



PROPOSED NEW SUBSTATION  
FIRGROVE SUBSTATION IN THE  
WESTERN CAPE

**GEOTECHNICAL REPORT**

***REPORT ON THE GEOTECHNICAL DESK TOP STUDY  
FOR THE PROPOSED NEW SUBSTATION NEAR THE  
EXISTING FIRGROVE SUBSTATION***



***GEOTECHNICAL INVESTIGATIONS  
TRANSMISSION TECHNOLOGY***

## ***CONTENTS***

- 1.0      INTRODUCTION**
- 2.0      THE NATURE OF THE PROJECT**
- 3.0      OBJECTIVES OF INVESTIGATION**
- 4.0      DESK STUDY**
  - 4.1      Maps Consulted**
  - 4.2      Aerial Photographic Interpretation**
  - 4.3      Review of Desk Study and Selection of Sites**
  - 4.4      Seismic Zoning**
- 5.0      THE SITE**
- 6.0      REGIONAL ENVIRONMENT**
  - 6.1      Geography**
  - 6.2      Geology**
  - 6.3      Water Table**
- 7.0      GEOTECHNICAL EVALUATION**
  - 7.1      Geometric Design**
  - 7.2      Geological Influences on Construction**
  - 7.3      Water Table**
  - 7.4      Topography –Substation Platform Construction**
- 8.0      CONCLUSIONS AND RECOMMENDATIONS**

**TITLE :** GEOTECHNICAL REPORT

REPORT ON GEOTECHNICAL DESK TOP STUDY  
FOR THE PROPOSED EXTENSION OF THE  
EXISTING FIRGROVE SUBSTATION

**PREPARED BY :** Specialist Consultant Geotechnical Engineering  
Transmission Technology

**CLIENT :** Land and Rights  
Transmission

**PROJECT TEAM:** F A Grov 

**REPORT NO :** GR05-11

**DATE :** June 2011

**Approved :**

F A Grov 

Senior Specialist Consultant  
Geotechnical Investigations

## 1.0 INTRODUCTION

Eskom plans to construct a new 400/132 kV Substation near the existing Firgrove Substation in the Western Cape.

It was requested by Transmission Lands and Rights to carry out a Geotechnical desk top study for the proposed site.



**PROPOSED SITE - EXTENSION OF THE EXISTING FIRGROVE SUBSTATION Figure-I**

A site for the proposed development was identified during the EIA phase of the Cape Peninsula Strengthening Project, which is located to the west of the existing Firgrove Substation (**Figure-I**). For the selection of the site, factors such as the availability of land, ESKOM installations and power line servitude routes were considered.

Information collected during this desk top study is considered **suitable for site assessment purposes**, and once the final design is required, a **Detailed Geotechnical Investigation** will be required to provide design parameters and confirm findings of this investigation..

## 2.0 THE NATURE OF THE PROJECT

The project comprises the construction of a new Substation in the Firgrove area, in the Western Cape.

The development would include the installation of typical equipment such as:

- Electrical transformers
- Circuit breakers or line termination structures
- High-voltage switchgear
- Low voltage switchgear
- Surge & lightning protection equipment
- Control and metering equipment
- Access roads and buildings

## 3.0 OBJECTIVES OF THE INVESTIGATION

The objectives of this investigation were defined as:

- Obtain Geotechnical information during a Desk Top Study, suitable to confirm the suitability of the site for the development.

## **4.0 DESK STUDY**

### **4.1 Maps Consulted**

An attempt was made to collect as much information as possible of the area, for the assessment of the Geotechnical suitability of the proposed site.

