INSTITUTE FOR SOIL CLIMATE AND WATER
AGRICULTURAL RESEARCH COUNCIL

SOIL INFORMATION FOR PROPOSED MUTSHO POWER PROJECT

By

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1 INTRODUCTION

1.1 Terms of Reference

The Agricultural Research Council-Institute for Climate and Water (ARC-ISCW) was requested by Savannah Environmental to provide baseline soil information for the Mutsho Power Project proposed on a site near Makhado (Louis Trichardt), Limpopo Province. The aim of the survey was to describe the soils occurring in the study area and to assess the agricultural potential.

2 STUDY AREA

2.1 Location

The broad study area (Figure 1, red area) is located approximately 43 km south-west of Musina and 7 km south-west of Mopane in Limpopo Province. Two farms, namely Du Toit 563MS and Vrienden 589MS, lying on either side of the Mopane-Waterpoort road, comprise the project area.

The area lies between latitudes 22º 38' 45" and 22º 42' 40" S and between longitudes 29º 47' 15" and 29º 51' 05" E.

However, for the second phase of the soil investigation, a smaller area, shown in grey in Figure 1, was selected. This area was delineated to cover all of the proposed sites for the power station and its associated infrastructure.

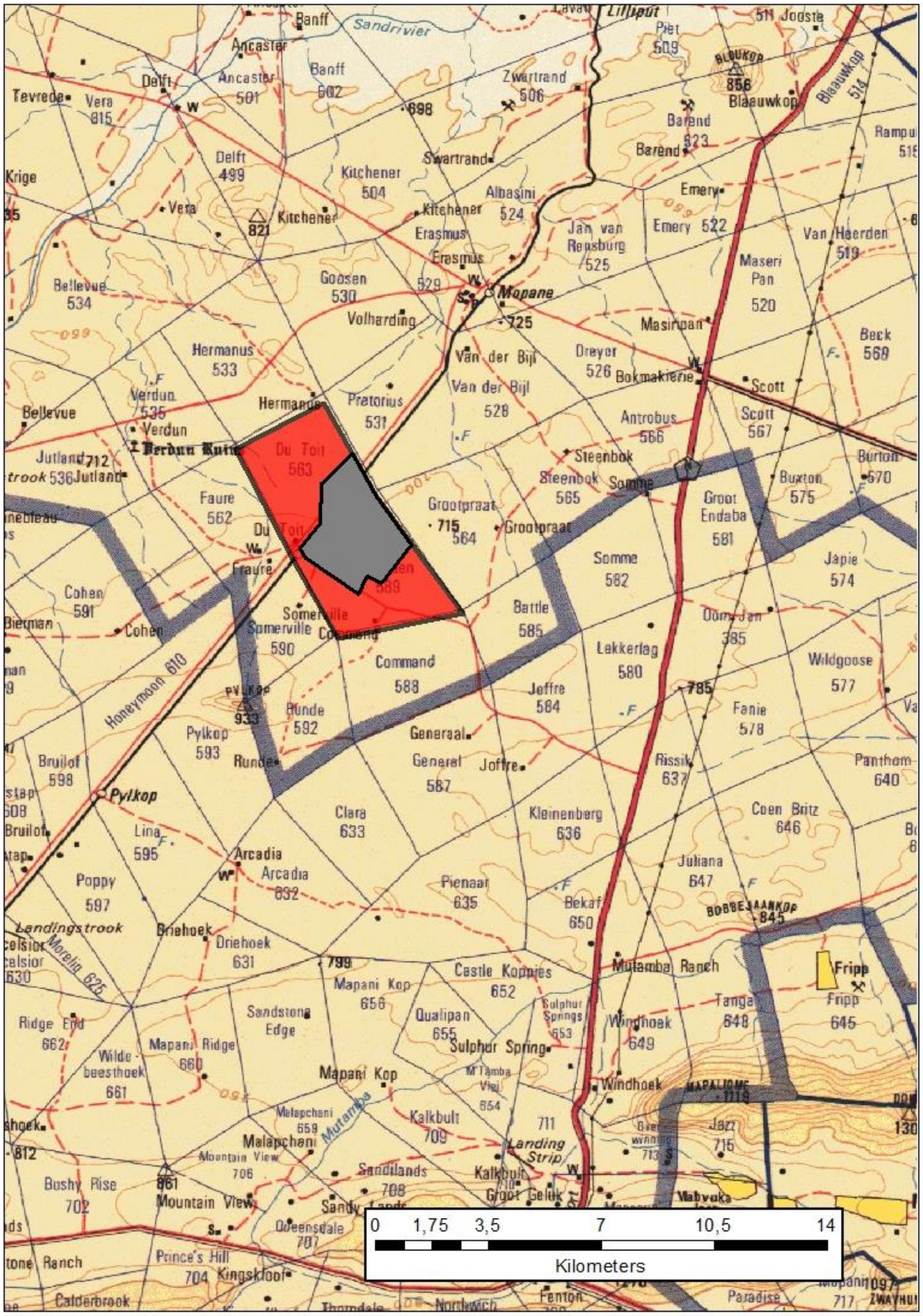

Figure 1 Location map

2.2 Survey area details

