Appendix H.12

GEOTECHNICAL DESKTOP STUDY

Tournée 2 Solar (Pty) Ltd

TOURNÉE SOLAR 2 PV GEOTECHNICAL DESKTOP STUDY

AUGUST 2023

CONFIDENTIAL

Tournée 2 Solar (Pty) Ltd

TOURNÉE SOLAR 2 PV GEOTECHNICAL DESKTOP STUDY

REPORT (REV2) CONFIDENTIAL

PROJECT NO. 41104569

DATE: AUGUST 2023

Tournée 2 Solar (Pty) Ltd

TOURNÉE SOLAR 2 PV GEOTECHNICAL DESKTOP STUDY

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QUALITY CONTROL

Issue/revision	Revision 0	Revision 1	Revision 2
Remarks	Geotechnical desktop report	Geotechnical desktop report	Geotechnical desktop report
Date	April 2023	July 2023	August 2023
Prepared by	Nthabiseng Mashego	Nthabiseng Mashego	Nthabiseng Mashego
Signature			
Checked by	Heather Davis	Heather Davis	Heather Davis
Signature			
Authorised by	Heather Davis	Heather Davis	Heather Davis
Signature			
Project number	41104569	41104569	41104569
Report number	Rev 0	Rev 1	Rev 2
File reference	\\corp.pbwan.net\za\Central_Data\Projects\41100xxx\41104569 Red Rocket Tournee Solar\41 MO Mine Waste\Final\Tournee 2	\\corp.pbwan.net\za\Central_Data\Projects\41100xxx\41104569 Red Rocket Tournee Solar\41 MO Mine Waste\Final\Tournee 2	\\corp.pbwan.net\za\Central_Data\Projects\41100xxx\41104569 Red Rocket Tournee Solar\41 MO Mine Waste\Final\Tournee 2

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1 INTRODUCTION

WSP Group Africa (Pty) was appointed to undertake geotechnical desktop studies for the proposed development of the Tournée Solar Photovoltaic Parks comprising two facilities namely:

- 150MW Tournée 1 Solar PV Park (Tournée 1 PV)
- 150MW Tournée 2 Solar PV Park (Tournée 2 PV)

The main objective of the desktop study is to perform a general assessment of the impacts of the proposed solar PV development on the geotechnical conditions on and around the site. These geotechnical assessments will form part of the Environmental Impact Assessment (EIA).

WSP was appointed by Tournée 2 Solar (Pty) Ltd for the Tournée 2 Solar facility and this report presents the geotechnical desktop study findings for this facility.

1.1 PROJECT DESCRIPTION

A layout of the proposed development area is shown in Figure 1-1 and the project is as outlined in Table 1-1 .

Figure 1-1 - Project layout

Table 1-1 - Tournée 2 PV project description.

Component	Description
Development	Solar photovoltaic energy facility
Municipality	Lekwa Local Municipality, Gert Sibande District Municipality
Affected Farms	▪ Remaining Portion of portion 3 of the Farm Dwars-in-die-Weg 350 IS ▪ Portion 6 of the Farm Dwars-in-die-Weg 350 IS.
Extent	573.78 hectares (ha)
Buildable area	Approximately 297 hectares, subject to finalization based on technical and environmental requirements
Capacity	Up to 150MW
Power system technology	PV Solar Energy Facility including bifacial solar PV modules installed on single axis tracker mounting structures at a height of up to 6m above ground level, and inverters and transformers.
Access road	Up to 8m width
Operations and Maintenance (O&M) building footprint	Operations building (including stores and workshop) = 1500m^2
Construction	Typical construction camp area 100m x 50m = 5,000m^2 Typical laydown area 100m x 200m = 20,000m^2 Sewage: Septic tanks and portable toilets
Paved areas	2500 m^2 Paved areas.
Cement batching plant (temporary)	Gravel and sand will be stored in separate stockpiles whilst the cement will be contained in a silo = 30 000m^2. *The Alternative of utilising ready-mix trucks will also be considered.*
Internal roads	Internal roads – Up to 4m width and approximately 20km in length.
Cables	Communication, AC and DC cables installed underground and overhead. AC cabling up to 33kV between project components
Independent Power Producer (IPP) site substation	Total footprint will be up to 7 ha in extent (4 ha for the BESS and 3 ha for the IPP portion of the substation). The back to back substation (including facility substation, and Eskom collector/switching station) will consist of a high voltage substation yard to allow for multiple (up to) 132kV feeder bays and transformers, control buildings, telecommunications infrastructure, access roads, etc. = 30,000 m^2. An up to 132kV Overhead Powerline ("OHPL"). The final interconnection solution will be dependent on the requirements of Eskom, which are still to be defined.

Component	Description
Battery Energy Storage System (BESS):	The Battery Energy Storage System's main components include the batteries installed in rows of containers, the power conversion system (inverters) and transformers. The capacity will be up to 150MW/600MWh. Area required = 40,000 m². Lithium-Ion batteries technology will be used.
Fencing	Fencing around development area

1.2 SCOPE OF WORK

The scope of work is limited to a desktop review and interpretive reporting on the findings. The desktop assessment included the following:

- Literature reviews of available published and unpublished information including, but not limited to, geological data, geological maps, topographical maps, aerial images and any existing geotechnical investigation reports of the study area.
- Assessment of the relevant geotechnical and geological information and to indicate any fatal flaws within the study area.
- Assessment of the excavation conditions across the sites.

1.3 SPECIALIST CREDENTIALS

The geotechnical desktop assessment was undertaken by a geotechnical engineer and the work was overseen by a professionally registered senior geotechnical engineer.

Nthabiseng Mashego is a geotechnical engineer with a Bachelor of Engineering degree in Civil Engineering and an Honours degree in Geotechnical Engineering from the University of Pretoria. Nthabiseng has two years of experience in geotechnical engineering including geotechnical site investigations.

The desktop assessment was reviewed and authorized by Heather Davis. Heather is a qualified Professional Engineer (Pr.Eng 960229) with 40 years of experience. She obtained a BSc Honours degree in Engineering Geology and Geotechnics from the University of Portsmouth (UK) in 1982. A post graduate diploma was obtained from the University of the Witwatersrand in 1993 which focused on geotechnical engineering and rock mechanics. She is currently the Geotechnical Team Lead at WSP. Her responsibilities include providing geotechnical inputs to various projects, quality assurance on all geotechnical work and provision of reports. She has accumulated extensive experience in Sub Saharan Africa which has included work on the Medupi and Kusile Power Plants and on renewable projects such as the Sere Wind Farm, for Eskom, in the Northern Cape.

The CV's for Nthabiseng Mashego and Heather Davis are included in APPENDIX A.

2 STUDY AREA INFORMATION

2.1 SITE DESCRIPTION

The proposed Solar PV plant is located approximately 27.7km north-east of Standerton in the Mpumalanga Province. The site can be accessed via the R38 and R39. The location of the site is indicated in Figure 2-1.

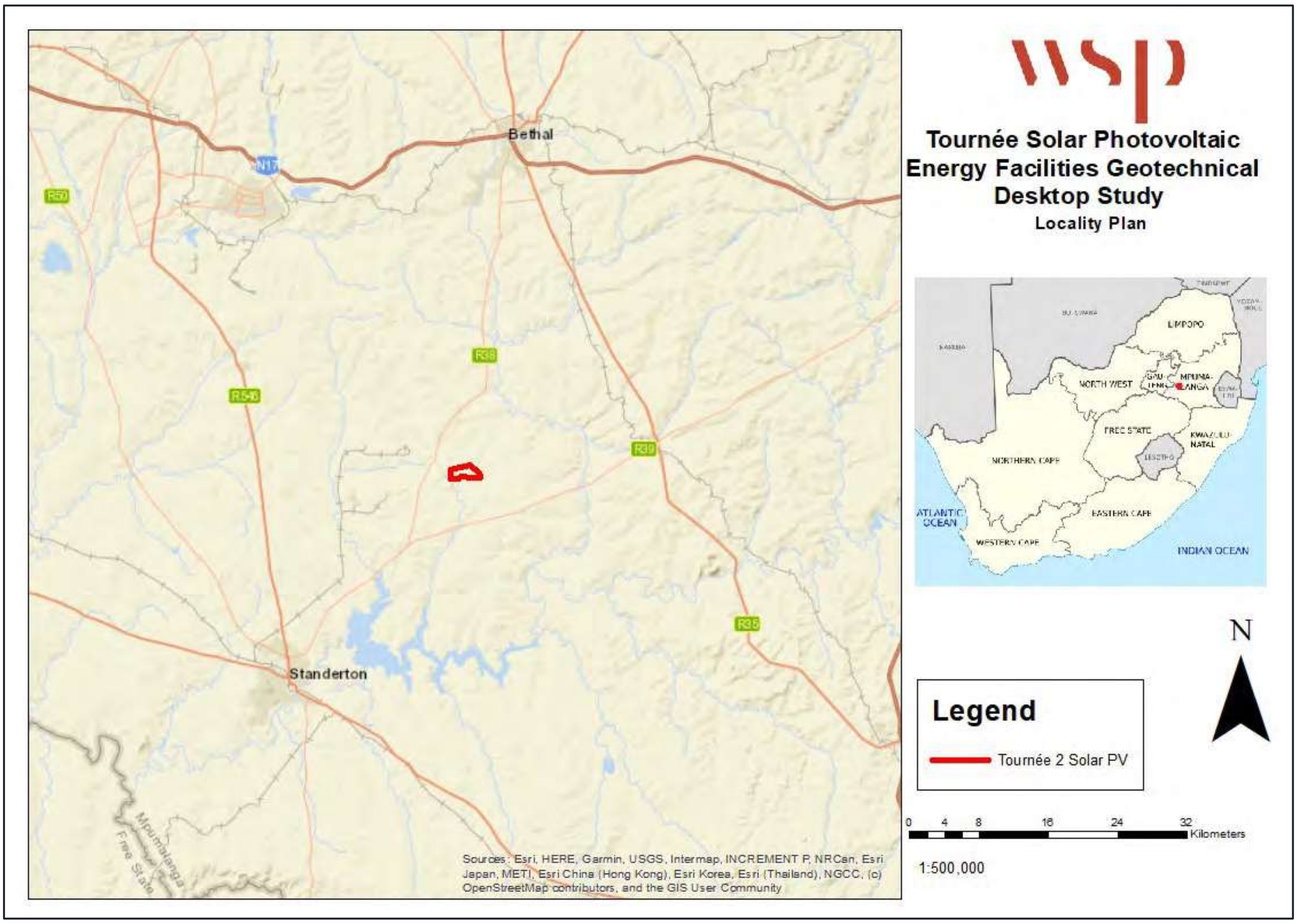


Figure 2-1 - Site Locality.

