

CRADLE OF MALELANE (Pty)Ltd

**A PRELIMINARY GEOTECHNICAL AND
HYDROGEOLOGICAL REPORT FOR THE PROPOSED
MALELANE HOTEL DEVELOPMENT, KRUGER PARK,
MPUMALANGA**



**Preliminary geotechnical and hydrogeological findings based on
desk study and visual observations**

February 2011

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and visual observations**

WH10072 – MALELANE HOTEL KRUGER PARK

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A PRELIMINARY GEOTECHNICAL AND HYDROGEOLOGICAL REPORT FOR THE PROPOSED MALELANE HOTEL DEVELOPMENT, KRUGER PARK, MPUMALANGA

1. INTRODUCTION

WSM Leshika Consulting (Pty) Ltd. was appointed to conduct a Preliminary Geotechnical and Hydrogeological Investigation for the development of a proposed resort on the northern bank of the Crocodile River in the Kruger National Park, Mpumalanga Province.

The main objective of the investigation is to determine for the identified parcels of land whether or not such land is suitable for human settlements and in the process comment on the **potential** ground conditions and geotechnical constraints within the zone of influence of foundation work and access the hydrogeological environment to supply water. A total of 5 potential sites have been identified by the client, and attention is given to each individual site. A brief discussion pertaining the geotechnical characteristics that will potentially affect road construction is also included.

The fieldwork, which consisted of a walk-over survey, was conducted on 8 February 2011.

This desk study report describes the methodology of the investigation, preliminary findings based on visual observations, expected geotechnical constraints and the way forward.

2. EXISTING INFORMATION USED IN THE STUDY

The following existing information was used during the investigation:

- 1:250 000-scale 2530 BARBERTON geological sheet;

- 1:50 000-scale 2531 BC topographic sheet;
- Google Earth[®] satellite images;
- Proposed site layout drawings.

Coordinates of all the potential stands were provided by the client, as well as the proposed route of the access road to the identified stands.

3. OBJECTIVE AND METHODOLOGY OF THE INVESTIGATION

The main objective of the Preliminary Geotechnical Investigation is to make an initial determination for an identified parcel of land as to whether or not such land is fit for human settlements.

This assessment is based on a detailed literature study of the available information on the area and on the visual observations made during the site walk-over survey.

The site walk-over survey was conducted for the five potential sites on the 8th of February 2011. The survey was done by a suitably qualified Engineering Geologist. The main aim of the walk-over survey is to get a “feel” for the site in an effort to premeditate any potential geotechnical constraints identified at a later stage during the Phase I and Phase II geotechnical investigations. Attention is focussed on the topography of the site, existing profiles (e.g. in gullies and road cuttings), surface characteristics of the material on site and to any rock outcrop that might exist.

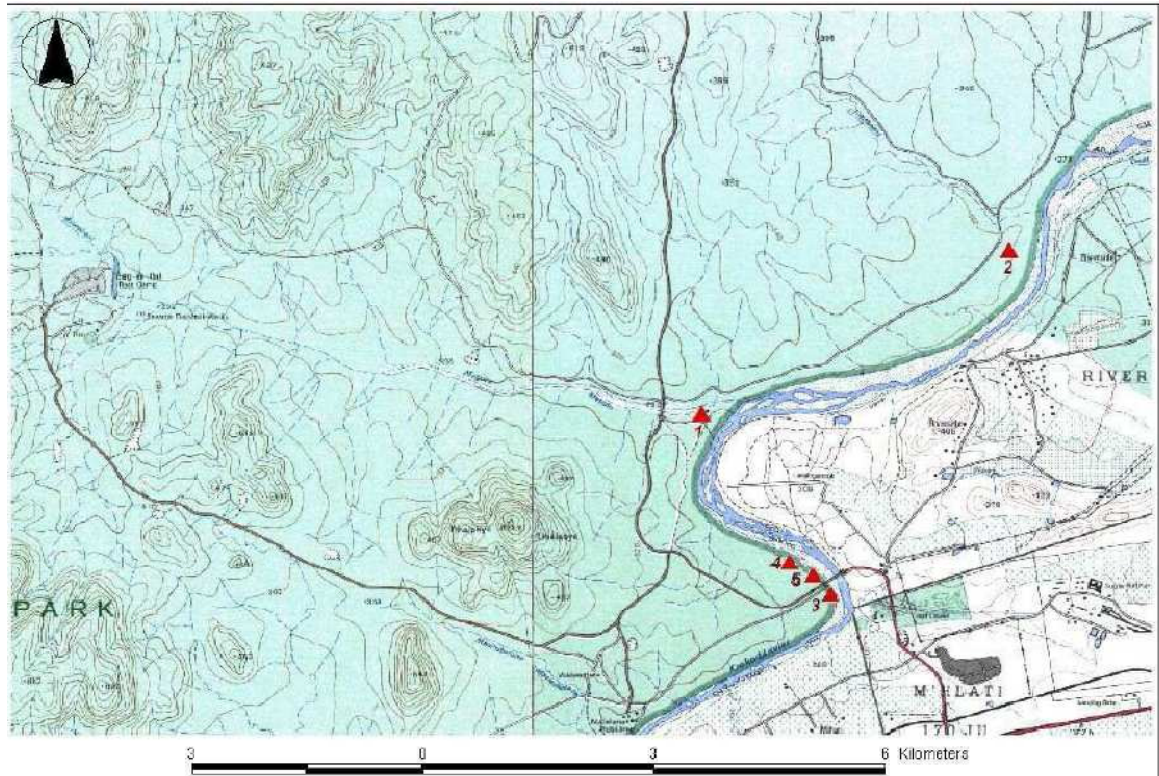
The main objective of the Hydrogeological Investigation was to determine the feasibility of providing water for the proposed development from groundwater resources.

4. SITE DESCRIPTION

Five potential sites were earmarked for the development of the proposed resort.

TABLE 1: SITE CO-ORDINATES

	Site 1	Site 2	Site 3	Site 4	Site 5
Latitude	S25°26'25.9"	S25°25'8.8"	S25°27'44.0"	S25°27'37.9"	S25°27'32.8"
Longitude	E31°31'21.2"	E31°33'23.6"	E31°32'3.90"	E31°31'57.5"	E31°31'53.7"

**MAP 1: LOCALITY OF THE FIVE PROPOSED SITES**

4.1 Site 1

4.1.1 Location

Site 1 is located at the confluence of the Matjulu River and the Crocodile River on the southern boundary of the Kruger Park (Map 1).

