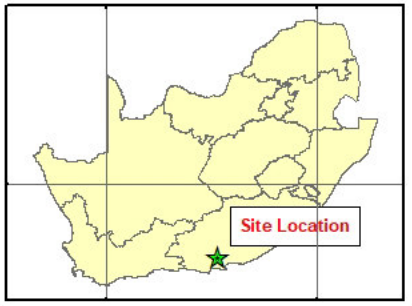
REFERENCE: WGS 84

5797_Mayogi PV Facility_JN

Scale:		A4
Drawn:	P. Subrayen	N/A
Checked:	K. Singh	N/A
Approved:	J. Norris	N/A

JG AFRIKA
6 Pin Oak Avenue
Hilton
3201
Tel: +27 33 343 6700
Email: subrayenp@jgafrika.com





Legend

- Site Location
- Towns
- Mayogi PV2 Boundary
- Mayogi PV1 Boundary
- J-Kk — Reddish and greenish mudstone and sandstone
- Da — Grey silty shale/ sandstone at base

SCALE:

0.85 0.425 0 0.85 Kilometers

PROJECT: Mayogi Photo Volatic (PV) Facility & Associated Infrastructure

TITLE: Figure 4 - Geological Map

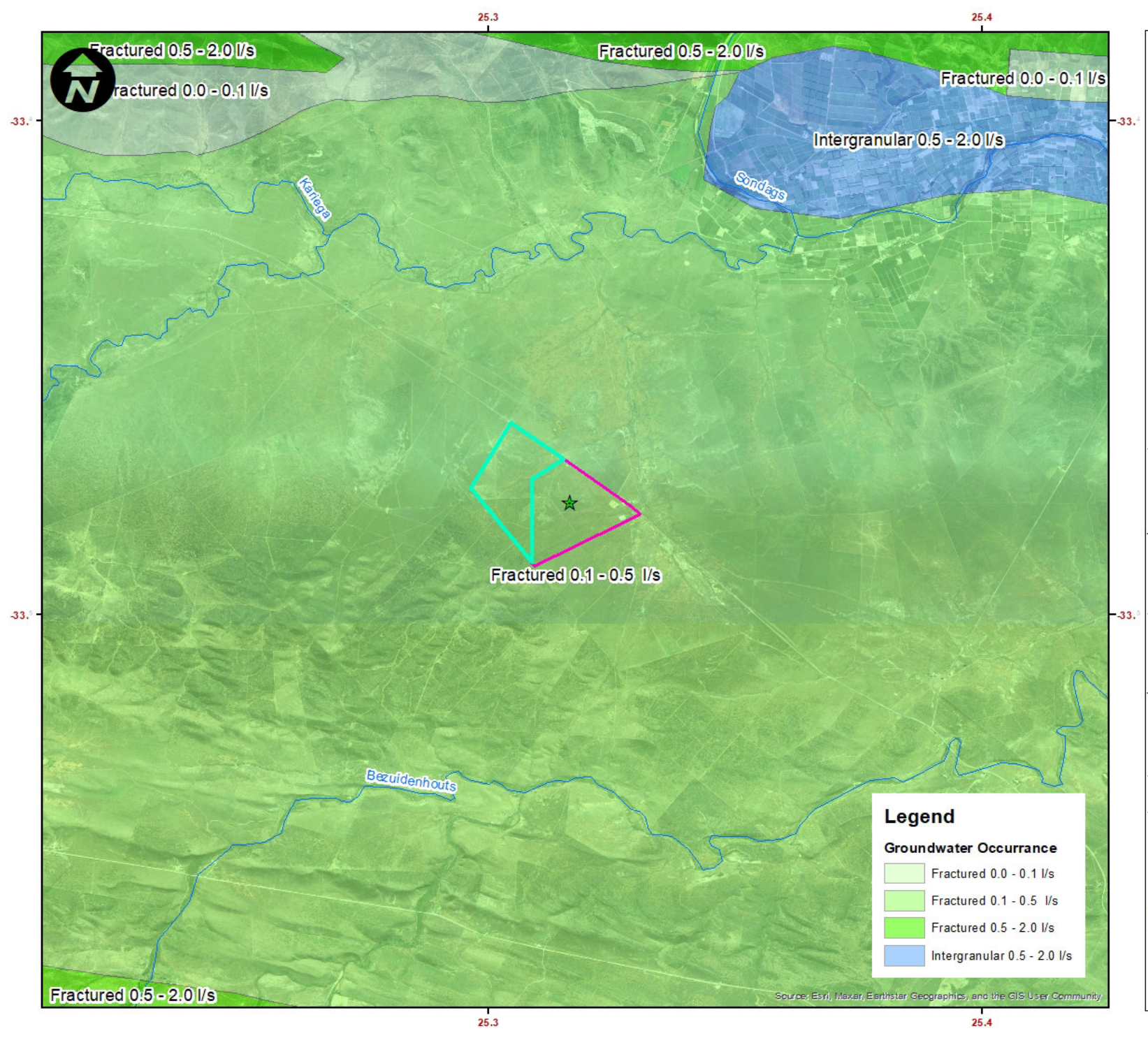
CLIENT: SiVest

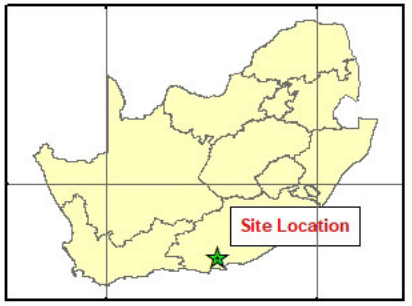
REFERENCE: WGS 84

5797_Mayogi PV Facility_JN

Scale:		A4
Drawn:	P. Subrayen	N/A
Checked:	K. Singh	N/A
Approved:	J. Norris	N/A

JG AFRIKA
6 Pin Oak Avenue
Hilton
3201
Tel: +27 33 343 6700
Email: subrayenp@jgafrika.com





Legend

- Site Location
- Mayogi PV2 Boundary
- Mayogi PV1 Boundary
- Rivers

SCALE:

2 1 0 2 Kilometers

PROJECT: **Mayogi Photo Volatic (PV) Facility & Associated Infrastructure**

TITLE: **Figure 5 - Hydrogeological Map**

CLIENT: **SiVest**

REFERENCE: WGS 84

5797_Mayogi PV Facility_JN

Scale:		A4
Drawn:	P. Subrayen	N/A
Checked:	K. Singh	N/A
Approved:	J. Norris	N/A

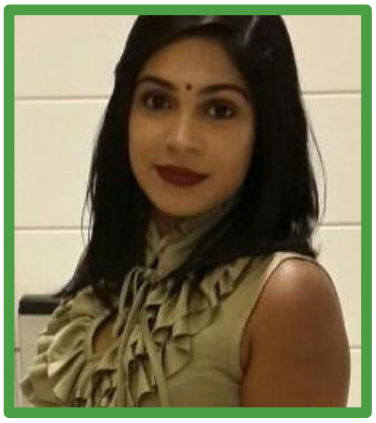
JG AFRIKA
6 Pin Oak Avenue
Hilton
3201
Tel: +27 33 343 6700
Email: subrayenp@jgafrika.com

Appendix B: SiVEST Impact Assessment Methodology

ENVIRONMENTAL PARAMETER - A brief description of the environmental aspect likely to be affected by the proposed activity e.g. Surface water	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE - A brief written statement of the environmental aspect being impacted upon by a particular action or activity e.g. oil spill in surface water.	