2.2 DRAINAGE AND TOPOGRAPHY

The site lies within the C11H and C11L quaternary catchment areas as shown in Figure 2-2. The area receives on average annual rainfall of approximately 645mm/year (Kaponda, et al., 2021). The highest rainfall and temperature occur during the month of December.

The site is relatively flat with an elevation ranging between 1618mabsl and 1649mabsl and the overall slope gradient is less than 2.5%.

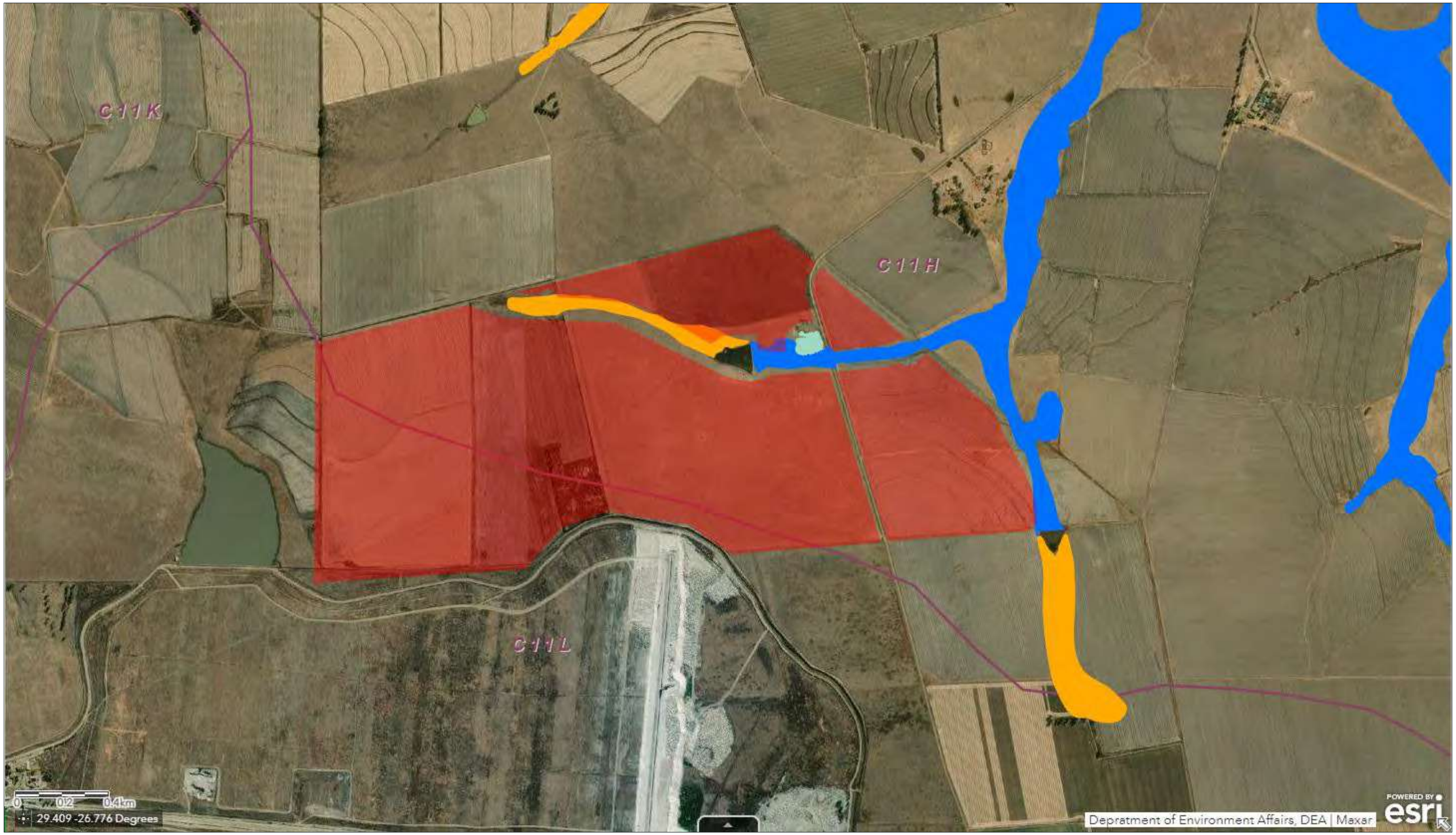


Figure 2-2 - Quaternary catchment and surface water across the site

3 GEOLOGY

According to the published 1: 250 000 geological map (Sheet 2628 East Rand), the study area is underlain by the Vryheid Formation (Pv), Ecca Group of the Karoo Supergroup and dolerite. An excerpt of the published geological map showing the project area is presented in Figure 3-1 and the lithostratigraphy is presented in Table 3-1.

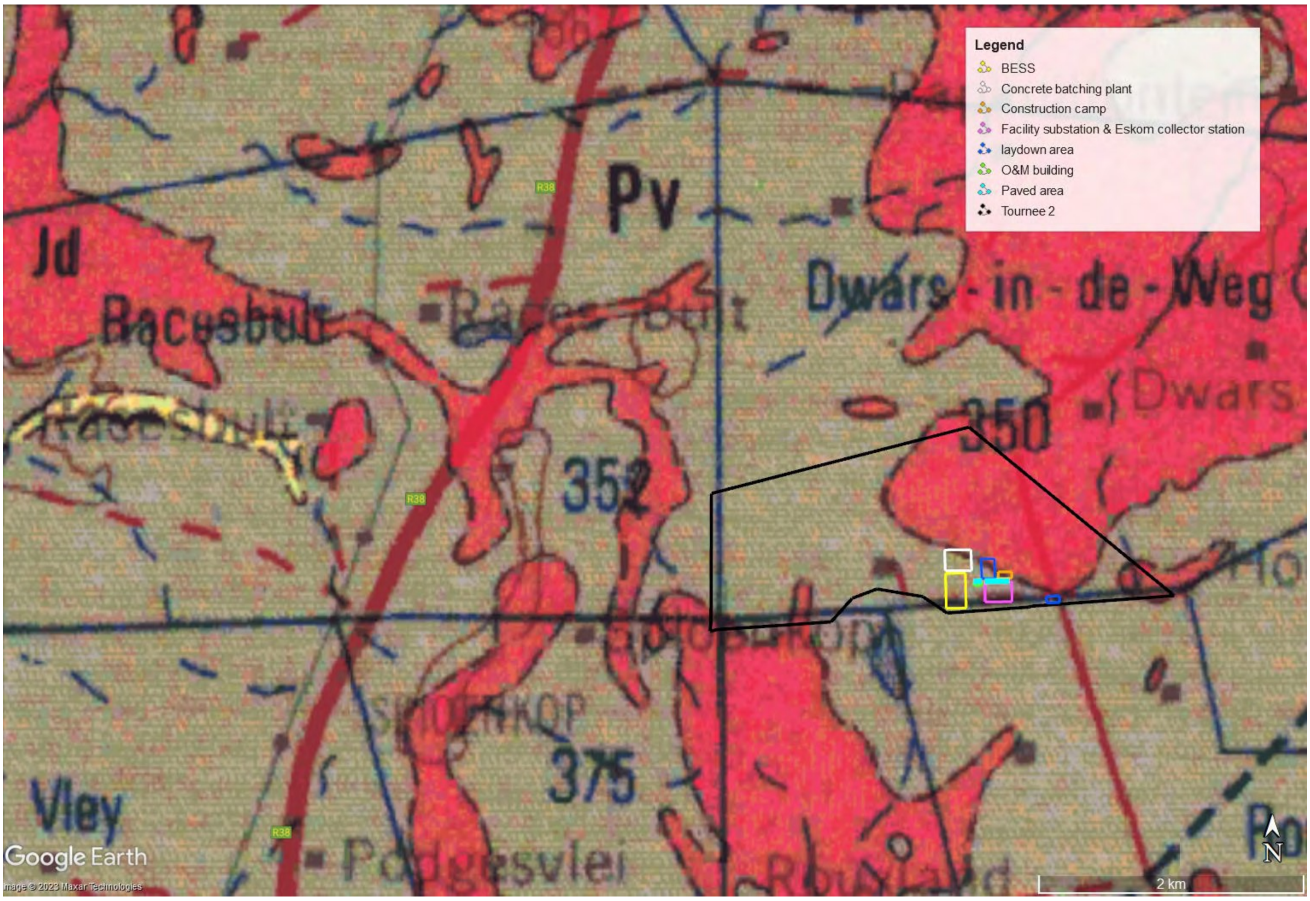


Figure 3-1 - Geology of the area

Table 3-1 - Lithostratigraphy of the Area

Supergroup	Group	Formation	Lithology	Map Symbol
			Dolerite	Jd
Karoo	Ecca	Vryheid	Sandstone, shale, coal beds	Pv

The Vryheid Formation comprises sandstone, shale and coal beds which have been extensively intruded by Jurassic age dolerite (Jd). The dolerites occur both as sills and linear dyke structures that may extend over tens of kilometres.

The geological map indicates that the western and central sections of the site are underlain by the Vryheid Formation with only a small area indicated as being underlain by dolerite. The eastern section of the site is shown as being underlain, in the majority, by dolerite.

4 RESULTS OF DESKTOP STUDY

4.1 WEATHERING

The type and rate of rock weathering, and hence the soil profile, is determined by the climate of an area. Weinert (1980) developed an N-value system, which is used to derive the type of weathering likely to occur in an area based on macro-climatic conditions including evaporation and rainfall.

The study area falls within the temperate highland sub-tropical region of South Africa where the N value is between 2 and 5 as illustrated in Figure 4-1. This indicates that moderate climatic conditions occur on the site and that the rock and soil are, therefore, expected to be subject to, predominantly, chemical weathering.

