APPENDIX A

GEOTECHNICAL REPORT

DWAALBOOM
SUBSTATION

PRELIMINARY GEOTECHNICAL INVESTIGATION: SITE SELECTION DWAALBOOM SUBSTATION

INTERPRETIVE REPORT

Report No.: J28199-02

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SYNOPSIS

This report describes the preliminary geotechnical investigation carried out for the Dwaalboom Substation, North West Province. Three alternative 500m x 500m sites were considered during this study; namely Site A, Site B and Site C.

The proposed development will comprise lightly loaded structures with loads typically in the order of 100kPa to 150kPa. The entire substation will be constructed on balanced cut to fill terrace some 148m x 118m with surrounding access roads. The final terrace position and levels are subject to the results of this investigation.

The purpose of the investigation carried out was to provide geotechnical information sufficient for site selection purposes and included limited testpit excavations and soil laboratory testing. Once the preferred site has been selected a detailed investigation will be required to confirm ground conditions.

This report presents the interpretation of the data including an aerial photograph interpretation, recommendations and parameters for earthworks and the design of practical foundation solutions. The Factual Report J28199-01 should be read in conjunction with this report.

Site A is underlain by shales of the Timeball Hill Formation which overlie quartzites of the Rooihoogte Formation, encountered on Site B, and dolomites of the Chuniespoort Formation evident on Site C.

There are at least two large displacement faults which run through the study area. One fault is encountered just east of Site A and the other marginally intersects the SW corner of Site B. Numerous lineaments are evident in the area and show the same regional trend as the faults, i.e. NW – SE. These lineaments are likely to be associated with shear zones or small displacement faults. One such lineament intersects the middle of Site C.

Site A

The soil profile encountered at Site A shows hillwash and nodular ferricrete horizons overlying residual shale / very soft rock shale and as well as a horizon comprising numerous cobbles and gravels of varying origin. Due to the structural complexity of the area, three separate interpretations are given for the origin of this material and will need to be confirmed by percussion drilling. Due to the proximity of Site A to the Chuniespoort Formation, this cobble bed may be an extension to the breccias often associated with the Chuniespoort, alternatively it may represent conglomerates of the Rooihoogte Formation and, for the purposes of this report, have been interpreted as a “paleo” colluvium horizon.

Additional investigation including percussion drilling, test pitting and laboratory testing will be required during the detailed phase of the investigation to better determine the origin, extent and nature of the “paleo” colluvium horizon

encountered on Site A.

It is recommended that the terrace footprint be positioned within the area underlain by dense or better "paleo" colluvium at 1,7 to 2,5m below ground level, refer Drawing J28199-A-001. As such a shallow footing foundation solution can be adopted for light and settlement tolerant structures. Alternatively light and settlement sensitive structures will be founded on an engineered mattress or concrete raft. Bearing pressures on the "paleo" colluvium and engineered fill should be limited to 200kPa and 150kPa respectively.

Most of the excavation on Site A will classify as soft excavation with intermediate exaction likely within the lower "paleo" colluvium profile.

The nodular ferricrete and "paleo" colluvium encountered on site classify as G8 and G7 material respectively and are suitable for use as selected fill. The colluvium may include some oversized material and therefore could require sorting. Material of G6 quality or better will have to be imported from a commercial source, if required.

An area of nodular ferricrete (1,1m) and "paleo" colluvium (>1,0m) has been identified as a potential borrow source within Site A and should be targeted for additional investigation during the detailed phase, refer Section 10.

Site B

The lithological contact between the Timeball Hill Formation shales and the underlying Rooihoogte Formation quartzites intersects the SE corner of Site B. The shale profile encountered is similar to that of Site A where "paleo" colluvium and residual shales were evident. The site is predominantly underlain by shallow quartzites occurring between 1,0m – 1,7m below ground level. Hardpan ferricrete, forming a N-S trending ridge, is located in the centre of Site B and typically occurs at 0,3m below ground level.

It is recommended that the cut to fill terrace footprint be located in the area of the hardpan ferricrete to allow for a shallow footing foundation solution, refer Drawing J28199-B-001. Bearing pressures on the very soft rock hardpan ferricrete and hard rock quartzite should be limited to 300kPa and 500kPa respectively.

The transported materials on Site B classify as soft excavation while, the hardpan ferricrete classifies as soft to intermediate excavation and the quartzite will require exaction by blasting.

The nodular ferricrete encountered on Site B classifies as a G8 material and is considered suitable for use as selected fill. Two potential borrow sources have been identified within Site B where the nodular ferricrete horizon is on average 0,7m thick, refer Section 10.

