



Hydrogeological study Report for Phaphama Project

Northern Cape, South Africa

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CLIENT

Kemu Holdings (PTY) LTD

Prepared for:

Kemu Holdings (PTY) LTD

Prepared by:



Mapoti Mahlangu

Mhlaba Hydro and Geotechnical (pty)

Ltd

mapoti@mapotiservices.co.za



Report Name	Hydrogeological study Report for Phaphama Project	
Submitted to	Kemu Holdings (PTY) LTD	
Report Writer	Bridget Moeketsi (Pr. Sci. Nat)	
Review	Mapoti Mahlangu (Pr. Sci. Nat)	



MHLABA HYDRO & GEOTECHNICALS (PTY) LTD

www.mhlabahg.co.za

mapoti@mapotiseservices.co.za

0609849630

Gauteng

10688 lengwane street

Thatchhill

Centurion

0187

KZN

25 Krenmore

Cnr Poort & Keate Street

Ladysmith

3370

MPUMALANGA

11160 Ext 34

Rondebosch

Middelburg

1050



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1 Introduction

Mhlaba Hydro and Geotechnical (PTY) LTD (hereafter Mhlaba) has been appointed by Kemu Holdings (Pty) Ltd (hereafter Kemu Holdings) to conduct hydrogeological desktop study report for the proposed Waterkloof iron ore project, "Waterkloof" and in support of the environmental authorisations application processes that are being conducted in accordance with the National Water Act (NWA) and the Minerals and Petroleum Resources Development Act (MPRDA).

Motjoli Iron Ore Company (Pty) Ltd (Motjoli) acquired the Blackridge prospecting right, NC 30/5/1/2/11434 PR, from Aquila Steel South Africa Pty (Ltd) (Aquila) in 2017. The principal prospecting right (NC 30/5/1/1/2/1023 PR) was renewed and ceded on granting to Motjoli.

The Blackridge prospecting right is located between Griquatown and Groblershoop in South Africa's Northern Cape Province and covers an area of 88 330 hectares. Access is by the Griquatown-Groblershoop main bitumen road and secondary gravel roads south to Prieska and north to Postmasburg. The Blackridge prospecting right is situated approximately 65km south of Kumba Iron Ore's Kolomela Iron Ore Mine.

This document detail only hydrological study of the proposed project area. Drilling must be conducted before commencement of mining.

1.1 Scope of the investigation

Mhlaba Hydro and Geotechnical (PTY) LTD was requested to produce a hydrological study report for the proposed Phaphama mine.

1.2 Location of the study area

The Phaphama project area forms part of the Blackridge Project and is located on farm Waterkloof 95 within the Siyancuma Local Municipality in the Pixley ka Seme District Municipality, Northern Cape Province in South Africa (Figure 1 1).

1.3 Information sources

The following source of information were referenced:

- Topographic maps and information
- Geological maps and information
 - 2822 Postmasburg Scale 1:250 000
- Hydrological maps and information
 - 2722 Kimberley Scale 1:500 000
- National groundwater archives

