Report to SiVEST SA (PTY) LTD

Desktop Geotechnical Specialist Study for the:

PROPOSED HENDRINA NORTH 132KV POWERLINE MPUMALANGA PROVINCE, SOUTH AFRICA

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F0. FINAL	20/10/2022	Issued to client for review / distribution	DSW	SNB
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Revision Details:	Made client corrections and updated report as per client request

Report by:	Approved by:
Duan Swart *MSc (Eng Geology) MSAIEG Pr.Sci.Nat*	Steven Bok *BSc Hons (Geology) Pr.Sci.Nat*

BASIC ASSESSMENT (BA) FOR THE PROPOSED CONSTRUCTION AND OPERATION OF THE HENDRINA NORTH 132KV POWERLINE TO HENDRINA POWER STATION IN THE MPUMALANGA PROVINCE OF SOUTH AFRICA
DESKTOP GEOTECHNICAL SPECIALIST STUDY

Executive Summary

This desktop geotechnical specialist study was undertaken for the development of the Hendrina North 132kV powerline in the Mpumalanga Province. The site area is underlain by sandstone, shale and coal beds of the Vryheid Formation, Ecca Group, Karoo Supergroup. A particularly significant feature of the formation is the close intercalation of the different rock types within it. It is not unusual for a lenticular body of coarse sandstone to occur within a predominantly finer siltstone horizon, while a weak lens of mudstone or siltstone occurring within a competent layer of sandstone is equally common. Similarly, bands of rock may be laterally discontinuous and may suddenly pinch out and may reappear some distance away.

The siltstone and mudrock residual soils are generally soft to stiff, clayey silty to sandy silt material and no excavation difficulties are expected. Hard rock sandstone bands may cause excavation difficult but will provide good founding conditions. The dolerite usually occupies the high lying areas and is generally deeply weathered and exhibits loose, red, clayey silt material to depths greater than 3.00 m BGL.

Ferricrete usually occurs on the midslopes and adjacent to streams. The ferricrete and sandstone can cause sub-surface flow to become return flow causes seasonal wet conditions at surface. Seasonal wetlands are known to be a common occurrence in this region and geology.

The lower-lying valleys, defined by streams, is expected to comprise thick (>1.50 m), unconsolidated, alluvial material. The alluvium may be clayey sand to clayey material and will be variable in composition.

No highly expansive or severely collapsible soils are expected to occur on the site. Some low to medium potential expansive may exist on the site.

Steep slopes or slope instabilities are not expected anywhere within the corridor areas.

Most the corridor areas are accessible via existing good gravel and small farm roads. The quality of the farm roads may vary and becoming non-trafficable during and after heavy rainfall due to loose to soft upper soil. The crop areas that have been ploughed will cause trafficability issues and 4x4 vehicles may bog down in these areas during and after heavy rainfall.

These constraints may be mitigated via standard engineering design and construction measures.

No fatal flaws or ‘no-go’ areas have been identified that would render any assessment areas unsuitable from a geological and geotechnical perspective.

The proposed route alignment corridors are assessed to have a “Negative Low impact - the anticipated impact will have negligible negative effects and will require little to no mitigation” provided that the recommended mitigation measures are implemented. The remaining mitigation measures provided to minimise the impacts relate to the appropriate engineering design of earthworks and site drainage, erosion control and topsoil and spoil material management. These do not exceed civil engineering and construction best practices.

The main impact of the proposed development from a geological perspective is the displacement and removal of soil and rock materials for the access roads and plinth excavations. These activities will predominantly take place during the construction phase. The degree of disturbance is largely dependent on the location of each powerline post location within the length of the proposed corridors and in using the corridor with existing access roads. Option 2 is preferred as less new and additional access roads during construction is require compared to Option 1.

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;	 1.3 Appendix B
b) a declaration that the specialist is independent in a form as may be specified by the competent authority;	Appendix A
c) an indication of the scope of, and the purpose for which, the report was prepared;	1.1, 1.2
(cA) an indication of the quality and age of base data used for the specialist report;	1.4, References
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	5, 6
d) the date and season of the site investigation and the relevance of the season to the outcome of the assessment;	Not applicable
e) a description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used;	1.4, Appendix C
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;	3, 6, 7
g) an identification of any areas to be avoided, including buffers;	None identified
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;	No sensitivities identified
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;	5,6,7
k) any mitigation measures for inclusion in the EMPr;	6.1 Appendix D
l) any conditions for inclusion in the environmental authorisation;	6.1 Appendix D
m) any monitoring requirements for inclusion in the EMPr or environmental authorisation;	6.1 Appendix D
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;	6.1, 8 6.1 Appendix D
o) a description of any consultation process that was undertaken during the course of preparing the specialist report;	Not applicable
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.	None
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.	Not applicable

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Tables

1. Introduction

GaGE Consulting (Pty) Ltd was appointed by SiVEST Environmental (PTY) Ltd (hereafter referred to as “SiVEST”) to undertake the required BA Process for the proposed construction and operation of electricity distribution infrastructure, to connect the proposed Hendrina North Wind Energy Facility (“WEF”) (14/2/16/3/3/2/2130)1 to the Hendrina Power Station.

The proposed Hendrina North 132kV powerline will be subject to a Basic Assessment (BA) process in terms of the National Environmental Management Act (Act 107 of 1998) (NEMA) as amended and EIA Regulations, 2014 (as amended). The project aims to feed the electricity generated by the proposed Hendrina North WEF into the national grid. The WEF will form part of the Renewable Energy Independent Power Producer Programme (REIPPP) (in line with the Integrated Resource Plan (IRP) – renewable wind energy). Accordingly, the BA processes as contemplated in terms of the EIA Regulations (2014, as amended) are being undertaken in respect of the proposed project. The competent authority for this EIA is the National Competent Authority (CA), namely the Department of Forestry, Fisheries and Environment, (DFFE).

1.1. Scope and Objectives

Assess the impacts associated with the installation of the Hendrina North 132kV powerline.

The following key considerations were taken into account during the desktop study:

- The geological and geotechnical conditions (ground conditions) and the influence thereof on the competency of founding of civil infrastructure and structures,
- Site topography and influence thereof on the site stability and suitability,
- The presence of geological or geomorphological features such as faults, lineaments and unstable ground,
- The presence of problem soils, geotechnical constraints, shallow groundwater conditions, and
- Geologically significant or sensitive features such as ridges, outcrops and exposures.

1.2. Terms of Reference

The terms of reference were provided by SiVEST to allow a consistent approach to the specialist studies that are required as part of the Basic Assessment (BA) process being conducted in respect of the Hendrina North 132kV powerline. This will enable comparison of environmental impacts, efficient review and collation of the specialist studies into the BA report, in accordance with the latest requirements of the EIA Regulations, 2014 (as amended).

A detailed description of the infrastructure required for the project including layouts of the proposed development were not provided by SiVEST.

1.3. Specialist Credentials

This study has been undertaken by Duan Swart, a Professional Natural Scientist registered by the South African National Council for Natural Scientific Professions (SACNASP) registration number 137549 (Geological Science). The report was reviewed by Steven Bok, a Professional Natural Scientist registered by the SACNASP registration number 400279/07 (Geological Science). Mr Swarts CV is attached in Appendix B.

1.4. Assessment Methodology

The assessment involved a review of the following information:

i) 1:250 000 Scale Geological Map Sheets 2628 East Rand
ii) Aerial photographs (Google Earth imagery, current and historical)
iii) Screening Report for Environmental Authorisation (national web based environmental screening tool)
iv) Literature as referenced within this report

An Environmental Impact Assessment matrix was used to quantify the impacts of the project on the receiving environment (provided by SiVEST and attached as Appendix C).

2. Assumptions and Limitations

The services performed by GaGE Consulting (Pty) Ltd were conducted in a manner consistent with the level of care and skill ordinarily exercised by members of the geotechnical profession practising under similar conditions in the locality of the project. The interpretation of the site conditions is based on available information, experience in the general project area and professional judgement and is considered to provide sufficient confidence to meet the objectives of this specialist study. The nature of geotechnical engineering is such that conditions at variance with those described may be encountered on site. Engineering recommendations provided in this report are preliminary and must be confirmed through further intrusive investigations.

Third party information has been utilised in good faith.

A site visit was not undertaken.

3. Technical Description

3.1. Project Location

The proposed alignments are located approximately 15km west of Hendrina, within the Steve Tshwete Local Municipality, in the Nkangala District Municipality, Mpumalanga Province. The Hendrina Power Station is located approximately 17km northwest of Hendrina, near Pullens Hope. The proposed powerline (up to and including 132kV) to Hendrina Power Station will be ~20km long depending on the exact route. A 500m corridor is proposed (250m from the centre lines).

