Appendix G

Hydrogeology

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63 Wessel Road Rivonia 2128 PO Box 2597 Rivonia 2128 South Africa

Telephone: +27 (0)11 803 5726 Facsimile: +27 (0)11 803 5745 Web: www.gcs-sa.biz

Leeuwpan Hydrogeological Scoping Paragraph

Version – 1

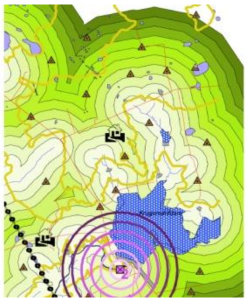
23 April 2012

Exxaro Resources

GCS Project Number: 11-447

POWERING POSSIBILITY

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1 INTRODUCTION

Exxaro Resources Ltd ("Exxaro") appointed GCS (Pty) Ltd to undertake a hydrogeological study investigation. This investigation is required for the update and consolidation of the current Environmental Management Plans (EMPs) and EMP Addendums into one consolidated EIA and EMP document according to the Minerals and Petroleum Resources Development Act, 2002 (Act No. 28 of 2002) (MPRDA). This report forms part of the scoping phase, a detailed investigation will form part of the EIA/EMP phase of the project.

2 BASELINE GROUNDWATER CONDITIONS

2.1 Location

Leeuwpan is situated approximately 8km east of the town of Delmas. The area falls within the Victor Khanye Local Municipality area, Nkangala District Municipality in the Mpumalanga Province.

The extent of the current open cast mining activities which started after 1995, are associated with Mining Blocks OWM, OG, OH, and OJ.. The expansion of the mining activities to blocks OL and UI on the farm Rietkuil 237 IR, scheduled for 2013.

2.2 Geology

The coal reserves located at the Leeuwpan expansion project area (blocks OL and UI) falls within the Witbank Coalfield. The Witbank coalfield's stratigraphy consists of sedimentary rocks of the Karoo Super Group; specifically the Transvaal Group and the lower coal-bearing Ecca Group. The geology map can be seen in Figure 2.1.

The newly proposed UI mining block is similar in geology to that of the Witklip and Kenbar Sections of the existing Leeuwpan Coal. The new mining area is thus underlain by a sedimentary rock succession of the Vryheid Formation, Ecca Group (Karoo sediments underlain by Transvaal sediments). The Karoo sediments are developed in the southeastern portion of the existing Leeuwpan Coal area. The general characteristics are as follows:

- The Karoo sediments are variable in thickness, ranging from 0 to 60 m;
- The variability in thickness is attributed to the undulating palaeofloor on which the Karoo sediments have been deposited;
- The top portion of the Karoo sediments consists of highly weathered Ecca material. Weathering extends into the coal seam. This weathering is the result of water and oxygen movement through the Ecca sediments during infiltration of rainwater, and

- Underlying this highly weathered horizon is a thick accumulation of coal as well as some development of carbonaceous shale. The coal and shale vary in thickness between 0 - 30 m.

The Dwyka Formation tillite overlies dolomite and chert of the Malmani Formation of the Pretoria Group of the Transvaal Supergroup.

The Delmas coal field is situated on the western border of the Witbank coal field. Three coal seams have been identified, namely the upper, middle and lower seams. The top seam corresponds with the No. 2 seam of the Witbank coal field, the bottom seam corresponds with the No. 4 seam.

Dolerite intrusions in the form of dykes and sills are widespread in both the Karoo Supergroup as well as the Malmani Subgroup, and are often found in the Leeuwpan Coal area. A dolerite sill or dyke is known to sub-outcrop immediately to the south of the existing Leeuwpan Coal area (Block OD EMPR, 2007).