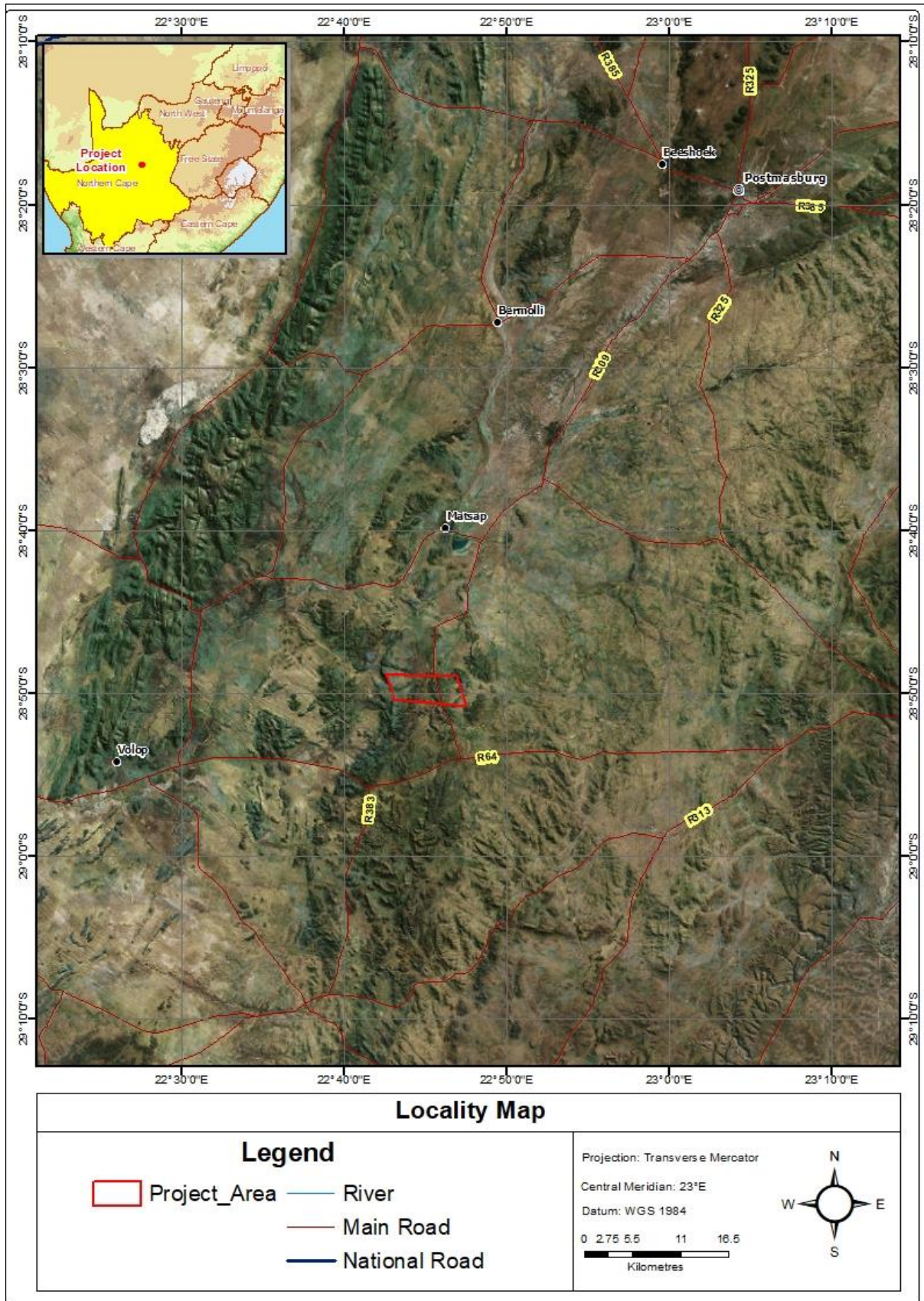


Figure 1-1: Locality of the Project Area



2 Existing information

2.1 Geological setting

The area is located within the Transvaal Supergroup lithologies (Figure 8) which has been deposited on a basement of Archaean granite gneisses and greenstones, and/or lavas of the Ventersdorp Supergroup. The oldest rocks of the Transvaal Supergroup form a carbonate platform sequence (i.e., dolomites with minor limestone, chert and shale) known as the Campbell Rand Subgroup. The upper part of the Transvaal Supergroup comprises a banded iron formation unit (i.e. the Asbestos Hills Subgroup), which has been conformably deposited on the carbonates.

The dolomites are overlain by BIF and other sediments of the Abestos Hill Subgroup. In contrast with the main Transvaal Basin, where BIF is confined to the Penge Formation, up to three successive BIF units occur in the Abestos Hills Subgroup in the Prieska Sub-basin, of which two units, the Kuruman - and Danielskuil Formations have been documented in the study area.

The Kuruman Formation displays full BIF macrocycles varying in thickness from one to several tens of meters. The overlying Danielskuil Formation is regarded as a reworked product by waves or currents of Kuruman type BIF. In the Prieska Sub-basin the BIF deposits are overlain by mixed siliciclastic and chemical sediments, including jasperoidal iron-formation, of the Koegas Subgroup. This subgroup in the study area has been subdivided into the Pannetje-, Kameelfontein-, Naragas-, Heynskop- and Kwakwas Formations and constitutes the only outcropping BIF deposits on the tenement.

The upper portion of the banded iron formations has in places, been supergene-enriched to ore grade. The iron ore / banded iron formation zone is often referred to as the Kuruman Formation. The ores found within this formation comprise the bulk of the higher-grade iron ores in the region. An altered, intrusive sill originally of gabbroic composition, usually separates the ore bodies from the underlying host iron formation. It intruded into the Transvaal Supergroup in late Proterozoic times.