The powerline will cross farm portions of the following Farms:

- Farm Driefontein
- Farm Roodepoort
- Farm Boschmanskop
- Farm Haartebeestkuil
- Farm Broodsneyerplaats
- Farm Hendrina Power Station
- Farm Gloria
- Farm Aberdeen

The general location is shown in Figure 3-1.

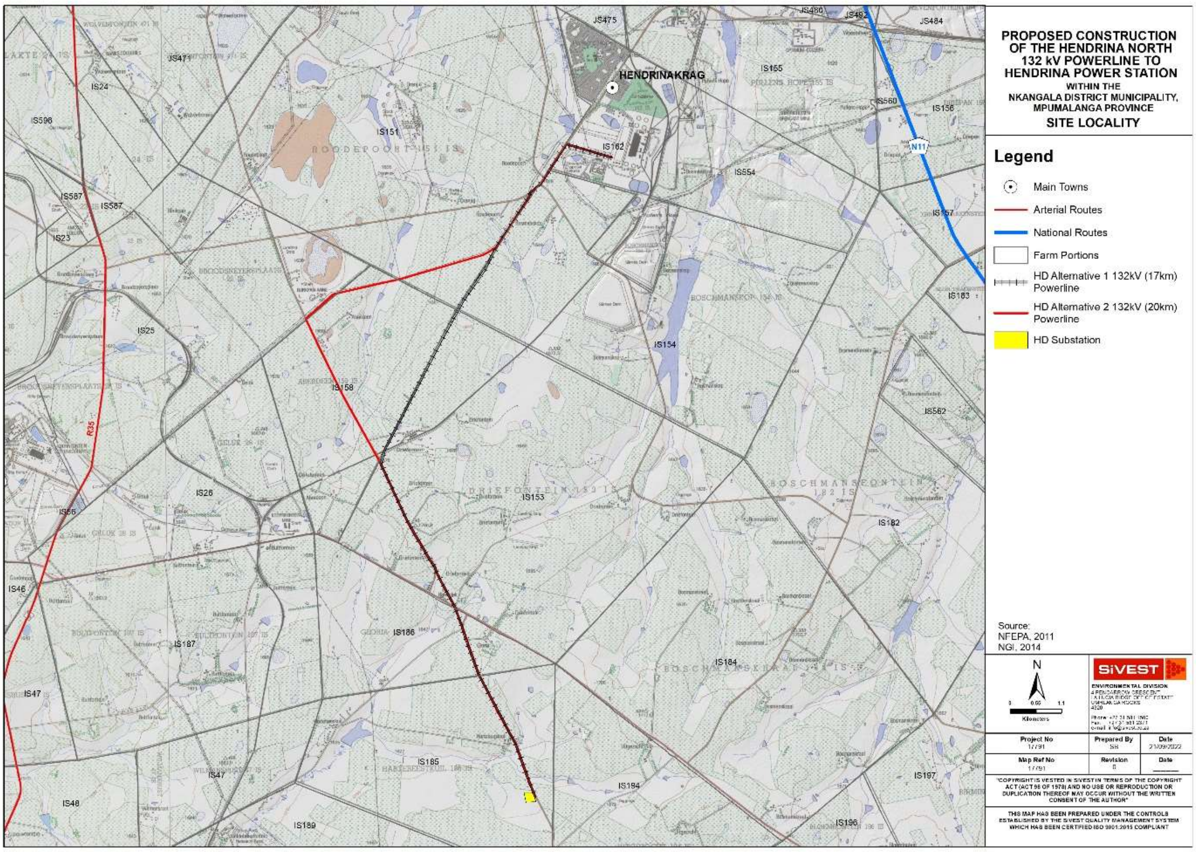

Figure 3-1 Location of the proposed Hendrina North powerline alignments

3.2. Project Description

In order to enable the evacuation of the generated power from the Hendrina North WEF to the existing Hendrina Power Station two alternative powerlines (within a 500m wide corridor) are to be assessed.

3.2.1. Project Components

The proposed powerline (up to and including 132kV) to Hendrina Power Station will be ~20km long depending on the exact route options. The servitude width for a 132kV distribution line is 31 m (15.5 m on either side of the centre line of the powerline).

3.3. Alternatives

3.3.1. Location Alternatives

No other location alternatives are being considered. The site has been confirmed to have sufficient capacity to evacuate the generation and the land has been confirmed as available from the private landowners.

3.3.2. Technology Alternatives

No technology alternatives exist for the distribution of electricity. Therefore, no technology alternatives are being assessed as part of this BA process.

3.3.3. Powerlines Layout Alternatives

The client has proposed grid connection infrastructure proposals include two (2 No.) power line route alignment alternatives with a 500 m wide corridor. These alternatives will be considered and assessed as part of the BA process and will be amended or refines to avoid identified environmental sensitivities.

The two alternative grid connections solutions will include:

- Grid Connection Alternative 1 (Preferred): The proposed powerline will be approximately 17 km and will connect to the Hendrina North WEF to the Hendrina Power Station. This alternative is shorter span over existing road and farm boundaries. This is the landowners preferred routing. The preferred pylon and powerline will be 132 kV Intermediate Self-Supporting single circuit or double circuit Monopole.
- Grid Connection Alternative 2: The proposed powerline will be approximately 20km and will connect to the Hendrina North WEF to the Hendrina Power Station. This alternative follows an existing a dirt road until it meets the Eskom HENDRINA-ABINA 132kV powerline. It then follows the Eskom powerline into the Hendrina Power Station. The preferred pylon and powerline will be 132 kV Intermediate Self-Supporting single circuit or double circuit Monopole.

Figure 3-1 shows the proposed route of the powerline routes.

3.3.4. No-Go Alternative

The ‘no-go’ alternative is the option of not undertaking the proposed Hendrina North 132kV powerline. Hence, if the ‘no-go’ option is implemented, there would be no development. This alternative would result in no environmental impacts from the proposed project on the site or the surrounding local area. It provides the baseline against which other impacts are compared and will be considered throughout the report.

4. Legal Requirement and Guidelines

The desktop study was undertaken according to the guidelines provided by The South African Institution of Civil Engineering Site Investigation (SAICE) Code of Practice published by The Geotechnical Division of SAICE, 2010.

This report has been prepared to meet the requirements for a specialist report as provided in Regulation GNR 326 of 4 December 2014, as amended 7 April 2017, Appendix 6.

5. Description of the Receiving Environment

The following description of the receiving environment is relevant to assessing the geological and geotechnical impacts.

5.1. Climate

The area surrounding Hendrina is considered to be a warm and temperate climate. Rainfall generally occurs in summer with much less rain in winter. The area is within a subtropical highland climate (Cwb) according to the Köppen-Geiger climate classification. The average annual rainfall is 794 mm with the average temperatures of 15.1°C.

Climate plays a fundamental role in rock weathering and soil development. The effect of climate on the weathering processes (i.e. soil formation) in a particular area can be determined from the climatic N-value, defined by Weinert (1980). A climatic N-Value of 5 or less implies a water surplus and the dominant mode of weathering is chemical decomposition. These climatic conditions are favourable for the development of a deep residual soil profile. Where the climatic N-value is greater than 5, mechanical disintegration is the predominant mode of rock weathering. In these drier areas residual soils are typically shallow. Climatic N-values of greater than 10 imply an arid climate with a limited or absent residual soil profile.

Weinert's climatic N-value for the site was determined to be 2, which indicates a water surplus climate condition. Therefore, rock and soil are expected to predominantly undergo chemical weathering and the presence of residual soils can be expected.

5.2. Topography and Drainage

The site topography is gently undulating and locally sloping between 2° to 4° on convex slopes and valleys throughout the alignment. The route alignment cut across ridges and small, shallow, valleys. The site exists between the elevations of 1705 m (in the middle of the route alignment) to 1600 m (at the Hendrina Power Station) above mean sea level (AMSL). The most southernly end of the alignment exists at 1640 m AMSL.

The flow on seeping from the alignment corridors are expected to occur as hill wash and shallow sub-surface seepage becoming concentrated flow in non-perennial and perennial streams. The southern portion of the site will drain into the Leeufonteinspruit flowing south into the Olifants River. The middle to northern portions of the alignment corridors will flow into the Woes-Alleenspruit flowing north into the Klein-Olifants and eventually in the Olifants River.

The site topography is shown in Figure 5-1. Some of the streams intercepting the alignments have small earth dams built in the channel. The area is known to have seasonal wetlands and return flow on the mid to lower slopes.

