SAVANNAH ENVIRONMENTAL (PTY) LTD

DRAFT SCOPING REPORT ON:

SEKOKO 2,571HA SOIL LAND USE LAND CAPABILITY ASSESSMENT

REPORT: P0467

Submitted to:

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EXECUTIVE SUMMARY

Savannah Environmental (Pty) Ltd requested during July 2012 a proposal for a baseline soil land use land capability wetland assessment for the amendment of the Mining Right for Sekoko Coal's Waterberg mine. The current mining right covers the farms Minnasvlakte, Hooikraal, Smitspan and Massenberg. The amended Mining Right needs to include three additional farms on which Sekoko currently have prospecting rights, *i.e.* Olieboomsfontein 220LQ (1,187ha), Swanepoelpan (924ha) and Duikerfontein (461ha). The total area of investigation is estimated at 2,571ha.

The objectives of the investigation include a soil survey and mapping of study area, measurement of the effective depth of the soil(s), assessment of agriculture potential of soils, assessment of the erodibility and misuse of soils, mapping of land use & land capability, formulation of a soil stripping guide and plan, determination of chemical, mineralogical and physical properties of representative soil forms, assessment of suitability of soils for rehabilitation purposes and an impact assessment of topsoil stripping on soils with recommendations to mitigate negative impacts.

From the draft scoping assessment it is concluded that the dominant soils according to the Taxonomical Soil Classification System of South Africa might include Plooysberg, Gamoep, Askam, Etosha, Clovelly, Hutton, Mispah, *etc*. soils. The effective depth of the soils could exceed 300mm inclusive of the *Orthic A, Red and Yellow Brown Apedalic B – Horizons*. The carbonaceous and rocky soil layers will be the limiting horizon in case of the shallower soils. From aerial interpretation and general reconnaissance, the study area occurs as a stabilised dune system with deep sandy well drained and carbonaceous soils distributed over the catena. Shallow Mispah soils are expected to occur on rocky outcrops in the landscape with effective depth up to the limiting geology. Deeper Clovelly and Hutton soils are expected to occur along the slopes of the dune system characterised by well aerated deep sandy profiles and there is a possibility these soils are most probably wind transported deposits. Natural pans were observed which will be associated with carbonaceous soil horizons represented by Etosha, Gamoep, Askam and Plooysberg soils. The *Orthic A-Horizon* of all the soils mentioned is most likely to be rich in organic matter and micro-organism activity representing a delicate micro-habitat. The *Red Apedalic B-Horizon* (Hutton) and *Yellow Apedalic B-Horizons* (Clovelly) are characterised by well aerated and drained sandy soil profiles with an average clay content of 10-15% represented by predominantly 1:1clay minerals. The *Soft and Hardbank Carbonate Horizons* of the Etosha, Gamoep, Askam and Plooysberg soils are $CaCO_3$ deposits in different forms of consistency and indicative of a prolonged negative water balance facilitating the upward migration and deposition of carbonates.

The agricultural potential under dry land and irrigation conditions will be determined as a function of effective depth, clay content and available water.

No evidence of soil erosion is anticipated on any of the soils.

The current land use will be assessed for natural veld, ploughed land and dams/pans/wetlands. Land capability will be classified as arable, grazing, pans/dams/wetlands or wilderness. The current land use is expected to be predominantly natural veld optimally used for game farming purposes utilising the veld system's natural carrying capacity to support indigenous wild life species. It is unlikely to encounter intensive dry land agricultural activities, however crop production might occur under irrigation with enough groundwater available for irrigation. Natural pans were identified during aerial photo interpretation and a general regional reconnaissance, and it would be critical to distinguish if the pans are salt or fresh water systems. The land capability as a function of effective soil depth is most likely to be classified as grazing and/or wilderness with the occurrence of natural freshwater and/or salt pans. The occurrence of wetlands will have to be carefully assessed as a function of soil types and associated hydrology in combination with the occurrence of vegetation indicator species

A soil stripping stockpiling strategy will be compiled to assess an estimated total area in ha that could potentially be covered 300mm thick @ bulk density 1,275kg.m^3 during rehabilitation taking into consideration a 10% loss of topsoil from the available m^3 due to handling, compaction *etc*.

The soils will be sampled and analysed to assess pH and electrical conductivity values. Furthermore plant available nitrogen, phosphorus, and potassium will be determined for uptake and sustainable plant growth. The structure and texture distribution of sand, silt and clay with anticipated drainage properties will be evaluated. The dominant clay mineral in the soil layers will be assessed and aligned to its rehabilitation potential and buffer capacity.

The soil horizons will be evaluated to determine if they are suitable for rehabilitation purposes.

The potential impacts and reasons/activities with proposed mitigation measures on the soil due to construction activities include:

- ***Loss of topsoil***:

  This is due to stripping, handling and placement of the soil associated with the pre-construction land clearing and rehabilitation and it is recommended to strip all usable soil irrespective of soil depth.

- ***Change to soil's physical, chemical and biological properties***:

  There is a high probability that topsoil will be loss due to wind and water erosion, which will alter the soils properties. Stockpiling and subsequent mixing of soil layers during handling will ultimately have a negative effect on altering the basic *soil properties. It is suggested to implement live management and placement of topsoil where possible, improve the organic content of the soils, and maintain fertility levels through fertilisation and to curb topsoil loss as much as possible.*

- ***Cumulative effect of the soil***:

Alteration of the natural surface topography due to reprofiling during construction after stripping will have an accumulation effect on the soils and careful consideration should be given to minimise compaction and ensure free drainage preferential surface water pathways.