4.1.2 Existing services/infrastructure

Site 1 was previously used as a roads construction camp and picnic area for park personnel. Existing infrastructure on the site include a temporary corrugated iron structure and a number of concrete slabs, with a dirt-track (management road) providing access to the site from the H3 tar road. This road is in a poor condition; being overgrown and flooded in places at the time of investigation.

4.1.3 Topography, Drainage and Vegetation

The regional topography can be described as undulating, with a number of valleys and ridges typical of the geological setting. Apart from the steep river banks along the eastern and northern boundary, Site 1 is generally flat-lying. The site gently slopes to the east at an approximate angle of 0.5 degrees to 2 degrees (based on the Google Earth[®] elevation data) at an average elevation of 280 mamsl. (Meters above mean sea-level).

The seasonal Matjulu River runs from west to east along the northern boundary of the site, draining towards the large perennial Crocodile River which forms the eastern boundary of the site. It is expected that rainwater will mainly drain as surface flow or sheetwash and percolate through the upper, more permeable topsoil and colluvium/alluvium horizons to drain with the angle of slope towards the lower slopes and in the direction of the Crocodile River.

The site is predominantly covered with tall grass and shrubs, with a number of large riparian trees (including Natal Mahogany, Sausage Tree, Jackal Berry and Ficus).



PHOTOGRAPH 1: EXAMPLE OF LARGE TREES ON SITE 1



PHOTOGRAPH 2: PERENNIAL CROCODILE RIVER TO THE EAST OF SITE 1



PHOTOGRAPH 3: SEASONAL MATJULU RIVER TO THE NORTH OF SITE 1

4.2 Site 2

4.2.1 Location

Site 2 is located at the confluence of the Timfene River and the Crocodile River on the southern boundary of the Kruger Park (Map 1).

4.2.2 Existing services/infrastructure

Site 2 is a “green field” site and contains no existing infrastructure apart from the S114 gravel road, which runs from Malelane towards Crocodile Bridge through Site 2. This road is currently in a good condition and will be able to provide access to the site for larger construction vehicles.

4.2.3 Topography, Drainage and Vegetation

The regional topography can be described as undulating, with a number of valleys and ridges typical of the geological setting. Apart from the steep river banks along the eastern and northern boundary, Site 2 is generally flat-lying. The site gently slopes to the east at an approximate angle of 0.5 degrees to 1 degrees (based on the Google Earth[®] elevation data) at an average elevation of 270 mamsl.

The seasonal Timfene River runs from west to east along the northern boundary of the site, draining towards the large perennial Crocodile River which forms the eastern boundary of the site. It is expected that rainwater will mainly drain as surface flow or sheetwash and percolate through the upper, more permeable topsoil and colluvium/alluvium horizons to drain with the angle of slope towards the lower slopes and in the direction of the Crocodile River.

The site is predominantly covered with tall grass and shrubs, with a number of large riparian trees.



PHOTOGRAPH 4: SEASONAL TIMFENE RIVER TO THE NORTH OF SITE 2



**PHOTOGRAPH 5: VIEW FROM TIMFENE RIVER UP SLOPE TOWARDS
SITE 2**

4.3 Site 3

4.3.1 Location

Site 3 is located near the H3 tar road to the southwest of the Malelane Entrance Gate on the southern boundary of the Kruger Park (Map 1).

4.3.2 Existing services/infrastructure

Site 3 is a “green field” site and contains no existing infrastructure. The proposed site is situated next to the H3 tar road which is in an excellent condition and will be able to provide access to the site for larger construction vehicles.

4.3.3 Topography, Drainage and Vegetation

The regional topography can be described as undulating, with a number of valleys and ridges typical of the geological setting. Apart from the steep river banks along the eastern boundary, Site 3 is generally flat-lying. The site gently slopes to the east at an approximate angle of 0.5 degrees to 1 degrees (based on the Google Earth[®] elevation data) at an average elevation of 290 mamsl.

The large perennial Crocodile River forms the eastern boundary of the site. It is expected that rainwater will mainly drain as surface flow or sheetwash and percolate through the upper, more permeable topsoil and colluvium/alluvium horizons to drain with the angle of slope towards the lower slopes and in the direction of the Crocodile River.

Site 3 is predominantly covered with tall grass and shrubs with scattered larger trees.

4.4 Sites 4 and 5

4.4.1 Location

Sites 4 and 5 are adjacent to each other and located near the H3 tar road to the northwest of the Malelane Entrance Gate on the southern boundary of the Kruger Park (Map 1).

4.4.2 Existing services/infrastructure

Sites 4 and 5 are “green field” sites and contain no existing infrastructure. Site 5 is situated next to the H3 tar road which is in an excellent condition and will be able to provide access to the site for larger construction vehicles.

An existing borehole was observed on Site 4. The water level in the borehole was duly measured at 9.45 metres below natural ground level using a standard dip-meter.



PHOTOGRAPH 6: BOREHOLE ON SITE 4

4.4.3 Topography, Drainage and Vegetation

The regional topography can be described as undulating, with a number of valleys and ridges typical of the geological setting. Apart from the steep river banks along the eastern boundary, Sites 4 and 5 are generally flat-lying. The site gently slopes to the east at an approximate angle of 0.5 degrees to 1 degrees (based on the Google Earth[®] elevation data) at an average elevation of 290 mamsl.

The large perennial Crocodile River forms the eastern boundary of the site. It is expected that rainwater will mainly drain as surface flow or sheetwash and percolate through the upper, more permeable topsoil and colluvium/alluvium horizons to drain with the angle of slope towards the lower slopes and in the direction of the Crocodile River.

Both sites are predominantly covered with tall grass and shrubs with scattered larger trees.

4.5 Proposed “Park-and-Ride” Facility

4.5.1 Location

A proposed “park-and-ride” facility is planned for the resort. The proposed site for the parking area, where visitors will be forced to leave their private vehicles, is situated adjacent to the H3 tar road immediately southwest of the Malelane Entrance Gate.

The proposed site layout is included as Figure 1 in Appendix A.

4.5.2 Existing services/infrastructure

The selected potential site is a “green field” site and contains no existing infrastructure. The site is situated next to Malelane Entrance Gate and the H3 tar road, which is in an excellent condition and will be able to provide access to the site for larger construction vehicles.

