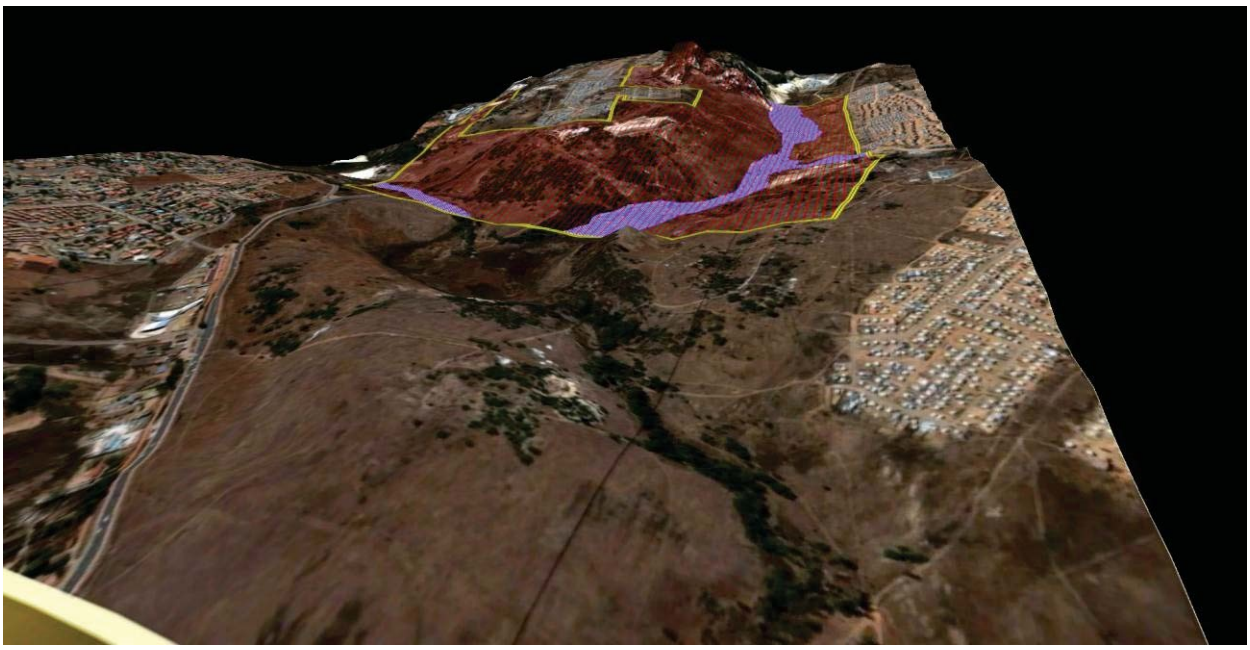
Wetland delineation - Remaining Extent of Portion 14 of the farm Roodepoort 237-IQ

MARSH ENVIRONMENTAL SERVICES



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SYNOPSIS
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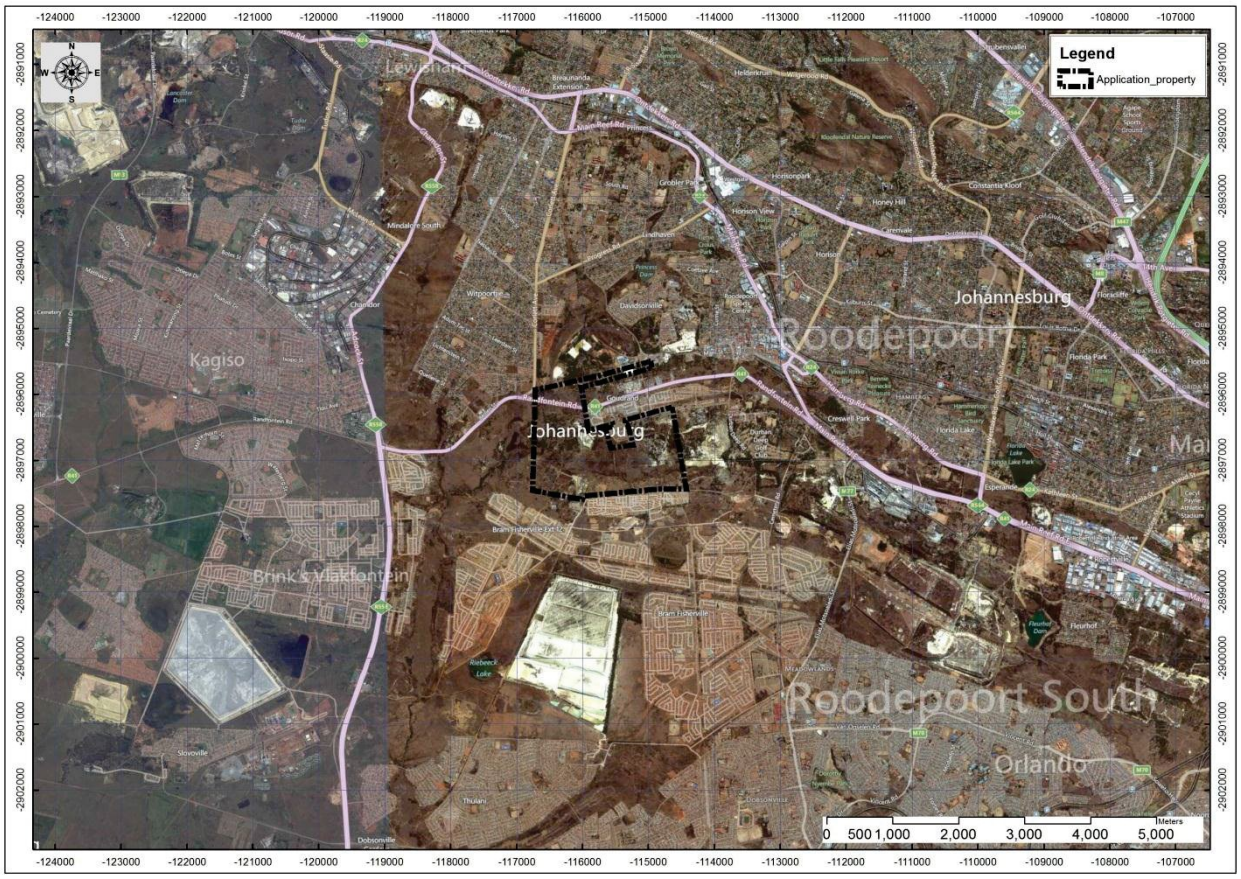
WETLAND EVALUATION

