



Report to SiVEST SA (PTY) LTD  
Desktop Geotechnical Specialist Study for the:  
**PROPOSED LEEUDORINGSTAD 132KV POWERLINE  
NORTH WEST PROVINCE, SOUTH AFRICA**

**DEA Reference:**

**Report Prepared by:** GaGE Consulting (Pty) Ltd

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Report to:



SiVEST Environmental Division  
51 Wessel Road, Rivonia,  
2129

Project name:

Proposed Bonsmara Solar Photovoltaic (PV) Facility

Report title:

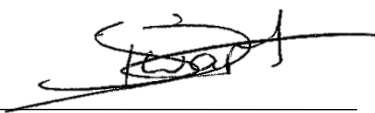

Desktop Geotechnical Specialist Study

Report number:

G0434

Revision	Date	Comment	Prepared by	Reviewed by
FO. FINAL	18/10/2022	Issued to client for review / distribution	DSW	SNB

Revision Details:

Report by:	Approved by:
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## **BASIC ASSESSMENT (BA) FOR THE PROPOSED DEVELOPMENT OF THE LEEUDORINGSTAD 132KV POWERLINE ASSESSMENT NEAR LEEUDORINGSTAD IN THE NORTH WEST PROVINCE, SOUTH AFRICA DESKTOP GEOTECHNICAL SPECIALIST STUDY**

### **Executive Summary**

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This desktop geotechnical specialist study was undertaken for the development of the Leeudoringstad 132kV powerline in the North West Province. The site area is underlain by mafic lavas of the Ventersdorp Supergroup. Residual soils are common in this climate zone and area expected to occur throughout the site. These soils are anticipated to be clayey and possesses swell-shrink behaviour with change in moisture (Brink, 1979). The thickness of this residual soil is variable but will most likely a few metres thick (Brink, 1979). The route alignment transverse streams and wetlands. Ferricrete will exist at the site but will be variable in thickness, depth and degree of development. 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.

Both corridor alignments have the same impact rating and neither alignment is preferred from a geological and geotechnical perspective.

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

**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 <i>gazetted</i> 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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## 1. Introduction

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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 Leeudoringstad solar plants to the Vaal reef ten Power Station. The EA that is required for the proposed grid connection is as follows:

Leeudoringstad 132kV Power Line to Vaal Reef Ten Power Station, North West Province, South Africa.

The proposed Leeudoringstad 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 proposed Project involves the construction and operation of electricity distribution infrastructure, to connect the proposed Leeudoringstad solar plants to the Vaal reef ten Power Station. 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 North West Department of Economic Development, Environment, Conservation and Tourism (NW DEDECT).

### 1.1. Scope and Objectives

Assess the impacts associated with the installation of the Leeudoringstad 132kV powerline is to facilitate the connection for the Leeudoringstad solar plants.

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 Leeudoringstad 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 2726 Kroonstad and 2626 West 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

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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

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### 3.1. Project Location

The proposed Leeudoringstad powerline is located approximately 20 km north-east from the town of Leeudoringstad, in North West Province. The site will fall within the Maquassi Hills Local Municipality within the Dr Kenneth Kaunda District Municipality in the North West Province. The site is accessible via an existing gravel road which branches off the tarred R502 Provincial Road.

The powerline will cross farm portions of the following Farms:

- Farm Leeuwbosch
- Farm Zwartlaagte
- Farm Matjiespruit
- Farm Nevada Vaal
- Farm Klerksdrift
- Farm Yzerspruit
- Farm Wolvehuis
- Farm Goedgenoeg

The general location is shown in Figure 3-1.



