Kaimsab Wes 364-Khomashoogland; Khomas Region

Desk Study Report for Borehole Siting

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1. INTRODUCTION

1.1 Background

Green Team Consultants was appointed by C.Deelie to carry out "Desktop Study and Siting of one borehole on the farm Kiamsab Wes 364 Khomashoogland in Khomas region. Works includes hydrological consulting services for Hydrocensus operations, geophysical surveys, borehole siting. The results of the siting will be presented in the siting report. The siting report is centered on a reconnaissance survey that was conducted.

1.2 Objectives

The report aims to provide an evaluation on the siting and geophysical works that has to be conducted in order to position a new site for drilling. The report aims to facilitate on recommendations for drilling methods to be used, the geology likely to be encountered and hydrogeological potential of the sites. In addition to the details of the sites, a generalized accessibility assessment of the site was done as well.

2. DESK STUDY

2.1 PHYSIOGRAPHY

2.1.1 LOCATION

The area of interest is located about 138km South West of Windhoek in the Khomas region. There are commercial farms are found in this area. The area shares boundaries with Koam 304 on the west and Ammams 318 in the North.

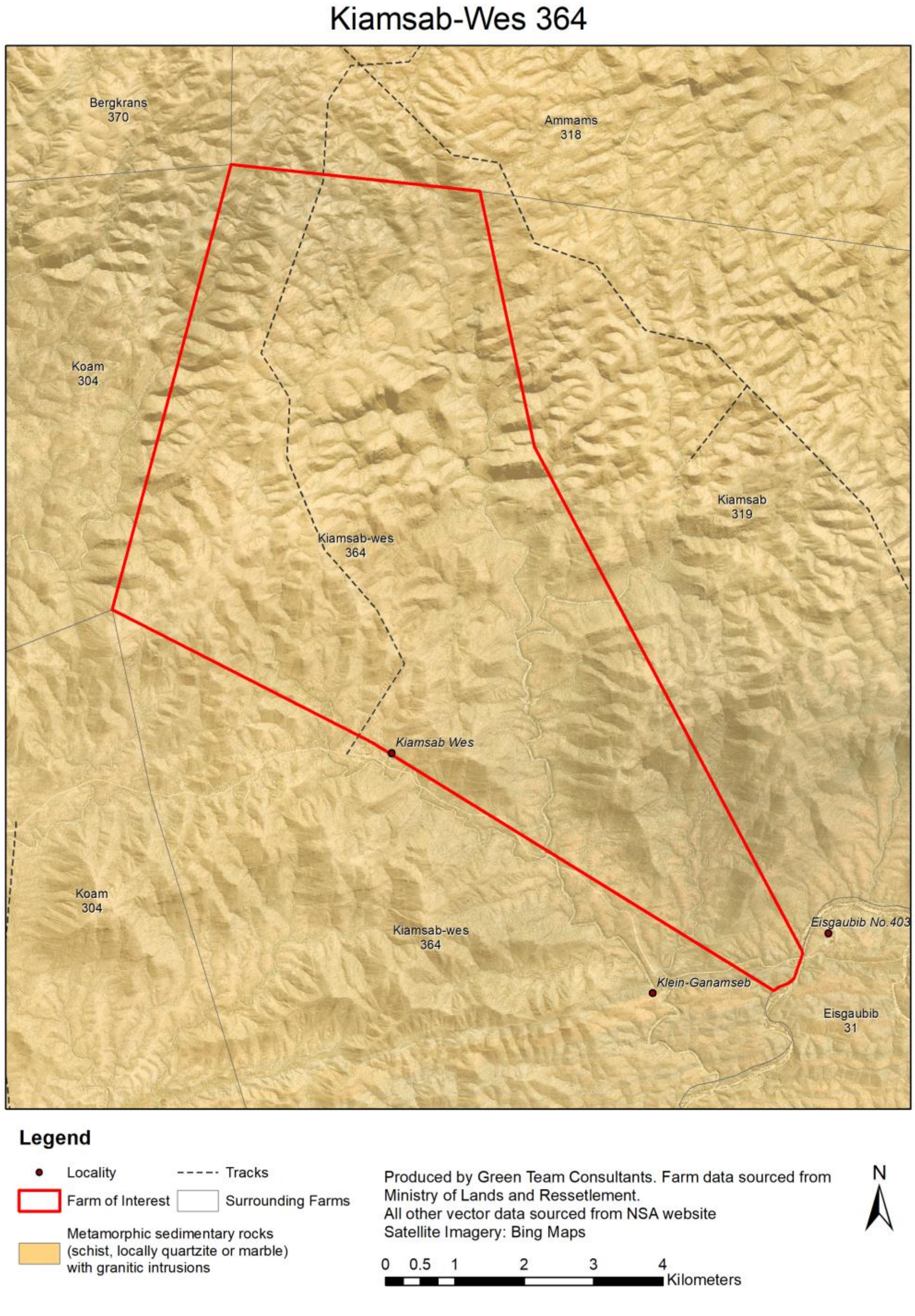

Figure 1a: *Project location*

2.1.2 VEGETATION COVER

The vegetation of the Khomas Region is mainly dense shrub land and can be classified as the Highland Savannah and the Camel Thorn Savannah. The Highland Savannah area, which covers most of the region, consists mainly of acacia thorn trees, such as the Acacia karoo, A. mellifera, A. erubescens and A. hereroensis. The other species which can be found in this area include Combretum apiculatum and Ziziphus mucronata. The vegetation comprises bushes, shrubs and good grass cover in parts. Towards the west, the vegetation becomes sparser and the trees do not grow to a great height. The Camel Thorn Savannah consists mainly of Acacia erioloba, which dominates the vegetation in the eastern and south-eastern parts of the region (Mendelsohn et al 2002 and KRC 2001).

2.1.3 CLIMATE

The climate in the region can be described as mild sub-arid with an average annual mean rainfall ranging from 200 to 400 mm across the region, increasing from west to east (Mendelsohn et al 2002). The evaporation potential is high, between 3,200 – 3,400 mm per year. As result of its high altitude, Windhoek and its immediate surroundings are the only parts in Namibia experiencing a dry steppe climate. The annual mean temperature varies from 18°C in the Central Highlands