SOIL AND LAND CAPABILITY IMPACT REPORT: **HES/515/AP**

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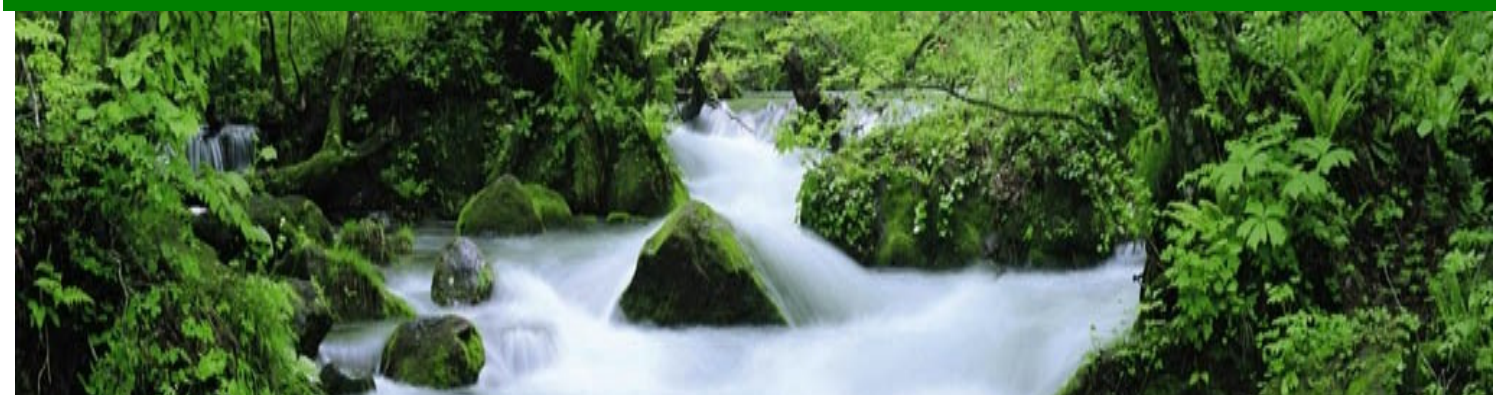
SOIL, LAND CAPABILITY AND IMPACT ASSESSMENT OF THE RUSTENBURG STRENGTHENING PHASE 2 (MARANG B): WITHIN THE RUSTENBURG LOCAL MUNICIPALITY OF BOJANALA DISTRICT IN THE NORTH-WEST PROVINCE



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1 Introduction

1.1 Project Background

Eskom Holdings intends to strengthen the Rustenburg electrical network. The intial scope of work entailed the construction of a new main fenced transmission substation (MTS), Marang B (3x 500MVA 400/132 kV) and approximately 2 km 400 kV (500 m corridor) via a loop in-loop out on the existing Bighorn-Marang 400 kV / Medupi / Marang 400 kV power lines and also the Marang-Midas 400kV power line. The first report therefore assessed three altenatives for substations and power line corridors. Eskom has since identified another feasible alternative of extending the substation by making provision for new 3x 500MVA 400/132kV transformers, as follows:

- Extension of the existing 400kV Busbar
- Establish a new 132kV Busbar to enable installation of 2 x 500MVA 400/132kV transformers initially and 1 x future 500MVA 400/132kV transformer
- Establish and Equip 4 x 132kV feeders to allow existing 88kV Marang load shift and
- Establishing 4 x future 132kV feeders.

The report thus makes room for the alternative 4 as indicated on figures 1 and 2.

1.2 Study Justification

The proposed development to meet energy needs will impact some agricultural land. In recent years considerable pressure is placed on land resources to meet both agricultural and industrial needs. To establish a productive agricultural sector, sustainable use of natural resources is vital to remain economically viable in the current globalised world. Both agricultural and industrial development entails numerous trade-offs in relation to sustainable resource utilization giving the competing demands of the two sectors for similar resources. Agricultural land is a valuable resource and must be used responsibility. To minimize loss of high potential and prime agricultural lands that may result from the proposed development, it is imperative to assess the impact of such projects on critical resources at the site. This assessment is essential as it will contribute to meeting the requirements of the *National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) in* compliance with *Regulation* R545, R546 of 18 June 2010*, promulgated in terms of Section 24 (5) of NEMA. It will also address some aspects of the Subdivision of the Agricultural Land Act No. 70 of 1970.*

1.3 Terms of Reference

The terms of reference requires the assessment of the impact of the project development on agricultural productivity of the area. This is to be assessed in terms of national criteria, specifically the impact on soil resources, water resources, vegetation and the overall agricultural activities at the project site.