The survey area is approximately 700 ha in extent, and lies at an elevation of around 700 metres above sea level, with the highest point in the south. The area is situated in virtually flat terrain, with slopes of less than 2%. Only occasional, small, non-perennial streams occur within the area.

2.3 Climate

Climate data was obtained from the national Land Type Survey (Monnik & Malherbe, 2005).

The climate of the area can be regarded as having hot, dry to moist summers and cool, dry winters with very little frost. On average, 85% of the annual average rainfall of 315 mm falls in the growing season (October to March).

The extreme maximum temperature is 45.2^{o}C and the extreme minimum -4.6 ^{o}C

The climatic data is given in Table 1 below.

Table 1 Climate data

Month	Rainfall (mm)	Min. Temp (^{o}C)	Max. Temp (^{o}C)	Average frost dates
Jan	69.7	21.0	33.5	Start date: 21/06
Feb	50.3	20.6	32.6	End date: 13/07
Mar	28.4	18.9	31.8	Frost Days: 4
Apr	18.1	15.4	29.9	
May	2.0	9.8	27.6	
Jun	3.0	5.9	24.8	
Jul	4.4	5.7	24.9	**Heat units (hrs > 10^{o}C)**
Aug	1.1	8.5	27.1	Summer (Oct-Mar): 2 905
Sep	2.9	13.1	29.9	Winter (Apr-Sept): 1 564
Oct	21.0	17.0	31.5	
Nov	50.5	18.9	32.2	
Dec	64.2	20.2	33.3	
Year	**315.6**	**Average 22.3**		

Evaporation rates are very high, around 2 800 mm yr^{-1}, which gives a climate with an extreme aridity index, as compared to the average annual rainfall.

2.4 Geology

Within the broader study area, the geology of the survey area consists largely of marble of the Gumbu Formation, with arenite (sandstone) Ecca Group in the north (Geological Survey, 1988).