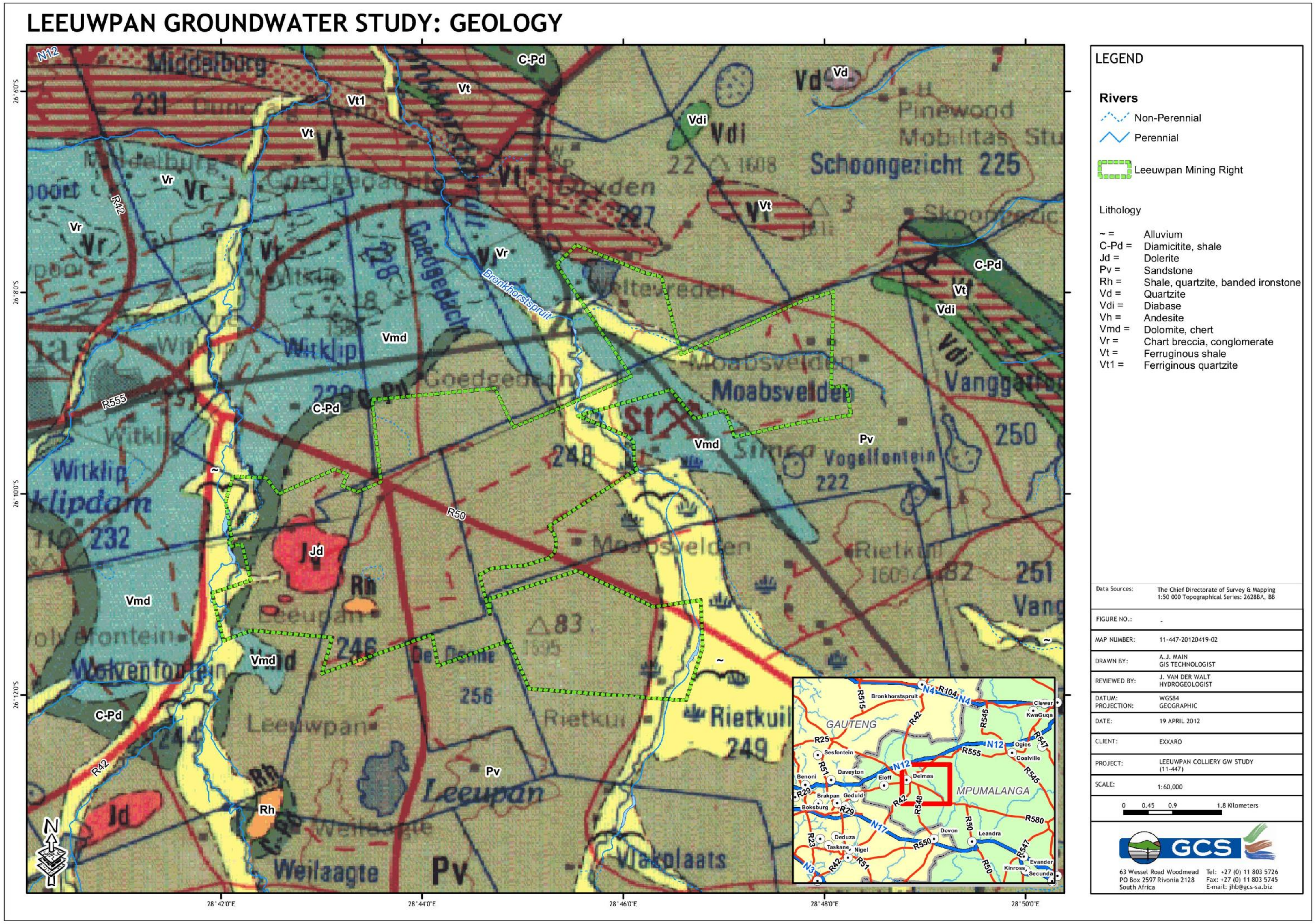

Figure 2.1 Leeuwpan Regional Geology Map

2.3 Aquifer Description

It is likely that the following three aquifers exist within the proposed mining area, of which the two upper aquifers are located within the Karoo Supergroup:

- The perched, weathered zone aquifer;
- Fractured Karoo aquifer (mainly sandstone with subordinate siltstone and shale) that possess a secondary porosity associated with weathering); and
- Dolomite & Chert rich aquifer of the Malmani Subgroup.

The fractured Karoo aquifer can be classified as the secondary source aquifer in this instance. It is generally considered low yielding (Parsons, 1995) and display characteristics of the intergranular and fractured regime, which indicate groundwater storage and flow occurs mainly within the fractures of the rock. This aquifer is reported to be approximately 40 metres thick. From previous investigation in similar geological units the saturated hydraulic conductivity of the Ecca Group was found to vary between $1x\ 10^{-1}$ and 1×10^{-3} m/day.