4.4.3 Topography, Drainage and Vegetation

The regional topography can be described as undulating, with a number of valleys and ridges typical of the geological setting. Apart from the steep river banks along the eastern boundary, the site topography is generally flat-lying. The site gently slopes to the east at an approximate angle of 0.5 degrees to 1 degrees (based on the Google Earth[®] elevation data) at an average elevation of 290 mamsl.

The large perennial Crocodile River forms the eastern boundary of the site. It is expected that rainwater will mainly drain as surface flow or sheetwash and percolate through the upper, more permeable topsoil and colluvium/alluvium horizons to drain with the angle of slope towards the lower slopes and in the direction of the Crocodile River.

The site is predominantly covered with tall grass and shrubs with scattered larger trees.

5. SITE GEOTECHNICAL EVALUATION

The geotechnical evaluation of the proposed sites is based on the data gathered during the desk study and the visual observations made during the site walk-over survey.

It should be emphasised that the geotechnical evaluation is preliminary and only comments on the potential geotechnical constraints typically associated with such geological settings, the presence/absence of which should be confirmed during the Phase I and Phase II investigations.

No test pits were excavated and no samples were available for laboratory analysis.

The geology is depicted in Figure 2, Appendix A.

5.1 Site 1

5.1.1 Regional Geology

According to the 1:250 000-scale 2530 *BARBERTON* geological sheet, the investigated area is underlain by:

- Biotite-Trondhjemite Gneiss (Goudplaats-Houtriver Gneiss Suite, Paleoarchean Granitoid Intrusion).

No potentially soluble rock formations such as dolomite are indicated on/or in close proximity of the site.

The formation and typical mineral composition of the rock types is briefly discussed below (Cairncross, 2004 and Keary, 2001).

Gneiss is a coarse-grained metamorphic rock that is characteristically banded or layered and forms by regional high-grade metamorphism of granite. Large crystals in gneiss are composed of quartz, alkali feldspar, mica, amphiboles, or, rarely, pyroxenes. Some gneisses (migmatites) that have undergone intensive metamorphism and deformation take on the appearance of swirled toothpaste.

5.1.2 Structural Geology

From the 1:250 000-scale geological sheet it can be seen that a large linear feature, trending north-south, runs approximately 800 metres to the west of the site. This feature was identified from the aeromagnetic data and most likely represents a fault or hypabyssal intrusion.

A number of diabase dykes, trending northwest-southeast, were also identified approximately three to four kilometres to the southwest of the site.

5.1.3 Site Geology

Gneissic outcrops were identified in the area immediately surrounding the site. The site itself however appears to be covered by surficial deposits of unknown depth.

5.1.4 Hydrogeology

The main aquifers thought to exist include fractured and weathered rocks and the alluvium along the Crocodile River although the alluvium does not appear to be extensive (river channel is mainly rock outcrop). Suitable targets for abstraction boreholes would be the alluvium along the Crocodile River, the linear feature 800m west of the site and along the diabase dykes.

Low to moderate borehole yields (up to 1l/s) can be expected. Water quality is expected to be potable.



PHOTOGRAPH 7: ALLUVIAL MATERIAL

5.1.5 Potential Geotechnical Constraints

Based on the available geological and site information, a number of potential geotechnical constraints have been identified that is might occur. This is based on the general geotechnical constraints pertaining to urban development as proposed by Partridge, Wood and Brink (1993), included as Table 2, Appendix B.

These include:

- Collapsible soils;
- Shallow seepage and/or perched water table;
- Compressible soils;
- Excavation difficulty;
- Soil with an intermediate to high erodability/dispersivity;
- Areas subject to flooding.



PHOTOGRAPH 8: INTERMEDIATE TO HIGHLY ERODIBLE/DISPERSIVE SOILS

5.2 Site 2

5.2.1 Regional Geology

According to the 1:250 000-scale 2530 *BARBERTON* geological sheet, the investigated area is underlain by:

- Basaltic and peridotitic komatiite, as well as various mafic and ultramafic schists interlayered with banded iron formation and ferruginous black, white grey chert and acidic to intermediate volcanic rocks (Barberton Supergroup, Onverwacht Group, Tjakastad Subgroup, Komati and Theespruit Formations).

No potentially soluble rock formations such as dolomite are indicated on/or in close proximity of the site.

The formation and typical mineral composition of the rock types is briefly discussed below (Cairncross, 2004 and Keary, 2001).

Komatiite is an ultramafic volcanic rock composed primarily of olivine and pyroxene. It has the morphological features of subaerial and submarine basaltic lava and a distinctive spinifex texture. Characteristic of Archean terrains.

Schists refer to high-grade metamorphic rocks that exhibit a schistose (foliated) structure.

Banded Iron Formation (BIF) is an iron-rich sediment with layers of chert and iron minerals.

5.2.2 Structural Geology

From the 1:250 000-scale geological sheet it can be seen that a large linear feature, trending north-south, runs approximately 2.2 kilometres to the northeast of the site. This feature was identified from the aeromagnetic data and most likely represents a fault or hypabyssal intrusion.

5.2.3 Site Geology

Komatiite and schist outcrops were identified in the Timfene River. The site itself however appears to be covered by surficial deposits of unknown depth.