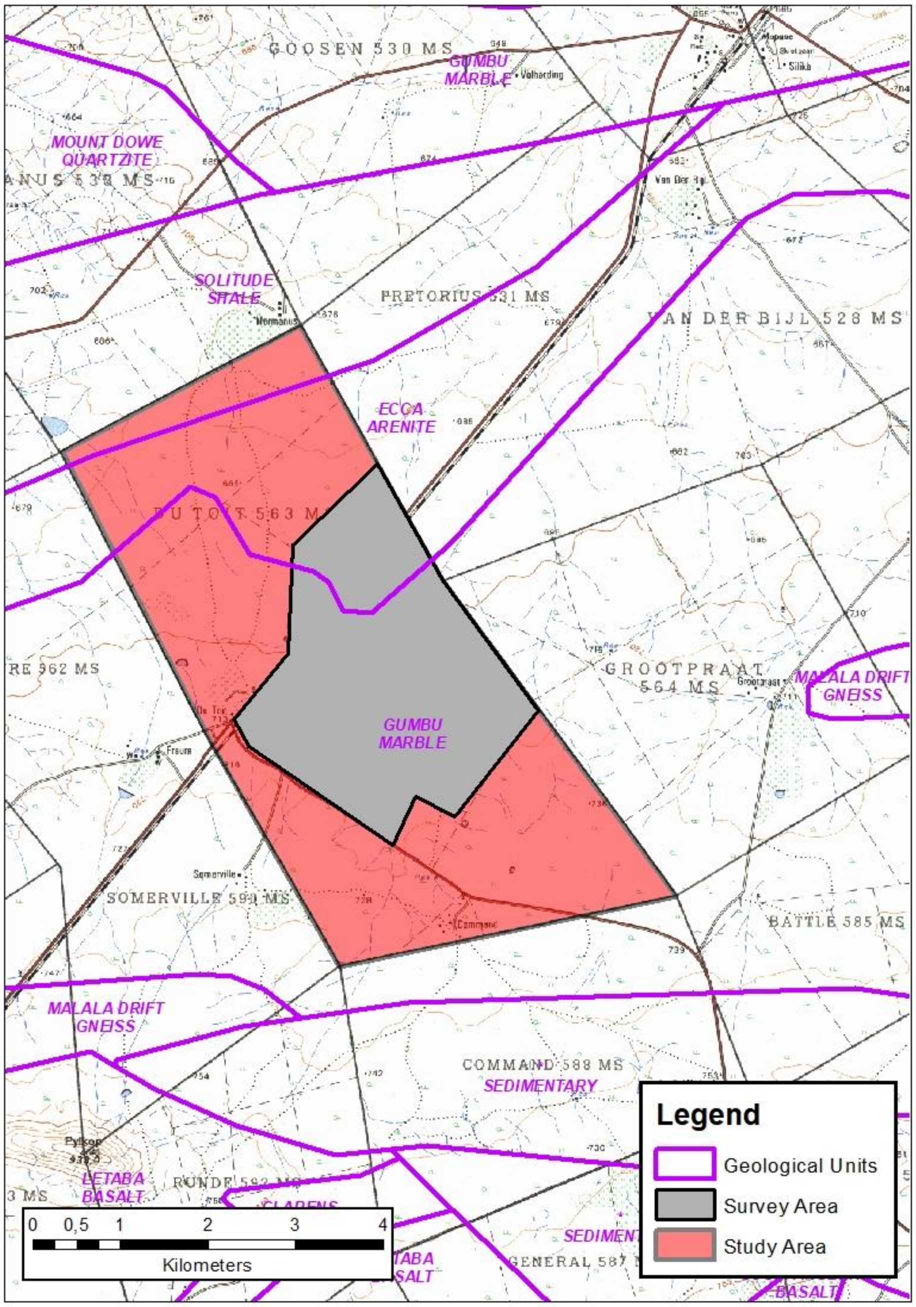

Figure 2 Geological map

3 METHODOLOGY

3.1 Reconnaissance scale

As far as pre-existing soil information is concerned, the area is covered by the national Land Type Survey at a scale of 1:250 000, which has been digitized using ArcGIS. The study area falls within the map sheet 2228 Alldays.

Each specific land type is a unique combination of broad soil pattern, terrain type and macroclimate. Where any of these changes, a new land type occurs.

Within any specific land type, the soil forms occurring (MacVicar *et al*, 1977) have been summarized according to their dominance, but the locality or distribution of the various soils within a land type cannot be further determined.

3.2 Semi-detailed field survey

As the second phase of the soil characterization phase, it was decided that the part of the study area covered by the various options for proposed infrastructure would be investigated in the field. In order to maximize the time available, a grid of 225 x 225 m was established using ArcGIS software, and these points loaded onto a GPS for use in the field.

The survey concentrated on the proposed sites for the power station and ash disposal facility. The soils were grouped into mapping units, whose distribution is shown on the soil map (Figure 3). Samples of topsoil and subsoil were collected at three localities (marked S1 to S3 on the map), and the soil analyzed for particle size (sand, silt and clay), exchangeable cations and CEC, and pH.

4 SOIL PATTERN

4.1 Land types

Within the study area, only one land type occurs, as follows:

- **Ah89** Yellow-brown and red, apedal, freely drained soils

The main characteristics of the soils occurring in the land type are red and yellow-brown, sandy loam to sandy clay loams of varying depths, along with some areas of shallow lithosols.

4.2 Soil mapping

The soils occurring in the survey area are brown to reddish-brown, sandy loam to sandy clay loams of the Hutton and Glenrosa forms, underlain by weathering rock. They are generally shallow (<400 mm), although deeper, red soils occur along the non-perennial stream beds in the area.

The soil legend is shown in Table 2.

Table 2 Soils occurring

Map Unit	Dominant Soils	Depth (mm)	Description	Agric. Pot.
Hu/Oa	Hutton, Oakleaf	400-1000	Red, structureless, sandy clay loam, apedal soils on rock. Occurs in lower parts of the landscape, along stream channels.	Wetland
Gs/Hu	Glenrosa, Hutton	150-450	Reddish-brown to brown, loamy sand to sandy loam, apedal soils on weathering rock. Isolated deeper patches of soil may occur	Low
Gs	Glenrosa, Mispah	100-350	Brown, loamy sand to sandy loam, apedal soils on weathering rock. Surface stones and rocks occur in places.	Low
S/R	Mispah, Rock	50-150	Brown, apedal soils on hard to weathering rock. Surface stones and rocks occur.	Very Low

The soil distribution is shown in Figure 3.