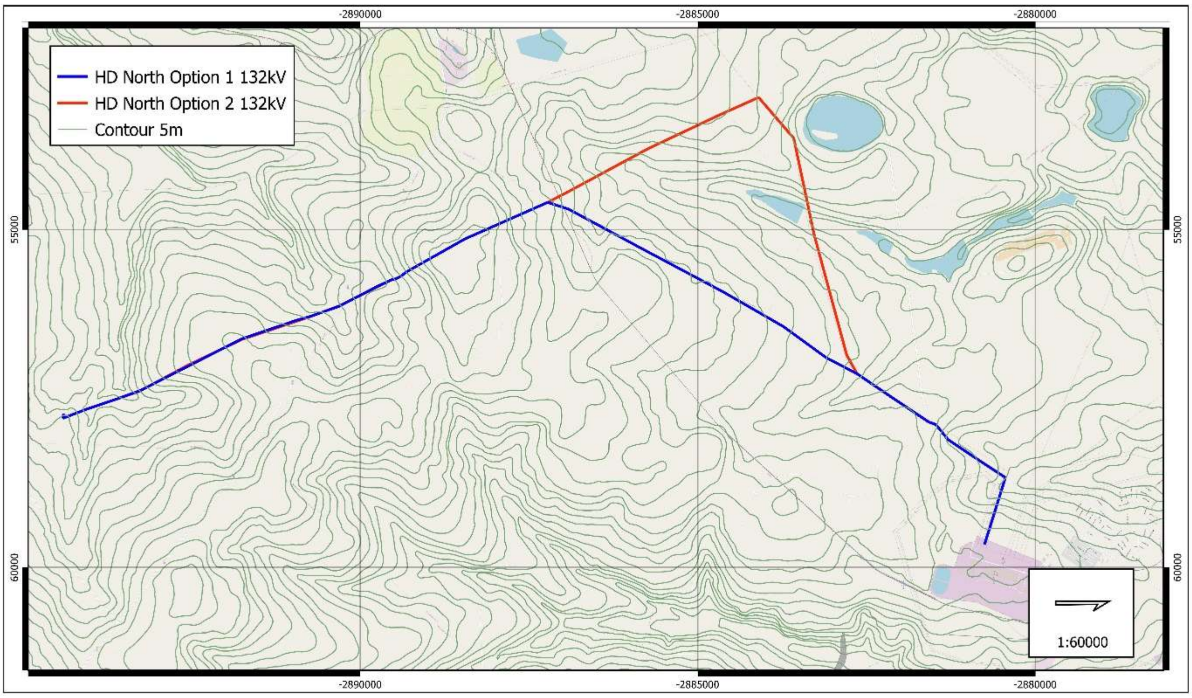

Figure 5-1 Site topography

5.3. Seismicity

According to the Seismic Hazard Map of South Africa (SANS 10160-4, 2017), the peak ground acceleration is approximately 0.1 g 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.

5.4. Bedrock Geology

According to the 1:250 000 2628 East Rand geological sheet, the proposed alignments are underlain by sandstone, shale and coal beds of the Vryheid Formation, Ecca Group, Karoo Supergroup. A particularly significant feature of the formation is the close intercalation of the different rock types within it. It is not unusual for a lenticular body of coarse sandstone to occur within a predominantly finer siltstone horizon, while a weak lens of mudstone or siltstone occurring within a competent layer of sandstone is equally common. Similarly, bands of rock may be laterally discontinuous and may suddenly pinch out and may reappear some distance away.

The Vryheid Formation has been intruded by dolerite dykes and sills and the map indicates dolerite is expected to underlain portions of the alignments, especially in the high lying areas. Alluvial material is expected to occur in low-lying areas adjacent to and within streams on the sites. The alluvium is expected to be thick, unconsolidated, variable, sand to clay material.

The regional geology of the site is illustrated in Figure 5-2.

Symbol	Age	Sedimentary and Volcanic Rocks			Intrusive Rocks	Geological Unit Type
		Supergroup	Group	Formation		
	Quaternary	N/A				Alluvium
Jd	Jurassic	-	-	-	Dykes / Sills	Dolerite
Pv	Permian	Karoo	Ecca	Vryheid	-	Sandstone, shale, coal beds

Figure 5-2 The regional geology of the site

5.5. Engineering Geology

The site area is expected to be underlain by alternating residual and completely weathered siltstone and mudrock with bands of hard rock sandstone with thin residual sandstone. The excavation conditions in the siltstone and mudrock is expected to be 'soft' to 3.00 m below ground level (BGL), according to the SANS 634:2012. The siltstone and mudrock residual soils are generally soft to stiff, clayey silty to sandy silt material. The sandstone may cause excavation difficult due to the hard rock material near surface. This is variable and difficult to map without high density trial pit study.

The dolerite usually occupies the high lying areas and is generally deeply weathered and exhibits loose, red, clayey silt material to depths greater than 3.00 m BGL. These areas are generally free-draining and have only weakly cemented ferricrete in the upper soils. Dolerite corestones are anticipated to exist in the dolerite residuum.

The residual soils will be covered by relatively thin (~0.50-0.80 m thick) colluvium soils comprising, loose, silty fine sand when not near streams. The colluvium and upper residual soils are expected to be reworked and ferruginised. The ferricrete can be variably cemented and varying in thickness between approximately 0.50 to 1.50 m thick. Where the ferricrete is strongly cemented, 'intermediate' excavations conditions may be anticipated. Ferricrete usually occurs on the midslopes and adjacent to streams. The ferricrete and sandstone can cause sub-surface flow to become return flow causes seasonal wet conditions at surface. Seasonal wetlands are known to be a common occurrence in this region and geology.

The lower-lying valleys, defined by streams, is expected to comprise thick (>1.50 m), unconsolidated, alluvial material. The alluvium may be clayey sand to clayey material and will be variable in composition.

No highly expansive or severely collapsible soils are expected to occur on the site. Some low to medium potential expansive may exist on the site.

Any steep slopes or slope instabilities are not expected anywhere within the corridor areas.

Most the corridor areas are accessible via existing good gravel and small farm roads. The quality of the farm roads may vary and becoming non-trafficable during and after heavy rainfall due to loose to soft upper soil. The crop areas that have been ploughed will cause trafficability issues and 4x4 vehicles may bog down in these areas during and after heavy rainfall.

5.6. Desktop Geotechnical Appraisal

Based on the desktop study, the assessment areas may be divided into four (4No.) ZONES, namely I, II, III and IV. The assessment covered a 500 m wide (250 m each side) corridor for each proposed alignment.

The assessment area is considered suitable for the development of the proposed infrastructure, from a geotechnical viewpoint, provided that standard engineering design and construction measures are implemented to mitigate the identified geotechnical constraints. The anticipated geotechnical constraints and mitigation measures are summarised in Table 5-1.

Table 5-1 Summary of geotechnical conditions

Ground Unit	Shallow Geology	Geotechnical Conditions / Constraints	Impacts on Engineering Design and Construction
I	Silty to sandy residual Vryheid Fm cover by silty sand transported material	• Silty sand (~0.50-0.80m thick) transported soil on surface • Locally occurring, variably cemented ferricrete at depths between 0.50 m to 2.00 m BGL • Mudrock and siltstone residual soils comprising clayey silt t sandy silt. • Variable bands of hard rock sandstone • Locally occurring seasonal wetlands and return flow during rainy season • Localised shallow subsurface water seepage within ferricrete horizon	• Generally good founding conditions for structures when ferricrete is well-cemented • Generally good founding conditions for structures on residual mudrock and siltstone • Generally good founding conditions for structures on sandstone • Excavation difficulties on hard rock sandstone • Conventional groundwork preparation • Conventional pad footing • Sub-surface seepage accommodated during construction via appropriate site drainage, plumbing and waterproofing precautions
II	Thick alluvium material adjacent and within streams	• Thick, soft to loose, alluvium material • Sub surface water seepage adjacent to stream • Surface water flow within streams	• Design powerline posts to exist outside the stream centre line • Removal and spoil of clayey alluvium material if at founding depth • Importing of G7 or better and earth works required at founding level when existing in clayey alluvium • Conventional pad footings on imported soil raft
III	Wetlands / water bodies	• Thick, soft to loose, wetland soils • Sub surface water seepage adjacent to wetland area • Surface water within wetlands during and after heavy rainfall • Well-developed ferricrete adjacent to wetlands	• Design powerline posts to exist outside the wetland areas • Removal and spoil of wetland soils if at founding depth • Importing of G7 or better and earth works required at founding level when existing in wetland soils • Conventional pad footings on imported soil raft
IV	Residual dolerite covered by silty sand transported material	• Silty sand (~0.50-0.80m thick) transported soil on surface • Locally occurring, variably cemented ferricrete at depths between 0.50 m to 2.00 m BGL • Deep residual soils of clay silt to sandy silt	• Generally good founding conditions for structures on residual dolerite • Conventional groundwork preparation • Conventional pad footing • Sub-surface seepage accommodated during construction via appropriate site drainage, plumbing and waterproofing precautions