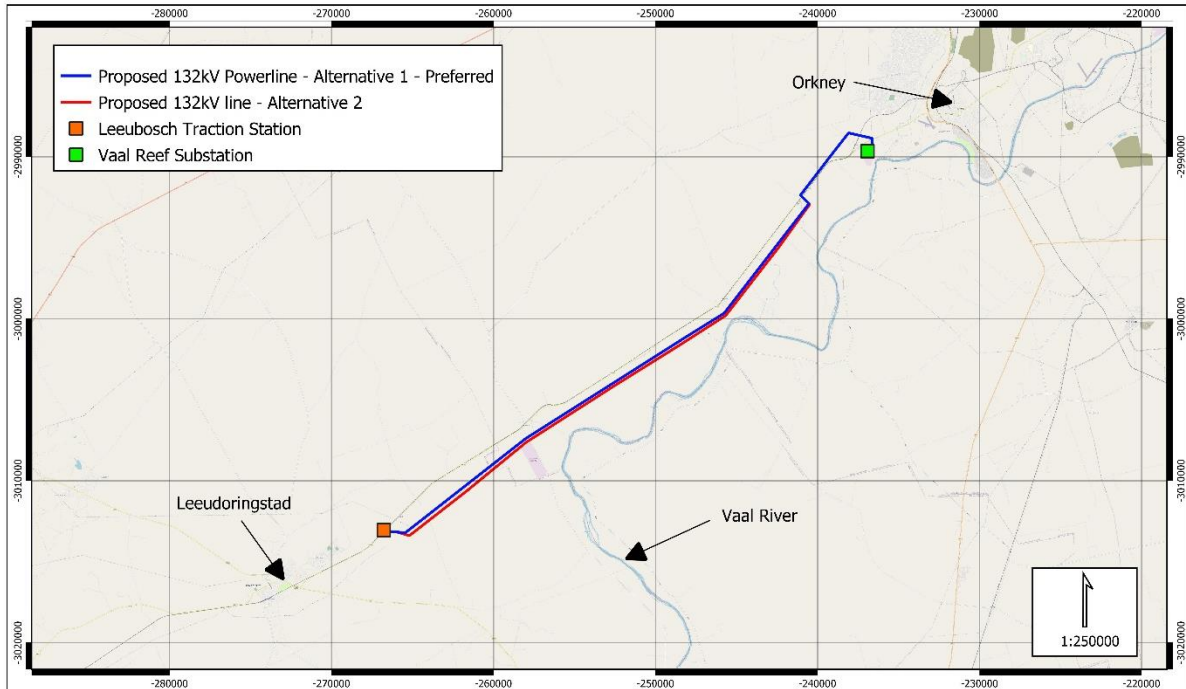


Figure 3-1 Location of the proposed Leeudoringstad powerline alignments

### 3.2. Project Description

In order to enable the evacuation of the generated power from the Leeuwbosch Traction Substation to the existing Vaal Reef ten Substation two alternative powerlines (within a 300m wide corridor) are to be assessed.

#### 3.2.1. Project Components

The proposed powerline (up to and including 132kV) to Vaal Reef ten Power Station will be ~42km 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 two alternatives to connect the Leeuwbosch Traction Substation to the Vaal Reef ten Substation, North West Province.

The dedicated 132 kV power line will connect the Solar plant to Vaalreefs Substation. The powerline will be around 42 km long depending on the exact route. The servitude width for a 132kV distribution line is 31m (15.5m on either side of the centre line of the power line). These alternatives will be considered and assessed as part of the Basic Assessment Process. 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 Leeudoringstad 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

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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

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

### 5.1. Climate

The area surrounding Leeudoringstad is considered to be a local steppe climate. There is little rainfall throughout the year. The area is considered to be a hot, semi-arid, climate (BSh) according to the Köppen-Geiger climate classification. The average annual rainfall is 593 mm with the average temperatures of 18.1°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 4.5, 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 3° at small valleys and ridges. The proposed routes general follow contour elevations. The site exists between the elevations of 1280 m to 1320 m above mean sea level (AMSL). The undulations are caused from erosion into underlying bedrock which has formed stream generally flowing onto a southerly direction into the Vaal River. The site drainage is expected to occur as sheetwash and subsurface flow, becoming concentrated flow into existing streams, before entering the Vaal River.

The site topography is shown in Figure 5-1.

