Eskom	Scope	Transmission

Title:	**Igesi Makalu: Scope of Works for Specialised Geotechnical Assessment of Undermined Land**	Unique Identifier:	**LES 1787**
		Alternate Document Number:	**N/A**
		Area of Applicability:	**Transmission**
		Documentation Type:	**Scope**
		Revision:	**1.0**
		Total Pages:	**12**
		Next Review Date:	**NA**
		Disclosure Classification:	**CONTROLLED DISCLOSURE**

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Date: 22/06/2023	Date: 22/06/2023	Date: 23/06/2023

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Revision Control:

Revision	Change Log	Date
0.1	Document outlining scope of works for Rock Engineering Assessment of historically undermined area	June 2023
1.0	Document outlining scope of works for Rock Engineering Assessment of historically undermined area	June 2023

1. INTRODUCTION

In March 2023, the *Employer* was made aware that a portion of the Igesi Makalu 1 275kV / Lethabo Igesi 1 275kV proposed line parallel routes had been subject to historical undermining (Refer Figure 1-1). The undermining had occurred approximately 35 years ago and had resulted in localised areas of subsidence in the area. Approximately of 1.2km of powerline i.e., 8 proposed tower positions are impacted (Refer Figure 1-2).

The *Employer* requires the services of a Professionally Registered Rock Engineer to:

1. assess the undermined area within the area of influence of the proposed infrastructure;
2. verify the undermining information received and;
3. propose and detail ground remediation methods for the undermined land or recommend alternate infrastructure positions (as needed).

The full scope of works is detailed within this document.