The Malmani Subgroup forms the main aquifer, and consists mainly of alternating layers of chert free dolomite and chert rich dolomite. (Visser, 1989). Overlying this is the Vryheid Formation of thick sandstone and gritstone alternated by sandy shale and coal beds. The Dwyka Formation separates the dolomitic aquifer from the Vryheid Formation. It consists of gravely diamictite with minor varved shale and mudstone that is less permeable than both the Vryheid Formation and the Malmani dolomite. The Dwyka is normally considered as an aquiclude. An effective depth of 300 metres has been accepted as the maximum depth to which significant dissolution of the dolomite has been taking place. A hydraulic conductivity that varies between 10 to 100 m/day is considered representative of the Malmani dolomite.

2.4 Potential Receptors

A number of privately used boreholes were identified in the area. Most of the boreholes identified represented sources of domestic water supply to farmers and their farm workers. In some instances the boreholes investigated were “high yielding”. The majority of the high yielding boreholes were used for irrigation (70 to 90 ha areas) of crops and vegetables. Measured groundwater levels in area range from 1.5mbgl[1] to 50 mbgl. There a number of groundwater receptors in the area. The surface water streams such as the Bronkhorstpruit may also be receptors for groundwater seepage. A list of some of the private borehole users can be seen in Table 2.1. Leeuwpan Colliery has an active groundwater monitoring programme, with a number of monitoring boreholes involved which are also found in and

[1] mbgl - metres below ground level

around the mining area. The location of hydrocensus and mine monitoring boreholes can be seen in Figure 2.2.

Table 2.1 Hydrocensus Borehole Information (Private Owners)

Sample ID	Property	Groundwater User	Meters (LO29 Metres-Cape)	
			Southing	Easting
Moa1	Moabsvelden, 248IR	Felix Matsenge	26.17434	28.76445
Moa2	Moabsvelden, 248IR	Marius v. Heerden	26.17488	28.75874
Moa3	Moabsvelden, 248IR	Marius v. Heerden	26.17086	28.76210
Moa4	Moabsvelden, 248IR	Marius v. Heerden	26.17448	28.75728
Vla 1	Vlakplaats, 268 IR	Ferriera	-26.2176	28.76279
Rie1	Rietkuil, 249 IR	Hannes Potgieter	26.18840	28.77486
Rie2	Rietkuil, 249 IR	Hannes Potgieter	26.18721	28.77445
Rie3	Rietkuil, 249 IR	Hannes Potgieter	26.18955	28.77307
Rie4	Rietkuil, 249 IR	Hannes Potgieter	26.18879	28.76842
Rie5	Rietkuil, 249 IR	Hannes Potgieter	26.18381	28.75929
Rie6	Rietkuil, 249 IR	Hannes Potgieter	26.18450	28.75168
Rie7	Rietkuil, 249 IR	Hannes Potgieter	26.18422	28.75242
Rie8	Rietkuil, 249 IR	Hannes Potgieter	26.19732	28.76819
Rie9	Rietkuil, 249 IR	Hannes Vermaak	26.20165	28.76345
Rie10	Rietkuil, 249 IR	Hannes Vermaak	26.2027	28.76261
Rie11	Rietkuil, 249 IR	Hannes & Vicky Vermaak	26.20407	28.77034
Rie13	Rietkuil, 249 IR	Sckalekamp	26.18695	28.79185
Rie14	Rietkuil, 249 IR	Snyman	26.2176	28.77602
Rie15	Rietkuil, 249 IR	Snyman	26.18190	28.79185
Rie16	Rietkuil, 249 IR	Snyman	26.1838	28.179614