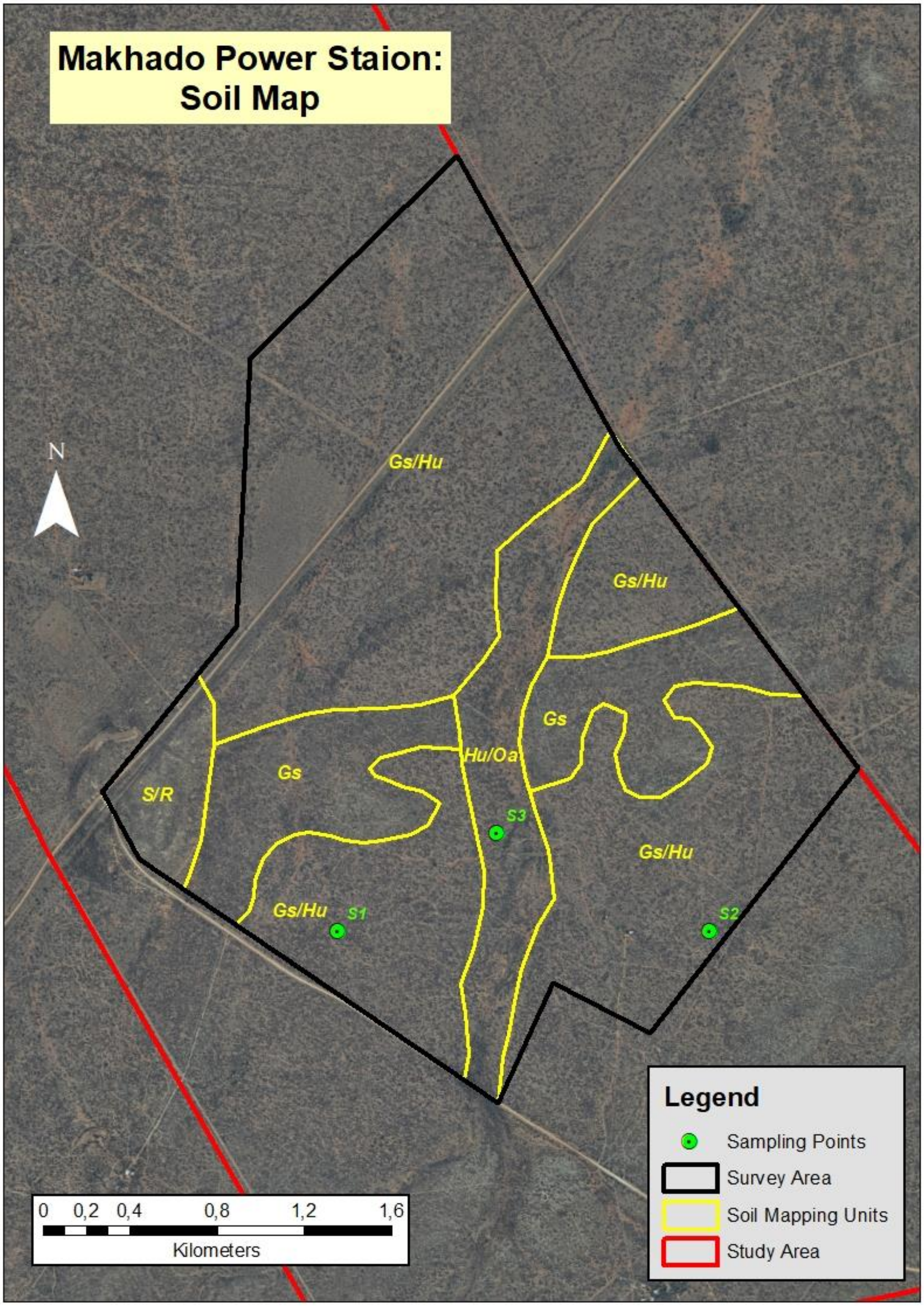

Figure 3 Soil map

4.3 Soil analyses

The results of the soil analyses are shown in Table 3.