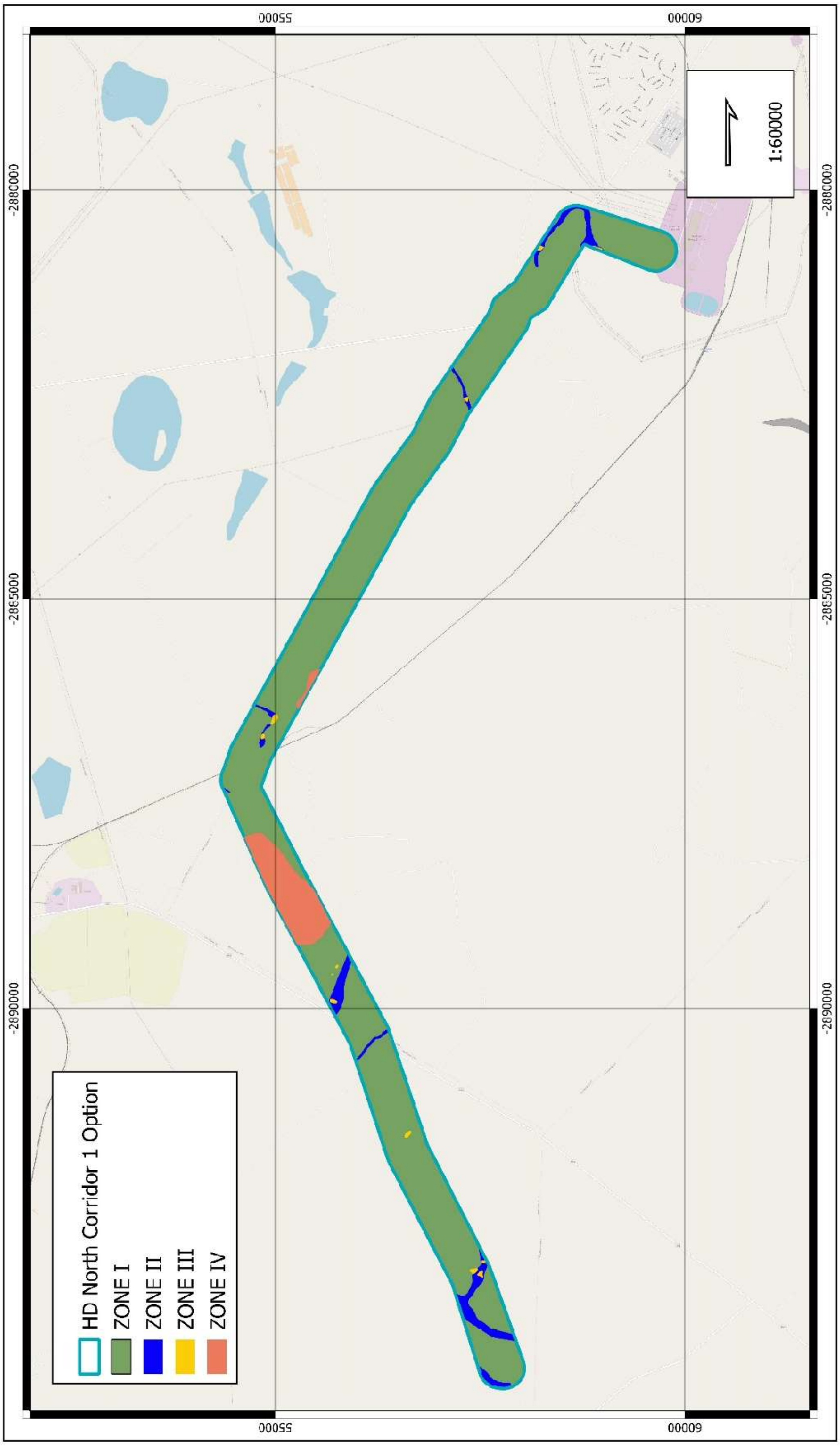

Figure 5-3 Geotechnical Desktop Zonation for Corridor 1 Option

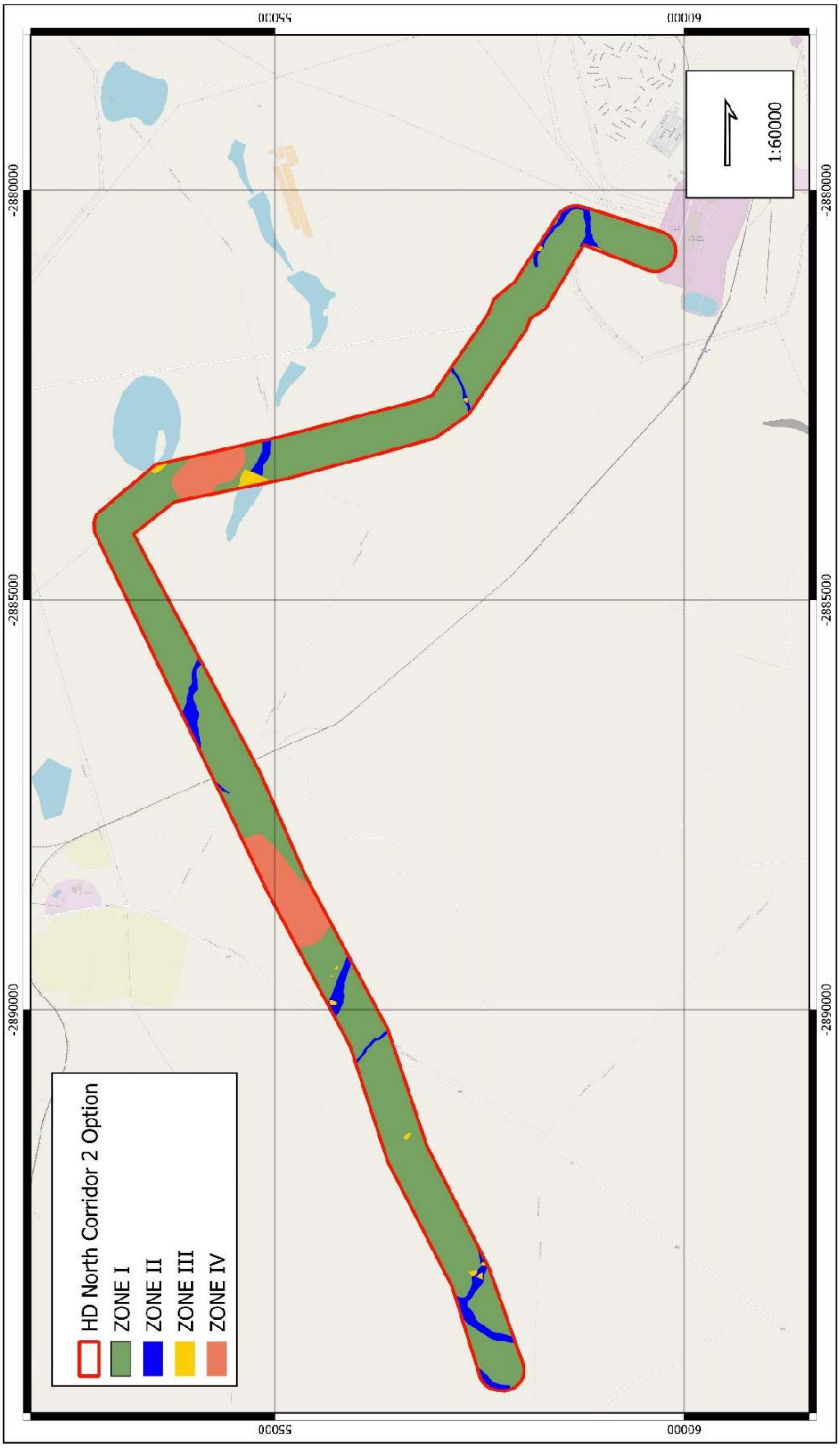

Figure 5-4 Geotechnical Desktop Zonation for Corridor 2 Option

6. Identification and Assessment of Impacts

No fatal flaws or 'no-go' areas have been identified that would render any assessment areas unsuitable from a geological and geotechnical perspective.

The impact of the powerlines on the geological environment is limited to topsoil stripping, excavations for plinth foundations, trenching, the construction of access roads and associated light infrastructure. From a geological and geotechnical perspective, Option 2 has a slightly higher impact rating due to the new and additional access roads required in the northern portion of the alignment, and therefore not preferred.

Option 1 will follow the existing gravel roads and then follow the existing Eskom powerline alignment. It is assumed the existing powerlines will have maintenance roads that can be used as access roads during construction., and therefore preferred.