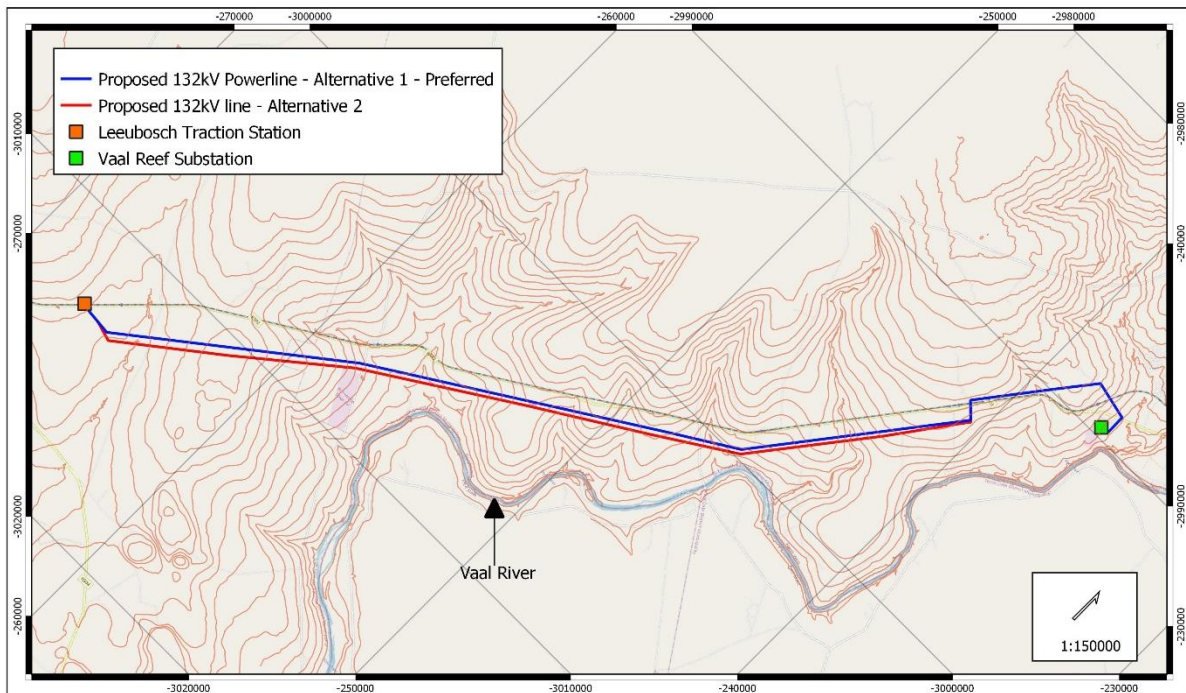


Figure 5-1 Site topography

## 5.3. Seismicity

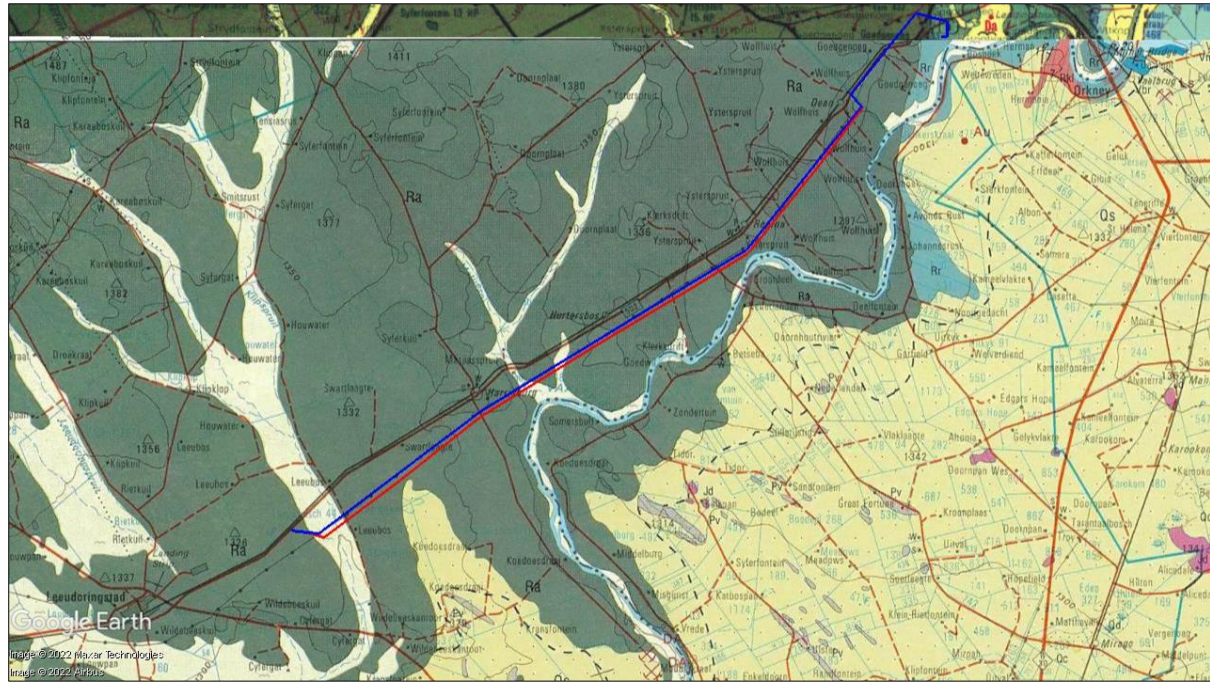
According to the Seismic Hazard Map of South Africa (SANS 10160-4, 2017), the peak ground acceleration is approximately 0.2 g for the site. The peak ground acceleration may be described as the maximum acceleration of the ground shaking during an earthquake, which has a 10% probability of being exceeded in a 50-year period.