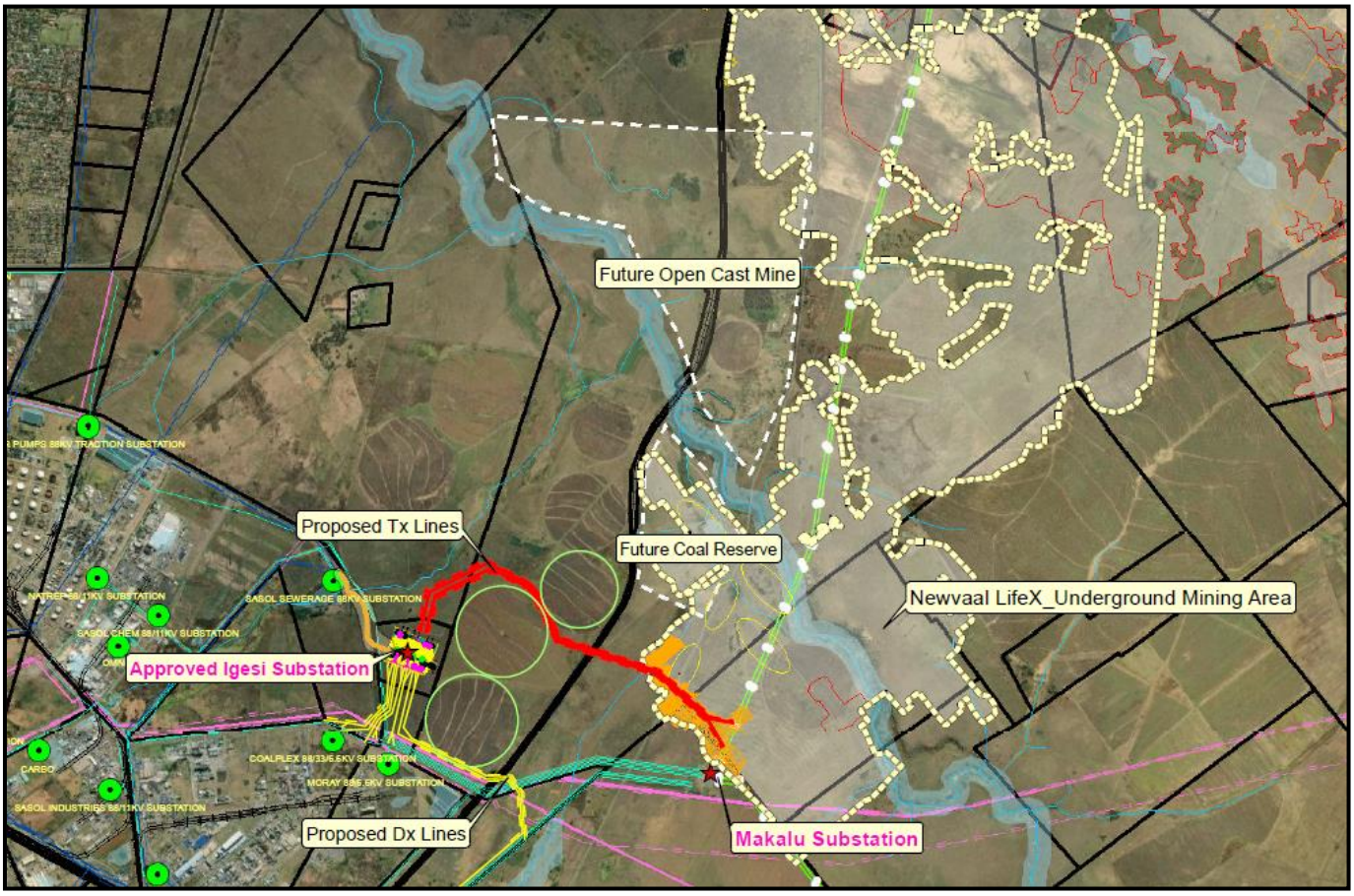

Figure 1-1 Igesi Makalu 1/Lethabo Igesi 1 275kV: Area Layout depicting Undermining