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		Extent [E] - The area over which the impact will be expressed	Probability [P] - The chance of occurrence of an impact	Reversibility [R] - The degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity	Irreplaceable loss of resources [I] - The degree to which resources will be irreplaceably lost as a result of a proposed activity	Duration [D] - The lifetime of the impact as a result of the proposed activity	Intensity / Magnitude [I / M] - A brief description of whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily	TOTAL = Extent + probability + reversibility + irreplaceability + duration) x magnitude/intensity	STATUS (+ OR -)	Significance Rating [S] - A brief description of the importance of an impact which in turn dictates the level of mitigation required		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	
Construction Phase																				
Vegetation and protected plant species	Vegetation clearing for access roads, turbines and their service areas and other infrastructure will impact on vegetation and protected plant species.	2	4	2	2	3	3	39	-	Medium	Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.	2	4	2	1	3	2	24	-	Low
Operational Phase																				
Fauna	Fauna will be negatively affected by the operation of the wind farm due to the human disturbance, the presence of vehicles on the site and possibly by noise generated by the wind turbines as well.	2	3	2	1	4	3	36	-	Medium	Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.	2	2	2	1	4	2	22	-	Low
Decommissioning Phase																				
Fauna	Fauna will be negatively affected by the decommissioning of the wind farm due to the human disturbance, the presence and operation of vehicles and heavy machinery on the site and the noise generated.	2	3	2	1	2	3	30	-	Medium	Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.	2	2	2	1	2	2	18	-	Low
Cumulative																				
Broad-scale ecological processes	Transformation and presence of the facility will contribute to cumulative habitat loss and impacts on broad-scale ecological processes such as fragmentation.	2	4	2	2	3	2	26	-	Medium	Outline/explain the mitigation measures to be undertaken to ameliorate the impacts that are likely to arise from the proposed activity. These measures will be detailed in the EMPr.	2	3	2	1	3	2	22	-	Low