The site is within seismic hazard Zone II as per SANS 10160-4 (2017) – regions of mine-induced and natural seismic activity.

## 5.4. Bedrock Geology

According to the 1:250 000 2726 Kroonstad and 2626 West Rand geological sheets, the proposed assessments is underlain by amygdaloidal lava and other mafic lava forming part of the Ventersdorp Supergroup. Locally, areas are underlain by thick, unconsolidated, alluvium material within the streams which the route alignment traverses.

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
Ra	Randian	Ventersdorp	-	Allanridge	-	Amygdaloidal lava
Rr			Platberg	Rietgat	-	Lava, chert and tuff

Figure 5-2 The regional geology of the site

### 5.5. Engineering Geology

The site area is underlain by mafic lavas of the Ventersdorp Supergroup. Residual soils are common in this climate zone and area expected to occur throughout the site. These soils are anticipated to be clayey and possess swell-shrink behaviour with change in moisture (Brink, 1979). The thickness of this residual soil is variable but will most likely be a few metres thick (Brink, 1979).

The residual soils will be covered by relatively thin colluvium soils comprising silty fine sand when not near streams. The colluvium and upper residual soils are expected to be reworked and ferruginised. If the ferricrete is strongly cemented and approximately 1.00 to 2.00 m thick, it may diminish the severe heave expected from the residual soils at depth. Ferricrete usually occurs on the midslopes and adjacent to streams.

Figure 5-3 shows the areas in South Africa where severe heave is expected. Note, the site area falls within this zone.



Figure 5-3 Map of potentially unstable soils in South Africa (Taken from NHBRC HBM, 2015)

The lower-lying valleys, defined by streams, is expected to comprise thick (>1.50 m), unconsolidated, alluvium material. The alluvium material may be clayey sand to clayey material. Since the streams are small, the alluvium material is anticipated to behave similarly to the local residual material, and therefore may possess shrink-swell properties.

Any steep slopes or slope instabilities are not expected anywhere within the site area.

#### 5.6. Desktop Geotechnical Appraisal

Based on the desktop study, the assessment areas may be divided into three (3No.) Ground Units (GU), I, II and III. The assessment covered a 300 m wide (150 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	Clayey residuum cover by transported material	<ul style="list-style-type: none"> <li>• Silty sand transported soil on surface</li> <li>• Locally occurring, variably cemented ferricrete at depths between 0.50 m to 2.00 m BGL</li> <li>• Residual soils clayey</li> <li>• Expected medium to high expansive potential soil material at depth</li> <li>• Localised shallow subsurface water seepage within ferricrete horizon</li> </ul>	<ul style="list-style-type: none"> <li>• Generally good founding conditions for structures when ferricrete is well-cemented</li> <li>• Not good founding conditions on residual soil</li> <li>• Removal and spoil of residual material when at founding depth</li> <li>• Importing of G7 or better and earth works required at founding level when existing in residual soils</li> <li>• Conventional soil raft required at founding depth</li> <li>• Conventional pad footing on soil raft</li> </ul>
II	Thick alluvium material adjacent and within streams	<ul style="list-style-type: none"> <li>• Thick, soft to loose, alluvium material</li> <li>• Sub surface water seepage adjacent to stream</li> <li>• Surface water flow within streams</li> </ul>	<ul style="list-style-type: none"> <li>• Design powerline posts to exist outside the stream centre line</li> <li>• Removal and spoil of clayey alluvium material if at founding depth</li> <li>• Importing of G7 or better and earth works required at founding level when existing in clayey alluvium</li> <li>• Deep pad footings on imported soil raft</li> </ul>
III	Wetlands / water bodies	<ul style="list-style-type: none"> <li>• Thick, soft to loose, wetland soils</li> <li>• Sub surface water seepage adjacent to wetland area</li> <li>• Surface water within wetlands during and after heavy rainfall</li> <li>• Well-developed ferricrete adjacent to wetlands</li> </ul>	<ul style="list-style-type: none"> <li>• Design powerline posts to exist outside the wetland areas</li> <li>• Removal and spoil of wetland soils if at founding depth</li> <li>• Importing of G7 or better and earth works required at founding level when existing in wetland soils</li> <li>• Deep pad footings on imported soil raft</li> </ul>