A thick sequence of younger clastic sediments (i.e. shales, quartzites and conglomerates) belonging to the Gamagara Subgroup unconformably overlies the banded iron formations. Some of the conglomerates consist almost entirely of haematite and are of lower-grade ore quality. The unconformity separating the iron formations from the overlying clastic sediments represents a period of folding, uplift and erosion. At the time, solution and karstification took place in the upper dolomitic units

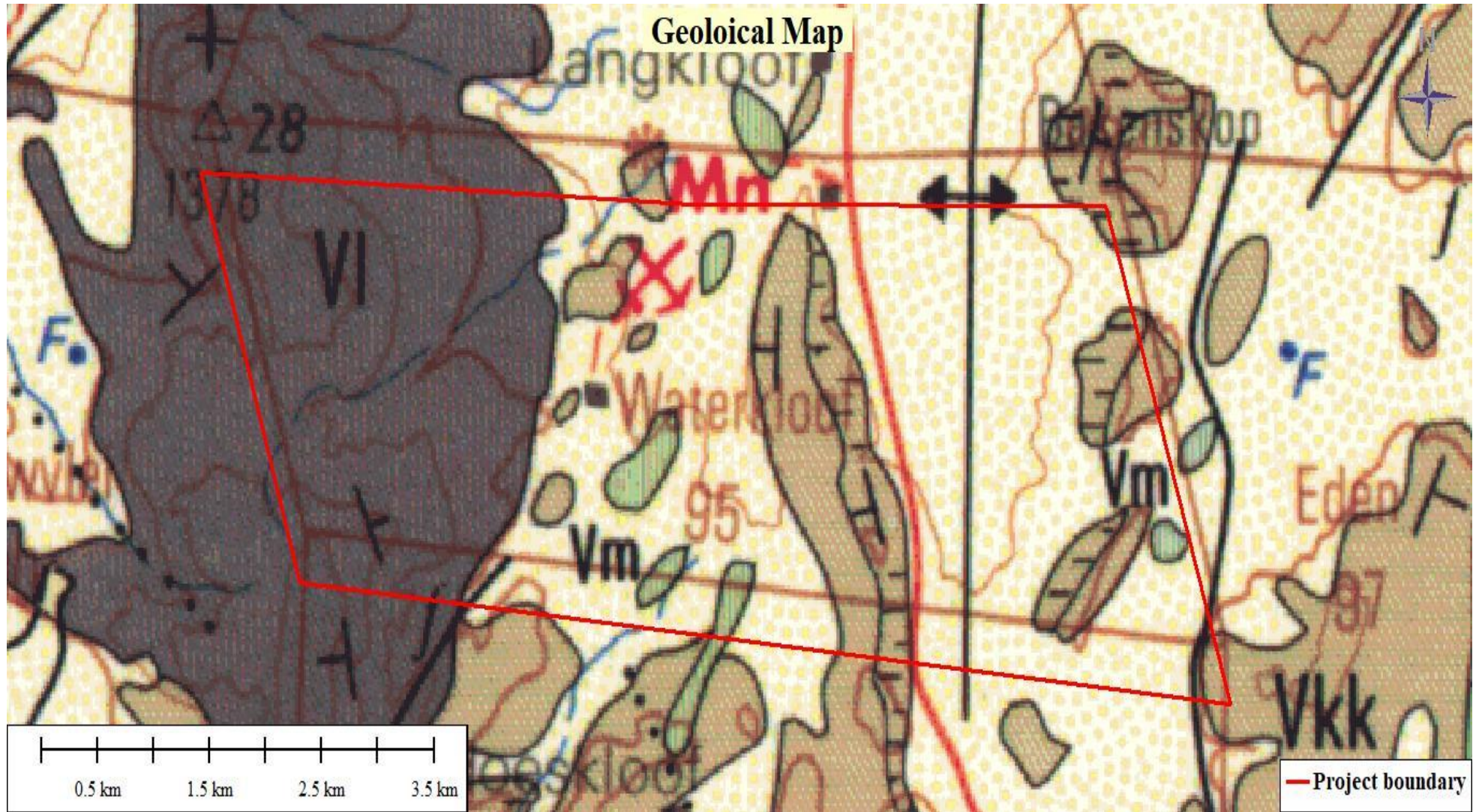


Figure 2-1: Geological map of the Project Area



2.2 Hydrogeological setting

The project area is in the quaternary catchment D73B which is located at the Orange Water Management Area (WMA 06) as revised in the 2012 water management area boundary descriptions (government gazette No. 35517), this is shown in Figure 2-2. The surface water attributes of the affected quaternary catchment namely Mean Annual Precipitation (MAP), Mean Annual Runoff (MAR), and Mean Annual Evaporation (MAE) were obtained from the Water Resources of South Africa 2012 Study (WR2012) and are summarised in Table 2-1.

Table 2-1: Summary of the surface water attributes of the D73B quaternary catchment

Catchment	Area (km ²)	MAP (mm)	MAR m ³ * 10 ⁶	MAE (mm)
D73B	1020	258	4.10	2450

Water Resources of South Africa 2012 Study

The D73B quaternary catchment has a net area of 1020 km² which receives an average of 258 mm of rainfall per annum whilst the potential evaporation is an average of 2450 mm per annum. The study also indicates that there is approximately 4.10 million m³ runoff on average per year.

The only perennial river associated with this quaternary catchment is the Soutloop which is situated at approximately 17 km west of the proposed project area. Few unnamed non-perennial streams or drainage lines exist within the site and feeds into the Soutloop. Runoff emanating from this quaternary catchment drains in a south-westerly direction via the – non-perennial streams and Soutloop until it eventually drains into the Orange River.

The aquifer in the project area are intergranular and fractured. Weathered zone and occasional joints and fractures in the andesitic lave and infrequent interbeds of chart and jaspers, as well as basal (mokganyene formation) diamictite, all of the postmasburg group, can be recommended for groundwater development. Yields generally between 0.1 l/s to 0.5 l/s on the successfully drilled boreholes and electrical conductivities of less than 300 mS/m.