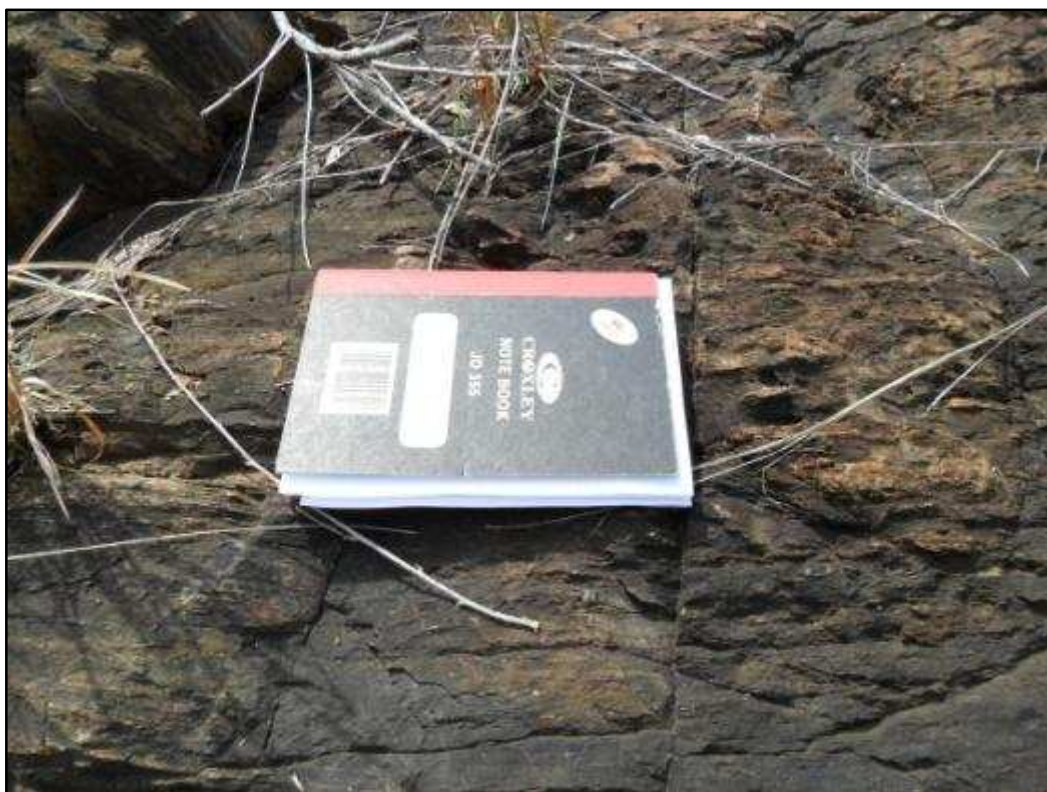
5.2.4 Hydrogeology

The main aquifers thought to exist include fractured and weathered rocks and the alluvium along the Crocodile River although the alluvium does not appear to be extensive (river channel is mainly rock outcrop). Suitable targets for abstraction boreholes would be the alluvium along the Crocodile River, the north south linear feature 2.2kms northeast of the site and along the diabase dykes .

Low to moderate borehole yields (up to 1l/s) can be expected in. Water quality is expected to be potable.



PHOTOGRAPH 9: KOMATIITE OUTCROP IN TIMFENE RIVER



PHOTOGRAPH 9: MAFIC/ULTRAMAFIC ROCKS EXHIBITING SCHISTOSE STRUCTURE

5.2.5 Potential Geotechnical Constraints

Based on the available geological and site information, a number of potential geotechnical constraints have been identified that is might occur. This is based on the general geotechnical constraints pertaining to urban development as proposed by Partridge, Wood and Brink (1993), included as Table 2, Appendix B.

These include:

- Shallow seepage and/or perched water table;
- Active soils;
- Compressible soils;
- Excavation difficulty;
- Soil with an intermediate to high erodability;
- Areas subject to flooding.

5.3 Site 3

5.3.1 Regional Geology

According to the 1:250 000-scale 2530 *BARBERTON* geological sheet, the investigated area is underlain by:

- Grey to white biotite granite (Nelspruit Suite).

No potentially soluble rock formations such as dolomite are indicated on/or in close proximity of the site.

The formation and typical mineral composition of the rock types is briefly discussed below (Cairncross, 2004 and Keary, 2001).

Granite is a coarse-grained igneous rock that forms from the crystallization of molten magma rich in silica. It is composed mainly of quartz and feldspars, notably the potassium-bearing varieties orthoclase and microcline. Other minerals include mica and hornblende.

5.3.2 Structural Geology

From the 1:250 000-scale geological sheet it can be seen that a large linear feature, trending north-south, runs approximately 2.2 kilometres to the west of the site. This feature was identified from the aeromagnetic data and most likely represents a fault or hypabyssal intrusion.

A number of diabase dykes, trending northwest-southeast, were also identified approximately three to four kilometres to the west of the site.

5.3.3 Site Geology

Granitic outcrops were identified in the area immediately surrounding the site. The site itself however appears to be covered by surficial deposits of unknown depth.

5.3.4 Hydrogeology

The main aquifers thought to exist include fractured and weathered rocks and the alluvium along the Crocodile River although the alluvium does not appear to be extensive (river channel is mainly rock outcrop). Suitable targets for abstraction boreholes would be the alluvium along the Crocodile River, the linear feature 2.2kms west of the site and along the diabase dykes.

Low to moderate borehole yields (up to 1l/s) can be expected. Water quality is expected to be potable.

5.3.5 Potential Geotechnical Constraints

Based on the available geological and site information, a number of potential geotechnical constraints have been identified that is might occur. This is based on the general geotechnical constraints pertaining to urban development as proposed by Partridge, Wood and Brink (1993), included as Table 2, Appendix B.

These include:

- Collapsible soils;

- Shallow seepage and/or perched water table;
- Compressible soils;
- Excavation difficulty;
- Soil with an intermediate to high erodability/dispersivity;
- Areas subject to flooding.

5.4 Sites 4 and 5

5.4.1 Regional Geology

According to the 1:250 000-scale 2530 *BARBERTON* geological sheet, the investigated area is underlain by:

- Grey to white biotite granite (Nelspruit Suite).

No potentially soluble rock formations such as dolomite are indicated on/or in close proximity of the site.

The formation and typical mineral composition of the rock types is briefly discussed below (Cairncross, 2004 and Keary, 2001).

Granite is a coarse-grained igneous rock that forms from the crystallization of molten magma rich in silica. It is composed mainly of quartz and feldspars, notably the potassium-bearing varieties orthoclase and microcline. Other minerals include mica and hornblende.

5.4.2 Structural Geology

From the 1:250 000-scale geological sheet it can be seen that a large linear feature, trending north-south, runs approximately 2.2 kilometres to the west of the sites. This feature was identified from the aeromagnetic data and most likely represents a fault or hypabyssal intrusion.

A number of diabase dykes, trending northwest-southeast, were also identified approximately three to four kilometres to the west of the sites.

5.4.3 Site Geology

Granitic outcrops were identified in the area immediately surrounding the sites. The sites itself however appear to be covered by surficial deposits of unknown depth.

5.4.4 Hydrogeology

The main aquifers thought to exist include fractured and weathered rocks and the alluvium along the Crocodile River although the alluvium does not appear to be extensive (river channel is mainly rock outcrop). Suitable targets for abstraction boreholes would be the alluvium along the Crocodile River, the linear feature 2.2kms west of the site and along the diabase dykes.