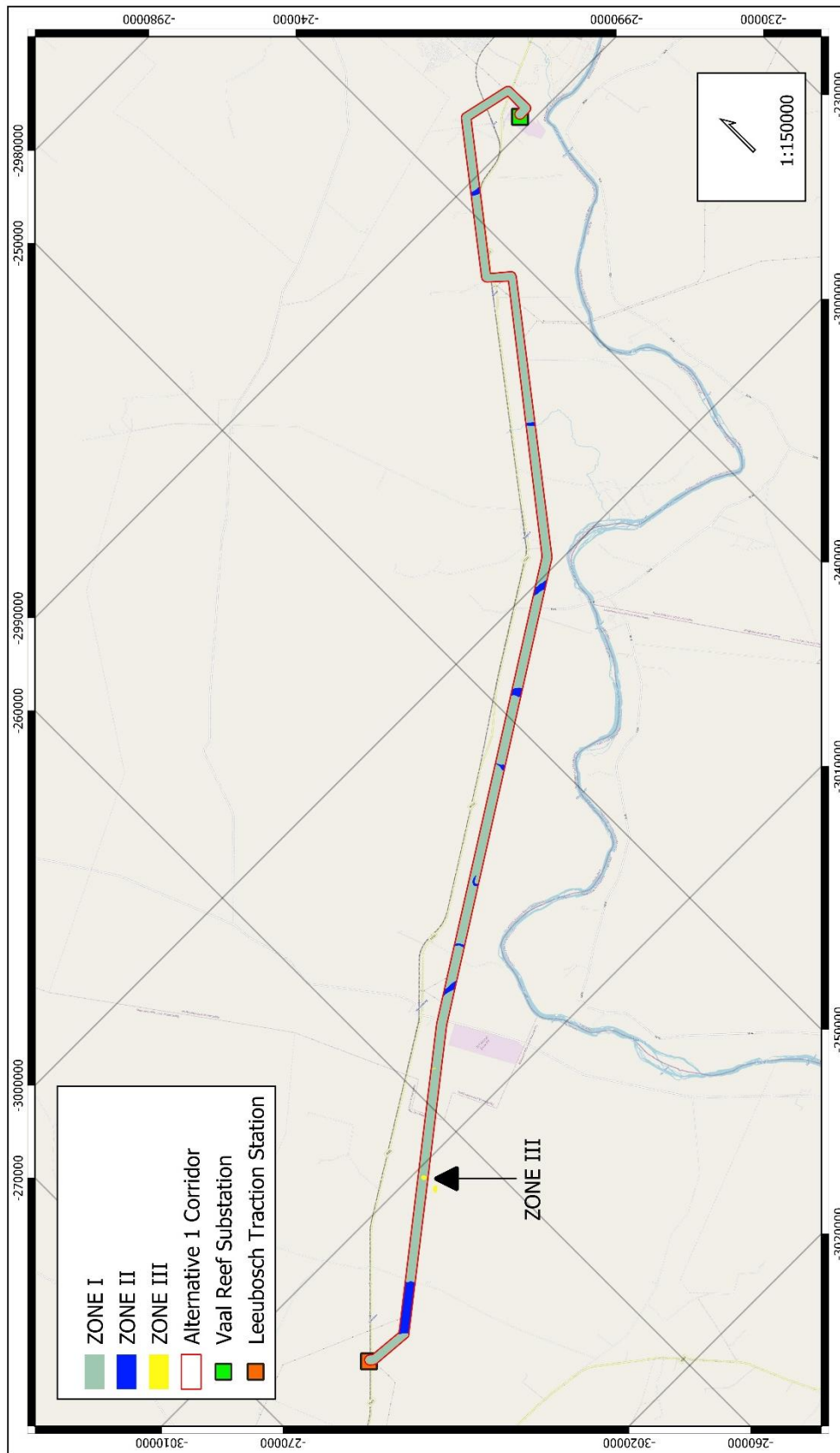


Figure 5-4 Geotechnical Desktop Zonation for Alternative 1 Corridor

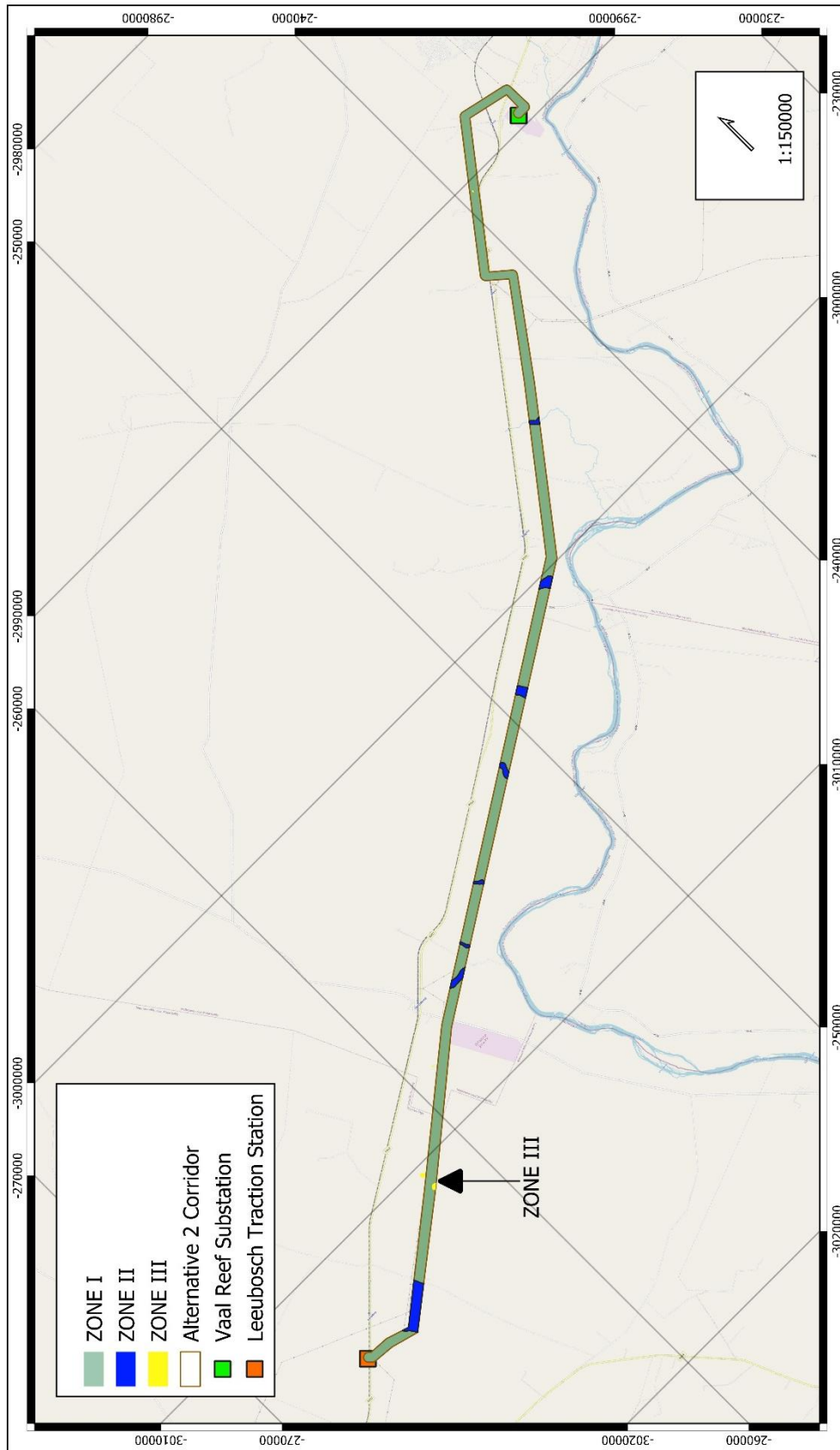


Figure 5-5 Geotechnical Desktop Zonation for grid infrastructure



## 6. Identification and Assessment of Impacts

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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. Both corridor options results in the same expected impact and neither are preferred from a geological and geotechnical perspective.

