1 INTRODUCTION

1.1 GENERAL

During 1994, Zn was highlighted as a strategic commodity for Iscor. The company's management set a target to find zinc deposits to sustain the current zinc operation, Rosh Pinah, and possibly enlarge Iscor's portfolio. Most of the global zinc produced at this stage was from volcanic hosted massive sulphide (VHMS) deposits and the obvious objective was to find a blind VHMS deposit with economic grades that would be suitable for an underground mining operation.

The use of lithogeochemical exploration to locate blind VHMS orebodies was developed and applied successfully in especially Canada and Australia (Urabe, Scott and Hattori, 1983; Whitford and Ashley, 1992). There appears to have been relatively little effort to locate VHMS deposits by this means in South Africa. Previous exploration efforts by Iscor Ltd., were aimed at the more viable, bigger-tonnage sedimentary exhalative (Sedex) deposits. A full understanding of both the VHMS and Sedex conceptual models in the mid-1970s came at a time of peak activity in exploration, especially in the Proterozoic Northern Cape terrain. A waning interest in sustained base-metal exploration in South Africa followed this period. In addition, electro magnetic (EM) technology has advanced considerably since the mid-1970s (Cain, 1994).

Falconbridge initiated exploration programmes, utilising this technology, in the greenstone belts of Botswana (Tati and Matsitama) from 1978 to 1981 and in Zimbabwe (Bulawayo, Gatooma-QueQue-Hartley and Bindura-Shamva) from 1980 to 1982. The primary target was gold, rather than VHMS deposits. Funds were in extremely short supply with Falconbridge, especially for VHMS exploration, and budget cutbacks were frequent. There were thus no long-term initiatives to apply and test the Canadian approach on a grass-roots basis (Cain, 1994).

The Maranda Zn-Cu deposits in the Murchison Belt (Terblanche, 1997), Limpopo Province, some Anglo American prospects in the Barberton greenstone belt of Mpumalanga, the closed Prieska Zn-Cu mine of the Northern Cape, Cactus Cu-Pb-Zn mine in Zimbabwe, Bushman in Botswana and Elbe, Matchless and Otohahasi in Namibia appear to be the only VHMS deposits in Southern Africa. This apparent paucity of VHMS deposits is in strong contrast to the high incidence of such deposits in favourable geological environments. This suggests that, since VHMS deposits are the most important source of zinc (Cain, 1994), a more active exploration effort for these deposits is warranted.

The entire Proterozoic Areachap Group in the Northern Cape, which represents a fossil island-arc environment (Geringer *et al.*, 1994), was targeted by Iscor. An intensive three-year exploration programme for blind VHMS deposits commenced at the beginning of 1995, which was extended by another year and a half, owing to personnel shortages.

Lithogeochemical sampling techniques were used for initial blind target identification, and constituted Phase 1 of the exploration work. Phase 2 and 3 work comprised of TDEM and detail TDEM surveys, drilling target definitions and evaluation in the third and fourth years, respectively (Rossouw, 1999).

Four possible geochemically and structurally related, calc-alkaline stratovolcanic centres make up the Areachap belt, viz. Upington, Klein Begin, Boksputs and Copperton centres (Middleton, 1976).

The Areachap belt's importance lies in the numerous VHMS base-metal sulphide showings hosted within its 250 km-outcrop length. Included is the more recently closed-down 47 Mt (3,87 % Zn, 1,74 % Cu [+8,0 g/t Ag and 0,4 g/t Au]) Prieska Zn-Cu mine of Anglo Vaal. The other more significant prospects were summarised by Humphreys (1985) (Appendix A) and include Areachap, Jannelsepan, Klipbakke, Boksputs, Kantienpan, Van Wyks Pan, Edenville, Kielder and Hedley Plains (Voet and King, 1986 and Theart, 1985).

1.2 STUDY OBJECTIVES

The objectives of this study are to document various aspects of the geology of the Kantienpan deposit and environs, to provide additional tools for exploration of VHMS deposits and to determine the economic viability of the Kantienpan deposit.

1.3 LOCATION

The project area is situated in the flat, arid Northern Karoo region of the Northern Cape Province of South Africa (Figure 1). The initial project area was a block 250 km by 40 km, covering the Areachap Group from Areachap mine, north of Upington, to Prieska Zn-Cu mine, southwest of Prieska. The area was then narrowed down to the few farms under option, shown in Figure 2.