For this purpose the following maps were consulted:

- i) Topographical Maps – 3418 BA
- ii) Geological Map – Geological Map 3318 Cape Town (1:250 000)

### **4.2 Aerial Photographic Interpretation**

In principle the following features are being studied, information being obtained and interpreted when studying aerial photographs for geotechnical purposes:

- Reflection of the action of nature in creating the existing conditions
- Grouping of materials according to certain patterns
- Definition of various boundaries and linear features of significance
- Field checking by visual inspection

Stereo-interpretation has a great advantage over interpretation of a single photograph, because it is better able to identify topographical and erosion features, grey tones, and textures have greater requisite clarity contrasts. Basically, two aspects of the air photo image are revealed in the stereo-model of a given area, and these are surface form and grey tone, which could be subdivided as:

- a) Elements of Surface Form
  - Topographic form
  - Drainage form
  - Erosion form
- b) Elements of Grey tone and Texture of :
  - vegetation
  - due to land use
  - soil and rock material

Geotechnical information obtained in this way was correlated with Geological Map data.

### **4.3 Review of the Site**

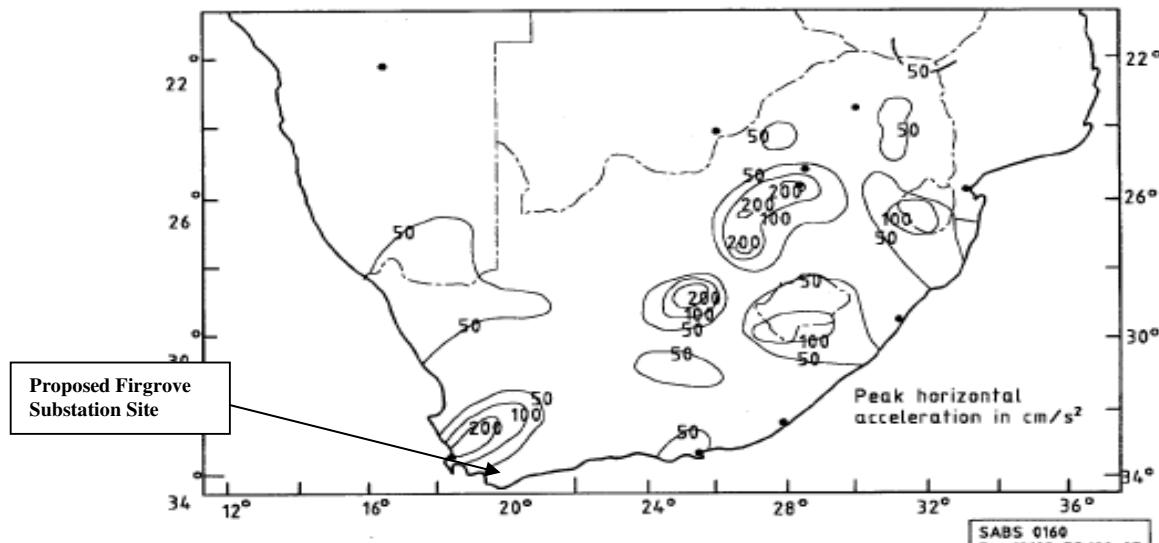
The size of the substation platform was not confirmed at the time of this report. It is however confirmed through this study that the site is limited in size with its trapezoidal shape and side dimensions of the order of:

- North western side 430m
- North eastern side 497m
- South eastern side 240m
- South western side 416m