Low to moderate borehole yields (up to 1l/s) can be expected. Water quality is expected to be potable.

5.4.5 Potential Geotechnical Constraints

Based on the available geological and site information, a number of potential geotechnical constraints have been identified that is might occur. This is based on the general geotechnical constraints pertaining to urban development as proposed by Partridge, Wood and Brink (1993), included as Table 2, Appendix B.

These include:

- Collapsible soils;
- Shallow seepage and/or perched water table;
- Compressible soils;
- Excavation difficulty;
- Soil with an intermediate to high erodability/dispersivity;
- Areas subject to flooding.

5.5 Proposed “Park-and-Ride” Facility

5.5.1 Regional Geology

According to the 1:250 000-scale 2530 *BARBERTON* geological sheet, the investigated area is underlain by:

- Grey to white biotite granite (Nelspruit Suite).

No potentially soluble rock formations such as dolomite are indicated on/or in close proximity of the site.

The formation and typical mineral composition of the rock types is briefly discussed below (Cairncross, 2004 and Keary, 2001).

Granite is a coarse-grained igneous rock that forms from the crystallization of molten magma rich in silica. It is composed mainly of quartz and feldspars, notably the potassium-bearing varieties orthoclase and microcline. Other minerals include mica and hornblende.

5.5.2 Structural Geology

From the 1:250 000-scale geological sheet it can be seen that a large linear feature, trending north-south, runs approximately 2.2 kilometres to the west of the site. This feature was identified from the aeromagnetic data and most likely represents a fault or hypabyssal intrusion.

A number of diabase dykes, trending northwest-southeast, were also identified approximately three to four kilometres to the west of the site.

5.5.3 Site Geology

Granitic outcrops were identified in the area immediately surrounding the site. The site itself however appears to be covered by surficial deposits of unknown depth.

5.5.4 Hydrogeology

The main aquifers thought to exist include fractured and weathered rocks and the alluvium along the Crocodile River although the alluvium does not appear to be extensive (river channel is mainly rock outcrop). Suitable targets for abstraction

boreholes would be the alluvium along the Crocodile River, the linear feature 2.2kms west of the site and along the diabase dykes.

Low to moderate borehole yields (up to 1l/s) can be expected. Water quality is expected to be potable.

5.5.5 Potential Geotechnical Constraints

Based on the available geological and site information, a number of potential geotechnical constraints have been identified that is might occur. This is based on the general geotechnical constraints pertaining to urban development as proposed by Partridge, Wood and Brink (1993), included as Table 2, Appendix B.

These include:

- Collapsible soils;
- Shallow seepage and/or perched water table;
- Compressible soils;
- Excavation difficulty;
- Soil with an intermediate to high erodability/dispersivity;
- Areas subject to flooding.

6. PROPOSED ACCESS ROAD

The proposed access road will run from the proposed “Park-and-Ride” facility near the Malelane Gate, up to the proposed Site 2, using existing park roads.

In the event of Site 2 being selected as the chosen site, the existing S114 gravel road will be rerouted to the north of the site and rejoin the existing road at a later stage (Figure 3, Appendix A).

Geotechnical constraints similar to those as outlined for the Sites 1-5 above might be expected along the length of the proposed route as it extends over similar geological settings.

No potentially soluble rock formations such as dolomite are indicated in the areas through which the proposed access road will run.

Suitable construction material will need to be sourced from the nearest available source outside the reserve.

All roads to be upgraded or new roads will conform to the road specifications manual for KNP.

7. CONCLUSION AND WAY FORWARD

All of the sites and the area affected by the proposed rerouting of the road are developable from a geotechnical and hydrogeological point of view. The major concerns regarding the foundation conditions are outlined within this report. Foundation modifications and precautionary measures will be necessary to limit damage to the proposed structures.

Low to moderate borehole yields are expected and each borehole could yield at least 25 m³/ day. A few production bores located on different features would therefore be required to meet the full water demand.

A Phase I and II Geotechnical Investigation is essential to refine the zones identified during this investigation and to make the necessary foundation adaptations depending on the soil conditions encountered below individual units. The Phase II geotechnical investigation will be necessary for individual stand classification required for NHBRC enrolment.

A borehole siting and drilling investigation would be required to confirm and develop the groundwater resource.

8. REPORT PROVISIONS

This is only a preliminary or progress report based on desk study information and visual observations from a site walkover survey. The conclusions and observations made in this report are subject to doing more in-depth investigations.

This report is only to inform the planners or design engineers of the potential for groundwater development and give expected geotechnical conditions and cannot be used for detailed design purposes.



C J Haupt

BSc (Hons) Pr.Sci.Nat.

9. REFERENCES

Das, B. M., 1990. Principles of Geotechnical Engineering. 2nd Ed. PWS-Kent. USA.

Jennings, J.E.B., Brink, A.B.A., Williams, A.A.B., 1973. Revised guide to Soil Profiling for Civil Engineering Purposes in Southern Africa. The Civil Engineer in SA. pp 3-12. January 1973.

Partridge, T.C., Wood, C.K., Brink, A.B.A., 1993. Priorities for Urban Expansion within the PWV Metropolitan Region: The primacy of geotechnical constraints. South African Geographical Journal, Vol 75, pp 9-13.

National Home Builders Registration Council, 1995. Standards and Guidelines. HBRC.

SAICE. 1995. Code of Practice: Foundations and Superstructures for Single Storey Residential Buildings of Masonry Construction. Joint Structural Division, Johannesburg. First Edition.