1. Background

1.1 Introduction

Index was requested by Marsh Environmental Services to undertake a wetland delineation study on a portion of land known as the Spitz Land situated on the Remaining Extent of Portion 14 of the farm Roodepoort 237-IQ. This report was prepared based on a site visits in June 2011 and a repeat visit in July 2012.

Figure 1 Locality (Subject property outlined in black)



1.2 Terms of Reference

The terms of reference were that the report should conform to all the requirements of the Department of Water Affairs and Forestry and the Gauteng Department of Agriculture and Rural Development and include the following:

- Brief description of the natural environment that has an impact on wetland formation; climate, rainfall and temperature, soil conditions and vegetation;
- Discussion of aspects determining wetland formation;
- Wetland delineation and
- Conclusions and findings.

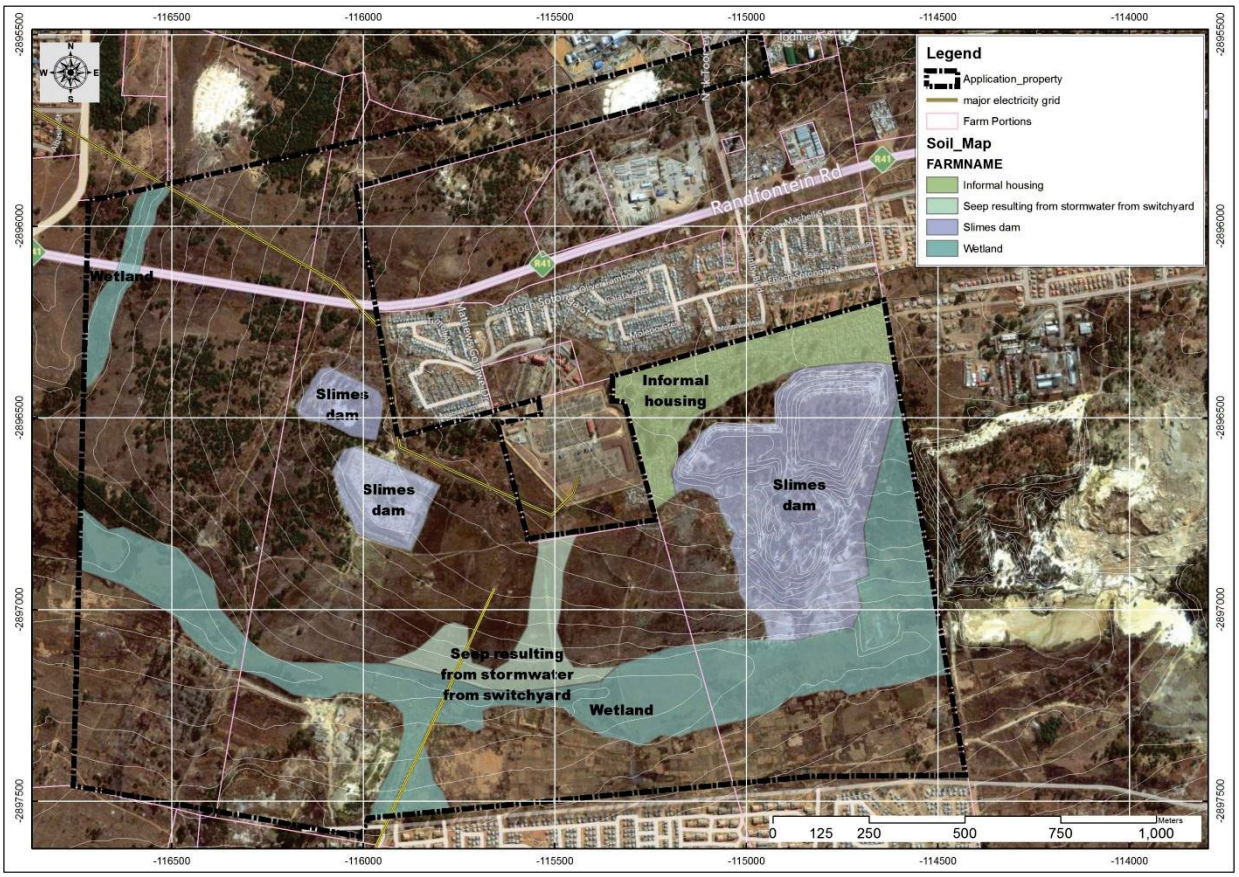
2. Description of the environment

2.1 Present land use

The area is mostly disturbed consisting of previously mining land with quarrying activities. The property is geomorphologically divided into three portions;

- the wetland that traverses the property in an east west direction;
- the area to the north consists that consist of mine waste dumps; various borrow areas for sand and an informal settlement and the remainder is predominantly rocky, and