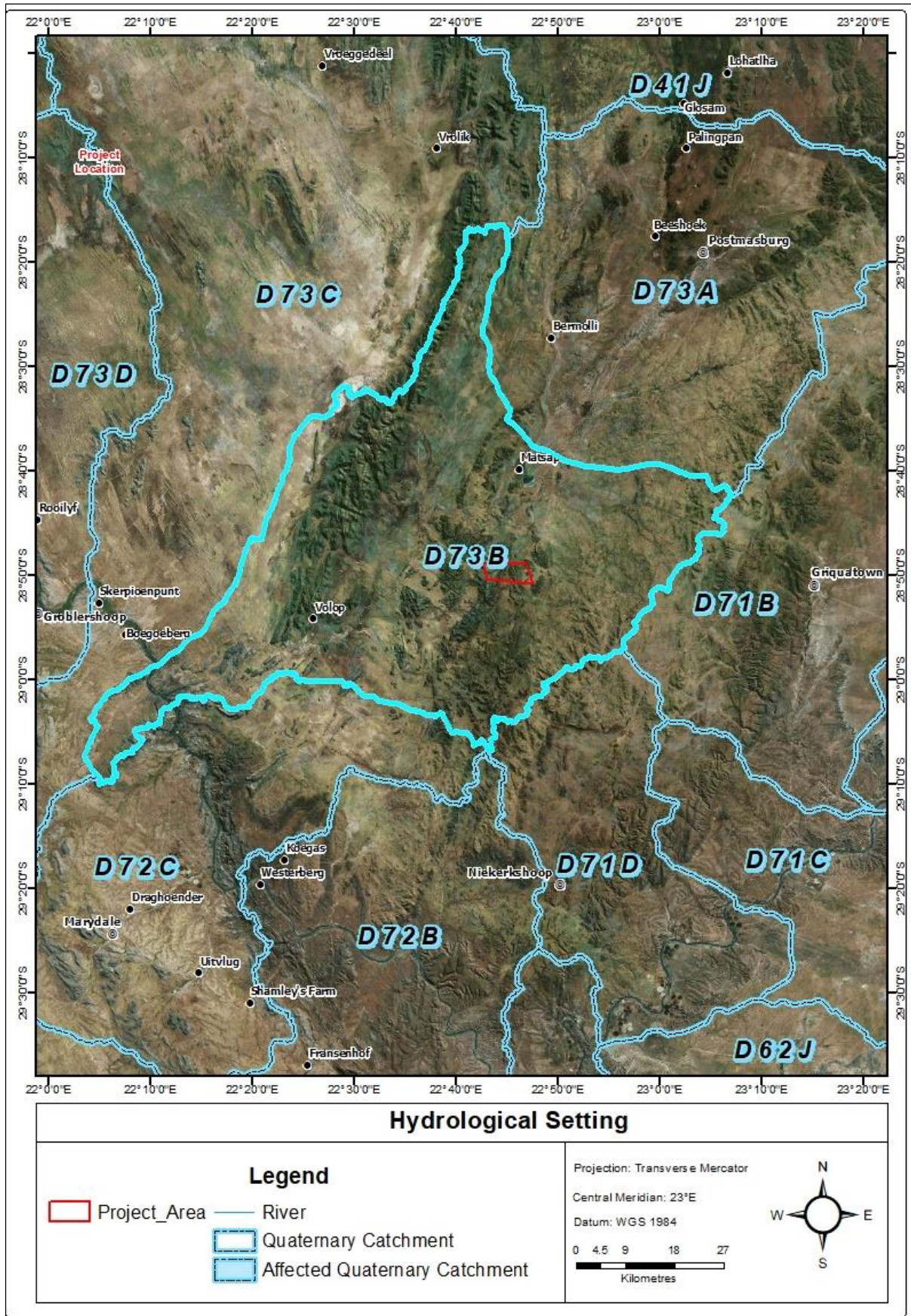


Figure 2-2: Hydrological Setting



2.3 Groundwater sources

Borehole information derived from the Department of Water Affairs (DWA), National Groundwater Archive (NGA) allowed for an assessment of the hydrogeology, aquifers and water levels in the area.

Two NGA (National Groundwater Archive) boreholes are present within an 2km radius of the site. However those boreholes are located outside the project boundary as shown in Figure 2-3 and listed in Table 2. Water level data and water use of the boreholes were not available

Although NGA data revealed that only two boreholes have been reported, it is expected that a detailed hydrocensus may reveal more boreholes in the project area or within a 2 km radius of the area.

Table 2: NGA boreholes

BH ID	Latitude	Longitude	Identifier	Farm Name
BH1	-28.82758	22.79659	2822DD00052	EDEN
BH2	-28.82869	22.80881	2822DD00053	EDEN

