REPORT

On contract research for

Envirolution Consulting (Pty) Ltd

April 2009

DETAILED SOIL SURVEY OF WASTE LANDFILL SITE 5, MATIMBA POWER STATION, LEPHALALE

By

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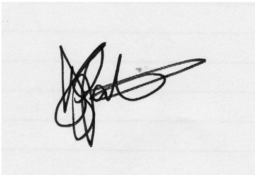
I hereby declare that I am an independent, unbiased specialist, with no interest in the development. I also confirm that I am properly qualified and registered to carry out the work involved under the Natural Scientific Professions Act 2003 (Act 27 of 2003).



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1. TERMS OF REFERENCE

The ARC-Institute for Soil, Climate and Water (ARC-ISCW) was originally contracted by Envirolution Consulting (Pty) Ltd to undertake a soil investigation for two alternative sites for a proposed waste landfill site, near Lephalale (Ellisras) in the west of Limpopo Province. After a selection process, the original "Site 5", adjacent to the Matimba Power Station, was chosen for further investigation. The purpose of the investigation is to provide an agricultural potential assessment for the site alternatives. The objectives of the study are;

- To identify the soils and to produce a soil map of the specified area as well as
- The agricultural soil potential and soil characteristics.

2. SITE CHARACTERISTICS

Site 5 comprises approximately 29.6 ha and is located within the fenced property of Matimba Power Station (see below), approximately 15 km west of the town of Lephalale:

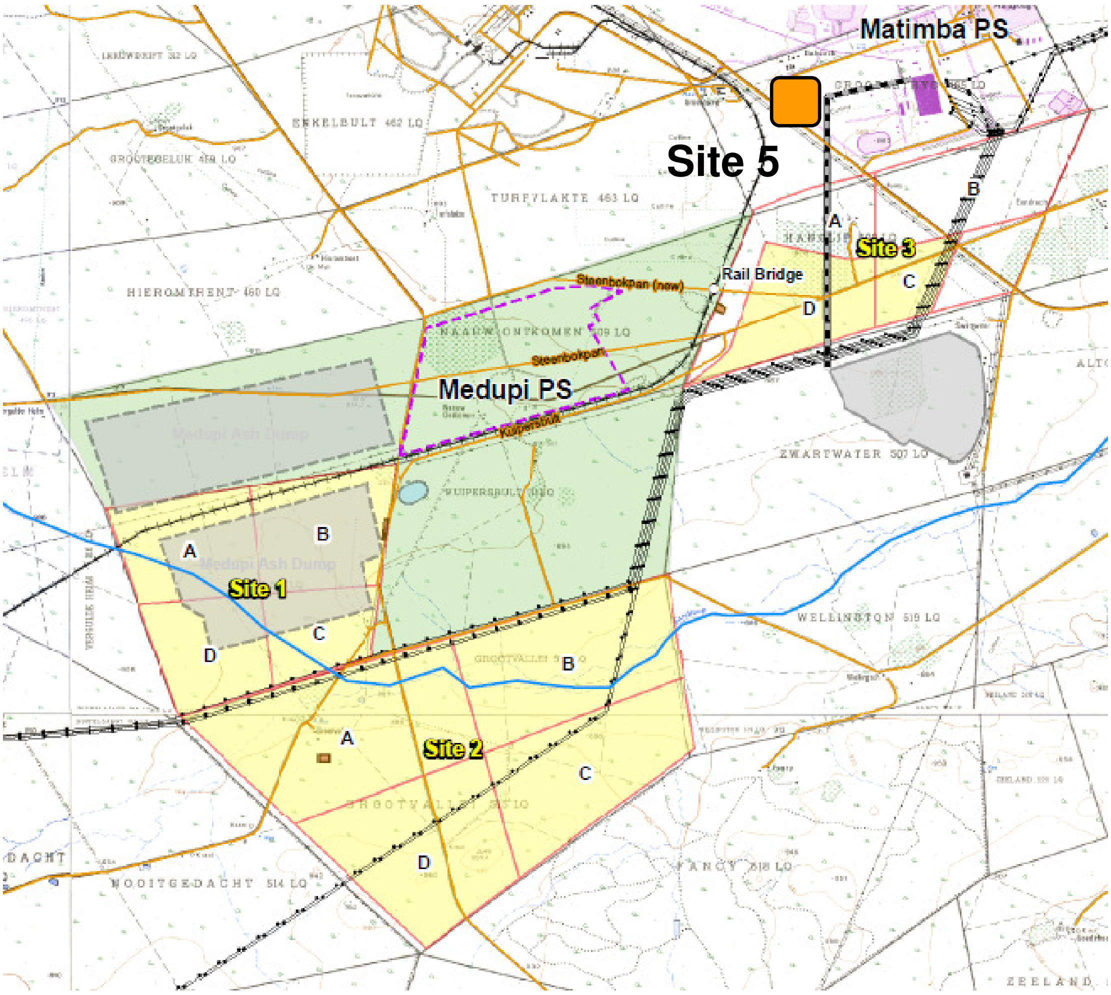

Figure 1. Site 5 locality map

2.1 Terrain and vegetation

The terrain morphological class of the area can described as plains with low relief, lying at an altitude of around 900 meters above sea level (Kruger, 1983). The area is virtually flat, with very gentle slopes (<2%).

However, the study area has previously been used as a dumping site and much of the south-eastern portion of the site comprises a mound of mixed earth materials, approximately 20 metres higher than the surrounding terrain (see Plate 1), with an area of excavation and deposition within this embankment.

Plate 1. Study area from coal discard dump on eastern side

The area is covered by treeveld, which is very dense and almost impassible in places (see Plate 2). However, on the embankment, and in the excavated areas, the trees are often much more sparse, with weeds and shrubs occurring in many places.

Plate 2. Looking west over study area from embankment

2.2 Parent Material

The geology of the area comprises sandstone and mudstone sediments of the Matlabas Subgroup, Waterberg Group, undifferentiated shale, sandstone and coal of the Karoo Sequence and also alluvium (Geological Survey, 1986).

2.3 Climate

The climatic regime of the study area (Koch, 2005) is characterized by hot, moist summers and mild, dry winters. The main climatic indicators are given in Table 1.

Table 1. Climate Data

Month	Average Rainfall (mm)	Average Daily Min. Temp (°C)	Average Daily Max. Temp (°C)	Average frost dates
Jan	95.5	18.2	31.7	Start date: 21/6 End date: 12/7 Days with frost: ± 2 Years with frost: 43%
Feb	81.4	17.9	30.2	
Mar	56.9	17.3	30.2	
Apr	36.3	13.2	26.7	
May	10.3	9.2	25.4	
Jun	5.0	6.0	23.1	
Jul	2.2	6.0	23.2	**Heat units (hrs > 10°C)**
Aug	2.2	8.9	25.9	Summer (Oct-Mar): 2 600 Winter (Apr-Sept): 1 385
Sep	9.7	12.6	29.0	
Oct	32.5	15.7	30.5	
Nov	67.0	17.2	31.0	
Dec	86.4	18.3	31.5	
Year	**485.4 mm**	**20.8 °C (Average)**		

The long-term annual average rainfall is 485.4 mm, of which 420 mm, or 86.5%, falls between October and March. Temperatures vary from an average daily maximum and minimum of 31.7ºC and 18.2ºC for January to 23.2ºC and 6.0°C for July respectively. The extreme high temperature that has been recorded is 44.5°C and the extreme low –4.3ºC. Frost is rare, but occurs occasionally in most years, though not severely.

3. METHODOLOGY

Using the co-ordinates of the extremities of the site, as supplied by Envirolution, a .shp file of the outline of the site was created using ArcInfo. A grid of 100 x 100 metres was then established, and these points were loaded onto a GPS for use in the field.