The farms under option cover an area of approximately 40 km by 20 km. This area lies approximately 75 km south-south-east of Upington, 45 km west-south-west of Groblershoop and 50 km east-north-east of Kenhardt (Figure 2).

1.3.1 Location Risk

As far as the location of the project is concerned, no particular risks exist, except that it is far from any smelters.

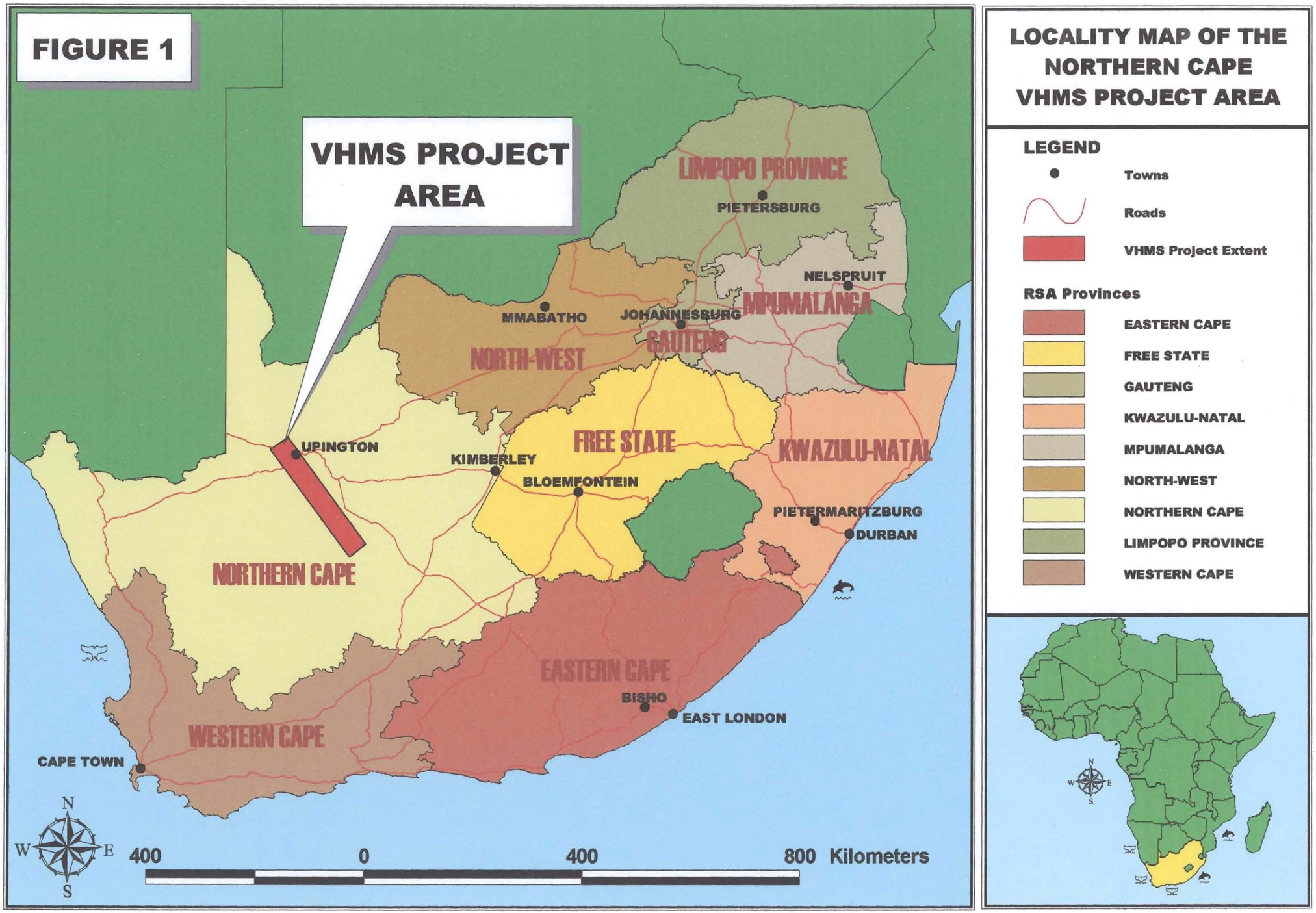

Figure 1. Locality map of the Northern Cape VHMS project area.