1.4 Project location

The proposed project site is situated in the Rustenburg Local Municipality of Bojanala District in the North West Province of South Africa. It is situated on Boitekong Ext 2. The site can be accessed from Rustenburg through the R510 towards Pardekraal (Fig. 1). The geographical coordinate at the central portion of the distinct sites of the area are **Site 1**: S25.613 E27.329; **Site 2**: S25.619 E27.346**; Site 3**: S25.624 E27.334; **Site 4**: S25.6136 E27.333.

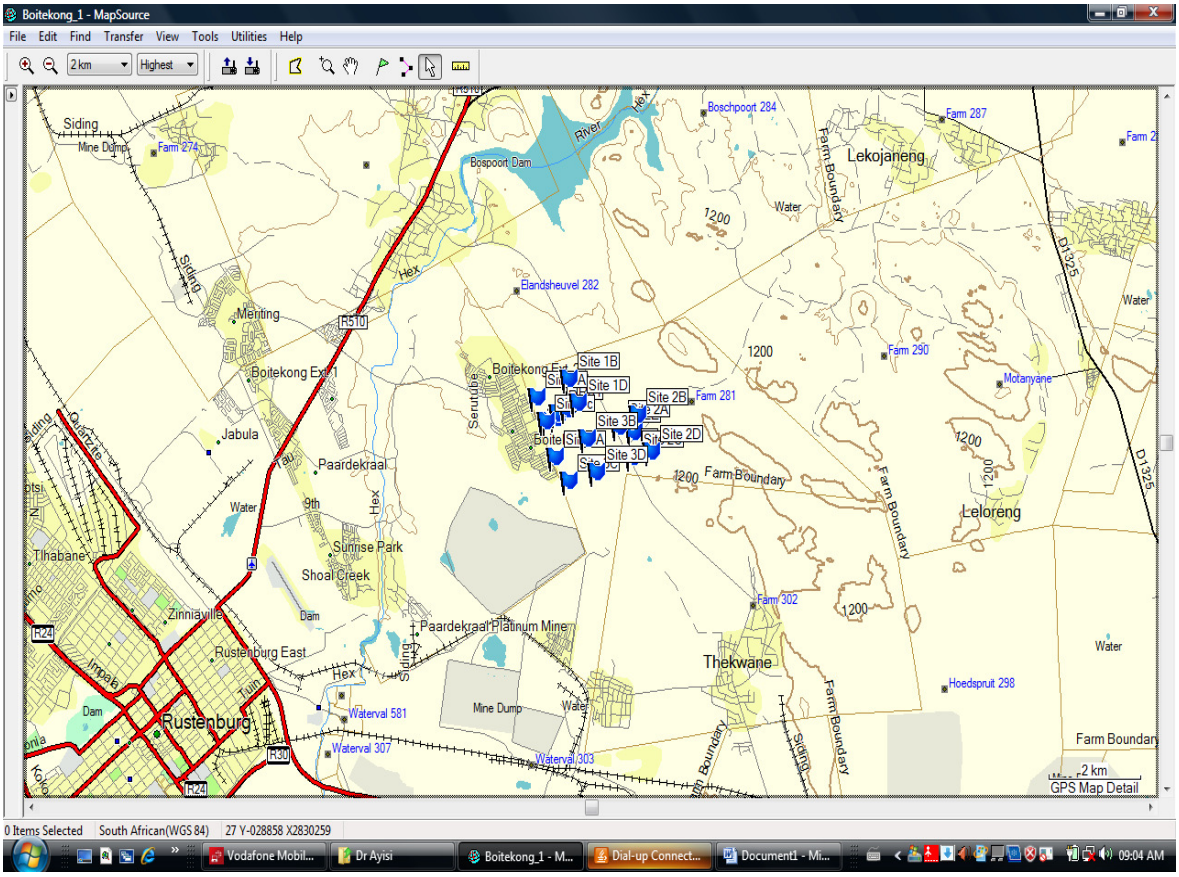

Fig. 1. General locality map of the proposed project site.

A locality map indicating the alternative substation (4) is presented in figure 2.