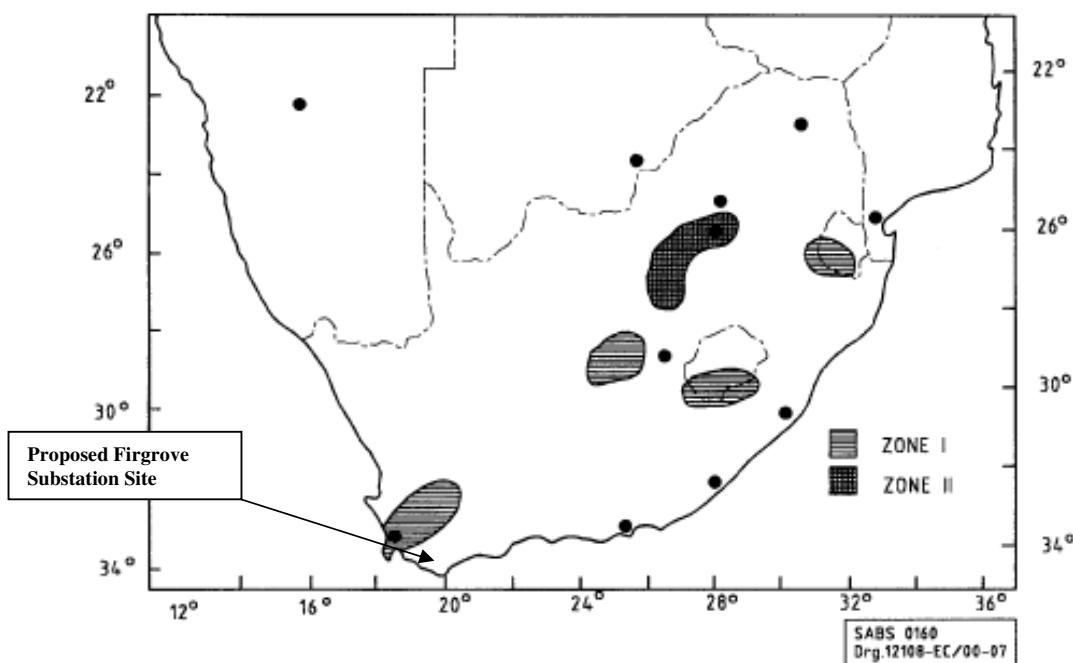
**For the purpose of flexibility the site area is limited and careful design would require fitting the conventional open plan substation on this site.**

#### 4.4 Seismic Zoning

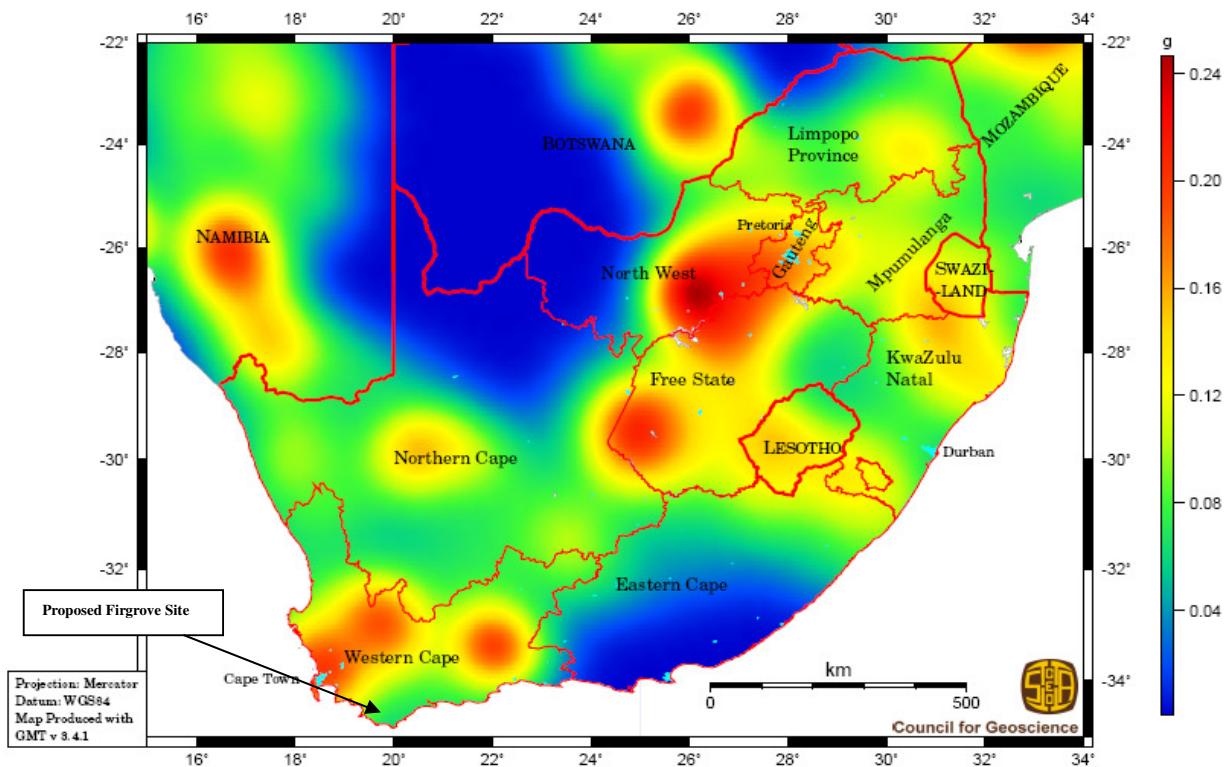
The South African loading code, SANS 10160 – 1969 (Figure-IIa and IIb) , shows that the proposed site for this study is situated in an area where the peak ground acceleration with a 10% probability of being exceeded in a 50 year period is  $50\text{cm/sec}^2$  . Figure-IIb also show the zones where detailed seismic design (Zone-I) and compliance with minimum requirements (Zone-II) are specified by the code. The proposed Firgrove site fall outside of these Zones.