A hand-held soil auger was used for the field survey to investigate the soils at each grid point to a depth of 1.2 metres (or shallower, if limited by rock or other layer).

The soils occurring were characterized, classified (Soil Classification Working Group, 1991) and grouped into representative map units.

4. SOILS

The immediate area is very homogeneous in terms of texture, structure and soil depth. The larger part of the area consists of deep (usually deeper than 1.2 m) soils, comprising a dark reddish brown, apedal, sandy topsoil on a red (occasionally reddish-brown to yellowish red), apedal, loamy sand subsoil. The soils belong to the Hutton soil form (Soil Classification Working Group, 1991), indicated as map unit **dHu** on the soil map in the Appendix. This map unit comprises 22.87 ha (or 77.2% of the total area of 29.63 ha).

Soil samples were not collected during the field investigation, but from previous surveys in the vicinity (Dreyer & Paterson, 2006), these red, structureless soils generally have a loamy sand to sandy loam texture, with clay contents of between 8% and 12% in the topsoil (approximately 0-300 mm), with clay contents of between 10% and 18% in the subsoil (300-1 000+ mm).

The sandy nature of the soils is also reflected in reasonably low levels of available cations as nutrients, with values of 2 to 5 cmol/kg being the norm.

The soils are non-calcareous, and are acidic, with pH(H_2O) values of between 5.2 and 5.8, with low organic carbon values, generally around 0.8% in the topsoil.

However, around one-third of the area has been severely disturbed, with an embankment of dumped earth materials (map unit **Emb**) surrounding an excavated area, where stones, concrete and other rubble, as well as ash which appears to be a waste product, have been dumped (map unit **Exc**). The embankment covers 6.23 ha (21.0%), while the excavation comprises 0.53 ha (1.8%).

5. AGRICULTURAL POTENTIAL

5.1 Dryland

The soils of the area are sandy and generally deep (> 1 200 mm). They will therefore drain rapidly. Due to this tendency, along with the lack of fertility as shown by the low CEC values, they have a moderate agricultural potential.

However, coupled with the hot, dry nature of the climatic regime (Section 2.3), it can clearly be seen that this area is not suited to dryland arable agriculture, and most of the farming enterprises in the vicinity are either game farms or cattle ranches. This is the optimum land use option given the environment.

5.2 Irrigation

The soils would have a moderate to high potential for irrigation, due to the lack of any restricting layer, but the sandy nature of the soils would necessitate very careful scheduling. The soils would require a substantial and reliable supply of water to ensure optimum soil moisture at all times.

6. REHABILITATION ASPECTS

The soils do not have a significant erosion hazard, due to their homogeneous nature, but any soil is erodible if not handled correctly. Care should be taken whenever excavation is carried out or other earthworks are created and where steep slopes are left unvegetated. If soils are required for cover purposes, a depth of at least 1 metre is available from the undisturbed portion (map unit **dHu**) of the site.

This gives an available volume of (at least) 1.0 m soil x 22.87 ha = **228 700 m^3**

7. IMPACT ASSESSMENT

Given the fact that around half the area has been severely disturbed, as well as the fact that the prevailing arable agricultural potential is low, the study area can readily be used for landfill and/or dumping purposes.

Mitigation

However, the existing soil should be removed and stored separately so that it can later be replaced as part of any rehabilitation process. This should preferably be carried out on a strip and cover basis, so that the entire site is left open for the duration of the dump. It is not recommended that topsoil is stored for longer than a period of approximately two years, at the most, before being re-used as a cover, and then re-vegetated.