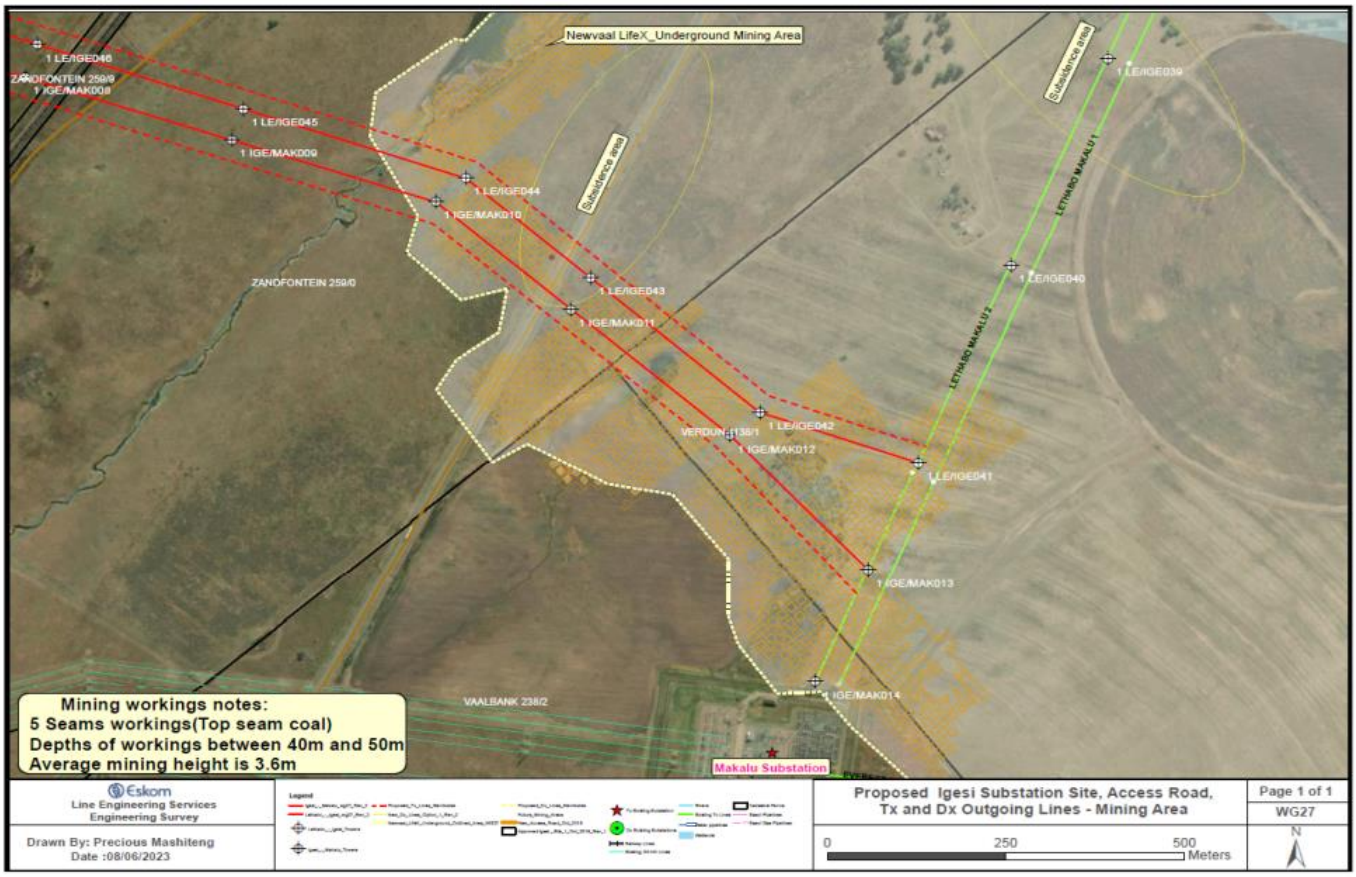

Figure 1-2 Igesi Makalu 1/Lethabo Igesi 1 275kV Layout indicating affected tower positions

2. SUPPORTING CLAUSES

2.1 SCOPE OVERVIEW

The *Works* comprises of a site walkover, ground surface and sub-surface assessment by intrusive and non-intrusive methods; including by not limited to; LIDAR survey review (provided by *Employer*), topographical survey, satellite imagery, desk study, geological drilling, laboratory testing.

The *Contractors* professionally registered Rock Engineer conducts the *works*.

The *Contractor* provides all equipment and resources required to execute the *Works*.

2.1.1 Purpose

The *Contractor*:

a) Confirm undermining information provided by the *Employer* for the impacted area (i.e. ground truthing by intrusive and non-intrusive methods);

b) Ensures alignment to guidelines, standards and legislature.

c) Details methods for ground improvement or infrastructure relocation (as needed).

d) Provides safety measures (as needed).

e) Obtains necessary licenses and approvals (as needed).

f) Appoints and ensures that all parties working within Eskom servitudes must conduct works under supervision of an allocated, qualified authorized persons (as per [5]).

g) All equipment working near live powerlines must be earthed as outlined in Annex C of [4] below.

h) All equipment used for repair works purposes must adhere to the necessary equipment height and width clearances requirements as advised by the *Employer* and Authorised Person.

2.1.2 Applicability

This document applies to the Igesi Makalu 275kV project.

2.2 NORMATIVE/INFORMATIVE REFERENCES

Parties using this document apply the most recent edition of the documents listed in the following paragraphs.

2.2.1 Normative

[1] All *works* are conducted in accordance with the requirements of the Occupational Health and Safety Act (Act 85 of 1993) as amended

[2] The successful tenderer conforms to all relevant legislation, whether natural, social, cultural or technical, and shall liaise with the appropriate authorities if required.

2.2.2 Informative

[3] 240-80605256: Access to Private Property Standard

[4] 240-47172520: “The Standard for the Construction of Overhead Powerlines (TRMSCAAC 6.0)

[5] 240-114967625: “Operating Regulations for High Voltage Systems (ORHVS)”

2.3 DEFINITIONS

2.3.1 Classification

Controlled disclosure: controlled disclosure to external parties (either enforced by law, or discretionary).

2.3.2 Definitions

Definitions	Description
Professionally Registered Rock Engineer	Professional Engineer/Scientist working in surface and underground Coal Mining industry with the SANIRE (South African National Institute for Rock Engineering), SAIMM (South African l Institute of Mining and Metallurgy) and Chamber of Mines Rock Mechanics/Engineering accreditations.