6.1. Impact of the Project on the Geological Environment

The main impact of the proposed development from a geological perspective is the displacement and removal of soil and rock materials for the access roads and plinth excavations. These activities will predominantly take place during the construction phase. The degree of disturbance is largely dependent on the location of each powerline post location within the length of the proposed corridors and in using the corridor with existing access roads. Earthworks on gentle slopes increases the risk of soil movements or initiation of erosion.

The risk of soil erosion is also increased during construction activities, by the removal of vegetation and by possible disturbance to the natural surface drainage environment. These activities may prevent infiltration of rainwater, increase surface runoff and cause concentration of surface water flow. Erosion will increase the disturbance and displacement of soils and the impact may extend beyond the infrastructure footprint/s over time.

The effects of the proposed development on the geological environment were evaluated using an Environmental Impact Assessment (EIA) Methodology, provided by SiVEST, which aids in determining the significance of an environmental impact on an environmental parameter through a systematic analysis. The EIA methodology is attached as Appendix C.

Based on the impact significance ratings, presented in Appendix D, the proposed construction for both corridor options for the Hendrina North powerline was determined. From a geological and geotechnical perspective, both options have a "Negative Low impact" rating assigned provided that the recommended mitigation measures are implemented. Option 2 is preferred as less new and additional access roads during construction is require compared to Option 1.

The topography of the major portion of the site is generally undulating and access routes should be carefully planned to avoid streams and areas within floodplains as heavy loaded trucks may become bogged in the soft to loose materials when wet. This will results in greater disturbance and generally wider access roads over time.

Detailed geotechnical materials investigations should be undertaken to assess the suitability of the in-situ ferricrete materials and sandstone, and the need for processing (e.g. crushing, stabilisation). The ground profile composition and location f hard rock sandstone bands will need to be confirmed during the investigation.

The soils do not render the site particularly susceptible to soil erosion, although mitigation measures need to be implemented, particularly within the lower-lying sections of the site where concentrated surface flow is anticipated after heavy rainfall events.

7. Comparative Assessment of Alternatives

The client has proposed two (2 No.) power line route alignment alternatives (Option 1 and Option 2) with a 500 m wide corridor each. These alternatives were be considered and assessed as part of the BA process for this geotechnical impact appraisal.

8. Conclusion and Summary

8.1. Summary of Findings

This desktop geotechnical specialist study was undertaken for the development of the Hendrina North 132kV powerline in the Mpumalanga Province. The site area is underlain by sandstone, shale and coal beds of the Vryheid Formation, Ecca Group, Karoo Supergroup. A particularly significant feature of the formation is the close intercalation of the different rock types within it. It is not unusual for a lenticular body of coarse sandstone to occur within a predominantly finer siltstone horizon, while a weak lens of mudstone or siltstone occurring within a competent layer of sandstone is equally common. Similarly, bands of rock may be laterally discontinuous and may suddenly pinch out and may reappear some distance away.

The siltstone and mudrock residual soils are generally soft to stiff, clayey silty to sandy silt material and no excavation difficulties are expected. Hard rock sandstone bands may cause excavation difficult but will provide good founding conditions. The dolerite usually occupies the high lying areas and is generally deeply weathered and exhibits loose, red, clayey silt material to depths greater than 3.00 m BGL.

Ferricrete usually occurs on the midslopes and adjacent to streams. The ferricrete and sandstone can cause sub-surface flow to become return flow causes seasonal wet conditions at surface. Seasonal wetlands are known to be a common occurrence in this region and geology.

The lower-lying valleys, defined by streams, is expected to comprise thick (>1.50 m), unconsolidated, alluvial material. The alluvium may be clayey sand to clayey material and will be variable in composition.

No highly expansive or severely collapsible soils are expected to occur on the site. Some low to medium potential expansive may exist on the site.

Steep slopes or slope instabilities are not expected anywhere within the corridor areas.

Most the corridor areas are accessible via existing good gravel and small farm roads. The quality of the farm roads may vary and becoming non-trafficable during and after heavy rainfall due to loose to soft upper soil. The crop areas that have been ploughed will cause trafficability issues and 4x4 vehicles may bog down in these areas during and after heavy rainfall.

These constraints may be mitigated via standard engineering design and construction measures.

No fatal flaws or ‘no-go’ areas have been identified that would render any assessment areas unsuitable from a geological and geotechnical perspective.

The proposed route alignment corridors are assessed to have a “Negative Low impact - the anticipated impact will have negligible negative effects and will require little to no mitigation” provided that the recommended mitigation measures are implemented. The remaining mitigation measures provided to minimise the impacts relate to the appropriate engineering design of earthworks and site drainage, erosion control and topsoil and spoil material management. These do not exceed civil engineering and construction best practices.

The main impact of the proposed development from a geological perspective is the displacement and removal of soil and rock materials for the access roads and plinth excavations. These activities will predominantly take place during the construction phase. The degree of disturbance is largely dependent on the location of each powerline post location within the length of the proposed corridors and in using the corridor with existing access roads. Option 2 is preferred as less new and additional access roads during construction is require compared to Option 1.

Further intrusive geotechnical investigations should be undertaken to confirm the engineering recommendations provided in this report.

8.2. Impact Statement and Conclusion

From a geotechnical and geological perspective, no fatal flaws or sensitivities have been identified within or close to the powerline assessment corridors. It is therefore recommended that the proposed activity be authorised.

References

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NHBRC HMB. National Home Builders Registration Council: Home Building Manual, 2015.

Appendix A. Specialist Declaration of Interest and Undertaking Under Oath

environmental affairs

Department:
Environmental Affairs
REPUBLIC OF SOUTH AFRICA

DETAILS OF THE SPECIALIST, DECLARATION OF INTEREST AND UNDERTAKING UNDER OATH

	(For official use only)
File Reference Number:	
NEAS Reference Number:	DEA/EIA/
Date Received:	

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)

PROJECT TITLE

BASIC ASSESSMENT (BA) FOR THE PROPOSED CONSTRUCTION AND OPERATION OF THE HENDRINA NORTH 132KV POWERLINE TO HENDRINA POWER STATION IN THE MPUMALANGA PROVINCE OF SOUTH AFRICA

Kindly note the following:

1. This form must always be used for 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 01 September 2018. 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.environment.gov.za/documents/forms.
3. A copy of this form containing original signatures must be appended to all Draft and Final Reports submitted to the department for consideration.
4. All documentation delivered to the physical address contained in this form must be delivered during the official Departmental Officer Hours which is visible on the Departmental gate.
5. All EIA related documents (includes application forms, reports or any EIA related submissions) that are faxed; emailed; delivered to Security or placed in the Departmental Tender Box will not be accepted, only hardcopy submissions are accepted.

Departmental Details

Postal address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Private Bag X447
Pretoria
0001

Physical address:
Department of Environmental Affairs
Attention: Chief Director: Integrated Environmental Authorisations
Environment House
473 Steve Biko Road
Arcadia

Queries must be directed to the Directorate: Coordination, Strategic Planning and Support at:
Email: EIAAdmin@environment.gov.za

1. SPECIALIST INFORMATION

Specialist Company Name:	GaGE Consulting			
B-BBEE	Contribution level (indicate 1 to 8 or non-compliant)	1	Percentage Procurement recognition	135%
Specialist name:	Duan Swart			
Specialist Qualifications:	BSc BSc(Hons) MSc			
Professional affiliation/registration:	Professional Natural Scientist SACNASP Reg. No. 137543			
Physical address:	17 Cowley Road, Bryanston, Johannesburg			
Postal address:	PO Box 71572, BRYANSTON			
Postal code:	2021	Cell:		
Telephone:	010 823 1621	Fax:		
E-mail:	duan@gageconsulting.co.za			

2. DECLARATION BY THE SPECIALIST

I, ________ Duan Swart___________________, declare that –

- I act as the independent specialist in this application;
- I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant;
- I declare that there are no circumstances that may compromise my objectivity in performing such work;
- I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity;
- I will comply with the Act, Regulations and all other applicable legislation;
- I have no, and will not engage in, conflicting interests in the undertaking of the activity;
- I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority;
- all the particulars furnished by me in this form are true and correct; and
- I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.

Signature of the Specialist

GaGE Consulting

Name of Company:

28/10/2022

Date

3. UNDERTAKING UNDER OATH/ AFFIRMATION

I, ____ Duan Swart ____________________, 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

GaGE Consulting

Name of Company

28/10/2022

Date

GUSTAF SWART PLS 1444 (PROFESSIONAL LAND SURVEYOR)

Signature of the Commissioner of Oaths

28/10/2022

Date

Appendix B. Specialist CV

DATE OF BIRTH
30 July 1993

NATIONALITY
South African

LANGUAGES
English
Afrikaans

QUALIFICATIONS

Professional registered SACNASP, PrSciNat (137543), MSAIEG, Master of Science (Engineering Geology), *Doctoral Candidate (Engineering Geology), Bachelor of Science (Hons) (Engineering Geology), Bachelor of Science (Environmental and Engineering Geology)

KEY SKILLS
Geotechnical Investigations, Dolomite Investigations, Borrow Pit and Quarry Investigations, Slope Stability Assessments, Materials Assessments, Vadose Zone Hydrology, Unsaturated Soil Mechanics, Limited Equilibrium Analysis.