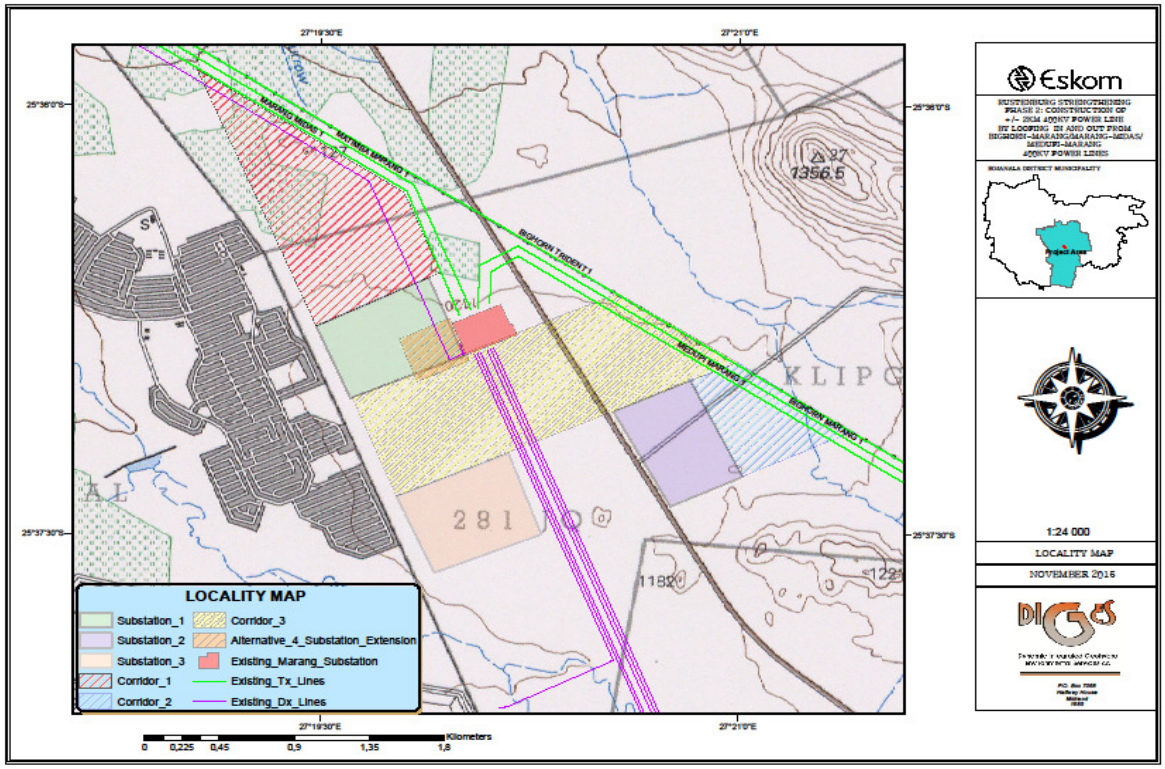

Fig. 2. Locality map indicating the alternative substation (4)

1.5 Assumption

The following fundamental assumptions are made in during execution of the project:

- The loss of high potential agricultural lands through urbanisation and unsutainable agricultural practices in South Africa is at an alarming rate.
- South African water resources are under severe constraint.
- Agricultural land includes all land outside towns and cities.

2 Project Objectives

2.1 Main objective

The main objective of the study is to assess the soil (land) capability of the project site and agricultural impact assessment resulting from the extension of the substation or the construction of a new Marang B substation and approximately 2 km 400 kV ia a loop in loop-out from an existing Bighorn-Marang 400 kV/ Medupi /

Marang 400 kV power lines in the Rustenburg municipality.

3 Methodology

The assessment of agricultural potential of the study area was based on a combination of desktop studies to amass general information and then through site visit for status quo assessment, soil sampling and characterization, and also the validation of generated information from the desktop studies.

3.1 General information

Pertinent information on the study area was obtained through a combination background information review, public database and literature as well as GIS information. The information amassed includes the following:

i. Definition of parameters of land as stipulated by the Subdivision of Agricultural Land Act, No. 70 of 1970 and the Amended Regulation of Conservation of Agricultural Resources Act No. 43 of 1983.
ii. Classification of high potential agricultural land in South Africa compiled by the Agricultural Research Council (Schoeman, 2004) for the National Department of Agriculture.
iii. *National Environmental Management Act (NEMA), 1998 (Act No. 107 of 1998) in* compliance with *Regulation R543 of* June *2010 promulgated in terms of Section 24 (5) of NEMA.*
iv. Landtype classification
v. Geophysical features of the site using Geographical Information System and walkover survey.
vi. Moisture availability class, determined through seasonal rainfall and fraction of the potential evapo- transpiration (ARC, 2002).

3.2 Site Visit

The project site was visited to document the following:

i. Current landuse of the site.
ii. Soil characteristics (landtypes, soil forms, depth, etc.), vegetation profile, water resources, terrain type and infrastructural profile.

The soil at the project site was classified using landtype description and the Binomial System for South Africa. This classifies soils into forms and families based on the diagnostic horizon of

the soil profile (Soil classification working group. 1991). A soil auger was used to assess soil depths at pre-determined distances during the walk-over survey on the property.

iii. Surface water information

iv. Other agro-ecological factors prevailing in the area including surface water.