### 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. 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. 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 Leeudoringstad 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. Both corridor options have the same impact rating, and neither are preferred from a geotechnical perspective.

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.

Detailed geotechnical materials investigations should be undertaken to assess the suitability of the in-situ ferricrete materials and the need for processing (e.g. crushing, stabilisation). The expansive potential and thickness of the residual soils 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

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There are no alternatives provided at this stage.

## 8. Conclusion and Summary

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### 8.1. Summary of Findings

This desktop geotechnical specialist study was undertaken for the development of the Leeudoringstad 132kV powerline in the North West Province. The site area is underlain by mafic lavas of the Ventersdorp Supergroup. Residual soils are common in this climate zone and area expected to occur throughout the site. These soils are anticipated to be clayey and possess swell-shrink behaviour with change in moisture (Brink, 1979). The thickness of this residual soil is variable but will most likely be a few metres thick (Brink, 1979). The route alignment transverse streams and wetlands. Ferricrete will exist at the site but will be variable in thickness, depth and degree of development. 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.

Both corridor alignments have the same impact rating and neither alignment is preferred from a geological and geotechnical perspective.

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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Brink, A.B.A. Engineering Geology of Southern Africa, The first 2 000 million years of geological time, Volume 1. Building Publications, 1979.

Brink, A.B.A. Engineering Geology of Southern Africa, Post-Gondwana Deposits, Volume 4. Building Publications, 1985.

Johnson, M.R. Anhaeusser, C.R. Thomas, R.J. The Geology of South Africa. Council for Geoscience, 2006.

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 DEVELOPMENT OF THE LEEUDORINGSTAD 132KV POWERLINE ASSESSMENT NEAR LEEUDORINGSTAD IN THE NORTH WEST PROVINCE, 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.
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Pretoria  
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Department of Environmental Affairs  
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473 Steve Biko Road  
Arcadia

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

18/10/2022  
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

---

18/10/2022

---

Date

GUSTAF SWART PLS 1444 (PROFESSIONAL LAND SURVEYOR)



---

Signature of the Commissioner of Oaths

18/10/2022

---

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 EXPERIENCE**

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 Schoemansklouf 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 ( <b>Candidate</b> )	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 20<sup>th</sup> 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 7<sup>th</sup> 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





<b>ENVIRONMENTAL PARAMETER</b>		
A brief description of the environmental aspect likely to be affected by the proposed activity (e.g. Surface Water).		
<b>ISSUE / IMPACT / ENVIRONMENTAL EFFECT / NATURE</b>		
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).		
<b>EXTENT (E)</b>		
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
<b>PROBABILITY (P)</b>		
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).
<b>REVERSIBILITY (R)</b>		
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.
<b>IRREPLACEABLE LOSS OF RESOURCES (L)</b>		
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.
<b>DURATION (D)</b>		
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.







# Appendix D. Impact Rating Tables

**BASIC ASSESSMENT (BA) FOR THE PROPOSED DEVELOPMENT OF THE LEEUDORINGSTAD 132KV POWERLINE ASSESSMENT NEAR LEEUDORINGSTAD IN THE NORTH WEST PROVINCE, 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
<b>Construction Phase (Corridor 1)</b>																				
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 resolution 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
<b>Construction Phase (Corridor 2)</b>																				
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 resolution ground contour information 2) Correct topsoil and spoil management	1	4	2	1	3	1	11	-	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	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
<b>Operational Phase (Corridor 1)</b>																				
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
<b>Operational Phase (Corridor 2)</b>																				
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
<b>Decommissioning Phase (Corridor 1)</b>																				
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

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	2	2	2	2	1	9	-	Low	1) Temporary 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
<b>Decommissioning Phase (Corridor 2)</b>																				
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) Temporary 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