SEKOKO 2,571HA SOIL LAND USE LAND CAPABILITY ASSESSMENT

1 TERMS OF REFERENCE

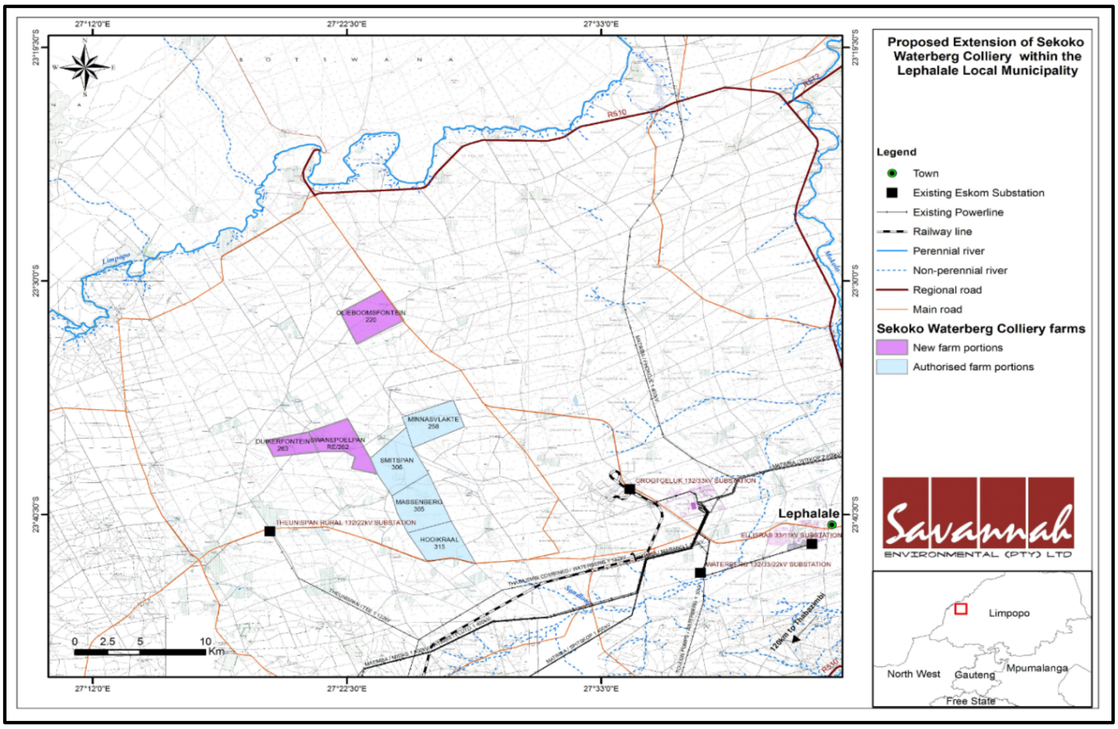

Figure 1. Investigation area.

During July 2012 Savannah Environmental (Pty) Ltd requested a proposal for a baseline soil land use land capability wetland assessment for the amendment of the Mining Right for Sekoko Coal's Waterberg mine. The current mining right covers the farms Minnasvlakte, Hooikraal, Smitspan and Massenberg. The amended Mining Right needs to include three additional farms on which Sekoko currently have prospecting rights, *i.e.* Olieboomsfontein (1,187ha), Swanepoelpan (924ha) and Duikerfontein (461ha). The total area of investigation is estimated at 2,571ha.

2 INVESTIGATION OBJECTIVES

The objectives of the investigation were interpreted as:

- **Objective 1:** *Soil survey and mapping of study area.*
- **Objective 2:** *Measurement of the effective depth of the soil(s).*
- **Objective 3:** *Assessment of agriculture potential of soils.*
- **Objective 4:** *Erodibility and misuse of soils.*

- **Objective 5:** *Land use & land capability.*

- **Objective 6:** *Soil stripping guide and plan*.

- **Objective 7:** *Determination of chemical, mineralogical and physical properties of representative soil forms.*

- **Objective 8:** *Assessment of suitability of soils for rehabilitation purposes*.

- **Objective 9:** *Impact assessment of topsoil stripping on soils with recommendations to mitigate negative impacts*.

3 METHOD OF INVESTIGATION

In order to meet the objectives of the investigation the following scope of work was proposed:

- Initiation meeting with project team.

- Collection and review of all available data.

- Soil survey on flexible grid 150 x 150m (opencast mining area), 300 x 300m (all related infrastructure as well as areas not impacted by mining areas & associated infrastructure) according to standard methods and techniques.