3.3 Determination of Agricultural potential

3.3.1 National assessment criteria

Interventions that will retain high potential and prime lands in South Africa is required to protect dwindling suitable agricultural lands for plant and livestock production. This is important for sustainable agricultural production for future generations. South Africa is generally dominated by shallow soils which are predominantly sandy. This poses a severe inherent limitation to crop production. The poor quality of the soil in South Africa is primarily due to the influence of the parent material from which they were formed. South Africa has only 13 % (approximately 14 million ha) arable land, of which only 3 % is considered to be high potential (Laker, 2005). Inferring from the international requirement of about 0.4 ha arable land to feed an individual person, South Africa could produce enough food to feed only 35 million people on the available 14 million hectares of arable land. In line with this goal, the Department of Agriculture has developed a set of criteria to define and preserve potential and prime areas for agricultural development in South Africa, as listed below:

By definition, an agricultural land in the Northwest Province is considered to be high potential if the land may be cultivated in terms of Part 1 of the Regulations of Conservation of Agricultural Resources Act 43 of 1983, and it is under permanent irrigation, or can be classified into one of the following soil forms: Avalon, Bainsvlei, Bloemdal, Clovelly, Glencoe, Hutton, Oakleaf, Pinedene, Shortlands and Tukulu. The minimum depth should be 900mm and clay content between 10 and 35%.

High potential soil here means prime or unique soil. Prime refers to the best available land, mainly from the national perspective, suited to and capable of consistently producing acceptable yields of a wide range of crops (food, feed, forage, fibre and oilseeds), with acceptable expenditure of energy and economic resources and minimal damage to the environment. Unique agricultural land means land that is or can be used for producing specific high value crops. Permanent irrigation refers to the availability for, and regular artificial application of water to the soil for the benefit of growing crops. The application may be seasonal.

3.3.2 Additional assessment criteria from provincial department

In addition to the necessary legislations relating to land classification in terms of its potential in South Africa, the assessment of agricultural potential at the project site took into consideration the following requirements from the National Department of Agriculture, Conservation and Environment:

- Soil assessment
- Economic viability
- Surrounding developments and activities
- Current status of the land and landuse options

3.4 Limitations

The major limitation during the study is the acquisition of some relevant data notably long-term climatic record for the project site.

4 Agro-Ecological Characterisation

4.1 Current land use

The proposed location for the proposed infrastructure occurs on a fallow land currently composed of the natural shrubs and grasses (Fig. 3). The surrounding area is bordered by human settlements located approximately 120m from the west of the sites. The settled area was previously used as grazing land. No acitve farming occurs in the vicinity of the site. There is a quarry located south of the proposed site.

Figure 3: Current condition of the proposed site for the development

4.2 Soil distribution

4.2.1 Geology

The geology of the area is predominantly norite and gabbro of the Bushveld Complex, with Bushveld granophyre in places. Occasional syenite and diabase dykes occur (AGIS Website: www.agis.agric.za/natural resources). The Bushveld Complex is largely igneous in origin and occurs in the north-eastern region of the Province, from Brits and Rustenburg in the east to north of Zeerust and Swartruggens into Botswana.

4.2.2 Land type

Landtypes are generally determined by position of localised terrain units on the landscape, being crest, scarp, mid-slope, foot slope or valley bottom. The demarcated site for development consists predominantly of landtype, Ib116 which is located mainly at the foot slope. The preferred alternative 4 however drift into landtype Ea3 which is also a relatively flat terrain (Fig. 4).