2.4 ABBREVIATIONS

Abbreviation	Description
DX	Distribution Division
HV	High Voltage
LES	Lines Engineering Services
OSH	Occupational Health and Safety
ORHVS	Operating Regulations for High Voltage Systems
PPE	Personal Protective Equipment
SAIMM	South African l Institute of Mining and Metallurgy
SANAS	South African National Accreditation System
SANIRE	South African National Institute for Rock Engineering
SANS	South African National Standards
SHEQ	Safety Health Environment and Quality
TX	Transmission Division

2.5 ROLES AND RESPONSIBILITIES

The *Contractor*:

a) provides adequate resources including provision of equipment for required *Works*;
b) receives undermining information from the *Employer* and confirms the validity thereof;
c) ensures all materials and ground checks are conducted timeously and recorded adequately;
d) manages cost and a scheduled time frame of work;
e) ensures the scope is carried out in full;
f) provides regular feedback on the status of the works;
g) ensures that all site work is undertaken by a Professionally Registered Rock Engineer;
h) ensures that prior to any works, all parties working on site familiarized themselves with the Employer's safety requirements and the Occupational Health and Safety (OSH) Act (85 of 1993);
i) ensures all works complies with applicable licenses and authorisations;
j) obtains all necessary approvals and acceptances (as needed);
k) applies his discretion in conducting works in areas of subsidence;
l) ensures that, should the ground conditions exhibit notable changes, the *Employer* is informed promptly;
m) notifies the *Employer* as soon as possible, if any impedance or ruptured services is encountered;
n) ensures that all work conducted in close proximity to live lines within Eskom servitude is conducted under the supervision of an Authorised Person (as needed);
o) must ensure that all equipment has maintained required height and width clearances as advised by the *Employer* and the Authorised Person (as needed);
p) must ensure that all equipment has been earthed to the satisfaction of the *Employer* (see [4] Annexure C) (as needed);
q) ensures the successful implementation of ground truthing and ground remediation/infrastructure relocation (as required);

2.6 PROCESS FOR MONITORING

a) The *Contractor* provides weekly progress updates and ensures that regular meetings are conducted to inform the *Employer* of progress and developments with regard to the Rock Engineers assessment.

2.7 TOWER DETAILS

a) Affected tower Co-ordinates:

Tower Number	X Easting (m)	Y Northing (m)	Centerline Z Elevation (m)
IGE/MAK 010	89999.024	-2967513.497	1436.740
IGE/MAK 011	90188.055	-2967677.570	1443.281
IGE/MAK 012	90409.810	-2967870.046	1446.537
IGE/MAK 013	90603.239	-2968075.431	1449.708
LE/IGE 044	90040.906	-2967477.022	1435.921
LE/IGE 043	90215.337	-2967628.734	1442.463
LE/IGE 042	90451.882	-2967834.469	1445.695
LE/IGE 041	90673.367	-2967912.120	1445.030

b) Minimum safe working clearance for TX Line: 3.0 m (with an Authorised Person)
c) Minimum safe working clearance for DX Line: 1.5m (with an Authorised Person)
All powerline clearances will need to be confirmed by relevant personnel prior to commencement of fieldworks.

3. SAFETY, HEALTH, ENVIRONMENT AND QUALITY (SHEQ)

The *Contractor*:

a) Submits a Safety File for acceptance by the *Employer* before commencement of the Works.
b) Submits a Safe Work Procedure (SWP) for acceptance by the *Employer* before commencement of the Works.
c) Ensures that all personnel are familiar with the Employers Health and Safety induction, and Personal Protective Equipment (PPE) requirements before commencement of the Works.
d) Identifies and submits strategic measures to execute works without contravening environmental compliances and/or guidelines put forth within South African National Standards and/or Legislation.
e) Ensures that all SHEQ activities are incorporated into the schedule.
f) If areas are deemed unstable, the *Contractors* Professionally Registered Rock Engineer must align to safety considerations as per required standards and guidelines.
g) Ensures that the SHEQ file must contain as a minimum:
    - Qualification/training requirements
    - PPE as identified by site Health, Safety and Environment personnel
    - Prevention/mitigation measures
    - Emergency procedures
    - Access
    - Equipment safety (working platforms etc) and earthing measures

