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GEOTECHNICAL ENGINEERS AND ENGINEERING GEOLOGISTS
Incorporating Drennan Maud & Partners (Est.1975)



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Our Ref : 32687-C

Your Ref :

15th July 2019

IDM Consultants
PO. Box 918
UMHLANGA ROCKS
4320

Attention : Mr. K. Wiggishoff

e-mail: Karlw@idmconsultants.co.za

Dear Sirs,

**PRELIMINARY GEOTECHNICAL SITE ASSESSMENT FOR THE PROPOSED IMFOLOZI
CAUSEWAY CROSSING, BABANANGO PRIVATE GAME RESERVE**

Following discussions held between Mr K. Wiggishoff of IDM Consultants and Drennan Maud (Pty) Ltd, (DML), DML was requested to submit an investigation proposal and cost estimate to carry out a Preliminary Geotechnical Investigation for the 'Proposed Environmental and Water Use Licence Assessments' for the Imfolozi Causeway Crossing and Leopard Rock Lodge at the Babanango Private Game Reserve.

An investigation proposal and cost estimate was submitted to IDM Consultants in our letter reference 91 dated 3rd June 2019 and DML was subsequently appointed by IDM Consultants on 10th June 2019 to undertake the preliminary site assessments.

In this regard, the preliminary site assessments was to comprised the following;

- Review of available information from;
 - previous investigations carried out in the area,
 - published reports.
- Carry out site inspection together with Client, Architect, Engineer to assess the general areas of the proposed development and general development recommendations.

Directors: **M.J.F BENET** [Pr.Sci.Nat. B.Sc. (Hons) M.Sc. FSAIEG], **M.J.HADLOW** [Pr.Sci.Nat. B.Sc.(Hons.) MSAIEG]

Managers: **M.J.F. BENET** (Durban), **G. NTAKA** (Margate)



B-BBEE LEVEL 4 CONTRIBUTOR

- Sampling of materials for laboratory testing.
- Preparation of a Preliminary Report suitable for use for the Environmental and Water use Licence Assessments.

Drennan Maud (Pty) Ltd, visited the site on 14th June 2019 and carried out an initial preliminary site assessment of the proposed **Imfoloz Causeway Crossing**. We now set out below our report on the geology of the site, an assessment of the geotechnical conditions and our preliminary recommendations for the proposed development.

1. INFORMATION SUPPLIED & REVIEWED

1.1 Information Supplied

1.1.1 In order to assist with the assessment of the site, IDM Consultants provided Drennan Maud (Pty) Ltd with a Drop Box link from which the following information was relevant to this assessment ;

- General Locality, comprising -
 - a Google KMZ file showing the location of the Babanango Game Reserve and adjacent properties,
 - a Site Map comprising an extract from 1:50,000 topographical plan showing the location of existing and proposed developments in Babanango Game Reserve,
 - a Land Owners Map giving the location of various farms within the Babanango Game Reserve and adjacent areas, including a Key identifying land owners,
 - a 1:50,000 plan showing the proposed BGR Boundary : March 2019.
- Imfolozi Causeway Crossing, comprising -
 - a report prepared by EnviroSwift for IDM Consultants titled 'Freshwater and Vegetation Assessment for the Proposed Development of a Bridge Traversing the White Mfolozi River near Babanango within the Ulundi Local Municipality, KwaZulu Natal, dated January 2019'.
 - two plans prepared by Undasa Project Partners, titled, Babanango Game Reserve: Roads and Stormwater Upgrade. Detail 11: New Concrete Drift on the Umfolozi River (For Rock Foundation Only). Drawing No U05-DBN-DT05, Rev AA.

1.2 Available Information

1.2.1 Available information used by Drennan Maud Pty Ltd for the investigation comprised the following ;

- The relevant 1:50 000 topographical sheets (2830DB Quydeni, 2831AA Nhlazatshe & 2831AC Babanango).
- The 1:250 000 geological series (2830 Dundee).

2. SITE DESCRIPTION

2.1 Site Locality

2.1.1 The site is located on the White Mfolozi River comprising the boundary between the two farms, Doornkoop_412 to the north and Non-Pareil_721 in the south. The proposed crossing will be accessed from the R34 National Road in the north, via a gravel road through the farm Jordaan 3-656 and 5-656 on which the current Zulu Rock Lodge is located and the farm Doornkoop_412.

2.1.2 The crossing is to be developed to provide a connection between the northern and southern portions of the Babanango Game Reserve as defined in the plan provided, dated March 2019. The approximate location of the proposed causeway crossing is shown on the Site Plan from a Google satellite image attached herewith as Drawing № 32687-C-01.