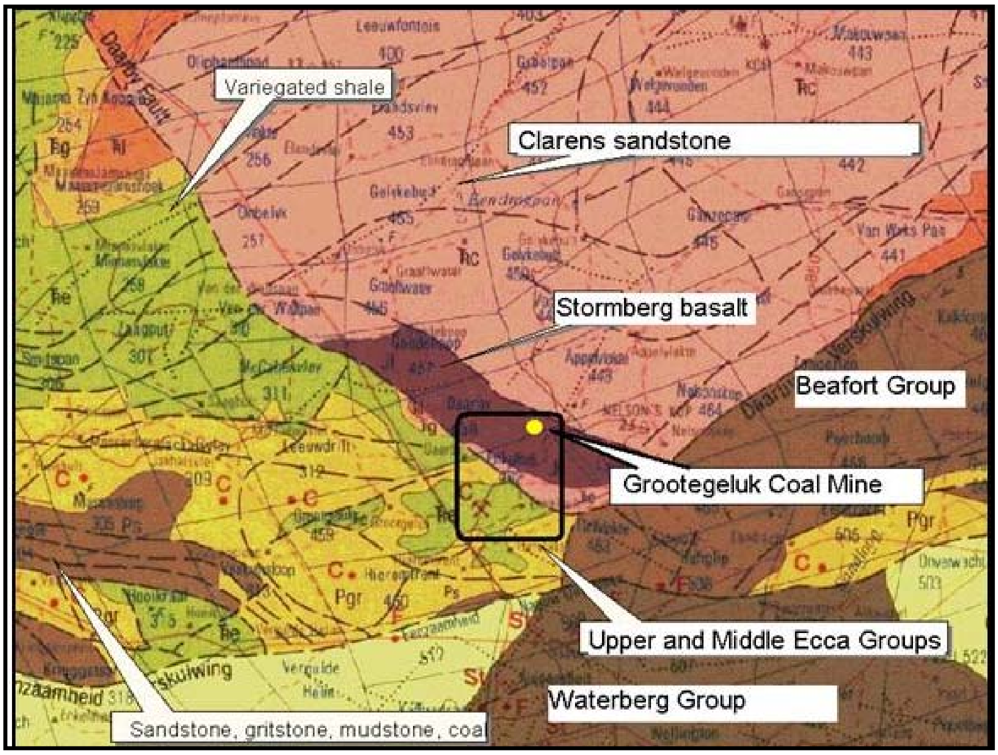

Figure 2. Map showing regional geology of the investigation area.

Interpretation of the regional geology (**Figure 2**), *i.e.* with specific reference to the occurrence of shale, sandstone and mudstone under a relative dry climate (*Weinert N-value <5*) it is most likely the following soil types (**Figure 3**) might occur in the investigation area.

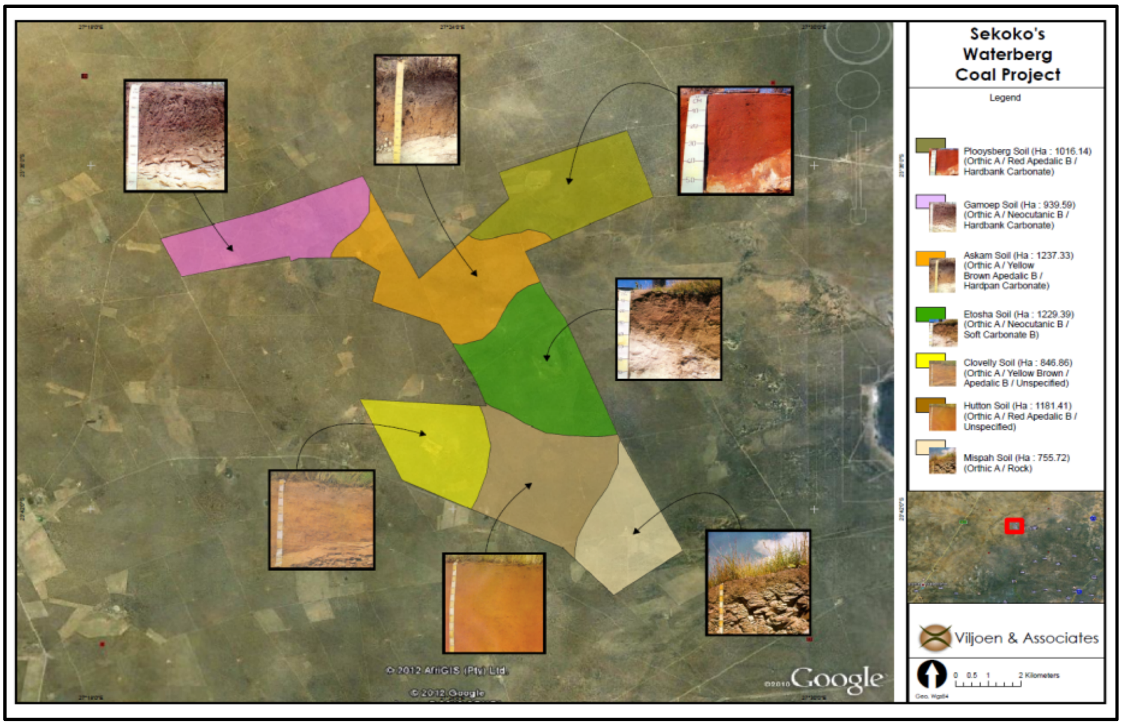

Figure 3. Anticipated soil types.