Sample No.	S1 (Gs)		S2 (Gs)		S3 (Hu)	
	0-250 mm	250-500 mm	0-150 mm	150-450 mm	0-250 mm	300-700 mm
Co-ordinates	22º 41' 29.3" 29º 48' 56.3"		22º 41' 29.3" 29º 49' 51.5"		22º 41' 14.7" 29º 49' 20.0"	
Sand (%)	76	72	80	80	64	58
Silt (%)	6	6	6	4	8	8
Clay (%)	18	22	14	16	28	34
Na (cmol (+) kg $^{-1}$)	0.039	0.056	0.037	0.046	0.042	0.087
K (cmol (+) kg $^{-1}$)	0.381	0.302	0.297	0.251	0.455	0.460
Ca (cmol (+) kg $^{-1}$)	3.189	2.715	3.044	3.533	4.251	5.389
Mg (cmol (+) kg $^{-1}$)	1.555	1.613	1.325	1.728	2.361	3.093
CEC* (cmol (+) kg $^{-1}$)	9.487	9.843	3.230	6.969	12.558	11.923
pH (WATER)	6.26	6.31	6.33	6.35	6.57	6.43
Org Carbon (%)	0.57	0.55	0.46	0.42	0.51	0.46

* Cation Exchange Capacity

The analysis results show the difference between the shallower Glenrosa soils (sites S1 and S2), which have sandy loam texture, and the deeper Hutton soils along the drainage channels (S3), which have a sandy clay loam texture.

The soils are generally neutral, with pH values between 6 and 6.5, with very low organic carbon levels, as might be expected in a hot, dry climate. The CEC values are what could be expected from the underlying geology, mainly due to the Ca and Mg content of the soils. The Hutton soil has a higher value, which agrees with the higher clay content.

No abnormal or unusual values were obtained.

4.4 Agricultural Potential

The survey area is dominated by shallow (<450 mm), apedal soils of the Glenrosa and Hutton forms (see Figure 4). Very few soils deeper than 900 mm occur. These soils are not suited for cultivation due to the shallow rooting depth, along with their stoniness in many parts.

Figure 4. Typical landscape in the study area

An additional limiting factor is the dry, hot climate (Table 1). The low annual rainfall, coupled with the hot summer temperatures, means that the only practical means of cultivation would be by means of irrigation, and there is little or no evidence of any cultivated lands in the area.

The deeper soils along the stream bed should be avoided for any sort of development. Although the study area is a dry environment, and these zones will remain dry in most years, occasional periods of heavy rain will cause water to accumulate, even at intervals of several years. Such zones must be left in their natural state, as they can be regarded as temporary wetlands.

The map of agricultural potential is shown as Figure 5.