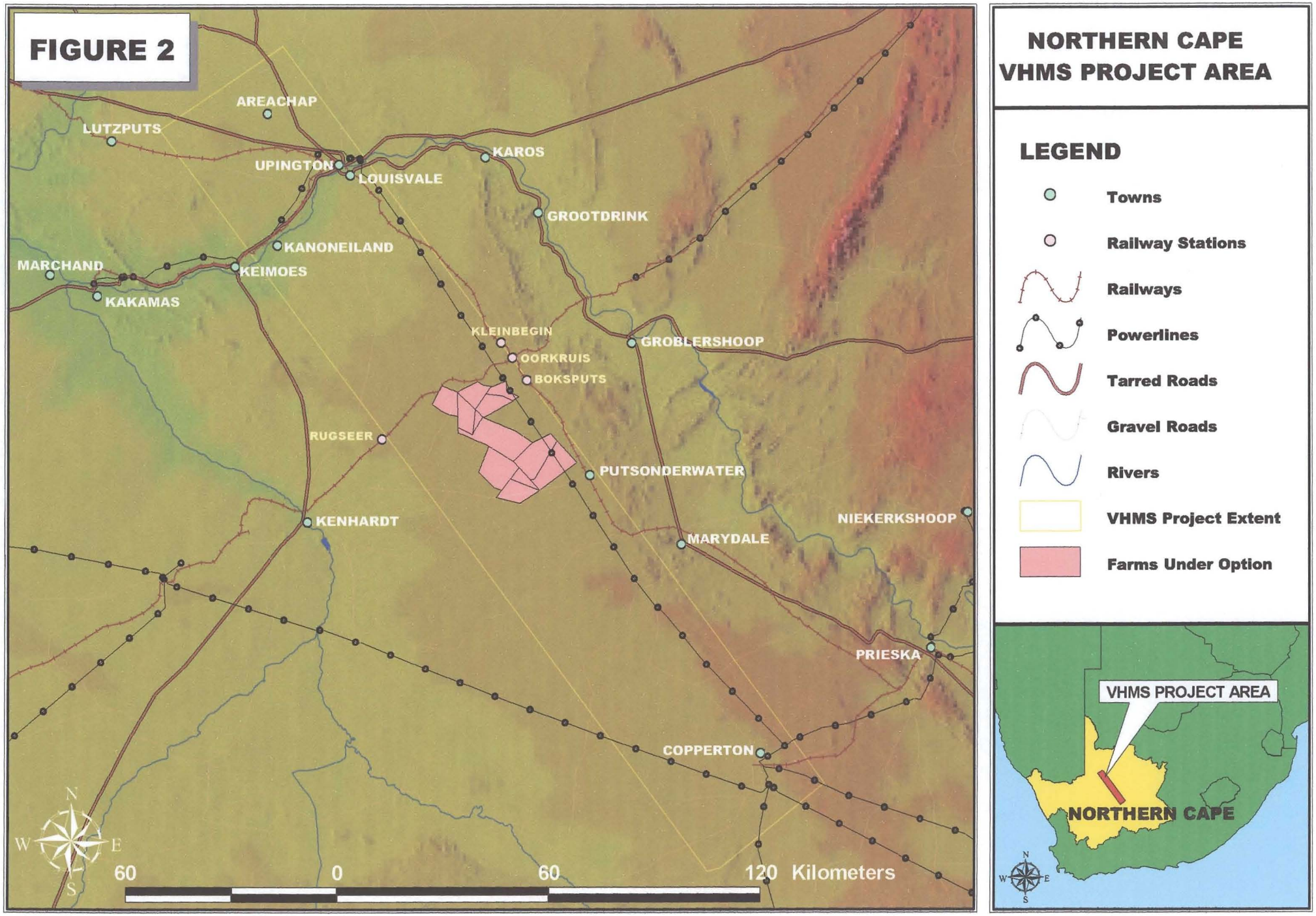

Figure 2. Locality map and local infrastructure of the VHMS project area.

1.4 INFRASTRUCTURE

The project area has a well-established infrastructure. Two major tarred roads and a network of good gravel roads traverse the area (Figure 2). Farm tracks vary from moderately good to very bad and some barely exist. Kenhardt and Groblershoop are respectively 53 km and 56 km from the project area via a well-maintained, gravel road (Rossouw, 1999).

The Upington-De Aar railway line runs along the eastern border of the Areachap Group project area, with the Boksputs station being the closest railway link at a distance of 18 km. The east-west Sishen-Saldanha railway line cuts across the belt directly north of the project area, with Kleinbegin station being the closest connection, also at 18 km (22 km via gravel road) (Figure 3). These two stations are equipped with loading facilities and, being on different railway lines, diversify the shipping option (Rossouw, 1999).