2.2 Topography and Drainage

2.2.1 The site is located on an outside curve around a spur of the White Mfolozi River. The river flows in an approximately south-south easterly direction in the position of the proposed crossing. The river gradient in the position of the proposed crossing is gentle.

2.2.2 The river banks on either side of the proposed causeway crossing comprises;

- In the east, a gentle to moderate slope from the spur to the riverbank comprising alluvial sediments overlying granitic bedrock. (Plate C1).
- In the west, granitic bedrock outcrops on the riverbank and is overlain by alluvial sediments extending to a relatively gentle natural slope rising to the west. (Plate C2).

2.2.3 Drainage from the spur and slope in the west and east is off the slopes into the White Mfolozi River.

3. GEOLOGY AND SOILS

3.1 The general location of the causeway crossing showing the general geology from the 1:250,000 Dundee Geological Plan, Plan No 2830, is included herewith as Drawing No 32687-C-02.

3.2 The regional geology of the immediate area is dominated by Swazian intrusive granite and the colluvial and residual soils derived therefrom. In addition, the granite in the area has been intruded into by both Radium diabase dykes and Jurassic dolerite dykes. Furthermore, both the northern and southern banks of the proposed causeway crossing are overlain by alluvial sediments comprising boulders, gravels and sandy soils.

3.3 Descriptions of the immediate riverbanks comprise the following;

3.3.1 *Eastern/Left Bank*

The immediate riverbank contains very hard rock granite bedrock outcropping as large boulders/massive granite slabs between joints and shears in the granite which have been eroded by the White Mfolozi River. The granitic bedrock is overlain by boulders and cobbles and relatively thick alluvial sands (Plates C3 & 4).

3.3.2 *Western/Right Bank*

The immediate riverbank contains very hard rock granite bedrock outcropping as large boulders/massive granite slabs between joints and shears in the granite which have been eroded by the White Mfolozi River. The granitic bedrock is overlain by thick alluvial sands. (Plates C5 & 6).

3.3.3 *River Channel*

The main river channel is underlain by granitic bedrock and alluvial sands and boulders. (Plate C7).

4. LABORATORY TESTS

4.1 No laboratory tests were carried out on the materials occurring on the causeway site. However when the detailed geotechnical investigation of the causeway crossing is carried out we recommend the following tests are carried;

- Grading analyses, modified AASHTO density tests and CBR tests are carried out on the alluvial and *in-situ* materials overlying the weathered bedrock, on the bridge approaches are carried out.
- UCS tests are carried out on the granite bedrock.

5. GEOTECHNICAL ASSESSMENT

5.1 General

5.1.1 In terms of the development proposals and our discussions the preliminary geotechnical assessment was primarily for the Environmental and Water Use License Assessment and to be used in the planning for the architect and the environmental consultant.

A more detailed second phase investigation would be carried out at a later date, specific to the engineering and technical construction needs of the causeway crossing.

5.1.2 Notwithstanding the above, based on our preliminary assessment we consider that the following are the aspects relevant to the proposed development;

- The suitability of the *in-situ* soils/bedrock for the founding of proposed causeway structure and approach abutment fills.
- The suitability of the *in-situ* subgrade materials for construction of the approach fills.
- The stability of slopes of the approach fills.

5.2 Problem Soils

5.2.1 Due to the sandy nature of the alluvial soils flanking the river, these soils must be considered highly erodible.

5.3 Excavatability

5.3.1 The alluvial sediments overlying the granitic bedrock in the area is expected to classify as “soft” excavation after SABS 1200D for its full thickness, likely to extend to in excess of 3m on the approach embankments. However, at the base of the alluvial sands gravels and boulders are likely to occur directly overlying the bedrock which may be more difficult to excavate.

5.3.2 The granitic bedrock is likely to classify as “hard”excavation and will require the use of pneumatic tools and blasting to excavate.

5.4 Founding Conditions

5.4.1 Although no testing has been carried out, from visual observations it is evident that granite bedrock outcrops in the riverbed and on the riverbanks is at a relatively shallow depth and will be suitable for founding of the proposed causeway structure.

5.4.2 Based on preliminary assessment we consider that for design purposes an allowable bearing pressure of 500 kPa can be used for foundations socketed into the granitic bedrock.

5.5 Slope Stability

5.5.1 As indicated above the alluvial sandy soils overlying the granitic bedrock are highly erodible. In addition, these soils are likely to be cohesionless and have an angle of internal friction Φ of 28 - 30°. As such, all cut and fill slopes in these materials must be restricted to a slope angle of 1:2, (26°).