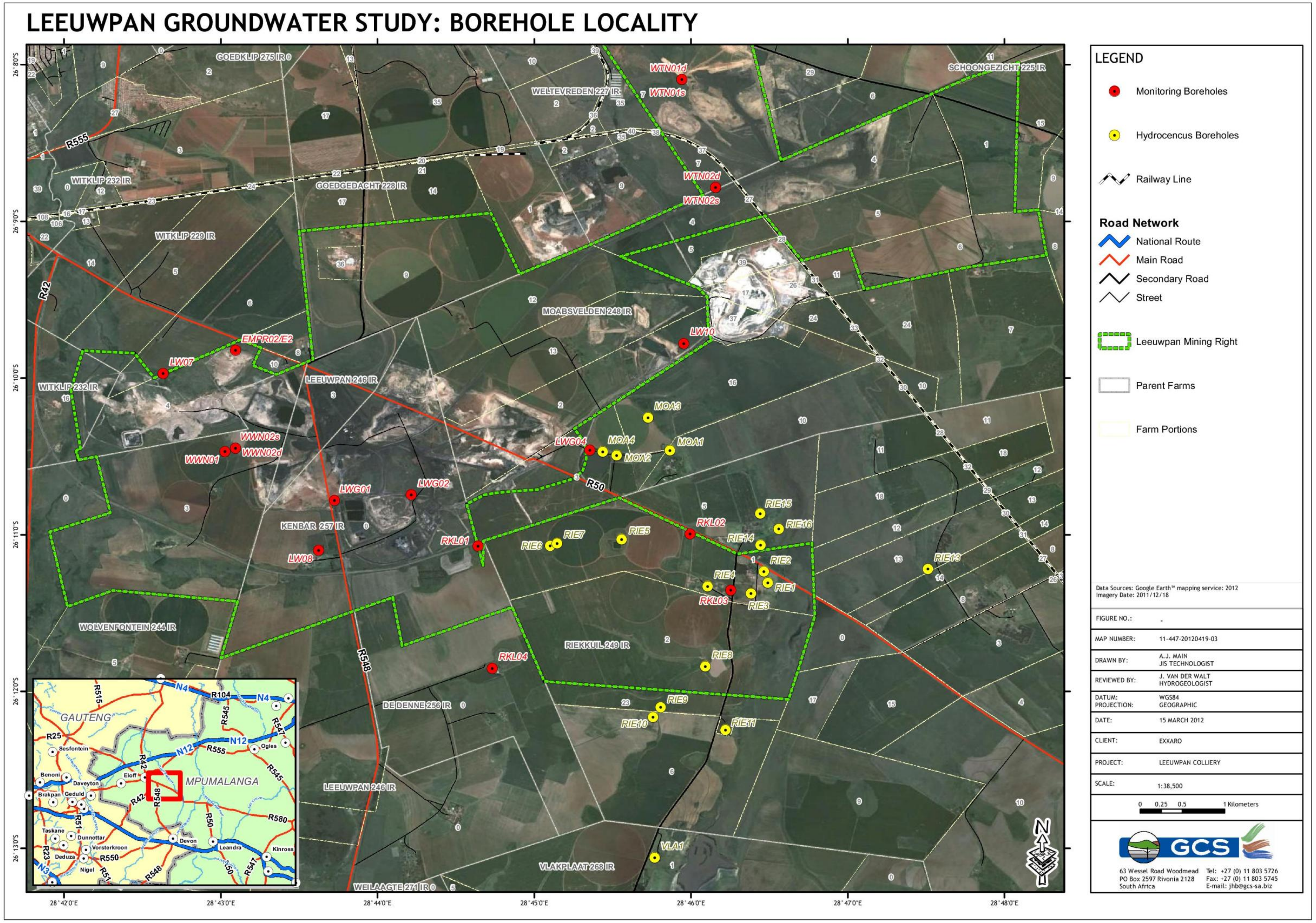

Figure 2.2 Leeuwpan Hydrocensus and monitoring boreholes locality map

3 POTENTIAL GROUNDWATER RISKS

The extent of dewatering of the groundwater as a result of mining is likely to be local and will be addressed in the detailed investigation. Potential contamination of the groundwater resources may occur as a result of mining, especially post closure and will be addressed in the detailed investigation. Furthermore potential groundwater contamination may be associated with waste facilities such as discard dumps, pollution controls dams etc. During this phase no fatal flaws could be foreseen. The interaction between the Karoo and dolomitic aquifers will be assessed in the next phase. A comprehensive groundwater management plan will be formulated during the detailed investigation.

4 GAP ANALYSIS

This scoping phase investigation revealed certain information gaps that will be covered during the following more comprehensive phase of which the findings will be documented in the final report:

- Geochemical Assessment of different lithological units to establish the ABA potential;
- Drilling and installation of monitoring testing holes to perform aquifer tests to obtain parameters for calibration of the groundwater model;
- Performing a dry season (winter) hydro census investigation to consider worst case scenario aquifer conditions.
- A groundwater management plan will be formulated during the detailed investigation.

A more involved EIA groundwater study investigation will follow as mentioned above, and will quantify groundwater related impacts as a result mining.

5 REFERENCES

Cleanstream Environmental Services (2007). Leeuwpan Coal: Extension of Block OD and UI, Draft EIA. Ref No: ERL/LC/03/2007.