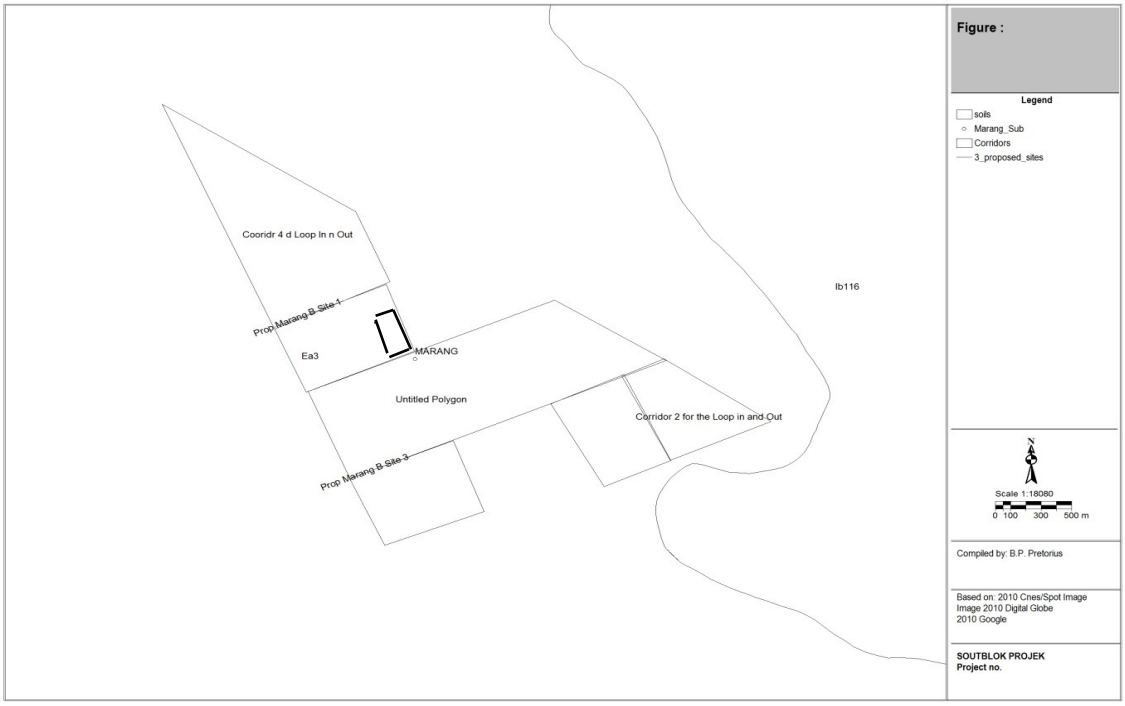

Fig. 4. Landtypes at the project site.

4.2.3 Local Soil Information

The landtype Ib116 consists of rock outcrop, Mispah, Arcadia and Rensburg soil forms. None of these forms is considered high potential according to the national high potential soil classification system (Schoeman 2004). The landtype Ea3 consists of Arcadia, Oakleaf, Hutton and Shortlands forms, of which only Oakleaf is considered as high potential. However, all the soil forms under the two landtypes are restricted by high clay content. The clay content in this area is over 35% and reaching up to 70% at some points. This far exceeds the limit of 35%, which is considered high potential at the proposed site of development. The hue in the Munsell soil colour chart is 2.5Y with a value of 2.5 and a chroma of 1 i.e black. The Arcadia soils have a strongly developed structure. It is a horizon that has both high clay content and a predominance of smectitic clay minerals. It has the capacity to swell and shrink markedly in response to moisture changes. At 90cm depth, there is a presence of weathering saprolite. Arcadia soils have low infiltration rate. The presence of a layer which limits root growth,

air and water penetration makes the effective soil depth to be very minimal. The Mispah soil form is predominantly a hard rock with minimal soil formation.

4.3 Climate

In this report, climate refers to the summation of the daily, weekly and monthly changes in weather over a long period and it is influenced by latitude, altitude, direction and intensity of wind and the presence of large bodies of water such as the ocean, lakes, dams and rivers. Long-term climatic record for the project was not easily accessible from Weather SA. The main climatic data used to assess potential impact were long-term monthly average precipitation, and temperature which are the major determinants of crop growth and development. The site is described as semi-arid receiving annual rainfall of about 513mm. Most of the rainfall occurs between October and April which coincides with the crop growing season. The highest rainfall peaks in January (Mid-Summer). However, significant variability in rainfall is observed in the Northwest province in general.

Regarding temperature, the monthly distribution of average daily maximum temperatures shows that, the average midday temperatures at the proposed site range from 19.3°C in June to 29.4°C in January. The region experiences the coldest period during July when the temperature drops to 1.7°C on average during the night. This creates possible occurrence of frost which could be detrimental if crops are not carefully selected for production. Frost does occur at the site with the mean number of days of frost being 31 days. The site is also characterised by great seasonal and daily variations in temperature, being very hot in summer (daily average high temperatures of 32ºC in January) and mild to cold in winter (average daily minimum in July is 0.9ºC). The relative humidity is low resulting in high potential evapo-transpiration rates. Evaporation exceeds precipitation, which is a major contributor of the arid and semi-arid conditions, dominating the area.

4.4 Water Resources

4.4.1 Moisture availability classification

Under the moisture availability classification, the proposed project site falls under Moisture Class 4 which is interpreted as conditions marginal for rain fed arable agriculture (ARC, 2002). The mean annual precipitation is approximately 513mm and this renders crop cultivation at the site risky except under reliable irrigation water supplies.

4.4.2 Surface Water

Water is one of the North West Province's most critical and limiting natural resources with only four sources available in the Province namely: surface water, groundwater, imported water and re-usable effluent (de Villiers and Mangold). There are no surface water on the proposed site but there are a number of seasonal streams located east to north-east of the site (Fig. 5). The existence of these streams in the vicinity of the project site creates the possibility of rendering the site high potential for cultivation. However, the seasonal nature of the streams and the considerable presence of rock outcrop, Mispah soil, in addition to the high clay soils of the Acadia sols will render crop cultivation marginal.