5.6 Materials Suitability

5.6.1 No samples of the sandy alluvial materials underlying the site were taken for laboratory testing. However, from our assessment of the materials and having carried out a number of tests on similar alluvial materials derived from the granite, we consider it likely that the material will be suitable for use as bulk fill, subgrade and upper selected layers material.

6. RECOMMENDATIONS

6.1 Location of Structures

6.1.1 From the site inspection and the examination of the Google satellite image and the plans provided, it is evident that the preliminary siting of the proposed main river causeway crossing is likely to be satisfactory, based the underlying geological/geotechnical conditions.

6.2 Founding

6.2.1 *Approach Abutments*

6.2.1.1 From the drawing provided it is evident that the approach abutments to the causeway crossing comprise a reinforced concrete slab over fill or mass concrete, overlying portals on either side of the crossing, founded into the granitic bedrock. The portals should be founded on shallow base slabs taken through all alluvial sediments into hard pickable granitic bedrock. Dowels or equivalent anchoring might be required at the discretion of the Engineer. The maximum allowable bearing pressure should be restricted to 500kPa.

6.2.1.2 All trenches excavated beyond a depth of 1.2m must be shored at the discretion of the Engineer due to the possibility of side wall failure within the loose sediments.

6.2.1.3 From the preliminary assessment it is evident that the suitable weathered bedrock is expected to occur from surface adjacent to the river to a depth of in the order of 3m below existing ground level on either side of the river. However, this must be investigated in the detailed geotechnical investigation.

6.2.2 Causeway Crossing

6.2.2.1 As shown on the drawing provided the causeway crossing is to comprise a concrete slab founded on rock and mass concrete taken into the granite bedrock, overlying portal culverts in the position of the main flow. The slab, supporting concrete and portal culverts should be founded onto the hard rock bedrock expected to be shallow level in the river bed.

6.2.2.2 The maximum allowable bearing pressures for the portal culvert foundations should be restricted to a maximum of not more than 500kPa. Dowels or equivalent anchoring might be required at the discretion of the Engineer.

6.3 Earthworks

6.3.1 Cut slopes in the sandy and gravelly alluvial soils overlying the weathered bedrock should not exceed a batter of 1:2 (26°). Where cuts are taken into the granite bedrock, may be increased to a batter of 1:1,5 (33°) or steeper at the discretion of the Engineer.

6.3.2 Prior to the placement of any fills, the natural ground should be stripped of all vegetation. The fills should be constructed on surfaces benched into firm *in-situ* soils, and should be constructed in layers a maximum loose thickness of 300mm, each layer being compacted to 93% Mod AASHTO density for the sandy materials occurring on the site. The maximum particle size of the fill material must be restricted to $\frac{2}{3}$ of the layer thickness.

6.4 Scour Protection

6.4.1 Erosion protection (i.e. gabions/reno-mattresses) is recommended for the portal culvert approaches and the up and downstream side of the crossing slab with supporting bollard's.

6.5 General Recommendations

6.5.1 The construction must be performed in the drier winter months to minimise the effects of groundwater seepage in the alluvial soils in the riverbed. Stream diversion and sump pumps may be necessary to deal with the seepage.

7. CONCLUSION

Based on the results of the preliminary geotechnical assessment carried out for the site of the proposed White Mfolozi low-level causeway Crossing, we consider that the proposed crossing site is feasible.

The area of the proposed crossing is underlain by granite bedrock at a shallow depth, with alluvial sediments overlying both the eastern and western abutment positions.

Founding of the proposed structure, comprising portal culverts overlain by a concrete slab surface with bollards, should be by means of concrete footings founded into the granite bedrock. The maximum allowable bearing pressures for the portal culvert foundations should be restricted to a maximum of not more than 500kPa. Dowels or equivalent anchoring might be required at the discretion of the Engineer.

Erosion protection (i.e. gabions/reno-mattresses) is recommended for the portal culvert approaches and the up and downstream side of the crossing slab with supporting bollard's.

The construction must be performed in the drier winter months to minimise the effects of groundwater seepage in the alluvial soils in the riverbed. Stream diversion and sump pumps will be necessary to deal with the seepage.

It should be noted that this report is a preliminary report outlining the concept and feasibility of the development and a detailed geotechnical assessment will be required prior to final design and during the development of the site.

We trust that this meets with your immediate requirements in this matter and will be pleased to furnish you with any further information you may require.

Yours faithfully

DRENNAN MAUD (PTY) LTD



M.J. HADLOW Pr.Sci.Nat.

<i>Encls.</i> Plates C1 - 7	-	Site Photos
Drawing No 32687-C-01	-	Site Plan
Drawing No 32687-C-02	-	Geological Plan

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