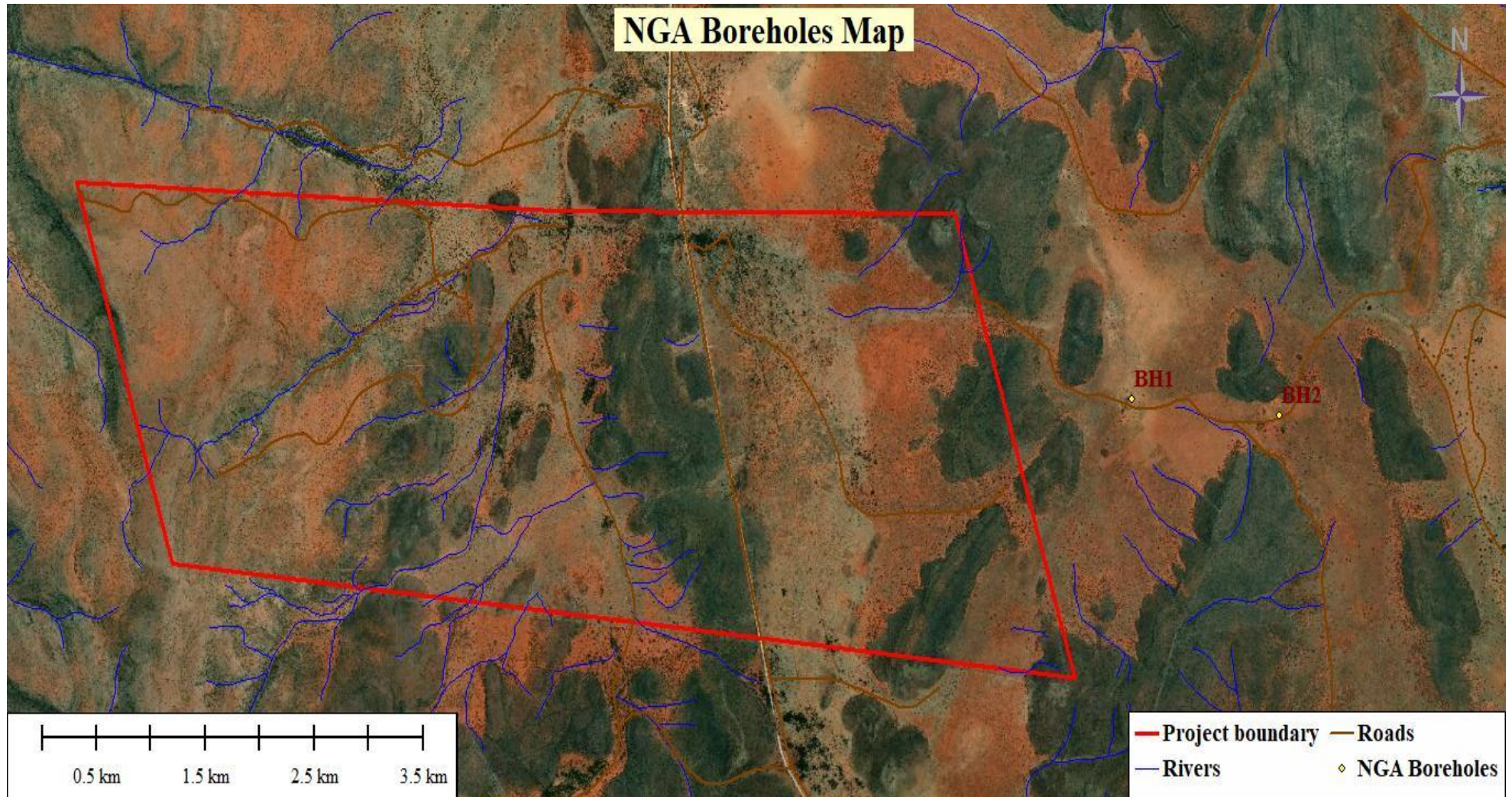


Figure 2-3: NGA Boreholes location



3 Conclusion

Waterkloof iron ore project is located approximately within the Siyancuma Local Municipality in the Pixley ka Seme District Municipality in Northern Cape and covers an area of 88 330 hectares. The area is within the Transvaal Supergroup lithologies which has been deposited on a basement of Archaean granite gneisses and greenstones, and/or lavas of the Ventersdorp Supergroup. The upper portion of the banded iron formations has in places, been supergene-enriched to ore grade. The iron ore / banded iron formation zone is often referred to as the Kuruman Formation.

The only perennial river associated with this quaternary catchment is the Soutloop which is situated at approximately 17 km west of the proposed project area. aquifer in the project area are intergranular and fractured. Weathered zone and occasional joints and fractures with the yields generally not between 0.1 l/s to 0.5 l/s on the successfully drilled boreholes .

Two National Groundwater Archive boreholes are present within an 2km radius of the site. However, those boreholes are located outside the project boundary and the water level data and water use of the boreholes were not available

4 Recommendations

The proposed Phaphama project is located on farm Waterkloof 95 within the Siyancuma Local Municipality in the Northern Cape province.

The general geology on site mainly comprises Weathered zone and occasional joints and fractures in the andesitic lave and infrequent interbeds of chart and jaspers, as well as basal (mokganyene formation) diamictite

The hydrogeological map of the area indicates that the fractured aquifer type occurs in the area. The yield from the local aquifers range from 0 to 05 l/s.

Only three boreholes were found from NGA within 2km radius of the project area have been reported by NGN and water level was not recorded on those boreholes.

The following recommendation are made for based on the current desktop study.

- There is a need to verify groundwater levels from the boreholes identified from NGA data base;
- At least four monitoring boreholes should be drilled within the project area; and
- Groundwater monitoring programme/plan need to be developed for the groundwater management of the area to monitor the potential contaminants.

5 References

- *GCS, Khumani Iron Ore Mine Infrastructure Expansion Project Environmental Impact Assessment (EIA) and Environmental Management Programme (EMP) Report, August 2015*



- *National Groundwater Archive Database*
- *SLR, Scoping report for the proposed Kolomela Mine Expansion Project, December 2015*
- *2722 Kimberley hydrological map Scale 1:500 000*
- *2822 Postmasburg Geological map Scale 1:250 000*