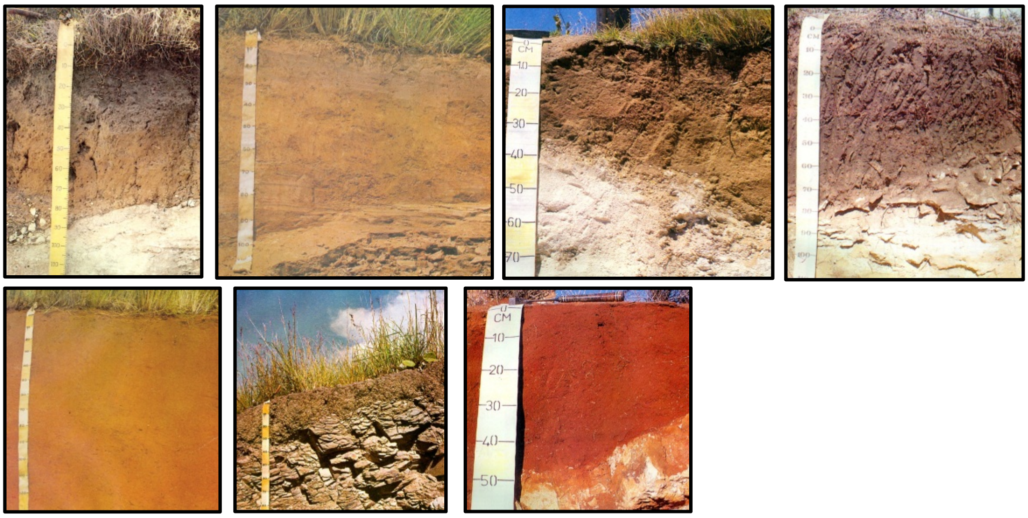

Figure 4. Anticipated Soil Types (*Left to right top: Askam, Clovelly, Etosha, Gamoep, Left to right bottom: Hutton, Mispah and Plooysberg*).

The anticipated soil types that might occur in the area of investigation are illustrated in **Figure 4**. Certain areas indicate drainage anomalies resulting in pans, however it is unlikely the areas are wetland soils due to the dry climate. However, this needs to be assessed by soil classification.

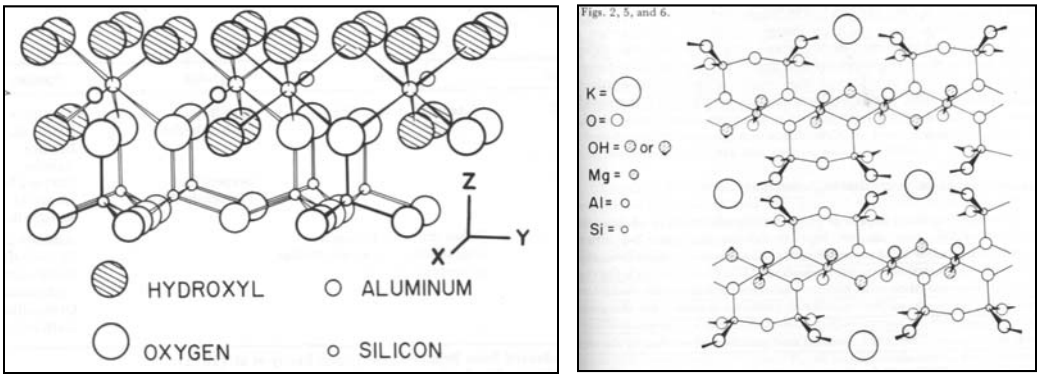

Figure 5. 1:1 & 2:1 clay minerals (fraction <0,002mm).

From aerial interpretation and general reconnaissance the study area occurs as a stabilised dune system with deep sandy well drained and carbonaceous soils distributed over the catena. Shallow Mispah soils are expected to occur on rocky outcrops in the landscape with effective depth up to the limiting geology. Deeper Clovelly and Hutton soils are expected to occur along the slopes of the dune system characterised by well aerated deep sandy profiles and there is a possibility these soils are most probably wind transported deposits. Natural pans were observed which will be associated with carbonaceous soil horizons represented by Etosha, Gamoep, Askam and Plooysberg soils. The *Orthic A-Horizon* of all the soils mentioned is most likely to be rich in organic matter and micro-organism activity representing a delicate micro-habitat. The *Red Apedalic B-Horizon* (Hutton) and *Yellow Apedalic B-Horizons* (Clovelly) are characterised by well aerated and drained sandy soil profiles with an average clay content of 10-15% represented by predominantly 1:1clay minerals. The *Soft and Hardbank Carbonate Horizons* of the Etosha, Askam, Gamoep and Plooysberg soils are $CaCO_3$ deposits in different forms of consistency and indicative of a prolonged negative water balance facilitating the upward migration and deposition of carbonates.

Each of the soil type options (**Figure 4**) are characterised by variance in quantity and type (**Figure 5**) of clay mineralogy that dictate different strategies in terms of rehabilitation and closure planning. A differentiated soil stripping and stockpile plan will address the potential variation that might occur.

- Selective sampling and analysis of samples (**Table 1**):

It is envisaged to take one sample at 300 and 600mm intervals per soil type. If for example 9 soil types occur on the study area a total number of 57 samples is estimated. It is possible that more than or less than 9 soil types might occur, which will influence this cost centre. Any other anomalies, *i.e.* salinity & contamination will also be sampled for verification (*will be communicated to Client for approval*).