around Windhoek to 22°C in the lowland areas. The mean maximum temperature in the summer months varies from 28°C in the Central Highlands around Windhoek to 34°C in the lowland areas, but this can also rise to 40°C. The mean minimum temperature in the winter months varies from 2°C in the Central Highlands around Windhoek to 8°C in the lowland areas, but can drop below zero. Temperatures in the Khomas Region fall within the average for the rest of the country with other regions experiencing more extreme temperatures during the coldest and hottest months (Mendelsohn et al 2002).

2.1.4 TOPOGRAHPY

The Khomas Region is divided into the escarpment of the Khomas Hochland and the Inland Plateau and has three prominent mountain ranges: the Eros Mountains to the north-east of Windhoek, the Auas Mountains to the south-east of Windhoek and the Khomas Hochland mountain range to the west of Windhoek. The Khomas Region, characterized by its hilly countryside and many valleys, averages an altitude between 1,400 and 1,600 metres above sea level, with the slope gradually decreasing to the west. The Khomas Hochland mountain range is an important water separator since some of Namibia's most important ephemeral rivers, the Swakop, Nossob, Oabob and Kuiseb, originate here, which are important for the recharging of ground water resources and surface water supplies. The Khomas Region has three types of rock formations, firstly, the Damara Sequence and the Swakop Schist that limit the use of groundwater to commercial farms, secondly, aquifers around Windhoek, which are important water reservoirs for Windhoek, and thirdly, sand and loam in the eastern part of the region.

2.2 HYDROGEOLOGY

The Khomas Hochland is a deeply dissected mountain-land of intermediate elevation, where the geomorphology is closely related to the underlying geology. The fracture pattern of the Kuiseb schist determines the direction of the drainage system. The area has a thin soil cover and sup-ports a thorn bush savanna, which is ideal for cattle ranching. West-flowing rivers have carved deep gorges (e.g. Kuisebcanyon) across the Khomas Hochland, especially where they break through the Great Escarpment. The fact that most towns in the western Central Region are situated on or near rivers is a reflection of ground water availability in the area. Sufficient water for larger settlements can only be obtained by surface water storage in dams or from alluvial aquifers, while the potential of bedrock aquifers is very limited. This is partly due to the low rainfall and lack of recharge, and partly to the generally unfavourable aquifer properties of Damara Sequence rocks.