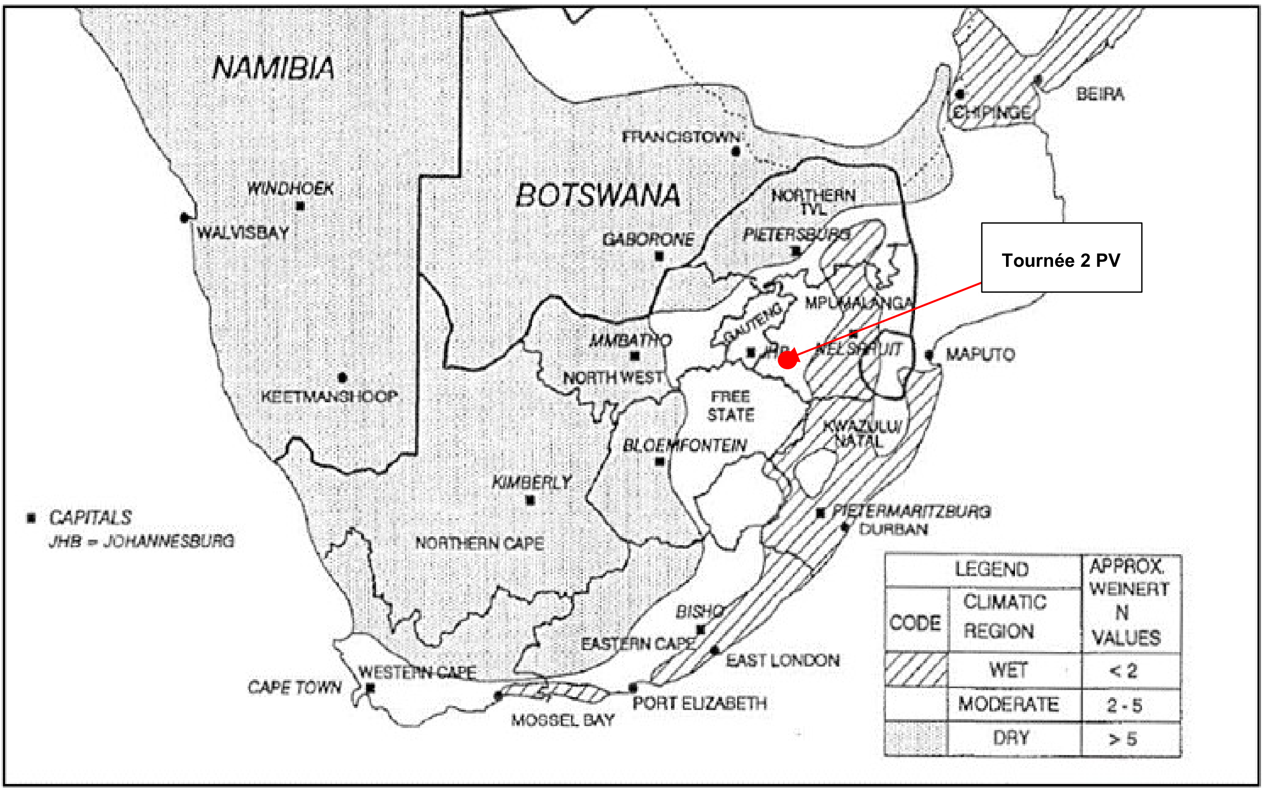


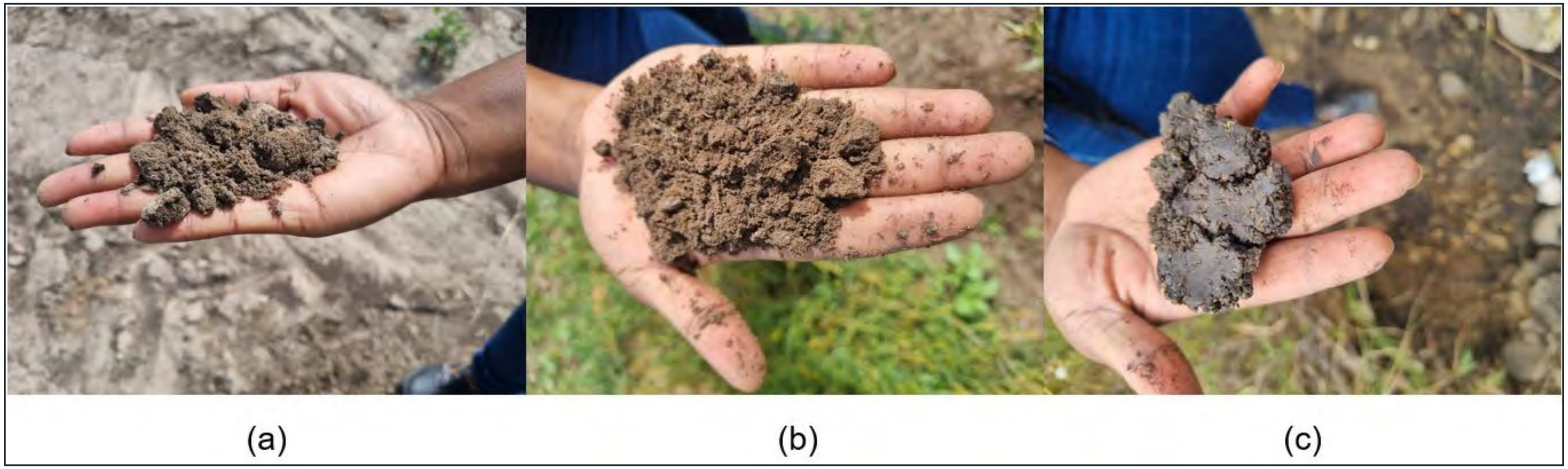
Figure 4-1 - Macro-climatic regions of Southern Africa

4.2 EXPECTED GROUND CONDITIONS

4.2.1 TRANSPORTED SOIL

Transported soil from different points across the site were profiled during the site visit and these are shown in Figure 4-2 and were profiled as:

- Slightly moist, grey, loose, silty sand. Transported. Figure 4-2(a).
- Slightly moist, greyish brown, soft, sandy silt. Transported. Figure 4-2 (b).
- Moist, greyish black, firm, intact, gravelly clay with roots with dark grey, highly weathered, very soft rock dolerite boulders. Transported. Figure 4-2 (c).



Silty sand	Sandy silt	Gravelly clay

Figure 4-2 - Transported soil present across the site

4.2.2 VRYHEID FORMATION

Shale

Vryheid shale generally weathers to a clayey residual soil which is often compressible and potentially expansive. Expansive soils are those materials that exhibit volume change with a change in moisture content. These materials “shrink” when the moisture content decreases and “heave” or “expand” when the moisture content increases. Where the residual clay profile is thinly developed, it is recommended that the material should be stripped. Where thickly developed, the structural design needs to take cognizance of the potential expansiveness and compressibility of this material

Shale rock and excavated shale, which presents as a gravel, often deteriorates on exposure. Although shale material can be considered for use in construction, the potential for deterioration needs to be pre-determined in the laboratory. If suitable, the gravel can be used in selected layers in road construction, but seldom as base course. Gravelly shales are occasionally used in the wearing course of gravel roads but not all types are suitable.

During construction, Karoo shales and siltstones can usually be excavated by ripping, but blasting might occasionally be required.

Slope instability may occur when sliding occurs on bedding planes which are inclined sufficiently. Ingress of water into layers and the resulting high pore-water pressure plays a major role in sliding failures. This is considered highly unlikely as the strata are mostly horizontally disposed and the site is relatively flat.

Sandstone

Vryheid sandstone generally weathers into sandy residual soils. In some cases, the residual sand may develop a potentially collapsible grain structure. These collapsible materials exhibit additional settlement upon wetting up without any change in load. This can occur many years after construction and is usually due to an inundation of some kind such as a broken water pipe. If recognized at investigation stage, these collapsible materials can be easily dealt with during construction with limited remediation, only, being required.

Sands below the water table are likely to fail during the installation of augered piles and hence the pile system used should be carefully considered.

Residual sandstone does not weather uniformly, leading to dense layers of the horizon being underlain by less competent layers of the same soil.

Slope stability issues can arise in areas where closely intercalated sandstones and mudrock (shale and siltstone) exist. When shales and siltstones slake or disintegrate, the exposed sandstone layers are undercut. This can result in rockfalls. Intercalated siltstone layers are relatively impermeable, and impede the flow of water, which leads to pore pressure build up and sliding along the interface. This can only happen if the rock is dipping at an angle, towards the slope face, greater than the friction angle of the material.

Where material is required for the construction of roads and laydown areas, natural sandstone gravel or crushed sandstone bedrock can potentially provide a suitable source. Consideration must be given to the presence of excessive pyrite and muscovite which can cause distress where sandstone is used as basecourse. In addition, where chemical stabilization is required the clay matrix of sandstones make them suitable for stabilization with lime. The occurrence, nature, material quality and quantity of sandstone and other potential construction material will have to be assessed during the detailed geotechnical investigation.

Coal Beds

Coal seams are present within the Vryheid Formation with a thickness ranging from centimetres to 10m but are not generally encountered at surface. There is mining activity around the area, and this is discussed in section 5.6.

4.2.3 DOLERITE

Dolerite generally weathers into a profile becoming coarser with depth eventually grading into dolerite rock. Cobbles and boulders are often present above the rock grading upwards into gravel, sand and/or residual clay.

Residual doleritic clay is generally compressible and potentially expansive in the “medium to high” range. Where any structure straddles residual dolerite and a different soil type, the structure should be moved to avoid differential settlement or designed accordingly.

Dolerite boulders were observed in a shallow cutting as shown in Figure 4-3(a). This layer of material can be described as:

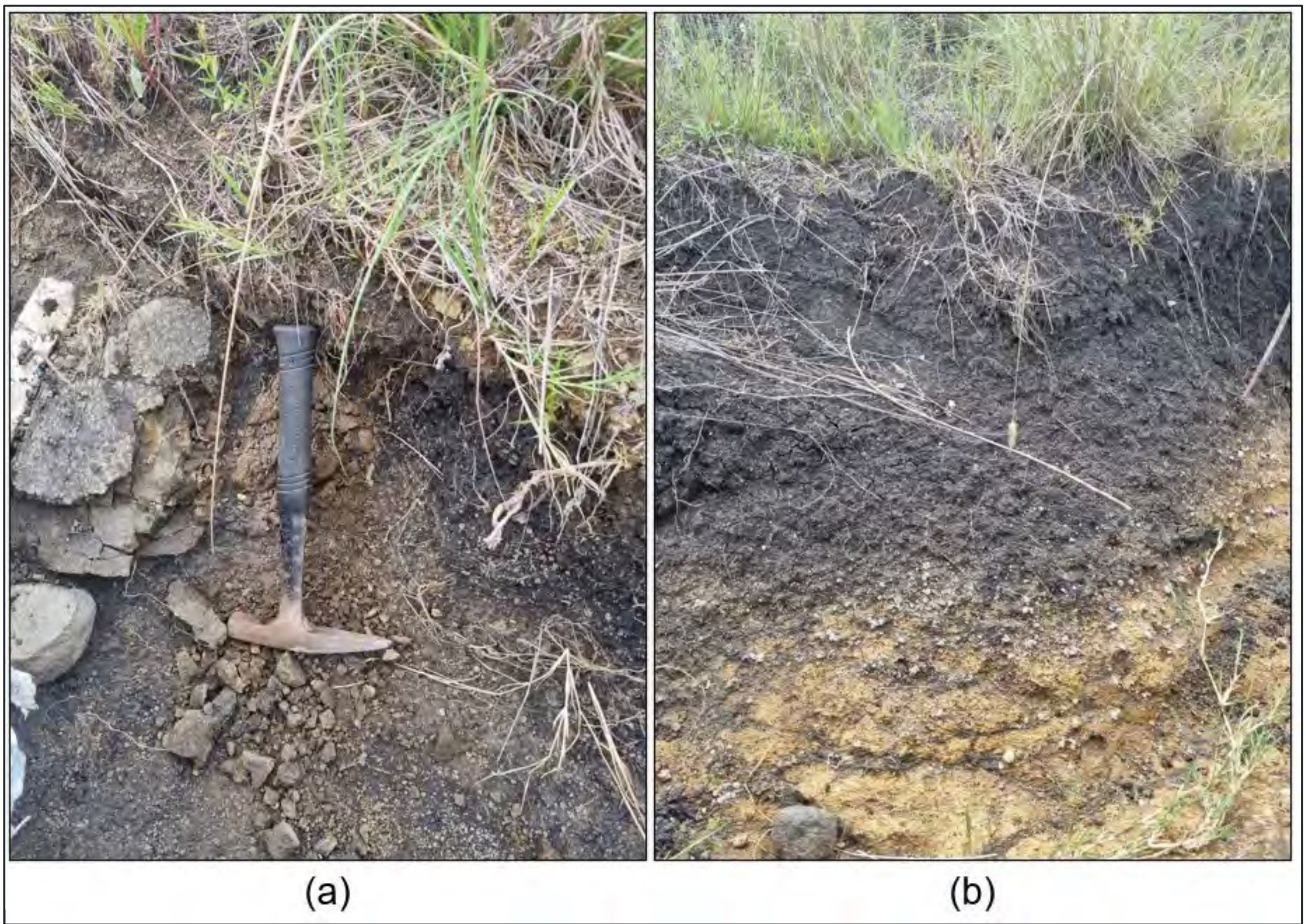
- Dark grey, highly weathered, medium grained, very soft rock dolerite boulders in a matrix of moist, greyish black, firm, intact, gravelly clay with roots. Transported.

Residual dolerite was encountered elsewhere on the site, generally, at depth of 0.8 m below topsoil as shown in Figure 4-3(b). This material was profiled as:-

- Moist, orangey brown, medium dense to dense, silty sand, Residual dolerite.

Dolerite rock does, occasionally, occur at surface or at very shallow depth. Dolerite was present at surface at a site located 57 km west of Tournée 2 PV and encountered at a depth of approximately 0.2m at a site approximately 28km northwest of Tournée 2 PV.

Dolerite rock, cobbles, boulders, gravel, and sand are generally durable and are suitable for a variety of purposes. The material is commonly quarried and used as a construction material for use as concrete aggregate and road construction materials.



Dolerite boulder within transported soil dolerite	Topsoil underlain by residual dolerite

Figure 4-3 - Dolerite encountered across the site

5 GEOTECHNICAL EVALUATION

5.1 SURFACE DRAINAGE

Flooding affects flat lying areas, areas confined to drained channels and flood plains. The Tournée 2 PV site is located on a relatively flat area and ponding of water is a possibility during wet periods, especially in areas where shallow rock or clay is present in the profile. Water management is recommended across all flat areas to facilitate water run-off and to alleviate the possibility of standing water at the foundation positions.

5.2 EROSION

The slope on site, as well as the soil structure will influence the amount of erosion. The low site gradient makes the probability of erosion unlikely. As is shown Figure 5-1, the site is covered in grassland, tall grass and crops, the presence of which reduces the risk of erosion.

Erosion, however, may occur following the disturbance of the natural vegetation during construction of the facility. Issues relating to erosion must be mitigated, by revegetation after construction.

Figure 5-1 - Vegetation across the site.

5.3 EXCAVATABILITY

The excavation characteristics of the soil horizons has been evaluated according to the South African Bureau of Standards standardized excavation classification for earthworks (SABS–1200D). The definition of the excavation classes is indicated in Table 5-1 and the assessment of the in-situ profile in Table 5-2 The ease of excavation is a critical financial factor for any development.

Table 5-1 – SABS 1200D Excavation Classes

Class of Excavation	General Definition
Soft	Excavation in material which can be efficiently removed or loaded by any of the following plant without prior ripping: A bulldozer with a mass of at least 22 tons (which includes the mass of the ripper, if fitted) and an engine developing approximately 145kW at the flywheel. Or A tractor-scraper unit with a mass of at least 28 tons and an engine developing approximately 245kW at the flywheel, pushed during loading by a bulldozer as specified for intermediate excavation. Or A track type front end loader with a mass of at least 22 tons and an engine developing approximately 140kW at the flywheel
Intermediate	Excavation (excluding soft excavation) in material which can be efficiently ripped by a bulldozer with a mass of at least 35 tons when fitted with a single tine ripper and an engine developing approximately 220kW at the flywheel.
Hard	Excavation (excluding boulder excavation) in material which cannot be efficiently ripped by a bulldozer with properties equivalent to those described for intermediate excavation. This type of excavation generally includes excavation in material such as formations of unweathered rock, which can be removed only after blasting.
Boulder Class A	▪ Excavation in material containing in excess of 40% by volume of boulders between $0.03m^3$ and $20m^3$ in size, in a matrix of softer material or smaller boulders. ▪ Excavation of fissured or fractured rock shall not be classed as boulder excavation but as hard or intermediate excavation according to the nature of the material.
Boulder Class B	Where material contains 40% or less by volume of boulders in a matrix or soft material or smaller boulders.

Table 5-2 - Excavatability on Site

Material	Excavation Class
Dolerite	Soft excavation in residual clay, sand and gravel. Boulder Class A and Boulder Class B where boulders are encountered. Hard excavation in dolerite rock
Vryheid shale and residual shale	Soft excavation in residual shale and very soft to soft rock shale. Intermediate to hard excavation in medium hard and harder rock shale.
Vryheid sandstone and residual sandstone	Soft excavation in residual sandstone and very soft to soft rock sandstone. Intermediate to hard excavation in medium hard and harder rock sandstone.

5.4 SLOPE STABILITY

Development on the site is unlikely to cause any slope instability as no significant cut slopes will be developed. Where excavations are required, up to a depth of 3m, excavations should be excavated at a batter of 1:1 in soil where no water or seepage is evident and to 1:2, or flatter, where water is encountered. Rock can be excavated at a batter of 1:0.5 or vertically in the temporary case up to a depth of 3m.

5.5 SEISMIC HAZARD

According to the Seismic Hazard Map of South Africa (Kijko et al., 2003), the peak ground acceleration is 0.12g for the site. The peak ground acceleration may be described as the maximum acceleration of the ground shaking during an earthquake, which has a 10% probability of being exceeded in a 50-year period (Figure 5-2). Mining induced seismicity is the failure of the earth's crust or rock mass as a result of mining induced changes in rock stress levels. Seismic events range in size from barely discernible ground motions to very large tremors. There are three types of mining induced seismicity namely:

- Failure at pre-existing geological weaknesses such as faults, dykes and joints which result in medium to large events often far away from workings.
- Failure of the intact rock mass in the form of shear fractures that result in larger events close to workings.
- Localized bursting or failure of brittle rock types often referred to as strain bursting or face bursting (small events at the working face).

The most economically exploitable coal seams in South Africa are encountered within the Vryheid Formation and there are several underground coal mines in this area. Thus, the Solar PV site could be influenced by mining induced seismic events due to the presence of the coal mines. All structures should be designed taking cognizance of this.

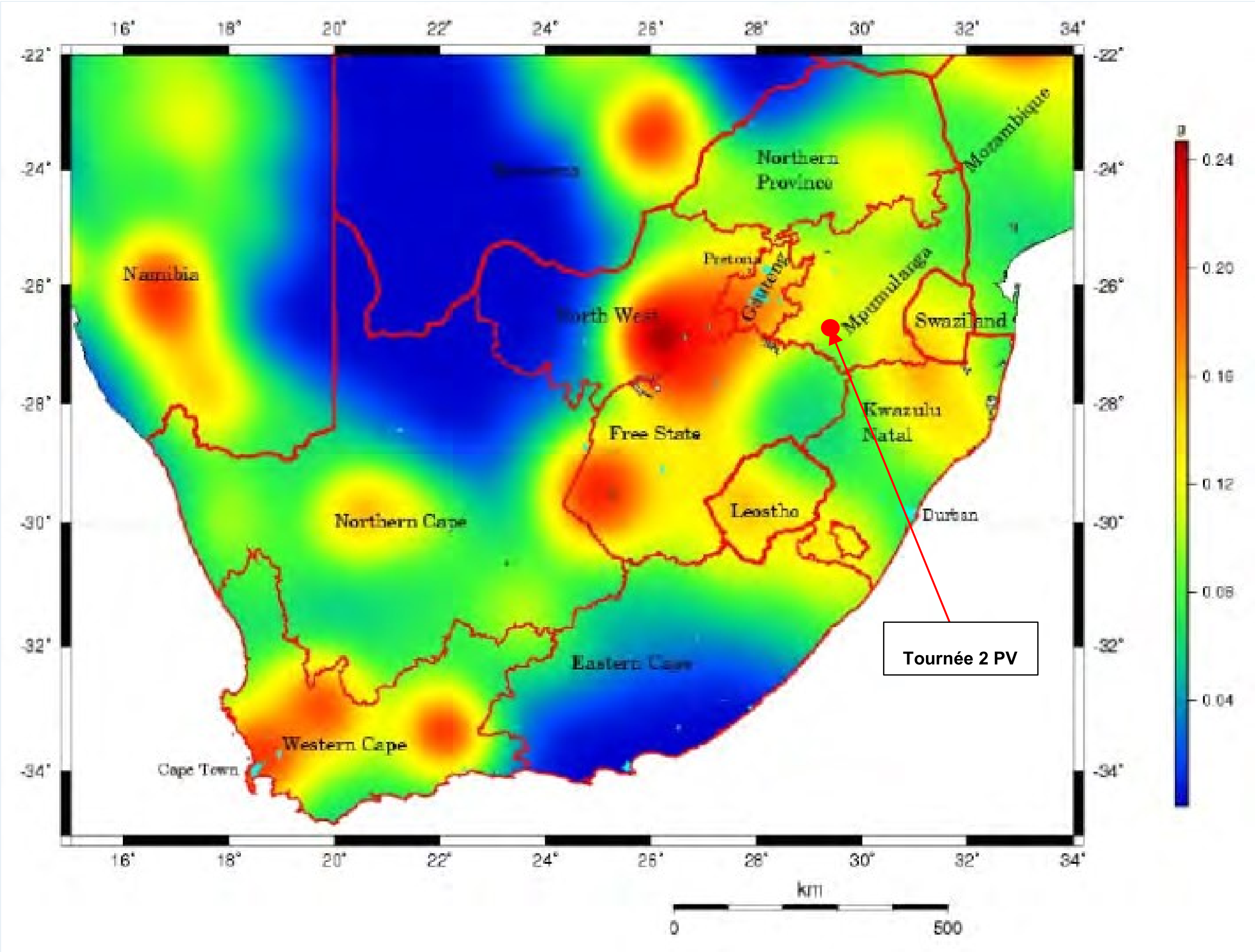


Figure 5-2 - Probabilistic seismic hazard map of South Africa

5.6 UNDERMINING

Subsidence at surface in undermined areas is caused by the collapse and failure of the underground mining voids relatively close to the surface (Heath and Engelbrecht, 2011). The extent of coal seams in South Africa as well as the location both historical and active opencast and underground mining activities are displayed in Figure 5-3.