A power line also runs parallel to the Areachap Group project area, lying immediately to the east, with the closest point to the line being 8 km and the distance to the nearest substation being 13 km (Figure 3).

Telephone lines and microwave towers (telecommunications), as well as radio transmission towers and masts and cellular phone network masts, provide a good communication network in the area.

A well-equipped airport is situated at Upington with daily flights to Cape Town and Johannesburg via Kimberley. Two small airports also exist at Kenhardt and Prieska, but are only used for light aircraft. Public and private landing strips are also present in the vicinity of the project area and at the small settlements along the Orange River.

The area is arid and sparsely populated. Very few homesteads, of which some are often unoccupied, occur in the region. The nearby towns, however, host a variety of tourist and accommodation facilities like game and hunting lodges,

hotels, caravan parks, guest houses, 4x4 trails, motorbike trails, hiking trails and golf courses.

1.4.1 Infrastructure Risk

Water supply for a concentrating plant may become a problem. The base case scenario is that sufficient groundwater can be extracted from drill holes and the mining operations to supply the plant's demand. The worst-case scenario is that a 40 km water pipeline must be built from the Orange River, should there not be sufficient water to supply the plant.

1.5 PHYSIOGRAPHY

Local topography is relatively flat within the project area. To the east of the Kheis Sub-Province there is a prominent range of mainly quartzite hills. To the west, the topography of the northern Karoo and Bushmanland is typically flat.

Farming activities include extensive sheep and limited beef cattle husbandry, with some dairy, poultry and ostrich farming taking place. Along the Orange River, at Upington and to the east of the project area, irrigation allows the large-scale cultivation of cash crops such as watermelon and melons, as well as the development of wheat, cotton and lucerne lands, date plantations, and particularly sultana, wine and table grape vineyards.

Altitudes of between 800 m and 1 100 m are recorded. Small amphibolite and amphibole gneiss hillocks rise up to about 50 m above the plains.

The mean annual rainfall of 200 mm occurs mainly as heavy thunderstorms in spring and late summer. Extremely hot summers and cold winters with frost are experienced.

Vegetation is sparse. Typical vegetation consists of open scrubby savannah with occasional acacia (e.g. Camel Thorn) and *Boscia albitrunca* (e.g. Witgat)

where water is available. Thick scrubby vegetation is present in low-lying alluvium-filled drainage beds.

1.5.1 Physiographical and Environmental Risk

The rehabilitation and self-regeneration potential of the very sensitive desert type vegetation is low and, therefore, disturbance should be restricted to the absolute minimum. Vegetation clearing should be avoided and, where this is unavoidable, measures must be implemented to avoid loss of topsoil through uncontrolled run-off. Should erosion start, it must be stopped by installing gabions or other methods to break the velocity of the water and dissipate rivulets into smaller streams.

An environmental management programme report and fire management plans must be completed and approved by the relevant provincial conservation authority before any development may proceed.

1.6 LAND TENURE

The relevant magisterial district is Kenhardt, which falls under the Gordonia Regional Services Council.

A summary of the mineral and surface right owners is given in Table 1 and can also be seen in Figure 3. All the portions of land mentioned in Table 1 were explored with the appropriate exploration permit. The title deeds of the different properties are not appended to this document.

Table 1. Mineral and surface right holders of the VHMS project area.

Farm Description	Mineral & Surface Rights Owners	Extent
Boksputs 118, Portion 7	A Strauss	3646.4051 ha
Boksputs 118, Portion 8	WP Stauss	1892.0203 ha
Boksputs 118, Portion 9	WP Stauss, T Strauss, M Niehaus	3284.7894 ha
Zonder Pan 173, Remaining Extent Zonder Pan 173, Portion 5	F Lacock	4286.1992 ha 4282.8694 ha
Kantienpan 119, Remainder of Portion 1	F Kruger	4282.6612 ha
Kantienpan 119, Remaining Extent Kantienpan 119, Portion 2	Schmidt Family Trust, S Schmidt	9396.6493 ha 409.7029 ha
Gemsbok Bult 120, Portion 2	Broer Visser Family Trust	4329.9477 ha
Rooi Puts 172, Portion 2 Rooi Puts 172, Portion 3	D Malan	1131.1804 ha 3747.2690 ha
Rooi Puts 172, Portion 4	K Visser	6929.1981 ha
	TOTAL : 47 618.892 ha	

1.6.1 Tenure Risk

In terms of the new minerals legislation (Mineral and Petroleum Resources Development Act, 2002) all mineral rights will be owned by government, which implies that the Kantienpan mineral option could no longer be exercised in future. Should the decision be taken to mine the deposit at Kantienpan, a mining permit or extended exploration permit must be obtained within a year after the act has come into power, otherwise the mineral right may be lost to another company. It is recommended that applications should be filed for the necessary permits.