Appendix C: Specialist's CV and Specialist Declaration

PRIANTHA SUBRAYEN



Profession	*Engineering Geologist*
Position in Firm	*Engineering Geologist*
Area of Specialisation	*Engineering Geology*
Qualifications	*Pr.Sci.Nat., BSc (Hons) (Environmental and Engineering Geology)*
Years of Experience	*6 Years*
Years with Firm	*3 Years*

SUMMARY OF EXPERIENCE

Priantha is a professionally registered natural scientist with the South African Council for Natural Scientific Professions. She currently occupies the position of Engineering Geologist with JG Afrika and has 6 years of experience in the Geotechnical Engineering field. She currently has a BSc Honours in Engineering Geology from the University of KwaZulu-Natal.

Previously a part of the Geotechnical division at JG Afrika, Priantha has since branched into the fields of Geohydrology, Water Quality Analysis, Water Use License Applications (WULAs) and Geographical Information Systems (GIS), and is now a part of the Geohydrology division based in Durban. Experience has also been obtained in compilation of contract documentation, cost estimates and tender compilation.

Apart from her numerous projects in South Africa, Priantha also has working experience in Africa.

PROFESSIONAL REGISTRATIONS & INSTITUTE MEMBERSHIPS

Pr.Sci.Nat - South African Council for Natural Scientific Professions (Registration No. 400006/16).

EDUCATION

2010 – BSc (Geological Sciences) – University of KwaZulu-Natal
2011 – BSc (Hons) (Environmental and Engineering Geology) – University of KwaZulu-Natal

SPECIFIC EXPERIENCE

JG Afrika (Pty) Ltd (Previously Jeffares & Green (Pty) Ltd): Groundwater

2022 (Current)
Position – Engineering Geologist/ Geohydrologist

City of Cape Town – Water Quality interpretation at City of Cape Town Landfill Sites. Client: City of Cape Town.

JG Afrika (Pty) Ltd (Previously Jeffares & Green (Pty) Ltd): Geotechnical

2013 - 2016
Position – Engineering Geologist

Lesotho Highlands Phase II Water Project – Information database management, site data analysis, interpretation and compilation, reporting. Client: Lesotho Highlands Development Authority.

Geotechnical Investigations (Quarry Rock Mass Ratings Determination – Afrimat Quarries) – Slope stability and rock quality assessments at various Afrimat Quarries in KwaZulu-Natal. Client: Afrimat.

Geotechnical Investigations (Single Storey Structures) – A determination of the appropriate founding depth and foundation type for single storey structures. These included residential developments, multi-purpose buildings and poultry farm sheds. Client: Various.

Geotechnical Investigations (Irrigation Schemes and Related Infrastructure) – Shallow site investigations to determine the suitability of a site for various irrigation scheme infrastructure, including pipes, reservoirs and pump stations. Client: Various.

Geotechnical Investigations (Industrial Developments) – Shallow geotechnical investigations for small and large scale industrial developments, to determine the founding depths and appropriate foundation types for various heavily loaded industrial structures. Client: Various.

Geotechnical Investigations (Cemetery Site Selection) – Shallow geotechnical investigations to determine site suitability for the development of a cemetery and related infrastructure. Client: Msunduzi Municipality.

Geotechnical Investigations (Roads and Related Infrastructure) – Road centreline investigations for the upgrade of lightly to moderately trafficked roads, borrow pit evaluation and bridge and culvert foundation assessments. Client: Naidu Consulting (Pty) Ltd.

Geotechnical Investigations (Low-Cost Housing Developments) – Shallow geotechnical investigations and NHBRC site classifications for numerous low-cost housing developments within South Africa. Client: various.

SRK Consulting (Pty) Ltd

2012 - 2013
Position – Junior Engineering Geologist

Geotechnical Investigations (Multi- Storey Structures) – Small scale, deep geotechnical investigations for multi-storey buildings in Pietermaritzburg. Client: Msunduzi Municipality.

Geotechnical Investigations (Roads and Related Infrastructure) – Road centreline investigations, borrow pit evaluation and culvert and over-topping structure founding condition inspections. Client: Naidu Consulting (Pty) Ltd.

Geotechnical Investigations (Low-Cost Housing Developments) – Shallow geotechnical investigations and site classifications for numerous low-cost housing developments within South Africa. Client: various.