(***The principle for the above proposed sampling frequency is based on the following calculation, i.e. 10,000m^2 0,3m deep at a bulk density of 1,275kg/m^2 contains approximately 3,825,000kg soil of which 500g are used for analytical purposes using on average 20-50g soil per analytical parameter. It is therefore imperative to sample at a cost benefit sampling frequency ensuring representative sampling of the soil material and prevention of cross contamination.***)

- Compilation of a soils map in the investigation area (1:10 000 scale), with descriptions based on the Taxonomical Soil Classification System of South Africa.

- Description of the chemical, physical and mineralogical properties of the soil types.

- Description of the effective depth and agricultural potential of the soils.

- Compilation of a soil utilization and topsoil stripping plan.

- Description of land use of the investigation area.

- Assessment of the land capability of the investigation area.

- Impact assessment of the proposed mining activities on the soils.

- Interpretation of analytical data and field observations.

- Compilation, internal review and submission of draft report.

3.1 Analyses

Table 1 outlines the analytical properties the soil samples will be analysed for:

TABLE 1. ANALYTICAL SOIL PROPERTIES

ELEMENT	METHOD
CHEMICAL	
Sample Preparation	Standard
pH (H_2O)	Standard
CEC+Ca+Mg+K+Na	NH_4Ac-extraction
EC+SO_4+NO_3+B	Saturated distilled water extract
P	Bray 1-extract
Zn+Cu+Co+Cr+Fe+Se+Ni+Pb+Cd+As+Hg+V+ Mo+Sn+Ba+Al+Be+Ti+Mn+Br+Sr+In+Sb+Te+ W+Pt+Tl+Bi+U+Cn+Li	ICP Scan-saturated distilled water extract
Lime Requirement	SMP Double Buffer Titration
MINERALOGY	
Clay fraction (<0.002mm) identification	XRD-scan (6 treatments)
PHYSICAL	
Particle size distribution (3 fractions-sand+silt+clay)	Hydrometer

3.2 Sampling Procedures

Soil sampling to be carried out according to the following procedure:

- Auger holes to be drilled with a 100mm diameter 1,8m hand driven steel auger.

- The ground surface at the position of the auger hole will be carefully cleared of loose material. When present, surface vegetation will be carefully removed and the soil clinging to any roots left behind to be collected with the surface soil sample.

- Sampling intervals in the auger holes will be 300mm and consolidated as specified.

- The auger will be advanced to the required depth and then carefully removed from the hole. The hole will be covered to prevent foreign material from entering.

- Approximately 1.5kg soil sample will be taken from the hole raisings and soil material removed from the auger. The samples will be quartered to produce a representative sample of suitable weight.

- Prior to the taking of each sample both the steel auger tool and stainless steel trowel used to collect the soil samples will be wiped clean of soil, washed with tap water, rinsed in a phosphate free detergent and finally sprayed with de-ionised water to prevent cross contamination between sampling depths.

- The soil samples will be placed directly in zip-lock freezer bags, clearly labelled in indelible ink with the name of the site, auger hole number and sampling date.

- Chain of custody forms will accompany the soil samples to the laboratory and the samples will be verified and signed for by the laboratory chemist.

- All auger hole logs will be geo-referenced, WGS 84 in degrees minutes seconds.

3.3 Quality Assurance Quality Control

The quality assurance / quality control procedure will entail a combination of the following International Best Practice Procedures:

- Conduct duplicate analyses on 5% of the samples submitted.

- Carry out additional checks using standard reference materials.

- Conduct multi linear regression techniques to ensure analytical equipment are properly calibrated.

- Double check calibrated equipment with spiked standards above highest standard and confirm with 10x dilution.

3.4 Wetland Delineation

The following section outlines the basic framework for the delineation of wetlands:

3.4.1 General Principles

Before undertaking a wetland delineation it is important that the following general principles are understood:

- A wetland is defined as land which is transitional between terrestrial and aquatic systems where the water table is usually at or near the surface, or the land is periodically covered with shallow water, and which under normal circumstances supports or would support vegetation typically adapted to life in saturated soil (Water Act 36 of 1998).

- A wetland is therefore defined in terms of hydrology (flooded or saturated soils), plants (adapted to saturated soils) and soil (saturated).

- Much of South Africa has a very variable climate so that in some years the wetland is much wetter than in others. This is particularly noticeable at the outer boundary areas of the wetland. Thus, unless long term data are available, the direct presence of water is often an unreliable indicator of wetland conditions, particularly for wetlands in arid and semi-arid regions.

- Although data are often not available to describe the hydrology of a wetland directly, this can be reliably done in an indirect way using soil morphology or vegetation. Prolonged saturation of soil has a characteristic effect on soil morphology, affecting soil matrix chroma and mottling in particular.

- Because of a wetland's transitional nature, as one moves from outside into a wetland, the hydrology, soils and vegetation generally change gradually along a continuum of increasing wetness. Thus, the boundary of the wetland is often not clearly apparent in the field and must be identified and placed across what is often a gradually changing gradient. While it is recognized that this boundary may be a human construct, it is necessary from a management and legal point of view and can be undertaken on the basis of scientifically defensible criteria.

- The gradual change in the vegetation along a wetland boundary gradient means that the outer parts of the wetland often have a mixture of species that occur widely outside of wetlands (*e.g. ngongoni* grass [*Aristida junciformis*] and rooigras [*Themeda triandra*]) and species specifically adapted to saturated soil conditions and confined to wetlands (*e.g.* the sedge *Pycreus macranthus*).