The Khomas Hochland situated between the Kuiseb and Swakop rivers is underlain by mica schist with occasional quartzite intercalations. Higher rainfall east of Windhoek leads to enhanced chemical weathering of the schist and thus less recharge, while joints and fractures in the Khomas Highland tend to be open. The prevailing fracture directions are north-south, north-west and north-east. Mean borehole yields of about **2.4 m3/h** are encountered east of Windhoek, **9 m3/h** in Windhoek and **2.9 m3/h** further west. Borehole success rates and yields decrease towards the Namib. Main targets for geological site selection are steeply dipping north-south trending fractures and joint zones, if possible in competent rocks, although feldspathic quartzites should be avoided. Marble bands also have a comparatively good yield potential.

2.3 GEOLOGY

The geology of the central region is dominated by the Damara Sequence. This sequence underlies most of central and northern Namibia. The basal arenitic succession of the Nosib Group was laid down between 850 and 700 million years (Ma) ago. Widespread carbonate deposition followed(Swakop Group) and inter bedded mica and graphite schist,quartzite, mass flow deposits, lavas and iron formation point to fairly variable depositional conditions south of a stable platform where only carbonates occur (Otavi Group, see Otavi Mountain Land or Karstland). Near the southern mar-gin of the Damara orogen deep-water fans of the Auas Formation were deposited. These rocks are overlain by thick schists of the Kuiseb Formation, which contains a narrow 350 km long zone of inter bedded oceanic amphibolites, theMatchless Member. The latter often contains massive sulphide orebodies (e.g. at Otjihase and Matchless mines).Deformation, apparently as a consequence of conti-nental collision some 650 Ma ago, was accompanied by syntectonic intrusion of serpentinites along the southern margin and syn- to post-tectonic granites.The Khomas

Highlands were created around 650 million years ago. The Khomas subgroup is the youngest of the Damara Sequence and consist of metamorphic rocks like mica schist, traversed by micaceous quartzite, subordinate calcareous schist and impure marble, and amphibole schist. The schists form a group of medium-grade metamorphic rocks, chiefly notable for the preponderance of lamellar minerals such as mica, chlorite, talc, hornblende, graphite, and others. Quartz often occurs in drawn-out grains to such an extent that a particular form called quartz schist is produced. By definition, schist contains more than 50% platy and elongated minerals, often finely interleaved with quartz and feldspar.

3. BOREHOLE SITING

3.1 METHODOLOGY

The borehole will be sited by satellite imagery interpretation and ground confirmation by means of geological/structural mapping and geophysical (electromagnetic) profiling using the FDEM 8B instrumentation. The proposed area where the borehole is to be sited is a fractured pattern of the Kuiseb schist which determines the direction of the drainage system. Due to complexity nature of the acquifer system in the area, borehole siting is a critical factor and successful borehole will mainly depend on the siting, drilling method, drilling depth and a proper borehole design. Although geophysical survey will be conducted prior to siting, the siting exercise will also be based on the desk study (evaluation of borehole completion reports, etc.) and under consideration of geological features identified on site or through remote sensing.

Some of the existing boreholes with known yield are tabulated in the table below

Location	**Latitude**	**Longitude**	**Borehole ID**	**Yield in M^3/h**	**RWL(m)**	**Depth (m)**
			wwXXXXX			
			wwXXXXX			

Table 2: *Existing boreholes in production*

Before the siting of the proposed water borehole, information from all the existing boreholes in the project vicinity has to be documented. Information gathered from remote sensing and satellite images interpretations will be employed in the geophysical survey.

4. SUMMARY AND CONCLUSION

The desk study showed that the Khomas Hochland situated between the Kuiseb and Swakop rivers is underlain by mica schist with occasional quartzite intercalations. Main targets for geological site selection are steeply dipping north-south trending fractures and joint zones, if possible in competent rocks, although feldspathic quartzites should be avoided. Marble bands also have a comparatively good yield potential. Based on the information from the existing boreholes and experience of previous work in the area, drill depth and proper borehole construction are of vital importance despite geophysical survey (EM-electromagnetic) has to be conducted prior to siting.

5. REFERENCES

Christelis G and Struck Meier W (2000) Groundwater in Namibia, an explanation to the Hydrogeological map. Department of Water Affairs, Geological survey of Namibia; Federal institute for Geosciences and Natural Resources and the Namibia Water Corporation. Mendelsohn, J, Jarvis, Robert C and Roberty T. (2002) *Atlas of Namibia*. Miller RC (2008): *The geology of Namibia* vol 2, Neoproterozoic to lower Palaeozoic, Geological survey of Namibia.

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