Geotechnical Investigations (Heavily Loaded Structures -Vopak Tank Storage Farm) – Deep geotechnical investigations to determine the suitability of the site and founding conditions for tank storage reservoirs within the Richards Bay Port: Vopak.

Mutamba Titanium Dioxide Feedstock Project – CPT Monitoring and evaluation, mineral resource estimation and orebody modelling. Client: RioTinto.

CONTINUED PROFESSIONAL DEVELOPMENT

Courses

2012 - LeapFrog Geo
2013 - SAIEG Soil, Rock and Chip Logging
2014 - Kaytech Engineered Fabrics - Introduction to Geosynthetics

PERSONAL DETAILS

Nationality – South African
Date of Birth – 1989-12-20
Domicile – Durban, South Africa

Languages
English – Excellent

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Priantha Moonsamy

Registration Number: 400066/16

is a registered scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following fields(s) of practice (Schedule 1 of the Act)

Earth Science (Professional Natural Scientist)

Effective **9 March 2016** Expires **31 March 2023**

Chairperson

Chief Executive Officer

To verify this certificate scan this code

forestry, fisheries
& the environment
Department:
Forestry, Fisheries and the Environment
REPUBLIC OF SOUTH AFRICA

Private Bag X447, Pretoria, 0001, Environment House, 473 Steve Biko Road, Pretoria, 0002 Tel: +27 12 399 9000, Fax: +27 86 625 1042

SPECIALIST DECLARATION FORM – AUGUST 2023

Specialist Declaration form for assessments undertaken for application for authorisation in terms of the National Environmental Management Act, Act No. 107 of 1998, as amended and the Environmental Impact Assessment (EIA) Regulations, 2014, as amended (the Regulations)

REPORT TITLE
MAYOGI PV FACILITY

Kindly note the following:

1. This form must always be used for assessment that are in support of applications that must be subjected to Basic Assessment or Scoping & Environmental Impact Reporting, where this Department is the Competent Authority.
2. This form is current as of August 2023. It is the responsibility of the Applicant / Environmental Assessment Practitioner (EAP) to ascertain whether subsequent versions of the form have been published or produced by the Competent Authority. The latest available Departmental templates are available at https://www.dffe.gov.za/documents/forms.
3. An electronic copy of the signed declaration form must be appended to all Draft and Final Reports submitted to the department for consideration.
4. The specialist must be aware of and comply with '*the Procedures for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the act, when applying for environmental authorisation - GN 320/2020)'*, where applicable.

1. SPECIALIST INFORMATION

Title of Specialist Assessment	DESKTOP GEOTECHNICAL INVESTIGATION
Specialist Company Name	JG AFRIKA (PTY) LTD
Specialist Name	PRIANTHA SUBRAYEN
Specialist Identity Number	8912200105086
Specialist Qualifications:	BSC(HONOURS) ENGINEERING GEOLOGY
Professional affiliation/registration:	PR.SCI.NAT (REGISTRATION NUMBER 400066/16)
Physical address:	6 PIN OAK AVENUE, HILTON, PIETERMARITZBURG, 3201
Postal address:	SAME AS ABOVE
Postal address	Click or tap here to enter text.
Telephone	033 034 6700
Cell phone	074 473 6439
E-mail	SUBRAYENP@JGAFRIKA.COM

2. DECLARATION BY THE SPECIALIST

I, PRIANTHA SUBRAYEN declare that –

- I act as the independent specialist in this application;
- I am aware of the procedures and requirements for the assessment and minimum criteria for reporting on identified environmental themes in terms of sections 24(5)(a) and (h) and 44 of the National Environmental Management Act (NEMA), 1998, as amended, when applying for environmental authorisation which were promulgated in Government Notice No. 320 of 20 March 2020 (i.e. "the Protocols") and in Government Notice No. 1150 of 30 October 2020.
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing –
    - any decision to be taken with respect to the application by the competent authority; and;
    - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- All the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of Regulation 48 and is punishable in terms of section 24F of the NEMA Act.

Signature of the Specialist

JG AFRIKA (PTY) LTD

Name of Company:

16 Aug 2023

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, _ PRIANTHA SUBRAYEN_____, swear under oath / affirm that all the information submitted or to be submitted for the purposes of this application is true and correct.

Signature of the Specialist

JG AFRIKA (PTY) LTD

Name of Company

16/08/2023

Date

Signature of the Commissioner of Oaths

COMMISSIONER OF OATHS
DAWN JANET BURGIN
9/1/8/2 (R/O) KZN (PIETERMARITZBURG)
6 PIN OAK AVENUE, HILTON

16/08/2023

Date