- In the Water Act definition of wetlands, "normal circumstances" refers to that which would be present without human modifications. Such modifications may include, for example: (a) the drying out of a wetland with artificial drains or (b) the removal of the natural vegetation through cultivation. In the case of drying out of the wetland, it is important to note that even if the characteristic wetland vegetation is lost, the soil retains, for decades at least, indications of the hydric conditions under which it was formed. Upon artificial drying out of a wetland, the vegetation tends to change more rapidly than soil morphology in response to the altered hydrology.

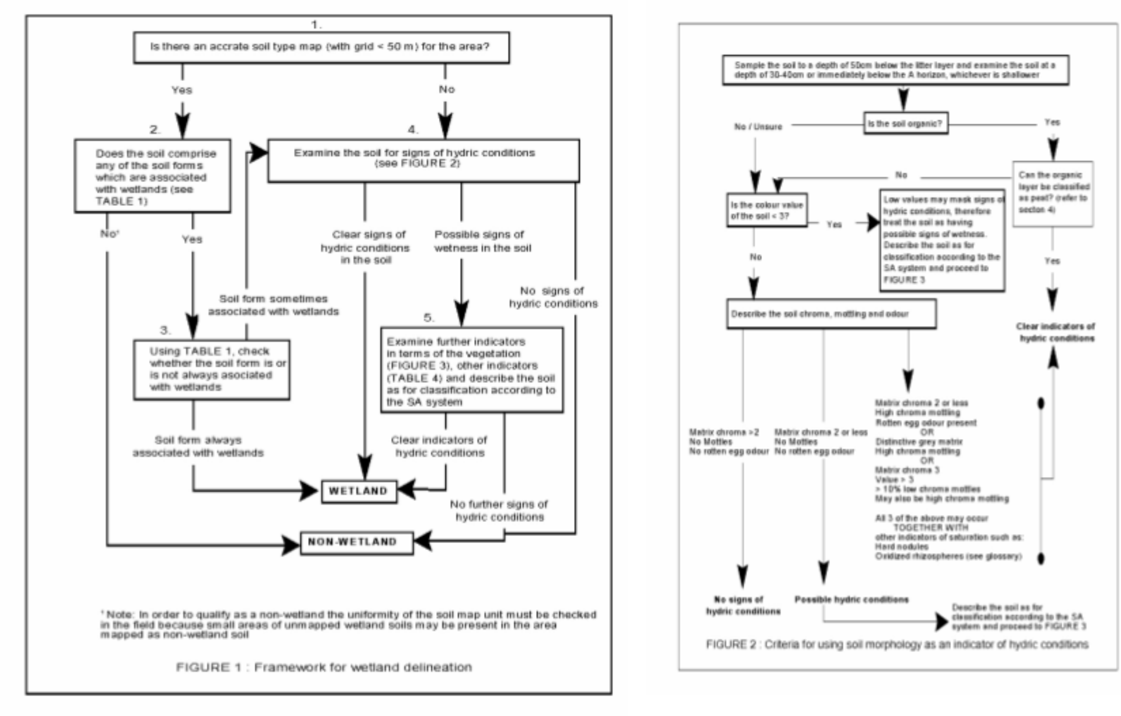

Figure 6. Framework for wetland delineation and criteria using soil morphology as indication of hydromorphic soil conditions.

Figure 6 shows a framework for wetland delineation and criteria using soil morphology to identify wetland soils, summarised in **Table 2**.

TABLE 2. SOIL FORMS ASSOCIATED WITH WETLANDS

Soil forms always associated with wetlands				
Champagne	Katspruit	Willowbrook	Rensburg	
Soil forms sometimes associated with wetlands				
Inhoek	Longlands	Wasbank	Lamotte	Estcourt
Klapmuts	Tukulu	Cartref	Fernwood	Westleigh
Dresden	Avalon	Pinedene	Glencoe	Bainsvlei
Bloemdal	Witfontein	Sterkspruit	Sepane	Valsrivier
Dundee				

3.4.2 Site Assessment:

- Undertake a preliminary delineation of the wetland boundary using an orthophoto or topocadastral map together with airphoto interpretation.

- Verify and adjust the preliminary delineation of the wetland using the following field verification:

    - Placement of lateral transects along the longitudinal length of the wetland. This spacing may need to vary depending on the complexity of the wetland. If a high level of accuracy is required in the delineation, and/or the wetland has been altered by artificial disturbance and land-use practices, then transects at more regular intervals may be required. Ensure that all transects are geographically referenced and marked on the orthophotos or topocadastral maps.

    - Start each transect well outside the perceived boundary of the wetland, and describe the soil at regular intervals along the transect.

    - Locate the point on the transect where the first clear signs of wetness are encountered. The boundary of the wetland may be unclear and it may be necessary to go back along the transect and take further samples.

    - Once the boundary has been determined continue with the transect through the wetland describing the soil at regular intervals. For each transect note the percentage distance occupied by the temporary, seasonal and permanent zones respectively. Finally, locate the far boundary of the wetland at the end of the transect using the same procedure employed to determine the initial boundary.

- When sampling the transects also take particular note of features not easily visible from the air- or orthophotos, including: artificial drains; localized features such as headcuts of erosion gullies and point sources of pollution. Mark the location of these features on the map.