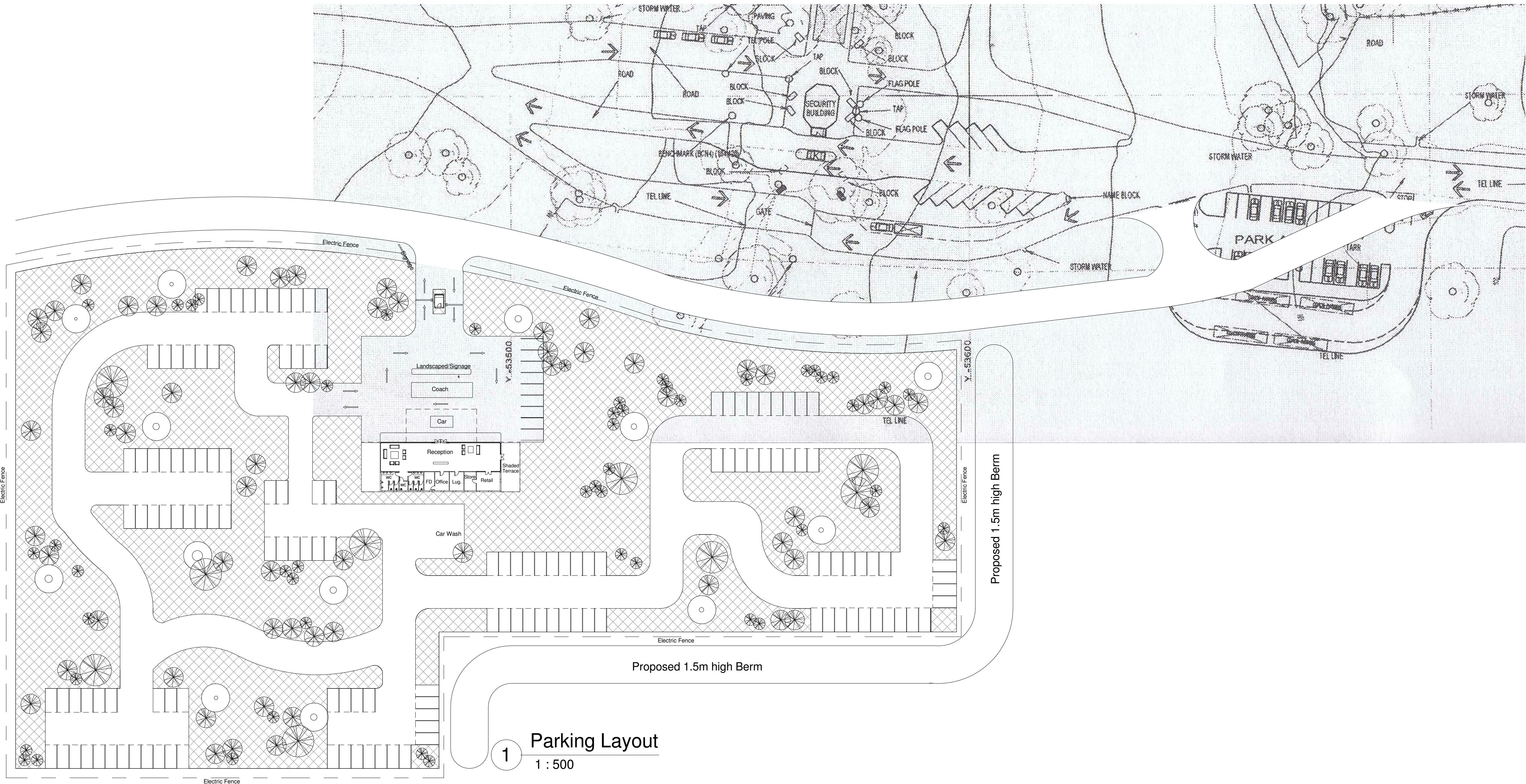
SAIEG, 1996. Guidelines for Soil and Rock Logging. SAICE/SAIEG.

Weinert, H.H., 1980. The Natural Road Construction Materials of Southern Africa. Academica. Cape Town.

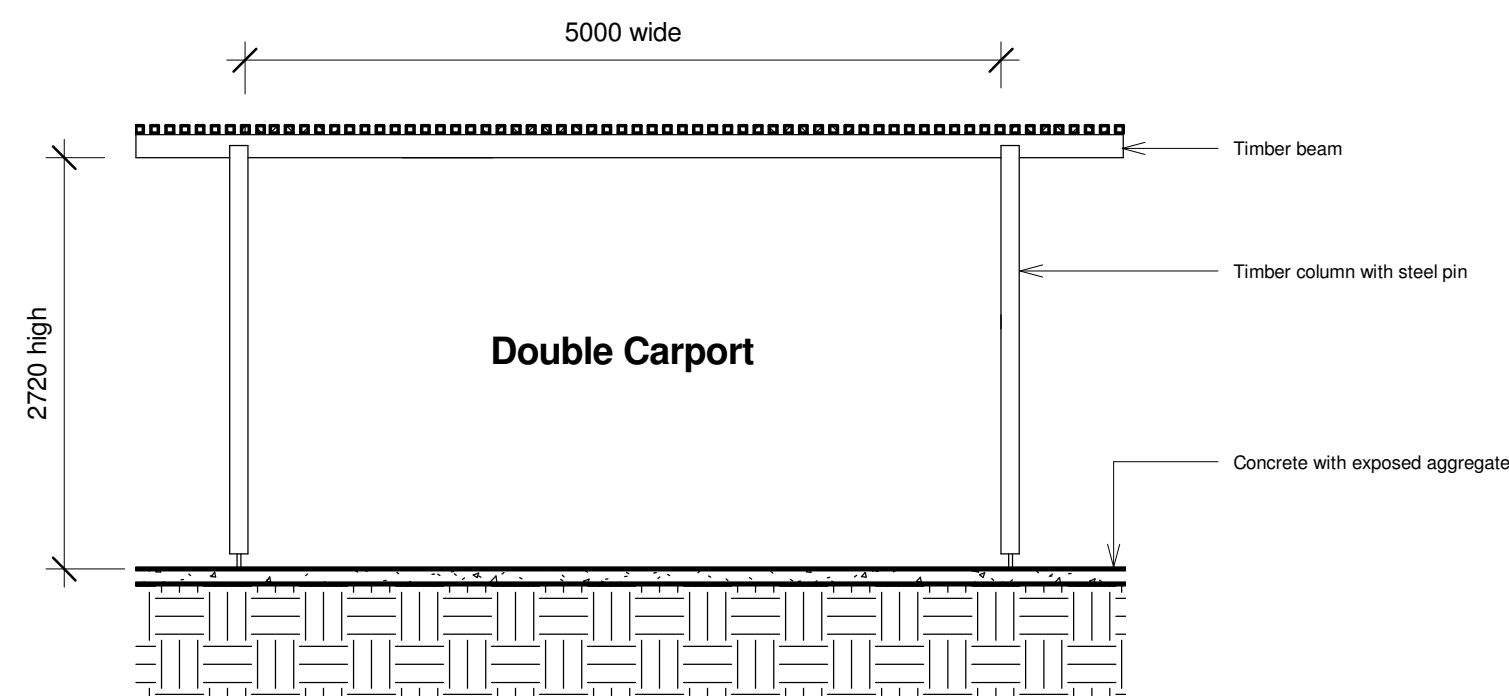
APPENDIX A

(FIGURES)