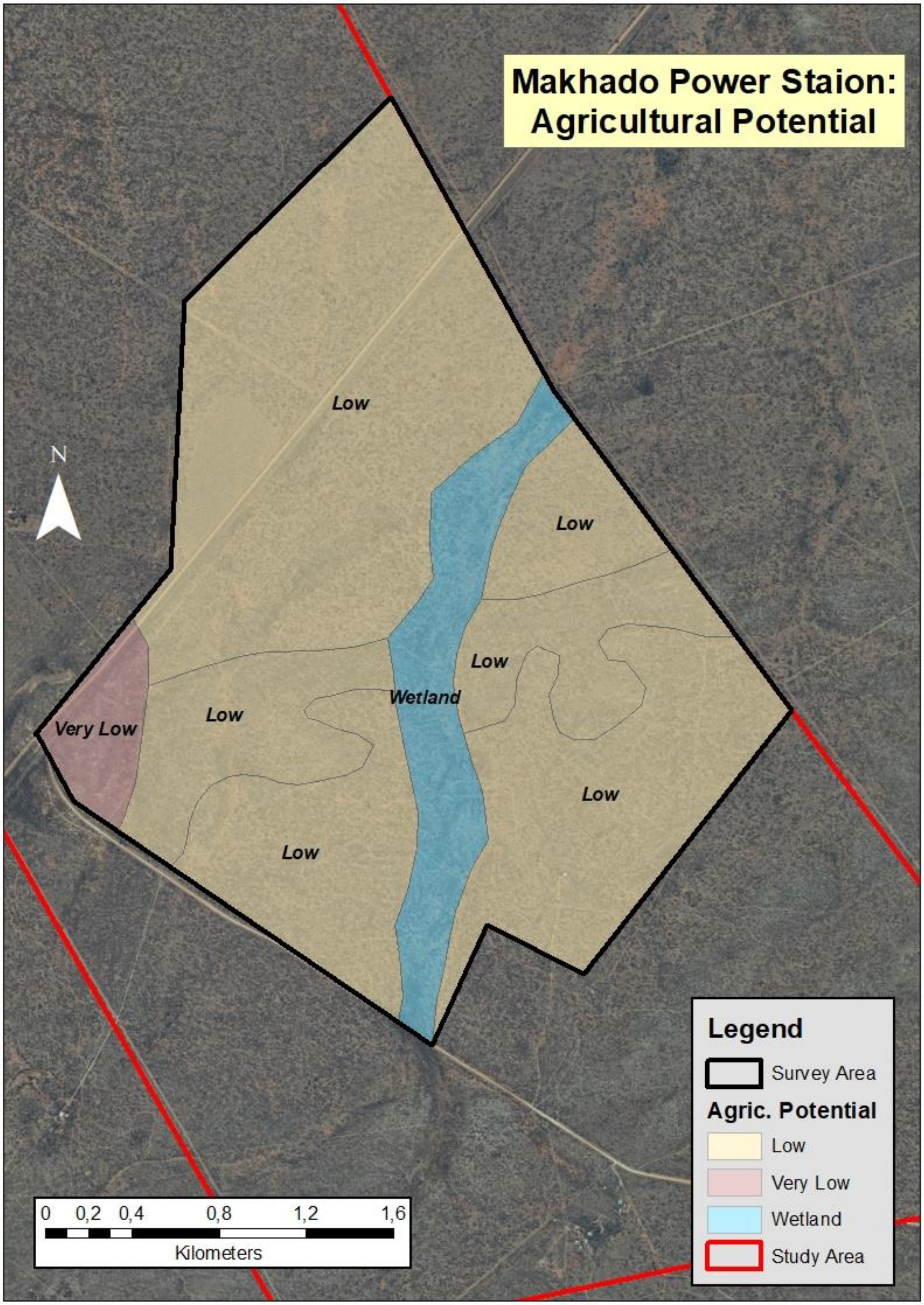

Figure 5 Land use

4.5 Erodibility

The soils do not have a high susceptibility to erosion, either by wind or water. The topsoils have a light to medium texture but are not excessively sandy. However, normal precautions regarding soil conservation should be taken in any construction phase, so that removal of vegetation cover is kept to a minimum and where activities that occur close to any stream bed should be avoided.

Once a facility is established where sites for waste materials are established, these should be kept wet to avoid wind erosion of the surface, especially in the drier winter months.

5 IMPACTS

The main potential impact will be the loss of agricultural soil due to the establishment of permanent infrastructure, including the power station and associated waste material sites.

Table 3 Impact significance

Nature: Loss of agricultural potential		
	Without mitigation	**With mitigation**
Extent (E)	Low (2)	Low (2)
Duration (D)	Long-term (4)	Long-term (4)
Magnitude (M)	Low (8)	Low (4)
Probability (P)	Highly probable (4)	Improbable (2)
Significance (E+D+M)*P	**Medium (42)**	**Low (20)**
Status (positive or negative)	Negative	Negative
Reversibility	Low	Medium
Irreplaceable loss of resources?	Yes	No
Can impacts be mitigated?	Yes	
Mitigation: The prevailing agricultural potential is low, so loss of agricultural potential will not be of huge significance. The main mitigation measure will be to avoid developing the facility on or close to the wetland zones across the study area, to avoid any potential seepage or other problems.		
Cumulative impacts: Little or none foreseen at this time. If a power station is established on the site, from the soils aspect there will not be a large off-site impact. However, there could be an increased wind erosion hazard from any ash disposal facilities if not properly handled and controlled.		
Residual Risks: Little or none, as long as proper rehabilitation measures are carried out. This would include ensuring that any soils where vegetation is cleared for construction are re-vegetated as soon as possible and ensuring that no excessive surface runoff is permitted to occur.		

In addition, for any area/s where a permanent waste facility is established, the existing topsoil (at least to approximately 300 mm depth, should be removed and stockpiled, where it can be used to a cover soil or fill material at a later stage, as required.

6. CONCLUSIONS

The soils in the study area are not a limiting factor in terms of the establishment of a power station. However, the wetland distribution (even if it involves temporary or seasonal wetlands, and associated recommendations such asbuffer distances, should be very carefully applied.

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