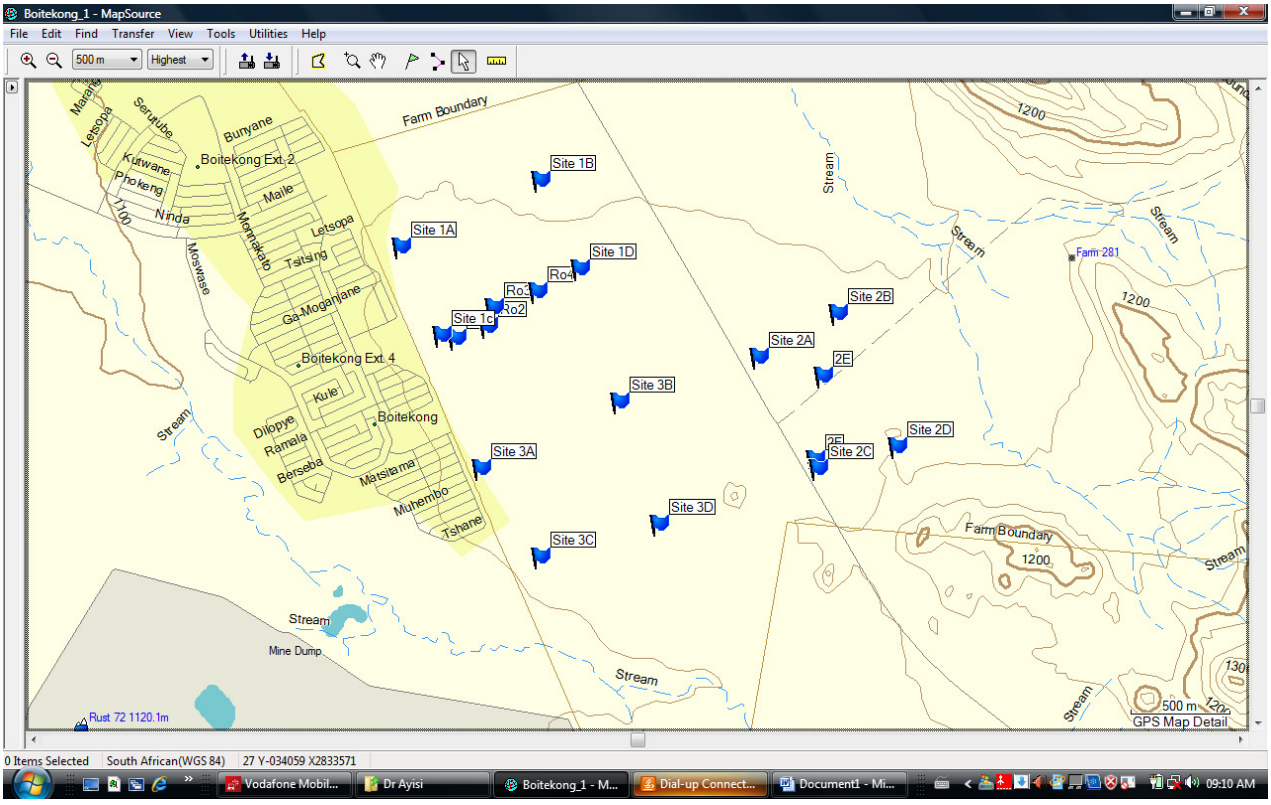

Figure 5: Locality map with the existence of seasonal streams

4.5 Vegetation

The general vegetation type at the proposed site of development forms part of the natural Bushveld. This comprises grassland, scrub and mixed woodland (Mucina & Rutherford, 2006). A significant part of the site has dense cluster of woody perennial species which reduces the availability of grass for grazing.

4.6 Topography

The assessment of slope class in an area is an important determinant in the evaluation of land for crop production. Slope influences the use of mechanical traction and together with soil textural classes, influences the rate of soil erosion. Field topography can also have a direct effect on crop growth and yield by redirecting soil water availability. Indirectly, it also has an effect on the distribution of such chemical and physical properties as organic matter content, base saturation, soil temperature, and particle size distribution (Franzmeier et al., 1969; Stone et al., 1985 and Jiang 2004). The topography of the project site is largely flat with slope class not exceeding 3 % (Fig. 6).