New Denmark Colliery is an underground mine located 12 kilometres west of the site and could potentially pose problems for the proposed Solar PV plant like the occurrence a seismic event, although subsidence in unlikely. The Tournée 2 PV site is underlain by shale, sandstone, coal beds and dolerite. Mined areas where the roof strata composed of shale are more susceptible to gradual movements. Roof strata composed of competent sandstone are less susceptible to deformation. Gradual subsidence and sudden collapse are accompanied by surface deformation including fractures, crevices, faults, step folds and slides.

The extent of any undermining below the site should be assessed, in detail, prior to development.

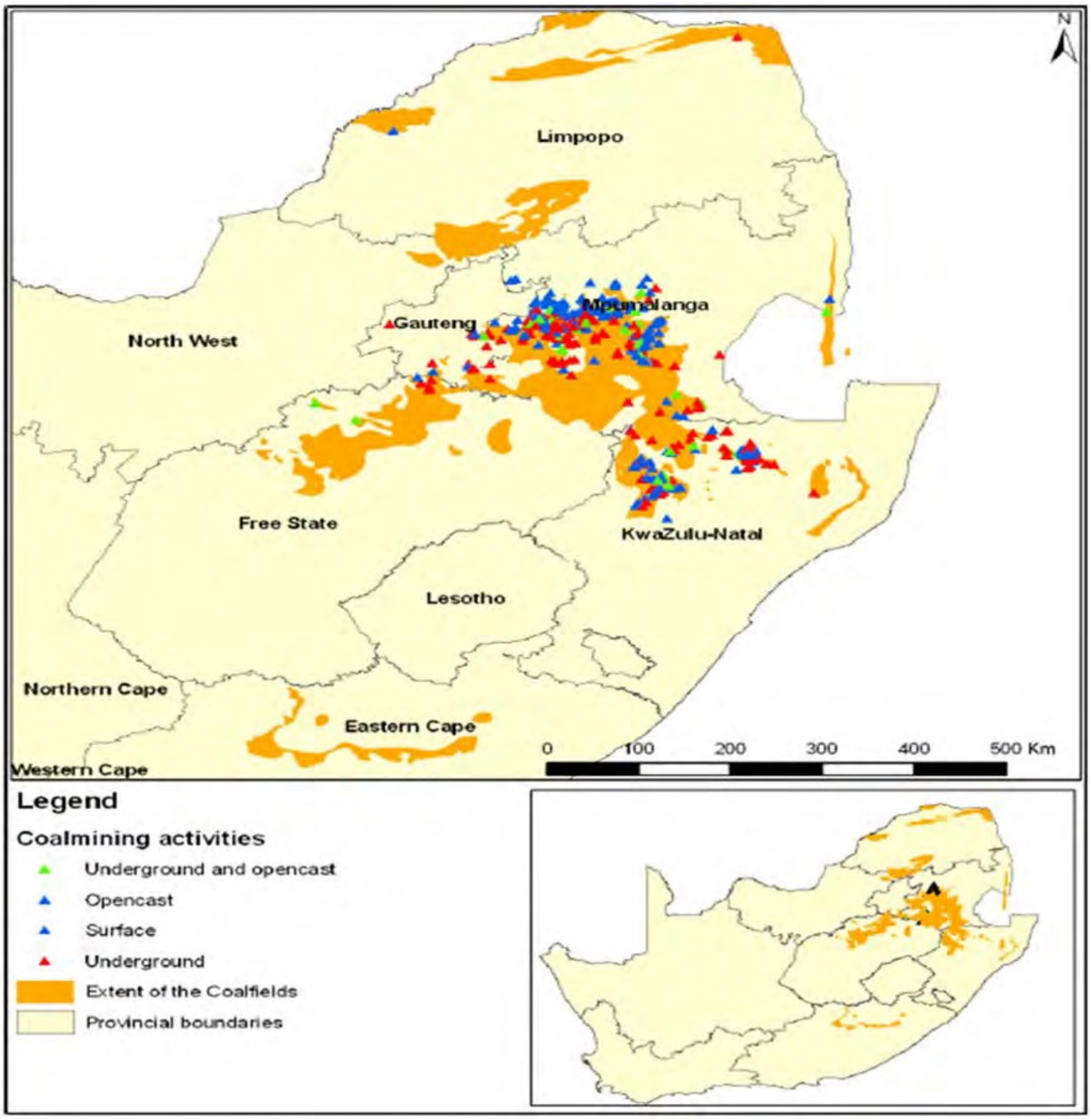


Figure 5-3 - Coal seams in South Africa

5.7 SOLAR PANEL ASSOCIATED INFRASTUCTURE FOUNDATIONS

The solar panels and the associated infrastructure will exert a static load on the founding material and competent material is required for founding to ensure sufficient bearing capacity and strength.

Where these structures are underlain by dolerite rock and Vryheid sandstone, rock may be present at a relatively shallow depth and founding on rock may be possible.

Where the structures are underlain by weathered dolerite, the residual profile may be more thickly developed with rock expected at a depth of, generally, more than 3m.

Test pits should be excavated at the foundation positions during the geotechnical site investigation to determine the depth to rock, the composition and consistency of the material within the soil profile and the strength characteristics thereof.

Some of the proposed associated structures may straddle different rock types and, hence, soil profiles. It should be noted that structures that span different profiles can be subject to differential movement such as differential settlement. If a structure spans different profiles, the easiest remedial action is to move the structure.

5.8 CABLE TRENCHES

Depending on the embedment depth, soft to intermediate excavation may be required for the cable trenches in areas underlain by dolerite rock. Soft excavation conditions are expected in the areas underlain by Vryheid sandstone and shale.

Selected sandy fill is required for laying buried cables. The overburden is expected to range from silty sand/sandy silt/sandy gravel/gravelly clay. Some excavated material may be suitable for bedding and backfill. However, it must be expected that not all of the excavated material is not expected will be suitable for bedding or backfill and as such, materials may have to be imported. This and the thermal conductivity of materials should be investigated.

5.9 ACCESS ROADS

The use of local weathered dolerite obtained during construction excavations, as a suitable gravel wearing course should be possible. The access road development will disturb the ground cover and erosion may occur.

6 GEOTECHNICAL IMPACT ASSESSMENT

The geotechnical impact assessment of the proposed Tournée 2 PV was performed according to the methodology provided and included in APPENDIX B.

Geotechnical impacts need to be taken into account as part of the Solar PV development. The identified risks can typically be mitigated by the implementation of an appropriate and effective plan. Mitigation measures must be implemented to avoid or reduce negative impacts during the construction, operation and decommissioning phases.

The assessment considers the entire development but the three main parts of the development, namely solar panels, cable trenches and access roads, are the primary consideration. Based on the impact assessment matrix undertaken for this project, from a geotechnical perspective the impact of the Tournée 2 PV was found to be "Negative very low to moderate impact - The anticipated impact will have negative effects and will require mitigation." With mitigation measures the impact will be "Negative very low". The assessment impact assessment matrix is presented in APPENDIX B

The Solar PV application site is considered suitable for the proposed development provided that the recommendations presented in this report are adhered to and which need to be verified by more detailed geotechnical investigations during detailed design.

7 FURTHER GEOTECHNICAL RECOMMENDATIONS

A detailed intrusive site investigation is recommended to further characterize site conditions, to better understand the key geotechnical risks characteristics and optimise the design of the Solar PV plant.

Based on the current lack of previous geotechnical investigation data, the primary objectives of the proposed intrusive investigation must include

- Determination of the founding conditions for all structures. The scope of the intrusive investigation should comprise test pitting, the drilling of a representative number of boreholes and laboratory testing.
- Investigation of subgrade conditions for service roads.
- Investigation of materials to be used during construction.
- Non-intrusive investigation techniques, such as geophysical (seismic refraction) surveys, thermal and electrical resistivity for ground earthing requirement.

8 CONCLUSION

The completed desktop assessment of the geotechnical conditions at the proposed development site for Tournée 2 PV has shown the site to be generally suitable for the proposed development.

A “negative very low to moderate” impact was assessed, from a geotechnical perspective, for the pre-mitigation situation. Post-mitigation, the assessed impact decreases significantly to “negative very low”.

A geotechnical site investigation must be undertaken to provide detailed geotechnical information for the design of the proposed structures and roads.

The proposed development should, from a geotechnical impact perspective, be authorized. The most significant geotechnical condition that will affect the development is the possibility of hard excavation conditions if shallow rock is present.

Minimal slope stability issues are expected as slope areas are minimal. Access roads can be developed as gravel road with suitable wearing-course to protect the subgrade likely being obtained from local weathered dolerite rock deposits.

9 ASSUMPTIONS AND LIMITATIONS

Your attention is drawn to Appendix C: Document Limitations

The statements presented in this document are intended to advise you of what your realistic expectations of this report should be, and to present you with recommendations on how to minimize the risks associated with the groundworks for this project. The document is not intended to reduce the level of responsibility accepted by WSP, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing.

10 REFERENCES

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Appendix A

CURRICULA VITAE

Nthabiseng Mashego

Earth and Environment, Junior Geotechnical Engineer

CAREER SUMMARY

Undergraduate qualification in Civil Engineering with an honour's degree in geotechnical engineering. 1 and ½ years of experience in geotechnical field investigations from a variety of sites including tailing's facilities and ash dams.