INTERNATIONAL EXPEREINCE
Democratic Republic of Congo, Botswana, Swaziland.

DUAN SWART

Senior Engineering Geologist

MSc (Engineering Geology), PrSciNat, MSAIEG

SUMMARY OF CREDENTIALS

Duan is a registered engineering geologist, with six years' experience, who has undertaken fieldwork and reporting of data for various projects including housing and township development, light structures, petrol stations, piling investigations, retaining walls, bridge foundations, roads, pipelines, tunnels and open cast mines. He has shown keen interest in development on dolomitic land and sinkhole occurrence. Additionally, he studies flow mechanics through a variably saturated soil medium, as well as logged many hours in the laboratory and the research environment.

Duan's doctoral research aims to improve the understanding of the variably saturated saprolitic soil found within the complex vadose zone and he uses this understanding in everyday consultancy. His Master's dissertation revealed interesting mineral occurrences within residual dolomite that contributes to the material's unique behaviour. Furthermore, he has successfully consulted on multiple D4 dolomite sites.

His experience has developed through numerous intrusive and non-intrusive site investigation methods for both rock and soil orientated projects and continues to display interest in learning and improving in the field of environmental and engineering geology and geotechnics.

Key professional experience and skills includes:

- Designing and executing detailed geotechnical investigations for the relevant infrastructure types according to guidelines as set out by: SAICE Geotechnical Division Code of Practice (2010); SANS 634; GFSH-2; as well as SANS 1936 for development on dolomite land.
- Competency in: soil profiling, chip and core logging as detailed in industry standards as set out by Brink and Bruin (2001); as well as material classification; on-site supervision; on-site testing and sampling.
- Skills in project management, such as: compiling cost estimates; client communication and liaison; health and safety compliance; delegating work to junior engineering geologists and students; as well as understanding responsibilities as part of a team of scientist and engineers within a project.

In addition to the professional work experience gained in industry, a strong set of skills have been accomplished in academia as a researcher, obtained during M.Sc. studies which form part of the Water Research Commission (WRC) project, K5/2326. Currently, the Ph.D. research contributes to the WRC project Complex Vadose Zone Hydraulics (K5/2826).

Key research experience includes:

- Investigating and executing fundamental scientific research questions on flow through variably saturated residual soil found in South Africa, as well as the influence of unique mineral occurrences on water storage of residual soils.

- Skills in research project management that include: working as a research team; addressing input from experts forming part of a reference group; managing a budget; managing and reviewing work of post-graduate students; and compiling deliverables as well as final research reports.

- Presenting research findings: at several conferences; as well as published papers in peer reviewed scientific journals and chapters in books, and as large research reports.

- Lecturing and mentoring to both undergraduate and postgraduate students in the Department of Geology at the University of Pretoria.

EXPERIENCE: KEY PROJECTS

Simandou Ore Mine, GUINEA (2022)
Client: Rio Tinto / WSP
Position: Engineering Geologist – The Simandou mountain range contains one of the largest iron ore reserves in the world. The proposed mine will be one of the largest operating iron ore mines in the world. Duan was the engineering geologist for the bulk earthworks of the entire mine, associated infrastructure, haul roads, and new airport, including upgrade of the existing 1.80 km dirt runway. The work included slope designs, material utilisation and integration with technical teams such as geometrics, water management and structures. Duan was responsible for the geological model and ground profiles for all the road cuts and bulk earthworks. Furthermore, Duan was task to design slopes for road cuttings ranging from 30 m high to 125 m high. Duan compiled sections of the 85% and 100% design review report, and presented weekly and work closely with technical staff in WSP Group, Rio Tinto and SRK UK.

Luphohlo – Ezulwini Hydro-Electric Scheme, Mbabane, SWAZILAND (2022)
Client: Swaziland Electricity Company
Position: Engineering Geologist – The scheme comprises a 45m high earth cored rockfill dam, which impounds a reservoir of 24 million cubic metres total capacity on the Lusushwana River. Water is drawn through an intake on the eastern side of the reservoir and transferred through the Luphohlo Mountain in a 4.3km long low-pressure tunnel to a surge chamber on the Ezulwini valley side of the mountain. The project involves the inspection of the 4.2 km long low-pressure tunnel. The tunnel inspection was carried out on foot from the intake down to the rock traps / access audit. Duan was responsible for inspection of tunnel features such as concrete lining; moisture drains and rock condition along the length of the tunnel. Duan wrote up sections within the geological and interpretive reports.

N4 Montrose Interchange, Mpumalanga, SOUTH AFRICA (2019-21)
Client: Trans African Toll Concession (TRAC) / South African National Roads Agency (SANRAL) SOC Limited
Agency (SANRAL) SOC Limited
Position: Engineering Geologist - The project involves the widening and upgrade of the National Route 4 at the intersection of the Ngodwana and Schoemanskloof bypasses. Geotechnical works comprises the investigation and design of cut and fill retaining walls, soil and rock slopes, structure abutments, foundations for the widening of the bridge over the Crocodile River, and identification of material sources. Duan was responsible for supervision of part of the site investigation, borehole core logging and write up of sections within the geological, materials and interpretive reports.

R574 Groblersdal, Limpopo, SOUTH AFRICA (2020-22)
Client: Nathoo Mbenyane Engineers/ South African National Roads Agency (SANRAL) SOC Limited
Position: Engineering Geologist - The project involves the widening and upgrade on the National Road R574 (District Road D1547) Section 1 from R33 Groblersdal (km 0.0) to R579 Morwaneng (km 38.9). Geotechnical works comprises the investigation and design of soil and rock slopes, structure abutments, foundations for the widening of the bridges, and identification and investigation of material sources. Duan was responsible for building the bill of quantities, supervision of the site investigation, borehole core logging and write up of sections within the geological, materials and interpretive reports.

R36 Tzaneen, Limpopo, SOUTH AFRICA (2020-22)
Client: Nathoo Mbenyane Engineers/ South African National Roads Agency (SANRAL) SOC Limited
Position: Engineering Geologist - The project involves the widening and upgrade of National Road R36 Section 6 from Manchabeni (Km 4.70) to Tzaneen (Km 33.50). Geotechnical works comprises the investigation and design of soil and rock slopes, structure abutments, foundations for the widening of the bridges, and identification and investigation of material sources. Duan was responsible for building the bill of quantities and write up of sections within the factual and interpretive reports.

R578 Giyani Materials, Limpopo, SOUTH AFRICA (2020-22)
Client: SMEC/ South African National Roads Agency (SANRAL) SOC Limited
Position: Engineering Geologist - The project involves the widening and upgrade of National Road R578 Section 1 from Nwamatatani (Km56.0) to R81 (Km 90.70). Geotechnical works comprises the on-site identification and investigation of material sources. Duan was responsible for building the bill of quantities, on-site investigation, write up of sections within the geological and materials reports.

N3 Mariannhill, Kwa-Zulu Natal, SOUTH AFRICA (2020-22)
Client: SMEC/ South African National Roads Agency (SANRAL) SOC Limited
Position: Engineering Geologist - The project involves the widening and upgrade of the National Route 3 between Key Ridge and Mariannhill Toll Plaza. Geotechnical works comprises the drilling and test pitting of existing cuts and laboratory testing. Duan was responsible for a portion of the on-site investigation, drawing of the geological models, write up of sections within the interpretive report.

KZN Quarries, Kwa-Zulu Natal, SOUTH AFRICA (2019-22)
Client: FDKL/ South African National Roads Agency (SANRAL) SOC Limited
Position: Engineering Geologist - The project involves the identification of potential quarry sources to prospect and secure for future SANRAL contracts in the KZN province. Geotechnical works comprise the on-site identification of material sources. Duan was responsible for developing and implementing of a Quarry-Potential Rating system to categorize and prioritize all sites quantitatively, building the drilling BoQ, writing up of sections in the preliminary assessment report.

N1 R36 Quarries, Free State, SOUTH AFRICA (2021)
Client: HHO/ South African National Roads Agency (SANRAL) SOC Limited
Position: Engineering Geologist - The project involves the identification of potential quarry sources, between Welkom and Koppies, for use on the N1-R34 Route Upgrade project. Geotechnical works comprise the identification and investigation of potential material sources. Duan was responsible for logging and supervising logging of core (1300 m) and percussion chips (950 m) retrieved during the investigation.