- Once all transects have been completed, use topographic and soil features to establish lines connecting boundary points of the outer limits of the wetland and the zones within the wetland. This is best done from a vantage point (*e.g.* on a hill next to the wetland) with the aid of features visible on the orthophotos. Make any changes to the preliminary delineation on the map.

3.5 Agricultural potential

The agricultural potential will be assessed using the following formula as a function of various variables:

$$YIELD\ (kg\ ha^{-1}) = R/B \times ED/A \times C \times X$$

Where:

R – Rainfall (mm)

B - Species growth characteristics factor.

ED - Effective depth of the soil.

A - Soil wetness factor for textural classes of soil above effective depth.

C - Correction factor for aeration of soil.

X - Fixed coefficient for species.

The main variables determining the soil's agricultural potential include the **effective depth**, **clay content** and **rainfall**.

3.6 Assessment of erodibility of soils and evidence of misuse

The exchangeable sodium percentage of the soils is anticipated to be below 15% of the cation exchange capacity, rendering the soils free of dispersion anomalies caused by the hydration of sodium and consequent soil erosion.

3.7 Land Use & Land Capability

The land use land capability will be classified and summarised as outlined in Tables 3 and 4:

TABLE 3. LAND USE

Area	Land Use	Surface Area (ha)	% of Total
Study Area	Natural Veld		
	Plantations		
	Wetlands?/Dams/Pans		
	Ploughed Land		
	Total		

TABLE 4. LAND CAPABILITY

Area	Land Capability	Surface Area (ha)	% of Total
Study Area	Arable		
	Wilderness		
	Grazing		
	Wetlands?/Dams/Pans		
	Total		

The current land use is expected to be predominantly natural veld optimally used for game farming purposes utilising the veld system's natural carrying capacity to support indigenous wild life species. It is unlikely to encounter intensive dry land agricultural activities, however crop production might occur under irrigation with enough groundwater available for irrigation. Natural pans were identified during aerial photo interpretation and a site visit and it would be critical to distinguish if the pans are salt or fresh water systems. The land capability as a function of effective soil depth is most likely to be classified as grazing and/or wilderness with the occurrence of natural freshwater and/or salt pans. The occurrence of wetlands will have to be carefully assessed as a function of soil types and associated hydrology in combination with the occurrence of vegetation indicator species.

3.8 Soil stripping utilisation guide and plan

It is recommended that all usable soil be stripped and stockpiled in advance of activities that might contaminate the soil.

The stripped soil should be stockpiled upslope of areas of disturbance or development to prevent contamination of stockpiled soils by dirty runoff or seepage. All stockpiles should also be protected by a bund wall to prevent erosion of stockpiled material and deflect surface water runoff.

Stockpiles can be used as a barrier to screen operational activities. If stockpiles are used as screens, the same preventative measures described above should be implemented to prevent loss or contamination of soil. The stockpiles should not exceed a maximum height of 6m and it is recommended that the side slopes and surface areas be vegetated in order to prevent water and wind erosion. If used to screen construction operations, the surface of the stockpile should not be used as a roadway as this will result in excessive soil compaction.

A conservative estimate of anticipated available topsoil to be stripped will be summarised in **Table 5**.

TABLE 5. AVAILABLE TOPSOIL FOR REHABILITATION PURPOSES.

Soil Type & Average Effective Depth (mm)	Size (ha)	Available Volume (m^3)
Soil 1 (Effective Depth)		
Soil 2 (Effective Depth)		
Soil 3 (Effective Depth)		
TOTAL		**x @ BD: 1,275kg/m^3**

A total area in ha that could potentially be covered 300mm thick @ bulk density 1,275kg.m^3 during rehabilitation taking into consideration a 10% loss of topsoil due to handling, compaction *etc*. will be calculated.

3.9 Objective 7: Overview of basic soil chemical, physical and mineralogical properties of soils

The soils will be sampled and analysed for characterisation of the chemical, physical and mineralogical properties from a baseline and rehabilitation perspective.

3.10 Assessment of suitability of soils for rehabilitation purposes.

The soil horizons will be evaluated to determine if suitable for rehabilitation purposes.

When stockpiled soils have been replaced during rehabilitation, the soil fertility should be assessed to determine the level of fertilisation required to sustain normal plant growth. The fertility remediation requirements need to be verified at time of rehabilitation. The topsoil should be uniformly spread onto the rehabilitated areas and care should be taken to minimise compaction that would result in soil loss and poor root penetration.

When returning soil to the rehabilitation site care should be taken to place soil in a manner that will allow for levelling of soil to take place in a single pass. The soil profile should not be built up using a repeated tipping and levelling action to increase the soil depth.

Proper water control measures should be implemented to ensure a free draining rehabilitated landscape.

3.11 Impact assessment

The potential significance of environmental impacts identified during topsoil stripping was determined by using a ranking scale, based on the following (the terminology is from the DEAT guideline document on EIA Regulations, April 1998):

Occurrence

Probability of occurrence (how likely is it that the impact may occur?), and duration of occurrence (how long may it last?)

Severity

Magnitude (severity) of impact (will the impact be of high, moderate or low severity?), and scale/extent of impact (will the impact affect the national, regional or local environment, or only that of the site?).

In order to assess each of these factors for each impact, the following ranking scales **(Table 6**) were used:

TABLE 6. RANKING SCALES FOR IMPACT ASSESSMENT.