3 months with WSP

1 & 1/2 years of experience

Area of expertise

Geotechnical Investigations

Language

English

EDUCATION

Undergraduate Degree (BEng) in Civil Engineering, University of Pretoria.	2019
Honours Degree (BEngHons) in Geotechnical Engineering, University of Pretoria	2022

PROFESSIONAL HISTORY

WSP Group Africa (Pty) Ltd	2023 - present
Mukona Consulting Engineers	2020 - 2022

PROFESSIONAL EXPERIENCE

Geotechnical Investigations

Eskom Duvha power station, Duvha Ash Dam CPTu Testing, South Africa
2020
Overseeing on site operations
Conducting Cone Penetration tests with dissipation tests and collecting mostap samples at the Duvha power station ash dam.

Bazi Dukhan, Unizulu Campus CPT Testing, South Africa
2020
Overseeing on site operations
Conducting Cone Penetration tests at Unizulu campus in KwaZulu Natal.

Trans Africa Projects, Kadett power station, South Africa
2020
Junior Engineer
Test pitting, DPL testing and laboratory sampling for the construction of a substation platform and access road at the Kadett power station.

Nthabiseng Mashego

Earth and Environment, Junior Geotechnical Engineer

Tsholetso Projects, Sand River Bridge, South Africa
2020
Junior Engineer
Rotary Core Drilling and Test Pitting for the widening of the Sand River Bridge in the Limpopo Province.

Arup (Pty) Ltd, Neo1 Power Station Geohydrological Investigation, Lesotho
2020
Overseeing on site operations
Water borehole drilling, pump testing and laboratory sampling for the Neo1 Power station in Lesotho.

Davies Lynn and Partners, Richards Bay Minerals CPTu testing, South Africa
2021
Junior Engineer
Cone penetration testing with dissipation test at Richard's Bay Minerals to locate depth of slimes layers.

ARQ Geotech (Pty) Ltd, Booysendal TSF CPTu and SCPT Testing, South Africa
2021
Overseeing on site operations
Conduction Cone penetration tests with dissipation tests and seismic cone penetration tests at the Booysendal Tailings Storage Facility in Mpumalanga.

ARQ Geotech (Pty) Ltd, Nkomati mine CPTu and SCPT Testing, South Africa
2021
Overseeing on site operations
Conduction Cone penetration tests and seismic cone penetration tests at the Nkomati mine in Mpumalanga.

Jones and Wagener, Grootegeluk coal mine Rotary Core Drilling, South Africa
2021
Junior Engineer
Rotary core drilling at Grootegeluk coal mine in the Limpopo province.

Eskom Kriel Power Station, Kriel Ash Dam Rotary Core Drilling, South Africa
2021
Junior Engineer
Rotary core drilling at Kriel Ash Dam near Secunda.

Heather Davis

Mine Waste, Geotechnical & Material Services, Senior Geotechnical Engineer

CAREER SUMMARY

Forty years of experience within the fields of geotechnical engineering and engineering geology. Most of the work has been gained in Sub Saharan Africa including South Africa, Swaziland, Botswana, Malawi, and Angola. A wide range of projects have been handled ranging from investigations for large projects such as coal fired power stations, hydroelectric power schemes, mine processing plants, major freeways and major pipelines to smaller scale projects for commercial developments and residential buildings. Forensic investigations have, also, been completed for failed tailings facilities, structures and slopes.

Responsibility has been taken for all facets of the geotechnical investigation including the site investigation planning, procurement, drilling supervision, fieldwork, in situ testing, analysis, reporting and supervision during construction. Contract documentation and administration for geotechnical investigations has, also, been handled.

Extensive experience in dolomitic terrain and was involved in the re-drafting of SANS 1936 Parts 1 and 2 and subsequent revisions to the standard. Also, involved in the ECSA feasibility study to have a specified category of registration for D4 level dolomite geo-professionals. Dolomite assessments for large facilities such as the Telkom site in Centurion, the Mispah tailings facility as well as for residential complexes and individual units have been carried out. Linear dolomitic assessments for roads and pipelines have been completed.

Heather is a registered professional engineer, a fellow of the South African Institution of Civil Engineers and served as Treasurer of the Geotechnical Division from 2006 to 2020.

4 months with WSP

40 years of experience

Area of expertise

Site Investigations.

Forensic Assessments.

Dolomitic Terrain Assessments.

Problem Soil Assessments

Language

English - Fluent

EDUCATION

Graduate Diploma in Civil Engineering in the field of Geotechnical Engineering, University of the Witwatersrand SA	1993
BSc (Honours) Engineering Geology and Geotechnics, Portsmouth University, England	1982

PROFESSIONAL MEMBERSHIPS

Professionally registered Engineer with the Engineering Council of South Africa (PrEng 960229)	1996
Fellow of the South African Institution of Civil Engineering.	1998

Heather Davis

Mine Waste, Geotechnical & Material Services, Senior Geotechnical Engineer

PROFESSIONAL HISTORY

WSP Group Africa (Pty) Ltd	April 2022 – present
Jones & Wagener (Pty) Ltd (following the merger with Verdi Consulting)	January 2018 – March 2022
Verdi Consulting Engineers (Pty) Ltd	March 2014 – December 2017
AECOM SA (Pty) Ltd (formerly BKS (Pty) Ltd.	February 2007 – February 2014
ARQ (Pty) Ltd	January 2003 – January 2007
Knight Hall Hendry (Pty) Ltd	January 2001 – December 2003
VKE Engineers (Pty) Ltd	November 1987 – December 2000
National Building Research Institute of the CSIR	November 1985 – October 1987
Geological Survey of South Africa	November 1982 – October 1985

PROFESSIONAL EXPERIENCE

SANRAL, N1 Sections 20 and 21 Geotechnical Investigation, Brakfontein, South Africa
2008 to 2012
Lead Geotechnical Engineer
Upgrade, extensions and additions to the N1 Ben Schoeman Freeway, Sections 20 and 21, between the Brakfontein and Allandale Interchanges as part of the Gauteng Freeway Improvement Project (GFIP) carried out for South African National Roads Agency SOC Ltd (SANRAL). Contract documentation for the subsurface investigation was drafted and all components of the project management of the SANRAL contract were handled. The site investigation included extensive rotary core drilling, percussion drilling and test pitting. Work included the analysis, assessment and provision of founding recommendations for the 22km of dual carriageway. Design components included culverts, retaining walls, cut slopes, embankments and bridges founded on ancient granite, sedimentary rocks of the Pretoria Group along with dolomite and dolomitic residuum. Both conventional and piled foundations were used for the various bridge structures and elements.

SANRAL, N11 Section 9, Hendrina, South Africa
2015 to 2016
Lead Geotechnical Engineer
Upgrade of National route N11 Section 9 between Hendrina and Hendrina Power Station. Planning and supervision of the linear investigation, by means of rotary drilling and test pitting, of 18.56km of roadway including two river bridges, cuts, fills and culverts. Full report complied including recommendations for all facets of the project. All work carried out as per the current SANRAL requirements and all contract administration for the drilling investigation handled.

SANRAL, National Route N5, between Harrismith and Kestell, Harrismith and Kestell, Orange Free State, South Africa
2011 to 2013
Lead Geotechnical Engineer
Carried out for SANRAL, which included drafting the contract documentation for the subsurface investigation which included extensive rotary core drilling and test pitting. The project includes the rehabilitation of the National Route 5 involving extending existing bridges, design and construction of new bridges and design of significant culvert structures. The bridge structures included river bridges, road over rail and road over road structures. Work carried out included supervision of the site investigation, analysis and provision of founding recommendations for all structures, contract administration and arbitration of claims.

Heather Davis

Mine Waste, Geotechnical & Material Services, Senior Geotechnical Engineer

Anglo Platinum. Mogalakwena Platinum Mine, New Northern Concentrator, Limpopo, South Africa.
2020 to 2021
Lead Geotechnical Engineer
Pre-feasibility and feasibility level investigations for the New Northern Concentrator. Supervision of all field work and provision of recommendations for all the structural elements. Additional design level investigation carried out for the M3C BOS Low Grade Stockpile.

NMPP/ Transnet, Multi Products Pipeline, Geotechnical Investigation, Johannesburg. South Africa
2008 to 2009
Section Lead Geotechnical Engineer
Geotechnical input for pipeline section running from Kendal to Waltloo and Jameson Park to Langlaagte in Johannesburg. Investigations have included test pitting; in situ testing and borehole have included test pitting, in situ testing and borehole drilling. The assessment of the route underlain by dolomite and dolomitic residuum was, also undertaken.

TCTA, Vaal River Eastern Sub-System Augmentation (VRESAP),Vaal, South Africa
2006 to 2008
Lead Geotechnical Investigation
Geotechnical investigation for TCTA for a pipeline to carry water from the Vaal Dam to Secunda for use by SASOL and ESKOM. Planning and preparation of contract documentation for drilling, trenching programmes, laboratory and in situ testing. Extensive field work was completed, and recommendations provided for trench sidewall stability, excavatability, construction through problem areas and recommendations for design and construction of the surge tanks, pipe bridges, abstraction works, de-silting works and access roads.

Aquarius Mining. Marikana, Mine Processing Plant, Rustenburg, South Africa
2001 to 2002
Geotechnical Engineer – Plant side
Several candidate sites and the detailed Geotechnical investigation of the final site for the processing plant for new platinum mine. Foundation recommendations for all plant elements were provided including those for silos, mills, crushers and conveyor trestles. Foundation design for large vibratory plant elements. Ongoing foundation inspections and providing geotechnical advice and recommendations to the client throughout construction.

Eskom, Medupi and Kusile Power Stations, Investigations and Foundation Assessments, Limpopo, South Africa
2008 to 2014
Lead Geotechnical engineer for AECOM
Assessment carried out for Hitachi/Eskom of existing information regarding the founding conditions. Provision of structure specific foundation recommendations which included settlement analysis, assessment of bearing capacity and determination of parameters for dynamic design. Site inspections and assessment of ground conditions during construction for both Kusile and Medupi. Also, project manager for an additional geotechnical investigation carried out at Medupi Power Station due to unforeseen ground conditions. Investigation included percussion drilling with the Jean Lutz computerised system along with triple tube rotary drilling. Analysis of data allowing optimisation of the power station design.

Harmony Goldfields. Mispah, Tailings Storage Facility, Far West Rand
2017 to 2018
Geotechnical Team Lead
Failure of a section of the Mispah Tailings Storage Facility (TSF) which is underlain by dolomite, dolomitic residuum and rocks of the Karoo Supergroup. The initial assessment lead to the entire facility being re-assessed and candidate sites for new facilities being investigated. Of specific note was the liaison with several other geotechnical/engineering geological consulting firms regarding the failure.