EXPERIENCE: OTHER MAJOR PROJECTS

Upgrades to Damani Water Treatment Plant, SOUTH AFRICA (2019)
Client: EVN Africa Consulting Engineers (Pty) Ltd
Position: Engineering Geologist - The project involved the investigation for the addition of 12 new water reservoirs in the Vhembe District Municipality as part of the upgrading of the Damani Water Treatment Plant. Duan was tasked to undertake visual inspections of soil profiles, in excavations and on slopes, and rock outcrops to make recommendations on foundation solutions for elevated steel tanks and large water reservoirs. Duan was responsible for the site investigation, interpretation and writing of reports.

Kisanfu Geotechnical Investigation, DEMOCRATIC REPUBLIC OF THE CONGO (2019)
Client: Piteau Associates
Position: Engineering Geologist - The project encompassed the drilling of rotary core and trial pit excavations by means of a 40-ton excavator to investigate the overburden materials above an enriched ore deposit in the Democratic Republic of Congo (DRC). The nature and depth to the ore deposit necessitated the establishment of an open cast mine. The investigation was undertaken to determine the overburden properties for design input of cut slopes, haul roads and material utilization. Duan was responsible for 2 months on-site supervision while surveying and logging over 150 trial pits and 800 m of core from boreholes and was responsible for sample retrieval and laboratory testing supervision.

Umlazi and Amatikwe Housing Project, KwaZulu-Natal, SOUTH AFRICA (2019-2020)
Client: Asande Projects Consulting & Engineering
Position: Engineering Geologist - The project involves construction of low-cost housing in the areas of Umlazi and Amatikwe, near Durban in the KwaZulu-Natal Province. Geotechnical works comprises the site investigation, NHBRC classification of the site and the recommendations on foundation design. Duan was responsible for planning of site investigation, supervision of the site investigation, test pit logging and write up of the final geotechnical report. The total project costs are estimated to be R 150 million.

New Ermelo Housing Project, Mpumalanga, SOUTH AFRICA (2020-2021)
Client: Asande Projects Consulting & Engineering
Position: Engineering Geologist - The project involves construction of low-cost housing in the areas of New Ermelo, near Ermelo in the Mpumalanga Province. Geotechnical works comprises the site investigation, NHBRC classification of the site and the recommendations on foundation design. Duan was responsible for planning of site investigation, supervision of the site investigation, test pit logging and write up of the final geotechnical report. The total project costs are estimated to be R 1.3 billion.

PROFESSIONAL HISTORY

2019 (Oct) – to date:	GaGE Consulting (Pty) Ltd, Johannesburg –Engineering Geologist
2019(Jan)-2019(Sep):	RockSoil Consult – Engineering Geologist
2018 – 2019:	University of Pretoria, Geology Dept. – Lecturer for the following modules: Groundwater (GLY 265), Engineering Geology (GLY 363), Rock Mechanics (GLY 364)
2018 - 2019:	JL Van Rooy - Graduate Engineering Geologist

PROFESSIONAL STANDING, MEMBERSHIPS AND COMMITTEES

Registered Natural Scientist the South African Council for Natural Scientific Professions (SACNASP): PrSciNat 137543
Member of the South African Institute of Engineering and Environmental Geologists (SAIEG): MSAIEG 21/526
Water Research Commission – Karst Research Group K5/2326 (2018 – 2020)
Water Research Commission – Complex Vadose Zone Research Group K5/2826 (2020 – 2022*)
University of Pretoria – Geology Dept. External Examiner BSc and BSc(Hons) (2020-2022)

TECHNICAL QUALIFICATIONS

2020*	PhD Engineering Geology (**Candidate**)	University of Pretoria
2019	Master of Science (Engineering Geology)	University of Pretoria
2017	Bachelor of Science (Hons) (Engineering Geology)	University of Pretoria
2016	Bachelor of Science (Environmental and Engineering Geology)	University of Pretoria

TECHNICAL COURSES AND CONFERENCES PRESENTED

2022 **Presenter**, Kirkham Conference, Soil Science Society of America, Skukuza, Kruger National Park, South Africa.

2022 **Presenter**, Proceedings of the 20th International Conference on Soil Mechanics and Geotechnical Engineering, Sydney 2022.

2021 Attendee, Foundation Design for Housing: a short course presented by Stellenbosch University

2021 **Presenter**, Webinar on Vadose Zone Hydraulics and unsaturated soil mechanics, University of Pretoria

2020 Attendee, Construction Material Seminar, South African Institute of Engineering and Environmental Geologists (SAIEG), Salt Rock, South Africa.

2018 **Presenter**, Dolomite: (dis)solution 2018, SAICE Geotechnical Division/GSSA Groundwater Division/South African Institute of Engineering and Environmental Geologists/University of Pretoria, Pretoria, South Africa

TECHNICAL PUBLICATIONS

- **Swart, D**., Dippenaar, MA., Van Rooy JL., (2022) Identification of silts. Bulletin of Engineering Geology and the Environment.
- Dippenaar, MA., Jones BR., Van Rooy JL., Maoyi M., **Swart, D**. (2022) The Karst Vadose Zone: Influence on Recharge, Vulnerability and Surface Stability. Water Research Commission Report No. TT 869/21.
- **Swart, D**., Gaspar, T.A.V., & Dippenaar, M. (2022). Testing of hydromechanical properties of the variable saturated residual dolomite (wad). Proceedings of the 20th International Conference on Soil Mechanics and Geotechnical Engineering, Sydney.
- Dippenaar, MA., **Swart, D.**, Van Rooy JL., Diamond RE. (2019) The Karst Vadose Zone: Influence on Recharge, Vulnerability and Surface Stability. Water Research Commission Report No. TT 779/19.
- **Swart, D**., Dippenaar, M., & Van Rooy, J. (2019). Mechanical and hydraulic properties of residual dolomite and wad. South African Journal of Geology, 122(3).
- **Swart, D** (2019). Hydromechanical Properties of wad and residual dolomite. Proceedings of the 7th African Young Geotechnical Engineers Conference, 7-12.

Appendix C. Environmental Impact Assessment (EIA) Methodology

1 ENVIRONMENTAL IMPACT ASSESSMENT (EIA) METHODOLOGY

The Environmental Impact Assessment (EIA) Methodology assists in evaluating the overall effect of a proposed activity on the environment. Determining of the significance of an environmental impact on an environmental parameter is determined through a systematic analysis.

1.1 Determination of Significance of Impacts

Significance is determined through a synthesis of impact characteristics which include context and intensity of an impact. Context refers to the geographical scale (i.e. site, local, national or global), whereas intensity is defined by the severity of the impact e.g. the magnitude of deviation from background conditions, the size of the area affected, the duration of the impact and the overall probability of occurrence. Significance is calculated as shown in **Table 1**.

Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. The total number of points scored for each impact indicates the level of significance of the impact.

1.2 Impact Rating System

The impact assessment must take account of the nature, scale and duration of effects on the environment and whether such effects are positive (beneficial) or negative (detrimental). Each issue / impact is also assessed according to the various project stages, as follows:

- Planning;
- Construction;
- Operation; and
- Decommissioning.

Where necessary, the proposal for mitigation or optimisation of an impact should be detailed. A brief discussion of the impact and the rationale behind the assessment of its significance has also been included.

The significance of Cumulative Impacts should also be rated (As per the Excel Spreadsheet Template).

1.2.1 Rating System Used to Classify Impacts

The rating system is applied to the potential impact on the receiving environment and includes an objective evaluation of the possible mitigation of the impact. Impacts have been consolidated into one (1) rating. In assessing the significance of each issue the following criteria (including an allocated point system) is used:

Table 1: Rating of impacts criteria

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		
Include a brief description of the impact of environmental parameter being assessed in the context of the project. This criterion includes a brief written statement of the environmental aspect being impacted upon by a particular action or activity (e.g. oil spill in surface water).		
EXTENT (E)		
This is defined as the area over which the impact will be expressed. Typically, the severity and significance of an impact have different scales and as such bracketing ranges are often required. This is often useful during the detailed assessment of a project in terms of further defining the determined.		
1	Site	The impact will only affect the site
2	Local/district	Will affect the local area or district
3	Province/region	Will affect the entire province or region
4	International and National	Will affect the entire country
PROBABILITY (P)		
This describes the chance of occurrence of an impact		
1	Unlikely	The chance of the impact occurring is extremely low (Less than a 25% chance of occurrence).
2	Possible	The impact may occur (Between a 25% to 50% chance of occurrence).
3	Probable	The impact will likely occur (Between a 50% to 75% chance of occurrence).
4	Definite	Impact will certainly occur (Greater than a 75% chance of occurrence).
REVERSIBILITY (R)		
This describes the degree to which an impact on an environmental parameter can be successfully reversed upon completion of the proposed activity.		
1	Completely reversible	The impact is reversible with implementation of minor mitigation measures
2	Partly reversible	The impact is partly reversible but more intense mitigation measures are required.
3	Barely reversible	The impact is unlikely to be reversed even with intense mitigation measures.
4	Irreversible	The impact is irreversible and no mitigation measures exist.
IRREPLACEABLE LOSS OF RESOURCES (L)		
This describes the degree to which resources will be irreplaceably lost as a result of a proposed activity.		
1	No loss of resource.	The impact will not result in the loss of any resources.
2	Marginal loss of resource	The impact will result in marginal loss of resources.
3	Significant loss of resources	The impact will result in significant loss of resources.
4	Complete loss of resources	The impact is result in a complete loss of all resources.
DURATION (D)		
This describes the duration of the impacts on the environmental parameter. Duration indicates the lifetime of the impact as a result of the proposed activity.		