**SEISMIC HAZARD MAP OF SA** *Figure-IIa*



**SEISMIC HAZARD ZONES OF SA** *Figure-IIb*



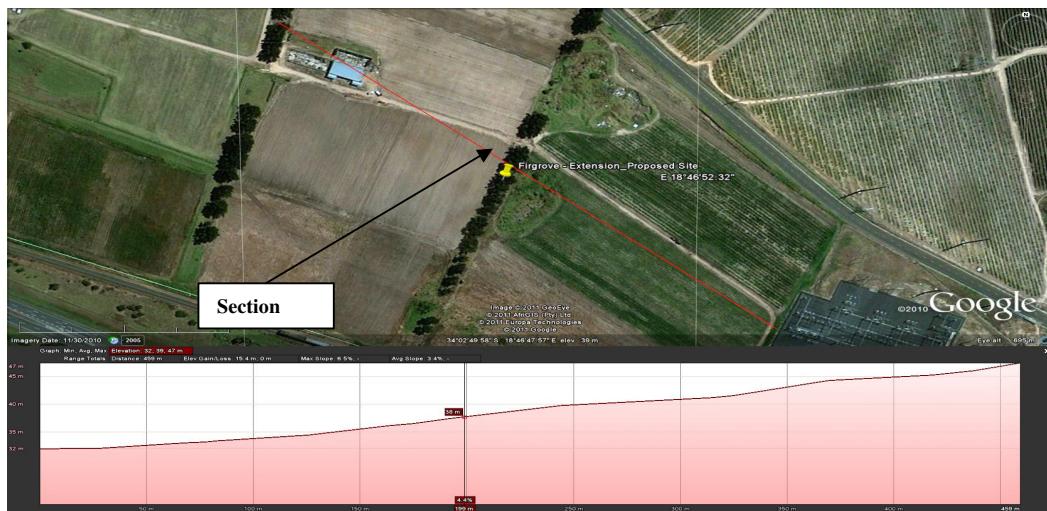
4.1 MAP 1: SEISMIC HAZARD MAP OF SOUTH AFRICA  
(INCLUDING THE KINGDOMS OF LESOTHO AND SWAZILAND)

Peak ground acceleration ( $g$ ) with a 10 % probability of being exceeded in a 50 year period

**Figure-III**

More recent data produced by the Council of Geoscience place the site within the zone where the minimum seismic event, with a 10% probability of being exceeded in a 50 year period, falls in the range of 0,06g to 0,10g (Figure-III). This data however, still needs to be verified.

## 5.0 THE SITE



THE SITE WITH SECTION INDICATING 20m RELIEF FROM WEST TO EAST

**Figure-III**

It should be noted that options for suitable sites are limited in the Study Area due to extreme development of the urban area.

## 6.0 REGIONAL ENVIRONMENT

### 6.1 Geography

#### 6.1.1 Topography and Drainage

General flat to occasionally waving topography with the presence of hillocks, hills and water ways forms features of the region. **The elevation of the site and its** located on a relatively high is well drained and has no risk of flooding.