Heather Davis

Mine Waste, Geotechnical & Material Services, Senior Geotechnical Engineer

Eskom. Medupi, Flue Gas De-sulphurisation Project, Limpopo
2017 to 2018
Lead Geotechnical Engineer
Construction of Units 1 to 6. The investigation comprises test pitting, geophysical surveys and drilling. Foundation recommendations for all facets of the project were provided.

Irene Village, Mall Extensions, Centurion, South Africa
2015 to 2018
Dolomite Specialist.
In depth assessment of existing information applicable to the Irene Village Mall retail development in Irene. Dolomite stability assessments for extensions to the existing shopping mall including the addition of a multi-level parkade and additional retail space. Provision of founding recommendations for all facets of the development including earthworks, roadways and foundations.

Gautrans. Gautrain Project, Centurion, South Africa
2007 to 2014
Geotechnical Engineer
Input and comment on aspects of the route underlain by dolomite including the Centurion Gautrain Station were provided. Assessment of the efficacy of the remedial measures utilised at the station including an extensive programme of grouting. Also, investigation of dolomite related subsidence and a sinkhole adjacent to the Gautrain route and below a raised section of the train line in the Centurion area. Subsequent design of the remedial measures for the sinkhole, drainage measures and long-term monitoring of the area.

Africa Kingdom Holdings. Serengeti Golf and Wildlife Estate, Estate Developments, Kempton Park, South Africa
2016 to 2022
Dolomite Specialist
Dolomite stability assessments, coupled with near surface investigations, of parcels of land throughout the Serengeti Golf and Wildlife Estate. Developments have included single, double and triple storey residential units, Hotel, Club House and artificial lake. All reports have been submitted to the Council for Geoscience (CGS) and have included IHC to IHC7 conditions with Dolomite Area Designations of D2 to D4 being represented. NHBRC applications have been made for all the residential developments.

Aerosud, Manufacturing Facility, Pierre van Ryneveld Park, Centurion . South Africa
2016 to 2018
Dolomite Specialist
Various dolomite stability investigations and reviews have been undertaken for warehouses, ablution blocks, workshops, parking areas and other infrastructure elements across the Aerosud manufacturing facility. All work has, and is, being carried out according to SANS 1936 Parts 1 to 4 of 2012. A Dolomite Risk Management Plan was drafted for the Aerosud Facility and is updated on a regular basis. The site manly classifies as IHC4 to IHC7 with Dolomite Area Designation D2 and D3 being applicable to most of the site.

Atterbury Properties. Erasmuspark/ Castlegate, Multi Use Development, Erasmuspark, South Africa
2016 to 2020
Geotechnical Engineer and Dolomite Specialist
Existing information in line with SANS 1936 on a site underlain by dolomite and dolomitic residuum and non-dolomitic formations. Programme of drilling and near surface investigation, to feasibility level, to de-lineate those areas underlain by dolomite and provision of recommendations for a mixed-use development which will include retail and residential components. Subsequent design level investigations have been completed for various large structures across the site and further de-lineation of developable and non-developable areas.

Appendix B

IMPACT ASSESSMENT METHODOLOGY AND IMPACT ASSESSMENT

IMPACT ASSESSMENT METHODOLOGY

SCOPING PHASE

REPORTING REQUIREMENTS

- Project Description
- Legislative Context (as applicable)
- Assumptions and limitations
- Description of Baseline Environment
- Site Verification Assessment (including sensitivity mapping) (as applicable)
- Identification and high-level screening of impacts
- Plan of Study for EIA

HIGH-LEVEL SCREENING OF IMPACTS AND MITIGATION

Appendix 2 of GNR 982, as amended, requires the identification of the significance of potential impacts during scoping. To this end, an impact screening tool has been used in the scoping phase. The screening tool is based on two criteria, namely probability; and, consequence (**Table 0-3**), where the latter is based on general consideration to the intensity, extent, and duration.

The scales and descriptors used for scoring probability and consequence are detailed in **Table 0-1** and **Table 0-2** respectively.

Table 0-1: Probability Scores and Descriptors

SCORE	DESCRIPTOR
4	**Definite**: The impact will occur regardless of any prevention measures
3	**Highly Probable**: It is most likely that the impact will occur
2	**Probable**: There is a good possibility that the impact will occur
1	**Improbable:** The possibility of the impact occurring is very low

Table 0-2: Consequence Score Descriptions

SCORE	NEGATIVE	POSITIVE
4	Very severe: An irreversible and permanent change to the affected system(s) or party(ies) which cannot be mitigated.	Very beneficial: A permanent and very substantial benefit to the affected system(s) or party(ies), with no real alternative to achieving this benefit.

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3	Severe: A long term impacts on the affected system(s) or party(ies) that could be mitigated. However, this mitigation would be difficult, expensive or time consuming or some combination of these.	Beneficial: A long term impact and substantial benefit to the affected system(s) or party(ies). Alternative ways of achieving this benefit would be difficult, expensive or time consuming, or some combination of these.
2	Moderately severe: A medium to long term impacts on the affected system(s) or party (ies) that could be mitigated.	Moderately beneficial: A medium to long term impact of real benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are equally difficult, expensive and time consuming (or some combination of these), as achieving them in this way.
1	Negligible: A short to medium term impacts on the affected system(s) or party(ies). Mitigation is very easy, cheap, less time consuming or not necessary.	Negligible: A short to medium term impact and negligible benefit to the affected system(s) or party(ies). Other ways of optimising the beneficial effects are easier, cheaper and quicker, or some combination of these.

Table 0-3: Significance Screening Tool

CONSEQUENCE SCALE

PROBABILITY SCALE		**1**	**2**	**3**	**4**
	1	**Very Low**	**Very Low**	**Low**	**Medium**
	2	**Very Low**	**Low**	**Medium**	**Medium**
	3	**Low**	**Medium**	**Medium**	**High**
	4	**Medium**	**Medium**	**High**	**High**

The nature of the impact must be characterised as to whether the impact is deemed to be positive (+ve) (i.e. beneficial) or negative (-ve) (i.e. harmful) to the receiving environment/receptor. For ease of reference, a colour reference system (**Table 0-4**) has been applied according to the nature and significance of the identified impacts.

Table 0-4: Impact Significance Colour Reference System to Indicate the Nature of the Impact

Negative Impacts (-ve)	**Positive Impacts (+ve)**
Negligible	**Negligible**
Very Low	**Very Low**
Low	**Low**
Medium	**Medium**
High	**High**

EIA PHASE

REPORTING REQUIREMENTS

- Project Description
- Legislative Context (as applicable)
- Assumptions and limitations
- Description of methodology (as required)
- Update and/or confirmation of Baseline Environment – including update and / or confirmation of sensitivity mapping
- Identification and description of Impacts
- Full impact assessment (including Cumulative)
- Mitigation measures
- Impact Statement

Ensure that all reports fulfil the requirements of the relevant Protocols.

ASSESSMENT OF IMPACTS AND MITIGATION

The assessment of impacts and mitigation evaluates the likely extent and significance of the potential impacts on identified receptors and resources against defined assessment criteria, to develop and describe measures that will be taken to avoid, minimise or compensate for any adverse environmental impacts, to enhance positive impacts, and to report the significance of residual impacts that occur following mitigation.

The key objectives of the risk assessment methodology are to identify any additional potential environmental issues and associated impacts likely to arise from the proposed project, and to propose a significance ranking. Issues / aspects will be reviewed and ranked against a series of significance criteria to identify and record interactions between activities and aspects, and resources and receptors to provide a detailed discussion of impacts. The assessment considers direct[1], indirect[2], secondary[3] as well as cumulative[4] impacts.

A standard risk assessment methodology is used for the ranking of the identified environmental impacts pre-and post-mitigation (i.e. residual impact). The significance of environmental aspects is determined and ranked by considering the criteria[5] presented in **Table 0-5**.

Table 0-5: Impact Assessment Criteria and Scoring System

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Magnitude (M) The degree of alteration of the affected environmental receptor	Very low: No impact on processes	Low: Slight impact on processes	Medium: Processes continue but in a modified way	High: Processes temporarily cease	Very High: Permanent cessation of processes

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

CRITERIA	SCORE 1	SCORE 2	SCORE 3	SCORE 4	SCORE 5
Impact Extent (E) The geographical extent of the impact on a given environmental receptor	Site: Site only	Local: Inside activity area	Regional: Outside activity area	National: National scope or level	International: Across borders or boundaries
Impact Reversibility (R) The ability of the environmental receptor to rehabilitate or restore after the activity has caused environmental change	Reversible: Recovery without rehabilitation		Recoverable: Recovery with rehabilitation		Irreversible: Not possible despite action
Impact Duration (D) The length of permanence of the impact on the environmental receptor	Immediate: On impact	Short term: 0-5 years	Medium term: 5-15 years	Long term: Project life	Permanent: Indefinite
Probability of Occurrence (P) The likelihood of an impact occurring in the absence of pertinent environmental management measures or mitigation	Improbable	Low Probability	Probable	Highly Probability	Definite
Significance (S) is determined by combining the above criteria in the following formula:	$[S = (E + D + R + M) \times P]$ $Significance = (Extent + Duration + Reversibility + Magnitude) \times Probability$				
IMPACT SIGNIFICANCE RATING					
Total Score	**4 to 15**	**16 to 30**	**31 to 60**	**61 to 80**	**81 to 100**
Environmental Significance Rating (Negative (-))	**Very low**	**Low**	**Moderate**	**High**	**Very High**
Environmental Significance Rating (Positive (+))	**Very low**	**Low**	**Moderate**	**High**	**Very High**

IMPACT MITIGATION

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

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

The mitigation sequence/hierarchy is shown in **Figure 1** below.