1	Short term	The impact and its effects will either disappear with mitigation or will be mitigated through natural process in a span shorter than the construction phase (0 – 1 years), or the impact and its effects will last for the period of a relatively short construction period and a limited recovery time after construction, thereafter it will be entirely negated (0 – 2 years).
2	Medium term	The impact and its effects will continue or last for some time after the construction phase but will be mitigated by direct human action or by natural processes thereafter (2 – 10 years).
3	Long term	The impact and its effects will continue or last for the entire operational life of the development, but will be mitigated by direct human action or by natural processes thereafter (10 – 50 years).
4	Permanent	The only class of impact that will be non-transitory. Mitigation either by man or natural process will not occur in such a way or such a time span that the impact can be considered transient (Indefinite).
INTENSITY / MAGNITUDE (I / M)		
Describes the severity of an impact (i.e. whether the impact has the ability to alter the functionality or quality of a system permanently or temporarily).		
1	Low	Impact affects the quality, use and integrity of the system/component in a way that is barely perceptible.
2	Medium	Impact alters the quality, use and integrity of the system/component but system/ component still continues to function in a moderately modified way and maintains general integrity (some impact on integrity).
3	High	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component is severely impaired and may temporarily cease. High costs of rehabilitation and remediation.
4	Very high	Impact affects the continued viability of the system/component and the quality, use, integrity and functionality of the system or component permanently ceases and is irreversibly impaired (system collapse). Rehabilitation and remediation often impossible. If possible rehabilitation and remediation often unfeasible due to extremely high costs of rehabilitation and remediation.
SIGNIFICANCE (S)		
Significance is determined through a synthesis of impact characteristics. Significance is an indication of the importance of the impact in terms of both physical extent and time scale, and therefore indicates the level of mitigation required. This describes the significance of the impact on the environmental parameter. The calculation of the significance of an impact uses the following formula: **Significance = (Extent + probability + reversibility + irreplaceability + duration) x magnitude/intensity.**		

The summation of the different criteria will produce a non-weighted value. By multiplying this value with the magnitude/intensity, the resultant value acquires a weighted characteristic which can be measured and assigned a significance rating.		
Points	**Impact Significance Rating**	**Description**
5 to 23	Negative Low impact	The anticipated impact will have negligible negative effects and will require little to no mitigation.
5 to 23	Positive Low impact	The anticipated impact will have minor positive effects.
24 to 42	Negative Medium impact	The anticipated impact will have moderate negative effects and will require moderate mitigation measures.
24 to 42	Positive Medium impact	The anticipated impact will have moderate positive effects.
43 to 61	Negative High impact	The anticipated impact will have significant effects and will require significant mitigation measures to achieve an acceptable level of impact.
43 to 61	Positive High impact	The anticipated impact will have significant positive effects.
62 to 80	Negative Very high impact	The anticipated impact will have highly significant effects and are unlikely to be able to be mitigated adequately. These impacts could be considered "fatal flaws".
62 to 80	Positive Very high impact	The anticipated impact will have highly significant positive effects.

The table below is to be represented in the Impact Assessment section of the report. The excel spreadsheet template can be used to complete the Impact Assessment.

Table 2: Rating of impacts template and example

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
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 D. Impact Rating Tables

BASIC ASSESSMENT (BA) FOR THE PROPOSED CONSTRUCTION AND OPERATION OF THE HENDRINA NORTH 132KV POWERLINE TO HENDRINA POWER STATION IN THE MPUMALANGA PROVINCE OF SOUTH AFRICA DESKTOP GEOTECHNICAL SPECIALIST STUDY																					
ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Construction Phase (Corridor 1)																				
Disturbance/ displacement/ removal of soil and rock	Ground disturbance during access road construction, foundation earthworks, platform earthworks	1	4	2	2	3	1	12	-	Low	1) Design access roads and post locations to minimise earthworks and levelling based on high resoultion ground contour information 2) Correct topsoil and spoil management	1	4	2	1	3	1	11	-	Low
Soil Erosion	Increased erosion due to vegetation clearing, alteration of natural drainage	1	4	2	2	2	1	11	-	Low	1) Avoid development in preferential drainage paths 2) Appropriate engineering design of road drainage and watercourse crossings 3) Temporary berms and drainage channels to divert surface runoff where needed 4) Landscape and rehabilitate disturbed areas timeously (e.g. regressing) 5) Use designated access and laydown areas only to minimise disturbance to surrounding areas	1	2	1	1	2	1	7	-	Low
Construction Phase (Corridor 2)																				
Disturbance/ displacement/ removal of soil and rock	Ground disturbance during access road construction, foundation earthworks, platform earthworks	1	3	2	2	3	1	11	-	Low	1) Design access roads and post locations to minimise earthworks and levelling based on high resoultion ground contour information 2) Correct topsoil and spoil management	1	3	2	1	3	1	10	-	Low

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Soil Erosion	Increased erosion due to vegetation clearing, alteration of natural drainage	1	3	2	2	2	1	10	-	Low	1) Avoid development in preferential drainage paths 2) Appropriate engineering design of road drainage and watercourse crossings 3) Temporary berms and drainage channels to divert surface runoff where needed 4) Landscape and rehabilitate disturbed areas timeously (e.g. regressing) 5) Use designated access and laydown areas only to minimise disturbance to surrounding areas	1	2	1	1	2	1	7	-	Low
Operational Phase (Corridor 1)																				
Soil Erosion	Increased erosion due to alteration of natural drainage	1	2	1	1	2	1	7	-	Low	1) Maintain access roads including drainage features 2) Monitor for erosion and remediate and rehabilitate timeously	1	1	1	1	2	1	6	-	Low
Operational Phase (Corridor 2)																				
Soil Erosion	Increased erosion due to alteration of natural drainage	1	2	1	1	2	1	7	-	Low	1) Maintain access roads including drainage features 2) Monitor for erosion and remediate and rehabilitate timeously	1	1	1	1	2	1	6	-	Low
Decommissioning Phase (Corridor 1)																				
Disturbance/ displacement/ removal of soil and rock	Ground disturbance during access road construction, foundation earthworks, platform earthworks	1	4	2	2	2	1	11	-	Low	1) Restore natural site topography 2) Landscape and rehabilitate access roads and disturbed areas timeously (e.g. regressing)	1	4	2	1	2	1	10	-	Low
Soil Erosion	Increased erosion due to vegetation clearing, alteration of natural drainage	1	2	2	2	2	1	9	-	Low	1) Temorary berms and drainage channels to divert surface runoff where needed 2) Restore natural site topography 3) Use designated access and laydown areas only to minimise disturbance to surrounding areas	1	1	1	1	2	1	6	-	Low
Decommissioning Phase (Corridor 2)																				

ENVIRONMENTAL PARAMETER	ISSUE / IMPACT / ENVIRONMENTAL EFFECT/ NATURE	ENVIRONMENTAL SIGNIFICANCE BEFORE MITIGATION									RECOMMENDED MITIGATION MEASURES	ENVIRONMENTAL SIGNIFICANCE AFTER MITIGATION								
		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S		E	P	R	L	D	I / M	TOTAL	STATUS (+ OR -)	S
Disturbance/ displacement/ removal of soil and rock	Ground disturbance during access road construction, foundation earthworks, platform earthworks	1	3	2	2	2	1	10	-	Low	1) Restore natural site topography 2) Landscape and rehabilitate access roads and disturbed areas timeously (e.g. regressing)	1	3	2	1	2	1	9	-	Low
Soil Erosion	Increased erosion due to vegetation clearing, alteration of natural drainage	1	2	2	2	2	1	9	-	Low	1) Temorary berms and drainage channels to divert surface runoff where needed 2) Restore natural site topography 3) Use designated access and laydown areas only to minimise disturbance to surrounding areas	1	1	1	1	2	1	6	-	Low