4. RECIEVABLES

Upon contract award, the *Contractor* will receive:

a) Existing Undermining Information (KMZ)
b) LIDAR Survey
c) 240-47172520: “The Standard for the Construction of Overhead Powerlines (TRMSCAAC 6.0)
d) 240-114967625: “Operating Regulations for High Voltage Systems (ORHVS)”

5. ACCESS

Access to the servitude/ tower positions is done in accordance with the Access to Private Property Standard (240-80605256). The *Employers Project Manager* gives guidance to the *Contractor* regarding access to the powerline proposed route and proposed towers positions.

6. SITE WALKOVER

a) The *Contractor* (and necessary *Contractor* team members including the Professionally Registered Rock Engineer) conducts a site walkover for the affected areas.
b) The *Contractor* identifies areas of notable adjacent and bisecting infrastructure.
c) The *Contractor* identifies landform features and contributing environmental factors.
d) The *Contractor* makes provision for the works to not be encumbered by the overall site conditions and ensures that the works take into consideration to stability of the area, and necessary safety considerations.

7. GROUND TRUTHING

a) The Professionally Registered Rock Engineer is required to conduct a site walkover and desk study and employ intrusive and non-intrusive ground investigation methods to confirm and determine the extent and impact of historical undermining in the Igesi Makalu 275kV proposed line route area.
    a. Desktop empirical analysis of the current and future expected mining layouts and possible impacts on these layouts on the proposed future surface stability and the pylon foundations. This work will include an analysis of current and future pillar stability and scaling, effect of roof and / or floor deterioration and roof falls, possible modes of failure, roof and floor failure, modes of subsidence and the effect of all of these on the surface.
    b. The incidence and rate of weathering, mining techniques, surcharge loading, spontaneous combustion of coal and also current and future probable hydrological conditions is investigated and considered. During this analysis, any recommended mitigation factors required either to stabilize pillars, roof collapse or pylon foundations must be considered.
b) The Professionally Registered Rock Engineer is expected assess the LIDAR survey provided by the *Employer*. Conduct topographical survey and satellite imagery as required.
c) The Professionally Registered Rock Engineer is expected to conduct geological drilling works in the area to confirm the ground stability and/or undermining in area; and determine the geology and potential for competent load bearing layers.
    a. From sourced undermining information, the undermining comprises of five (5) seams at a depth of 40m to 50m below Natural Ground Level (NGL), average mining height 3.6m.
    b. A total of eight (8) structures are currently impacted (co-ordinates for impacted structures can be seen in Section 2.7 above).
    c. Additional drilling may be conducted at the discretion of the Professionally Registered Rock Engineer.

   d. Reasonable estimates will be made of the rock conditions using the Rock Mass Classification (RMR) system. Estimates of current and future stress conditions will be made and observations on the sustainability and longevity of the support systems used will be made.

d) Laboratory testing may be conducted at the discretion of the Professionally Registered Rock Engineer based on available information and site observation.
e) The Professionally Registered Rock Engineers report includes but is not limited to geotechnical risks due to surface instability and/or depression from mining, mining related activities and associated surface damage due to rat-holing and/or subsidence and/or any ground –related failures.
f) The Professionally Registered Rock Engineer must confirm if a surface expression of failure be limited to 1 pylon, or an entire pylon set (affecting both parallel lines)? [It should be noted that considerable surface disturbance implies that the surface expression of subsidence may not be the normally expected status quo (i.e., “rat-holing)]
g) The Professionally Registered Rock Engineer must also assess the area to be traversed by construction plant.
h) The Professionally Registered Rock Engineer determines if the *Employer* be able to perform safe routine maintenance on the powerlines in the undermined and subsidence affected areas. What conditions or procedures will need to be followed in order execute safe working procedures. This will need to be covered/considered from a geotechnical perspective and would need to be augmented by any site specific SHEQ procedures normally used by the *Employer*.
i) Prior to commencement, all drilling and required soil/rock testing must be accepted by the *Employer*.