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1 Parking Layout
1 : 500



3 Carport Section
1 : 50

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Revision Schedule			
Rev	Date	Description	Issued to
1	15/12/2010	1-Layout for Welcome Centre revised	
2	14/01/2011	1-Layout of Welcome Centre rotated and revised	

PARKING SPACES

RADISSON HOTEL 105
KRUGER PARK VISITORS 40

- ISSUE FOR COUNCIL SUBMISSION
- FOR INFORMATION ONLY
- FOR TENDER PURPOSES ONLY
- ISSUE FOR APPROVAL
- ISSUE FOR CONSTRUCTION

SIGNED FOR CONSTRUCTION

ARCHITECT:

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PROJECT
Radisson Blu- Safari Hotel- Kruger National Park

ADDRESS
Enter address here

DESCRIPTION
Gate Parking Facility and Welcome Centre

CRONJE ASSOCIATED ARCHITECTS CC

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Ballito Business Park

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reg no 2621



Drawn Sarah	Project nr: Project Number Sheet nr: SK01-101	Date: 2011/01/17 01:18:10 PM
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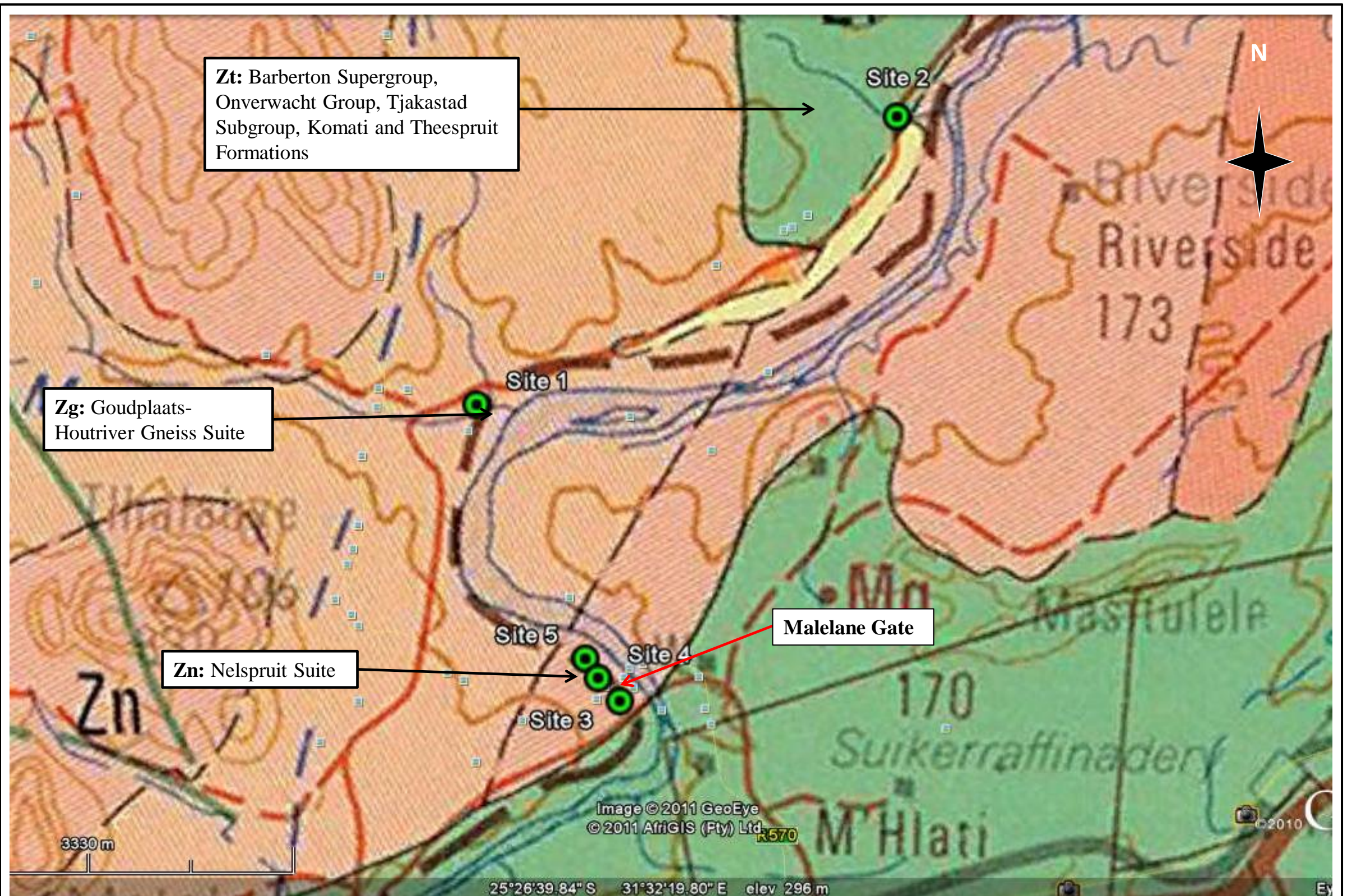
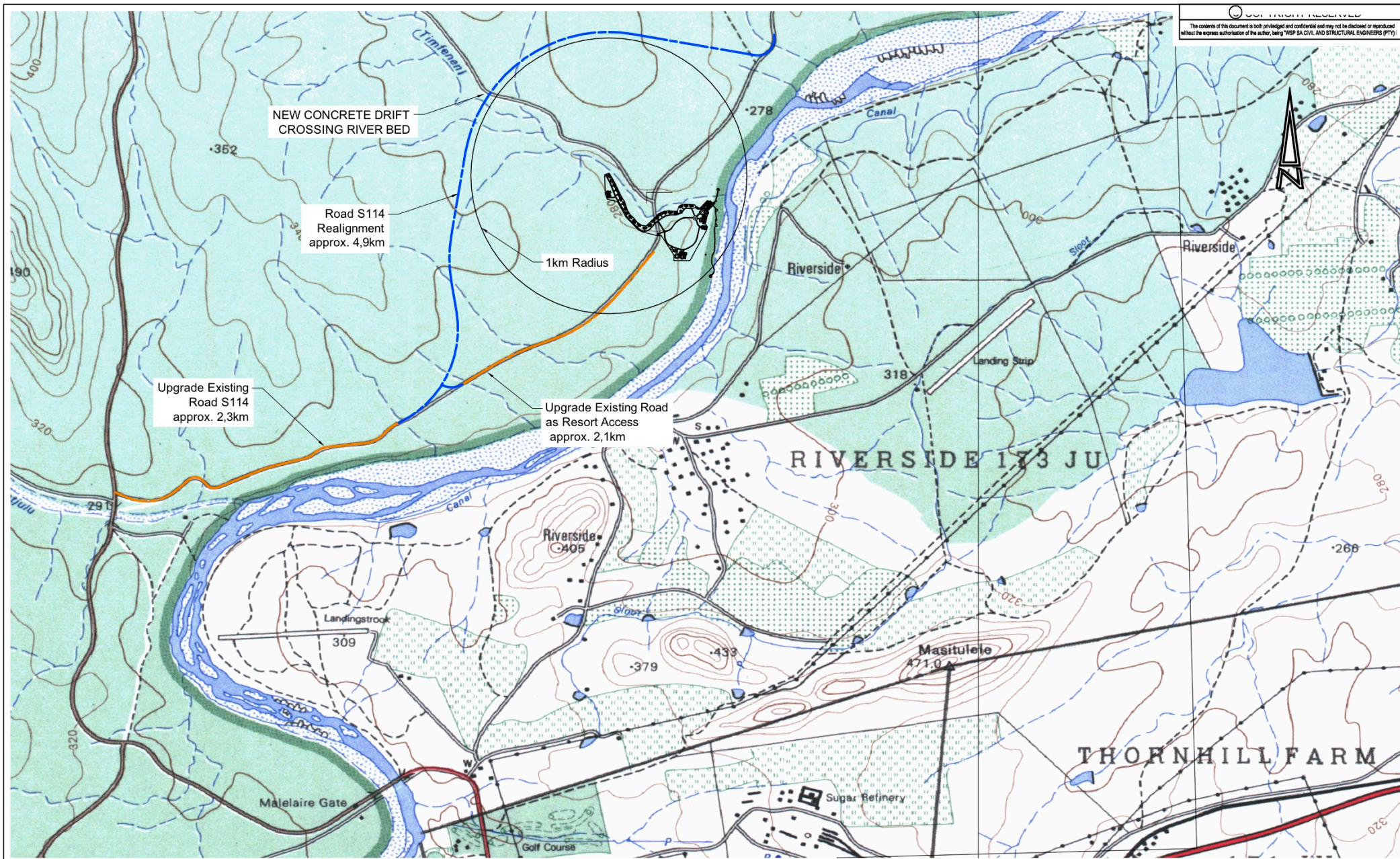