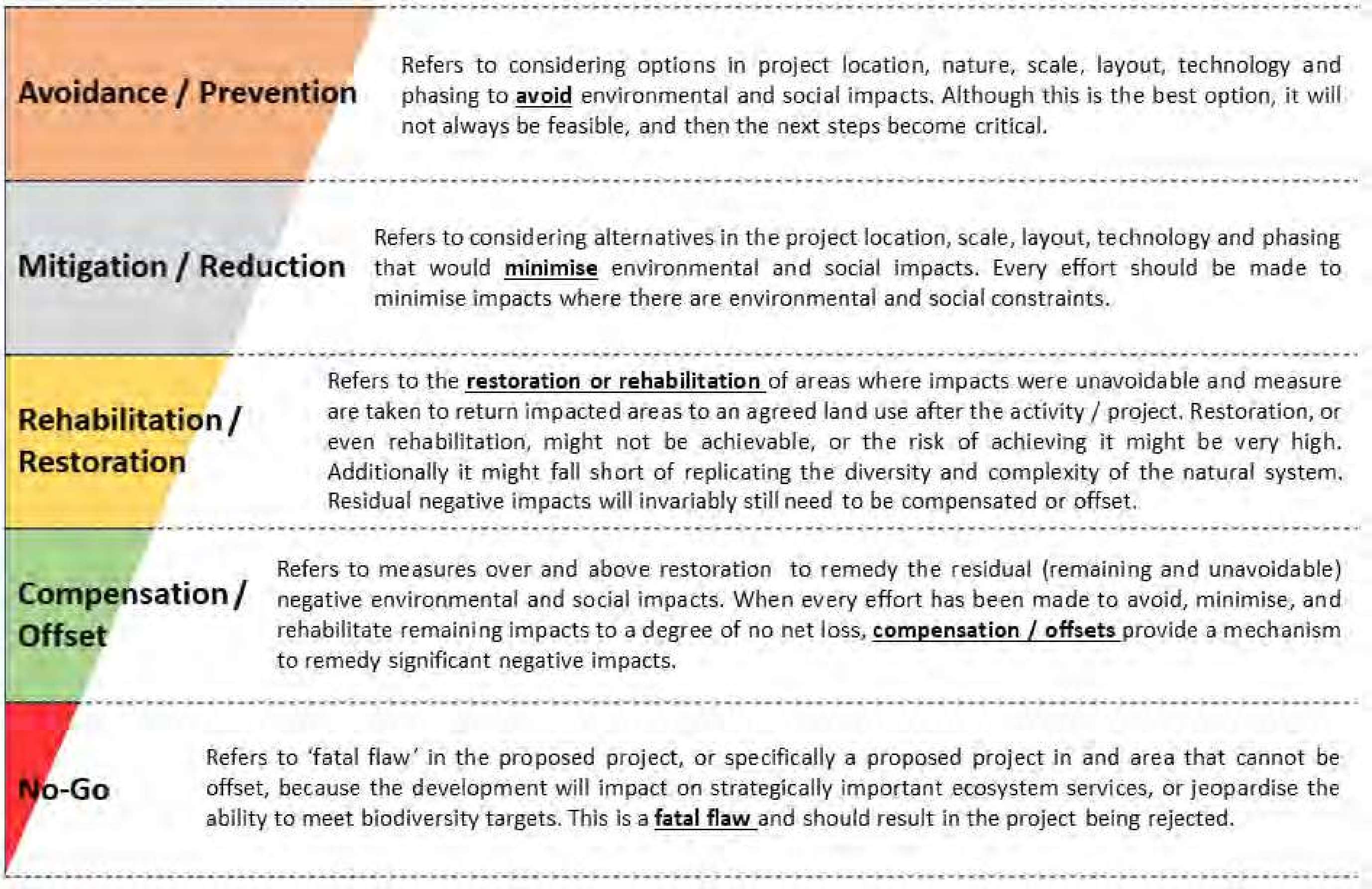

Figure 1: Mitigation Sequence/Hierarchy

Project Name	41104569 - Tournée 2 PV Geotechnical Impact Assessment

Impact Assessment

CONSTRUCTION

Impact number	Aspect	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation							Mitigation Measures
						(M+	E+	R+	D)x	P=	S	Rating	(M+	E+	R+	D)x	P=	S	Rating	
Impact 1:	Soil Erosion	• Increased stormwater velocity. • Increase in soil and wind erosion due to clearing of vegetation. • Creation of drainage paths along access tracks. • Sedimentation of non-perennial features and excessive dust.	Construction	Negative		3	3	3	3	4	48	N3	2	1	1	2	2	12	N1	• Rehabilitation of affected areas (such as revegetation). • Construction of temporary berms and drainage channels to divert surface water. • Minimize earthworks and fills. • Use existing road network and access tracks. • Correct engineering design and construction of gravel roads and water crossings. • Control stormwater flow.
					Significance	N3 - Moderate							N1 - Very Low							
Impact 2:	Oil Spillages	Contamination of ground and surface water resources from heavy plant leading to quality deterioration of the water resources.	Construction	Negative		3	3	3	3	4	48	N3	2	2	1	1	2	12	N1	• Vehicle and construction machinery repairs to be undertaken in designated areas with proper soil protection. • Frequent checks and conditional monitoring
					Significance	N3 - Moderate							N1 - Very Low							
Impact 3:	Disturbance of fauna and flora	The displacement of natural earth material and overlying vegetation leading to erosion.	Construction	Negative		3	1	3	3	3	30	N2	2	1	1	2	2	12	N1	Limit and control excavations
					Significance	N2 - Low							N1 - Very Low							
Impact 4:	Slope stability	Slope instability around structures.	Construction	Negative		2	1	3	3	2	18	N2	1	1	3	2	2	14	N1	• Avoid steep slope areas. • Design cut slopes according to detailed geotechnical analysis.
					Significance	N2 - Low							N1 - Very Low							
Impact 8:	Seismic activity	Damage of proposed development.	Construction	Negative		4	1	3	4	1	12	N1	2	1	3	3	1	9	N1	Design according to expected peak ground acceleration.
					Significance	N1 - Very Low							N1 - Very Low							

OPERATIONAL

Impact number	Receptor	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation							
						(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S		
Impact 1:	Soil Erosion	• Increase in soil and wind erosion due to clearance of structures. • Displacement of soil and damage to vegetation by vehicles	Operational	Negative		2	1	3	2	2	16	N2	1	1	1	1	1	4	N1	• Use existing road network and access tracks. • Use of temporary berms and drainage channels to divert surface water. • Minimize earthworks and demolish footprints. • Rehabilitation of affected areas (such as revegetation). • Reinstate channelized drainage features. • Strip, stockpile and re-spread topsoil.
					Significance	N2 - Low							N1 - Very Low							
Impact 2:	Potential Oil Spillages	Potential oil spillages from service vehicles and heavy plant.	Operational	Negative		3	2	5	5	3	45	N3	2	1	3	1	1	7	N1	• Vehicle repairs to be undertaken in designated areas.
					Significance	N3 - Moderate							N1 - Very Low							

DECOMISSIONING

Impact number	Receptor	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation							
						(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S		
Impact 1:	Soil Erosion	• Increase in soil and wind erosion due to clearance of structures. • Displacement of soil and damage to vegetation by vehicles	Decommissioning	Negative		4	2	3	3	4	48	N3	2	1	1	2	2	12	N1	• Use existing road network and access tracks. • Use of temporary berms and drainage channels to divert surface water. • Minimize earthworks and demolish footprints. • Rehabilitation of affected areas (such as revegetation). • Reinstate channelized drainage features. • Strip, stockpile and re-spread topsoil.
					Significance	N3 - Moderate							N1 - Very Low							
Impact 2:	Potential oil spillages	• Potential oil spillages due to clearance of structures.	Decommissioning	Negative		3	3	3	3	4	48	N3	2	1	3	1	2	14	N1	• Vehicle and construction machinery repairs to be undertaken in designated areas with proper soil protection. • Frequent checks and conditional monitoring
					Significance	N3 - Moderate							N1 - Very Low							
Impact 3:	Disturbance of fauna and flora	The displacement of natural earth material and overlying vegetation leading to erosion.	Decommissioning	Negative		3	1	3	3	3	30	N2	2	1	1	2	2	12	N1	Limit excavation
					Significance	N2 - Low							N1 - Very Low							
Impact 4:	Slope stability	Slope instability around structures.	Decommissioning	Negative		2	1	3	3	2	18	N2	1	1	3	2	2	14	N1	• Avoid steep slopes areas. • Design cut slopes according to detailed geotechnical analysis.
					Significance	N2 - Low							N1 - Very Low							

CUMULATIVE

Impact number	Receptor	Description	Stage	Character	Ease of Mitigation	Pre-Mitigation							Post-Mitigation							
						(M+	E+	R+	D)x	P=	S		(M+	E+	R+	D)x	P=	S		
Impact 1:	Erosion	The displacement of natural earth material and overlying vegetation leading to: • Exposure of upper soil layer. • Increase in stormwater velocity. • Soil washed downslope into drainage channels leading to sedimentation. •The erosion of these slopes will be exacerbated during periods of heavy rainfall.	Cumulative	Negative		3	2	3	3	4	**44**	**N3**	2	1	1	2	2	**12**	**N1**	• Use existing road network and access tracks. • Use of temporary berms and drainage channels to divert surface water. • Minimize earthworks and demolish footprints. • Rehabilitation of affected areas (such as revegetation). • Develop a chemical spill response plan. • Reinstate channelized drainage features.
					Significance	**N3 - Moderate**							**N1 - Very Low**							
Impact 2:	Potential Oil Spillages	Contamination of ground and surface water resources from heavy plant leading to quality deterioration of the water resources.	Cumulative	Negative		3	3	3	3	4	**48**	**N3**	2	1	3	1	2	**14**	**N1**	• Vehicle and construction machinery repairs to be undertaken in designated areas with proper soil protection. • Frequent checks and conditional monitoring
					Significance	**N3 - Moderate**							**N1 - Very Low**							
Impact 3:	Disturbance of fauna and flora	The displacement of natural earth material and overlying vegetation leading to erosion.	Cumulative	Negative		3	1	3	3	3	**30**	**N2**	2	1	1	2	2	**12**	**N1**	Limited excavations
					Significance	**N2 - Low**							**N1 - Very Low**							
Impact 4:	Slope stability	Slope instability around structures.	Cumulative	Negative		2	1	3	3	2	**18**	**N2**	1	1	3	2	2	**14**	**N1**	• Avoid steep slopes areas. • Design cut slopes according to detailed geotechnical analysis.
					Significance	**N2 - Low**							**N1 - Very Low**							
Impact 5:	Seismic activity	Damage of proposed development.	Cumulative	Negative		4	1	3	4	1	**12**	**N1**	2	1	3	3	1	**9**	**N1**	Design according to expected peak ground acceleration.
					Significance	**N1 - Very Low**							**N1 - Very Low**							

Appendix C

DOCUMENT LIMITATIONS

DOCUMENT LIMITATIONS

This document has been provided by WSP Group Africa Pty Ltd ("WSP") subject to the following limitations:

i) This Document has been prepared for the particular purpose outlined in WSP's proposal and no responsibility is accepted for the use of this Document, in whole or in part, in other contexts or for any other purpose.

ii) The scope and the period of WSP's Services are as described in WSP's proposal, and are subject to restrictions and limitations. WSP did not perform a complete assessment of all possible conditions or circumstances that may exist at the site referenced in the Document. If a service is not expressly indicated, do not assume it has been provided. If a matter is not addressed, do not assume that any determination has been made by WSP in regard to it.

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