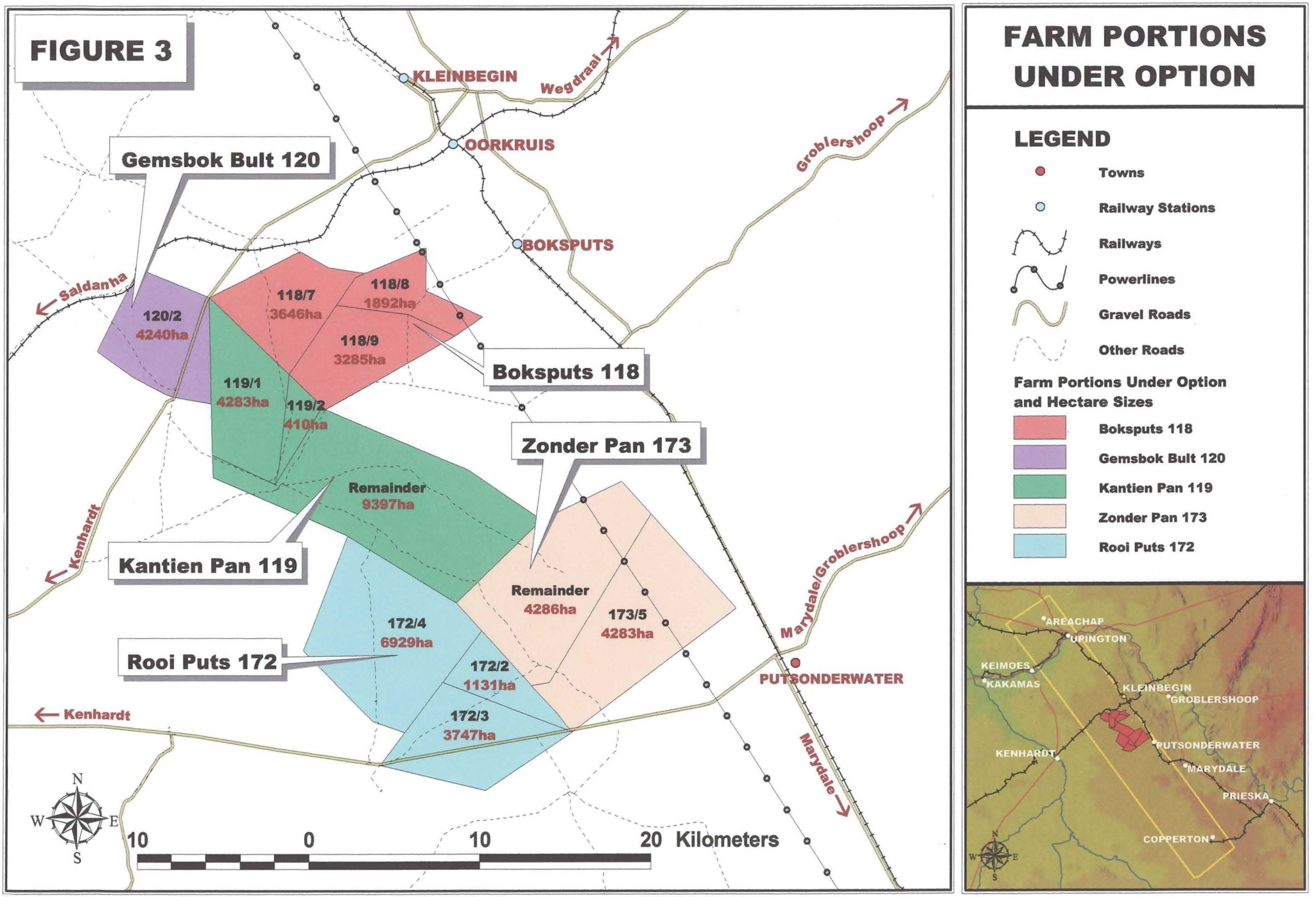

Figure 3. A map of farms taken under option within the project area.