Table 2. Impact Assessment

Develop-ment Phase	**Impact:** Loss of Agricultural Land						
	Nature of Impact	Extent	Duration	Intensity	Probability	**Significance**	
						WM	**WOM**
Pre-construction	None	-	-	-	-	-	-
Construction	None	-	-	-	-	-	
Operation	Dumping of materials on top of usable soil	Site	Long-term	High	Highly probable	Low	Medium

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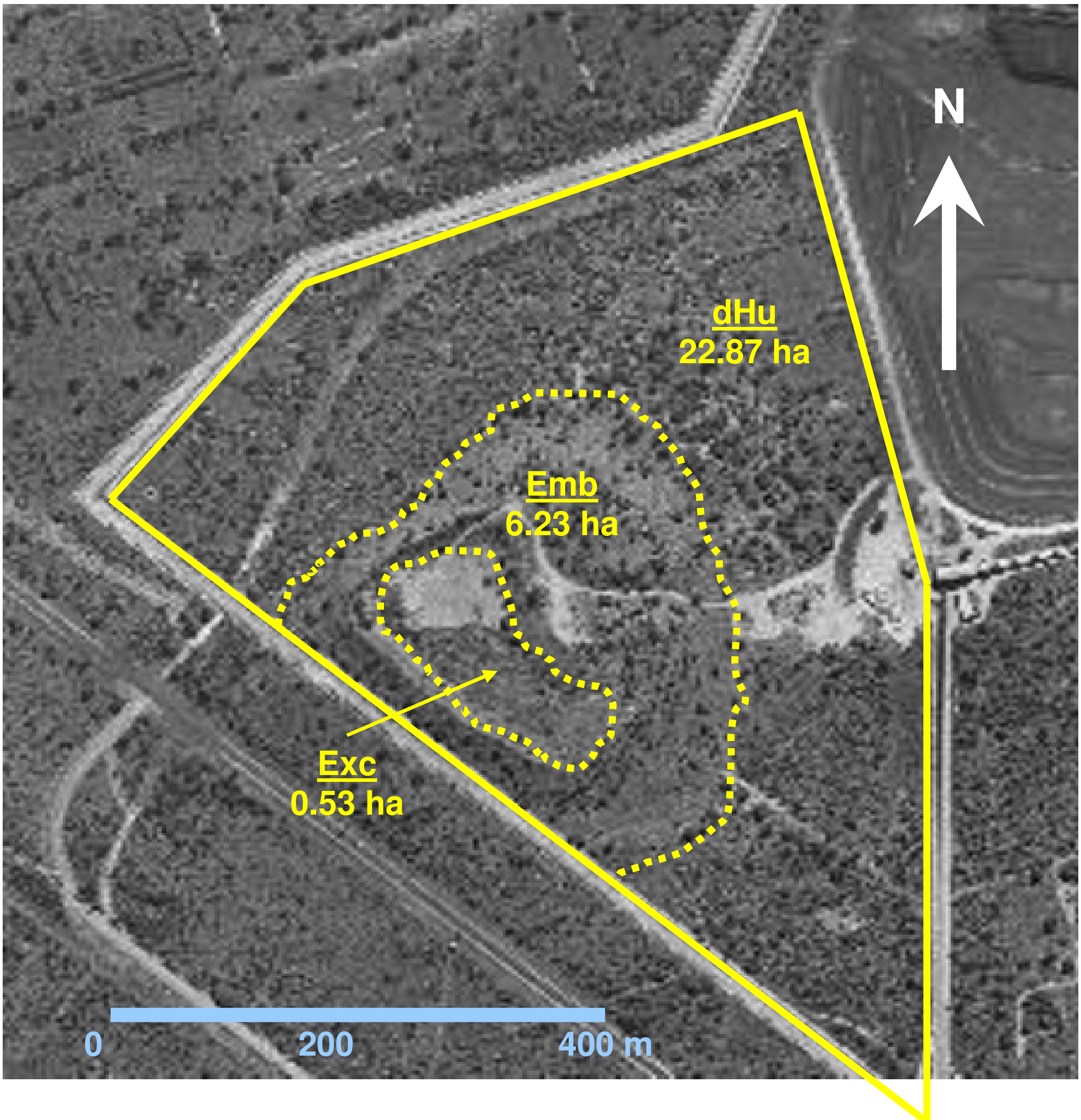
APPENDIX:

SOIL MAP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dHu
22.87 ha
Emb
6.23 ha
Exc
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200
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