The colluvium overlying the hardpan ferricrete and quartzite contains oversized material and is not considered suitable for use as selected fill.

Material of G7 quality or better will either have imported from a commercial source. The paleo colluvium encountered on Site A could however, provide a source of G7 material.

Site C

The dolomite rockhead encountered on Site C shows an undulating profile varying from 0,3m below ground level to 2,8m below ground level and is overlain by residual chert breccia.

It is recommended that the cut to fill terrace and access roads be located within the area underlain by shallow dolomite bedrock. A shallow footing founding solution could therefore be opted for founding structures or alternatively a soil raft in cut areas, with limited depth of founding. The recommended position for the terrace footprint is in the vicinity of TPC13, TPC16 and TPC17 shown on Drawing J28199-C-001 where depth to medium hard rock or better bedrock is shallowest varying from 0,3m to 0,9m.

However, dolomitic terrain is typically associated with sub-surface cavities which could result in surface subsidence and possible sinkhole formation. As such an alternative piling solution cannot be ruled out and would need to be confirmed during the detailed geotechnical investigation. Bearing pressures on the dolomite bedrock are limited to 500kPa.

Excavation characteristics for Site C include soft excavation and excavation by blasting within the medium hard rock or better dolomite.

Materials encountered on site are generally unsuitable for use as selected fill and all structural fill below roads and surface beds will need to be imported from commercial sources or alternatively sourced from potential borrow pit areas identified during the investigation, refer Section 10.

A well defined lineament has been identified in the aerial photographic interpretation and could represent a shear or fault zone (Figure 1). If faulting is present it could prove a fatal flaw for development on dolomite terrain as water ingress along fault zones is particularly problematic in terms of sinkhole development.

General

The topography characterising all three site alternatives is relatively flat (1:<1). The fill is likely to be limited in depth on all three sites which will require founding of most structures on insitu materials. As such, the cut to fill terrace volumes are likely to be similar for Site A, Site B and Site C and therefore no one option appears preferable in terms of earth work volumes.

Allowance should be made for importing G6 or better material from a commercial

source. The Dwaalboom PPC Cement factory has stockpiles of dolomite aggregate of various size fractions, including <2,4mm, <13mm and <19mm, which could be potential source for subbase and base course materials.

No ground water was encountered in any of the testpits excavated in the study area.

Site C is directly underlain by dolomite and is therefore considered to be at risk in terms of subsidence and sinkhole formation. As such, this site is considered as the least favoured alternative.

Site A has a variable soil profile comprising residual shale overlain by pockets of "paleo" colluvium. Additional test pitting and laboratory testing will need to be carried out on Site A in order to better define the nature and extent of the paleo colluvium for detailed design.

Due to the variable nature of the soil profile encountered at Site A, it is not considered as the preferred site alternative.

In terms of founding, Site B would be considered the preferred alternative given that it is underlain by shallow lying hardpan ferricrete and hard rock quartzite.

According to the aerial photograph interpretation the dolomite contact lies >500m north of Site A (Figure 1) and 150m to >500m to the north of the Site B. The Council of Geoscience recommends that a detailed dolomite risk and stability assessment be carried out where development over dolomite terrain is <100m below surface. It is recommended that detailed geological mapping be carried to confirm the dolomite contact surface expression and the dip and dip direction of the sedimentary strata.

This investigation forms part of the feasibility study for the Dwaalboom Substation site selection phase. Detailed geotechnical investigations must be undertaken prior to the final design stage. The detailed investigation should cover all the various structures/development areas and potential borrow sources to assess extents and volumes. The detailed investigation should cover all the various structures/development areas and potential borrow sources to assess extents and volumes as well as, a dolomite stability and risk assessment.

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1 INTRODUCTION

During October 2008, Arcus Gibb (Pty) Ltd conducted preliminary geotechnical investigations for the proposed Dwaalboom substation. The study area is situated in a remote area of the North West Province, some 100km WSW of Thabazimbi.

Three alternative sites have been proposed by Eskom and include Site A, Site B and Site C. The purpose of the investigation carried out was to provide geotechnical information sufficient for site selection purposes and included limited testpit excavations and soil laboratory testing.

This report presents the interpretation of the data including an aerial photograph interpretation, recommendations and parameters for earthworks and the design of practical foundation solutions.

All three sites are discussed separately in the sections which follow. Once the preferred alternative has been selected a detailed geotechnical investigation will be required to confirm ground conditions and parameters sufficient for design purposes.

The factual data from the field investigations is presented in a separate factual report (J28199-01) and should be read in conjunction with this report.