Figure 2: Geology



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REV	DATE	BY	DESCRIPTION	CHK	APD
A	18/01/2011	PSR	RESORT LAYOUT REVISED	PSR	PSR
DRAWING STATUS: FOR INFORMATION					

CLIENT:	MALELANE SAFARI RESORT INVESTMENTS
---------	------------------------------------

WSP

401 Pinnacle Building
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Sonpark
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Tel (013) 752-2457, Fax (013) 752-2189

PROJECT:	RADISSON BLU SAFARI RESORT, KRUGER PARK
TITLE:	PROPOSED REALIGNMENT OF KRUGER PARK ROAD

SCALE:	1:25000	CHECKED:	PSR	APPROVED:	-
DESIGN:	PSR	DRAWN:	SEM	DATE:	2011-01-19
PROJECT No:	335470	DRAWING No:	335470/C/1000	REV:	A
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APPENDIX B:

(REFERENCE TABLE)

TABLE 6: GEOTECHNICAL CLASSIFICATION FOR URBAN DEVELOPMENT (after Partridge, Wood and Brink 1993)

CONSTRAINT		Most favourable (1)	Intermediate (2)	Least favourable (3)
A	Collapsible Soil	Any collapsible horizon or consecutive horizons totalling a depth of less than 750 mm in thickness.*	Any collapsible horizon or consecutive horizons with a depth of more than 750 mm in thickness.	A least favourable situation for this constraint does not occur.
B	Seepage	Permanent or perched water table more than 1,5 m below ground surface.	Permanent or perched water table less than 1,5 m below ground surface	Swamps and marshes.
C	Active soil	Low soil-heave potential predicted. *	Moderate soil heave potential predicted.	High soil-heave potential predicted.
D	Highly compressible soil	Low soil compressibility expected.*	Moderate soil compressibility expected.	High soil compressibility expected.
E	Erodability of soil	Low.	Intermediate.	High.
F	Difficulty of excavation to 1,5 m depth	Scattered or occasional boulders less than 10% of the total volume.	Rock or hardpan pedocretes between 10 and 40 % of the total volume.	Rock or hardpan pedocretes more than 40 % of the total volume.
G	Undermined ground	Undermining at a depth greater than 100 m below surface (except where total extraction mining has not occurred.)	Old undermined areas to a depth of 100m below surface where stope closure has ceased.	Mining within less than 100 m of surface or where total extraction mining has taken place.
H	Instability in areas of soluble rock	Possibly unstable.	Probably unstable.	Known sinkholes and dolines
I	Steep slopes	Between 2 and 6 degrees (all regions).	Slopes between 6 and 18 degrees and less than 2 degrees (Natal and Western Cape). Slopes between 6 and 12 degrees and less than 12 degrees (all other regions).	More than 18 degrees (Natal and Western Cape). More than 12 degrees (all other regions).
J	Areas of unstable natural slopes	Low risk.	Intermediate risk.	High risk (especially in areas subject to seismic activity).
K	Areas subject to seismic activity	10% probability of an event less than 100 cm/s ² within 50 years	Mining-induced seismic activity more 100 cm/s ² .	Natural seismic activity more than 100 cm/s ² .
L	Areas subject to flooding	A "most favourable" situation for this constraint does not occur.	Areas adjacent to a known drainage channel or floodplain with slope less than 1%.	Areas within a known drainage channel or floodplain.

These areas are designated as 1A, 1C, 1D, or 1F where localised occurrences of the constraint may arise