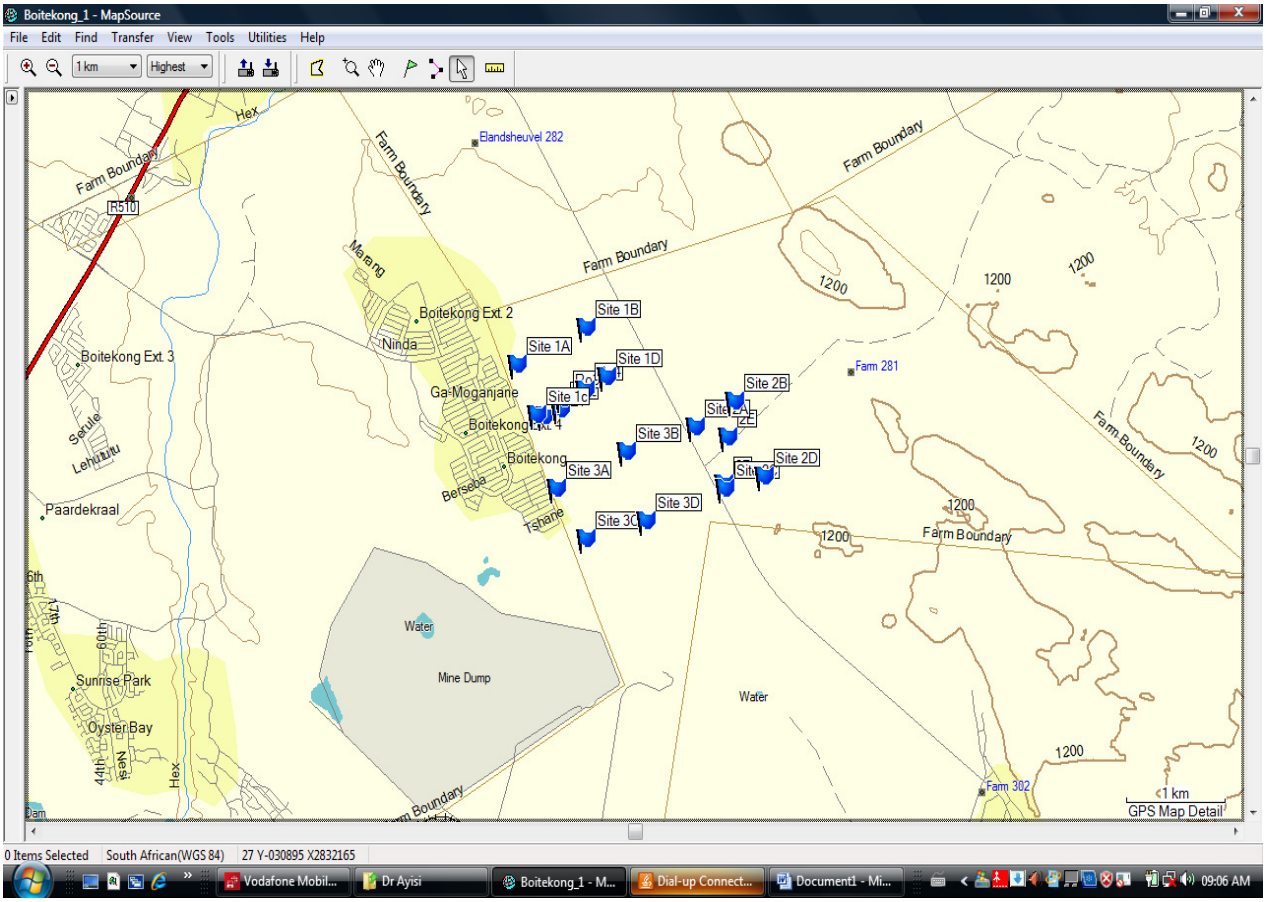

Figure 6: Contours depicting topography at the proposed development site

5 Infrastructure

The proposed project site is situated within rural and peri-urban areas with fairly good accessible roads. It is located next to Boitekong Ext 2 RDP area (Fig. 7).

Fig.7. Locality map of the proposed project site including the proposed substation site 4, close to a settlement area.

The site had been fallow for some time and currently does not have any real infrastructure or development. Eskom Power line runs across some portion of the project site. The area is well connected to cellular network.

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6 AGRO-Enterprise

Potential agricultural activities at the project site could be classified into crop cultivation and livestock production. The potential for successful agricultural productivity of any given area is a function of several natural or biological factors of the target area, socio-economic conditions as well as prevailing legislations impacting on agriculture in the country.

6.1 Crop Production

The main natural factors limiting crop production are: climate; terrain form, and soil type. Biological factors encompass prevailing diseases, pests and, selected plant and animal species to be cultured and their ability to adapt and withstand the growing and developmental conditions prevailing at the particular site. Socio-

economic considerations will include factors such as level of education, managerial skills and technical experience of the prospective farmer or group of farmers as well as market availability. The interactive effects of these factors determine the potential of an area for agricultural activity. In South Africa, water availability, temperature and soil characteristics are major determinants of agricultural productivity.

The proposed project site receives on average, about 513mm total annual rainfall and it is considered marginal for dryland arable cropping. The implication is that no effective cropping activities can be carried out without irrigation water supply. The site is however dominated by rock outcrops and shallow soils, a soil property which will reduce the moisture holding capacity. In addition, the prevailing strong clayey Acadia soil in excess of 40% constitutes a major restriction for effective root development. Hence, even with irrigation facility, no effective planting could be carried out due to restrictive root zone capacity for plant growth and development as well as potential frequent moisture stresses.