8. RECOMMENDATIONS FOR GROUND REPAIR/SPECIALISED FOUNDATION SYSTEMS OR STRUCTURE RELOCATION

a) From the ground investigation findings, the Professionally Registered Rock Engineer recommends and details ground improvement methods or proposes infrastructure relocation to more stable ground conditions.
b) The Professionally Registered Rock Engineer advises on any reasonable interventions that can be performed to reduce the probability and consequence of subsidence or whether the timelines for failure be favorably altered.
c) The Professionally Registered Rock Engineer may also deem the need for specialised foundation systems.
d) Allowance must be made for the review of the foundation design documentation at Project Execution.
e) All recommendations are adequately detailed to allow for constructable implementation this includes material specifications and material quantities as well as placement methodologies and Quality Management (QM) items such as e.g., material testing frequencies and strength testing yields.
f) Designs are presented to the *Employer* for acceptance.

9. DELIVERABLES

a) The *Contractor*s Professionally Registered Rock Engineer assesses the area affected by undermining by intrusive and non-intrusive methods; and recommends and details ground remediation and/or infrastructure relocations.
b) The *Contractor*s Professionally Registered Rock Engineer manages all works on site and all outputs of sub-contracted works (as needed).
c) The *Contractor*s Professionally Registered Rock Engineer consolidates all field information and produces a comprehensive technical report of findings. The technical report contains:

a. Explanation of failure types and warning signs associated with the identification of failure types.
b. Time guidance for failure or unreasonably high risk of failure leading to the founding surface being too risky to enter.
c. A clear recommendation as to the level of risk of more than a single pylon or set of pylons collapsing. In addition to this, whether the proposed chosen tower locations have a stable footprint of up to 20m away from the base of a tower footing position.
d. Mining activity maps for the length of the proposed line route which include underground activity that detail column sizes, channel widths and lengths.
e. Recommendations and details of ground improvement or infrastructure relocation.
f. The Contractor provides a preliminary report and final report.
g. All documentation to be submitted in digital (word-friendly *.pdf format , shape files /Cad files) and hardcopy formats (2 x copies).
h. The Professionally Registered Rock Engineer presents the final report to the Employer at the Employers Design Review Team (DRT) meeting.

d) The *Contractor* ensures all works conducted by yellow plant at height in close-proximity to existing powerlines are overseen by the Contractors Authorised Person.
e) The *Contractors* provides all plant, and resources to execute the works.
f) The *Contractors* applies for all necessary authorizations and approvals (as required).
g) The *Contractors* Quality Management (QM) manages all documentation and records for handover to the *Employers* Project Manager.

NB. Written consent must be received from the Employer for any and all deviations from the works as outlined herein.

10. AUTHORISATION

This document has been seen and accepted by:

Name	Designation
A Simbudayal	Senior Engineering Geologist: LES Structures, Civils & Mechanical PrSciNat
S Nzama	Cluster Manager: LES Structures, Civils & Mechanical Pr Eng
D A Dukhan	Chief Civil Engineer: LES Structures, Civils & Mechanical Pr Eng
K Molaodi	Senior Civil Engineer: LES Structures, Civils & Mechanical PrEng
G Pillay	Civil Engineer: LES Structures, Civils & Mechanical
D Abrahams	Systems Integration
A Sirkar	Project Manager
V Mashego	Contract Manager

11. REVISIONS

Date	Rev.	Compiler	Remarks
2023-05	0.1	A Simbudayal	Internal draft for review
2023-06	1.0	A Simbudayal	Final document for signature

12. DEVELOPMENT TEAM

The following people were involved in the development of this document:

- Alicia Simbudayal: Senior Engineering Geologist, LES Structures, Civils & Mechanical PrSciNat
- Dan Dukhan: Chief Civil Engineer, LES Structures, Civils & Mechanical PrEng
- Kabelo Molaodi: Senior Civil Engineer, LES Structures, Civils & Mechanical PrEng
- Gino Pillay: Civil Engineer, LES Structures, Civils & Mechanical