Probability:	**Duration**:
5 – Definite/don't know	5 – Permanent
4 – Highly probable	4 - Long-term (ceases with the operational life)
3 – Medium probability	3 - Medium-term (5-15 years)
2 – Low probability	2 - Short-term (0-5 years)
1 – Improbable	1 – Immediate
0 – None	
Scale:	**Magnitude**:
5 – International	10 - Very high/don't know
4 – National	8 – High
3 – Regional	6 – Moderate
2 – Local	4 – Low
1 – Site only	2 – Minor
0 – None	

Once the above factors had been ranked for each impact, the environmental significance of each was assessed using the following formula:

SP = (magnitude + duration + scale) x probability

The maximum value is 100 significance points (SP). Environmental effects were rated as either of high, moderate or low significance on the following basis:

- More than 60 significance points indicated high environmental significance.
- Between 30 and 60 significance points indicated moderate environmental significance.
- Less than 30 significance points indicated low environmental significance.

TABLE 7. IMPACTS ON SOIL

Environmental component	Potential impact	Activity/Reason	Environmental significance score						Criteria for magnitude	Mitigation measures
			P	D	S	M	Total	Rating		
Soil	• Loss of topsoil	• Stripping, handling and placement of soil associated with pre construction land clearing and rehabilitation	4	2	1	8	56	SBM M	**High:** Loss of finite resource due to poor stripping	• *Strip all usable soil, irrespective of soil depth*
			2	3	1	4	24	SAM L	**Low:** Recovery of as much usable soil material as possible	
	• Change to soil's physical, chemical and biological properties	• Loss of topsoil through erosion. • Stockpiling of soils • Mixing of deep and surface soils during handling, stockpiling and subsequent placement	4	3	1	8	64	SBM M	**High:** Soil properties are changed to such an extent that the associated agricultural potential cannot be maintained and/or realised.	• *Implement live placement of soil where possible* • *Improve organic status of soils* • *Maintain fertility levels* • *Curb topsoil loss*
			3	3	1	4	28	SAM L	**Low:** Change to soil properties do not adversely affect land capability.	
	• Cumulative effect on soil	• Change in natural surface topography due to reprofiling of surface after stripping	4	3	1	4	32	SBM L	**High:** Agricultural potential is compromised. **Low:** Pre-mining agricultural potential is maintained.	• *No specific measures are required. Stipulated remedial measures must be implemented*

3.11.1 Construction phase

Loss of topsoil and usable soil

Land transformation will lead to some losses of topsoil during construction and soil stripping.

Contamination of topsoil and stockpiled soil

Topsoil may be contaminated during the construction. Soil contamination is the result of surface runoff and seepage.

Contamination of stockpiled soil may occur due to seepage or contact with dirty surface water.

Soil erosion

Soil stockpiles may be exposed to erosion by surface water and wind. The aspect that would cause erosion is runoff.

3.11.2 Operational phase

Loss of topsoil and usable soil

During the construction usable soil may be lost due to inefficient stripping practices.

Contamination of soil

Seepage from contamination sources may contaminate stockpiled soil or *in situ* soil that has not yet been stripped.

Depending on the chemical composition of dust pollution, soil adjacent to the mining areas may be contaminated.

Leakages or spillages from conveyor may contaminate adjacent soils.

Soil erosion

Surface runoff leads to soil erosion. Soil stockpiles will be exposed to erosion activities during operation of the tailings dam, return water dam and concentrator areas.

3.11.3 Decommissioning and Closure phase

Loss of topsoil and replaced soil

Soil that has been used for rehabilitation purposes may be lost due to erosion caused by surface water runoff.

Soil erosion

The consumption of potable water during rehabilitation may lead to soil erosion if not done efficiently.

Contamination of soil

Depending on the content of the dust pollution, soil adjacent to construction areas may be contaminated.

The generation of hazardous and non-hazardous waste may pose a risk of soil contamination through seepage.

Potential incidents such as failure may cause contamination of topsoil if spills take place.

Visual impact

The use of stockpiled topsoil for rehabilitation purposes will have a positive visual impact.

3.11.4 Post-closure phase

Soil erosion

Soil erosion may occur due to surface water runoff across the rehabilitated construction sites.

Contamination of soil

Seepage from all construction and mining areas may contaminate surrounding soil.

4 REFERENCES

VAN DER WATT H. AND VAN ROOYEN, T.H. 1990. A Glossary for Soil Science. V&R Printing Works (Pty) Ltd.

5 EXPERIENCE AND EXPERTISE

Viljoen Associates specialise in soil remediation, and have broad experience of soil surveys, geotechnical assessments, soil pollution investigations, soil remediation and rehabilitation of gold slimes dams, coal discard dams, industrial polluted areas, industrial effluent evaporation dams and footprints of gold slimes dams, principles & practise of environmental management and stabilisation of ecological sites that have been eroded naturally.

A combination of theoretical and practical soil chemistry, physics and mineralogy and 16 years professional experience of the mining and environmental industry have resulted in a sound grasp of specialist environmental remediation and rehabilitation issues.

Viljoen Associates have undertaken numerous soil specialist studies and have been a key project member of several large multi-disciplinary projects, including environmental impact assessments, mine closure planning and rehabilitation of gold tailings, coal discard dumps and industrially polluted sites.

This investigation was done using available information and subsequent interpretation of data to reveal the properties on site with the techniques described.

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