6.2 Livestock Production

The general vegetation type at the proposed site is a mixture of grassland and woody perennials. A significant part of the site has dense cluster of woody perennial species which reduces the availability of grass for grazing. External fodder supply either from cultivation or purchases needs to be sourced to supplement the natural pasture at the project site if successful livestock production is to be embarked upon. The poor soil condition and lack of access to irrigation water facilities will not permit the cultivation of planted pastures at the site to supplement livestock feed.

7 Summary and Conclusion

By definition (based on Part 1 of the Regulation of Conservation of Agricultural Resources Act 43 of 1983), the land occurring at the proposed project site consists of combination of factors that can be considered as either high or low potential for agriculture.

High potential

The occurrence of streams at the site offers potential for irrigation. However, this water is too brackish for irrigation or human consumption. The occurrence of the soil form Oakleaf at a portion of the proposed site is considered high potential but it consists of high clay content in excess of 35% to 60% which far exceeds the amount considered to be high potential. The combination of very shallow soils and high and hard clay content at the site will not permit effective irrigation activities even if external water is supplied. This is primarily due to low moisture holding capacity, accelerated runoffs and high demand for increase irrigation resulting from the shallow or restrictive soil.

Low potential

It is low potential for the following reasons:

- The proposed site of development is composed of rock outcrops, shallow Mispah and hard clay soils resulting in poor effective root depth. The soil nature is not considered as high potential for arable cropping and will not support effective crop production due to potential root zone moisture limitation.
- There is currently no irrigation facility at the farm, neither is there any indication of water permit for irrigation.
- The size of available grazing land is too small and will not support viable economic crop and livestock production.

The proposal to include Site 4 as an extending the existing Marang substation generally falls within similar landtypes and other biophysical conditions as the three sites initially proposed which are not high potential. Thus, the impact of this additional development will not significantly alter agricultural activities at the development site (Table1).

Table 1. Magnitude of impact of the proposed developments on agricultural activities.

Resource / Activity	Low	Medium	High
Soil resource	x		
Water resource	x		
Vegetation		x	

Overall conclusion: The proposed development will generally have low impact on soil resources, water resources, vegetation and the overall agricultural activities at the project site and the surroundings.

8 Recommendations

Based on the information gathered on the project site, the site demarcated for the proposed construction of a new main fenced transmission substation (MTS), Marang B (3x 500MVA 400/132 kV as well as the additional alternative site will not support viable crop and livestock production. This is primarily due to the shallow depth, non-qualifying and non-supportive soil forms, non-conducive nature for dry land farming, non-availability of irrigation water, low carrying capacity and low land area for livestock production. The proposed extension of the existing substation or all three alternatives for the construction of 2 km, 400 kv loop in loop out power line and 400/132kv Marang B substation can be pursued as it may not result in significant interference on agricultural productivity in the province. The developments will however need to consider the other necessary environmental legislations required.

The major consideration during construction of the substation is to restrict the soil to the site composed of rock outcrops, shallow Mispah and hard clay soils.

9 References

1. AGIS Website: www.agis.agric.za/natural resources map.
2. ARC. 2002. Areas in which high potential agricultural land may occur, superimposed on moisture availability zones. Map Scale: 2 500 000. Project No. 041_2000/bw/Mois.gra.
3. De Villiers B., and Mangold, S. Biophysical Environment. Geography Department, Potchefstroom University, Potchefstroom, North West Department Agriculture, Conservation and Environment, Mafikeng. *www.nwpg.gov.za/soer/FullReport/bio-physical.html*.
4. Franzmeir, D.P., E.J. Pedersen, T.J. Longwell, J.G. Byrne, and C. Losche. 1969. Properties of some soils in the cuberland plateau as related to slope aspect and position. Soil Sci. Soc. Am. Proc. 33:755-761.
5. Jiang, P., and K.D. Thelen. 2004. Effect of soil topographic properties on crop yield in north-central corn-soybean cropping system. Agron. J. 96:252-258.
6. Laker, M.C. 2005. South Africa's soil resources and sustainable development. http://www.environment.gov.za/nssd_2005/Web/NSSD%20Process%20Documents%20and%20Reports/REVIEW_Soil_and_Sustainability_Oct 05.pdf.
7. Mucina, L. & Rutherford, M.C. (eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African Biodiversity Institute, Pretoria.
8. Schoeman, J.L. National Department of Agriculture. 2004. Criteria for prime or unique agricultural land in South Africa. Report Number GW/A/2002/21.
9. Soil classification working group. 1991. Soil classification, A Taxonomic System for South Africa. Soil and Irrigation Research Institute, Department of Agricultural Development. Pretoria.
10. Stone, J.R., J.W. Gilliam, D.K. Cassel, R.B. Daniels, L.A. Nelson, and H.J. Kleiss. 1985. Effect of erosion and landscape position on the productivity of piedmont soils. Soil Sci. Am. J. 49:987-991.