#### 6.1.2 Flood –line

The elevation of the site with a limited storm water catchment area has no risk of flooding within a 1:50 year flood.

#### 6.1.3 Climate

##### N-Value

*The "Weinert N-Value", that describes the climatic environment, is approximately 2 for the area. Where "N" is more than "5", disintegration is the prominent form of weathering, and where "N" is less than "5", decomposition affects those rocks whose minerals are liable to change chemically under atmospheric conditions.<sup>i</sup>*

The **Cape Peninsula** has a **Subtropical Mediterranean climate (Koppen Csa)**, with mild, wet winters, and dry and very warm summers. In winter time, which lasts from the beginning of June to end of August, large cold fronts come across from the Atlantic Ocean with heavy **precipitation** and strong north-westerly winds. The winter months are cool, with an average minimum of 7.0 °C (45 °F) and maximum of 17.5 °C (63 °F).

##### Rainfall

Most of the city's annual rainfall occurs in wintertime, but due to the mountainous topography of the city, rainfall amounts for specific areas can vary dramatically. Newlands, to the south of the city, is the wettest suburb in South Africa. The valleys and coastal plains average 515 millimeters (20.3 in) of rain per annum, while <sup>ii</sup>mountain areas can average as much as 1,500 millimeters (59 in) per annum.

##### Temperatures

Summer, which lasts from November to March, is warm and dry. The Peninsula gets frequent strong winds from the south-east, known locally as the **Cape Doctor**, because it blows away pollution and cleans the air. The south-easterly wind is caused by a **high-pressure system** which sits in the **South Atlantic** to the west of Cape Town, known as the South-Atlantic High. Summer temperatures are mild, with an average maximum of 26.5 °C (80 °F)<sup>iii</sup>. Cape Town can be uncomfortably hot when the Berg Wind, meaning "mountain wind" blows from the **Karoo** interior for a couple of weeks in February or early March.

##### Vegetation

*The site is partly cultivated and covered with typical indigenous grass and bush.*

## **6.2 Geology**

The area is underlain by loam and sandy loam, with greywacke, phyllite and quartz sandstone, interbedded lava and tuff of the Beaufort Group.

## **6.3 Water Table**

A perched water table is likely to be present during the rainy season.

# **7.0 GEOTECHNICAL EVALUATION**

## **7.1 Geometric Design**

Careful design will be required for the construction of a substation on this site. The conventional open yard substation will probably not fit on this site.

## **7.2 Geology Influences on Construction**

The sandy loam, probably masking the greywacke with limited thickness, might have a collapse potential due to not being consolidated, which will require special measures for founding of structures. The greywacke is probably underlying the Transported soils shallowly, forming a low permeability membrane. The loam mixed with weathered greywacke is likely suitable for substation platform construction.

This material could be suitable for construction, pending the Plasticity Index and Grading Modulus.<sup>iv</sup>

The greywacke will increase in consistency with depth, changing to a soft to medium hard rock with depth.

## **7.3 Water Table**

The presence of a perched water table is not expected to have a severe influence during construction.

## **7.4 Topography - Geometry (Earthworks)**

The construction of a substation platform will result in relatively deep cut and high fill, with a relief of 20m (*Figure-II*).

# **8.0 CONCLUSIONS AND RECOMMENDATIONS**

**Considering the results of the desk studies carried out it is clear that** the site is suitable for the construction of a substation platform and founding of substation structures conventionally. However, the site is limited in size for the construction of an conventional open substation,

---

<sup>i</sup>Jennings Brink & Williams (1973). *Revised Guide to Soil Profiling for Civil Engineering purposes in South Africa*. The civil Engineer in S.A. Jan. 1973.

<sup>ii</sup> *The Natural Road Construction Materials of Southern Africa – HH Weinert*

<sup>iii</sup> [http://www.1stweather.com/regional/climate/index\\_climate.shtml](http://www.1stweather.com/regional/climate/index_climate.shtml)

<sup>iv</sup> *Engineering Geology of South Africa Volume 2 A.B.A. Brink*