- The area to the south of the wetland adjoins a formal township. This area is cultivated at present. There are numerous channels with deeper hydromorphic yellow soils where the stormwater from the roads of the township discharges stormwater into the centre wetland. The south western portion consists of restored or partially restored mining land.

FIGURE 2: CURRENT LAND USE



2.2 Natural resources

2.2.1 Climate

2.2.1.1 Rainfall

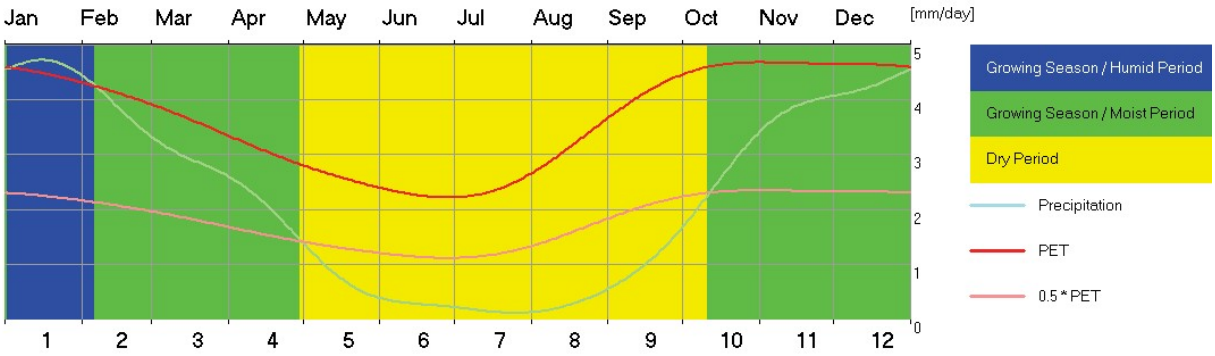
The rainfall is typical of the Highveld's summer rainfall pattern, where more than 80% falls from October through to April. An average of 740 mm rain is received per year in the area, of which 628 mm is considered as effective rainfall during the active growing period that spans from December to the end of March. Flooding conditions can be expected throughout the year but the probability increases between November and March. See the table below:

TABLE 1. AVERAGE ANNUAL RAINFALL FOR ROODEPOORT

	Best Estimate	Low Estimate	High Estimate	Standard Error
Prec	[mm]	[mm]	[mm]	[mm]
January	137.05	120.76	153.34	16.29
February	95.21	85.19	105.23	10.02
March	85.37	79.04	91.69	6.33
April	56.78	46.00	67.55	10.77
May	17.40	11.95	22.85	5.45
June	10.15	8.64	11.67	1.51
July	5.42	2.85	8.00	2.57
August	7.54	5.97	9.11	1.57
September	25.49	22.24	28.74	3.25
October	75.64	65.03	86.26	10.61
November	107.79	89.51	126.06	18.28
December	117.04	110.23	123.84	6.80
Mean	61.74	53.95	69.53	7.79

The plotting of the rainfall against the temperature at a ratio of 2:1 indicates the growing season and where drought conditions could be expected. See the graph below:

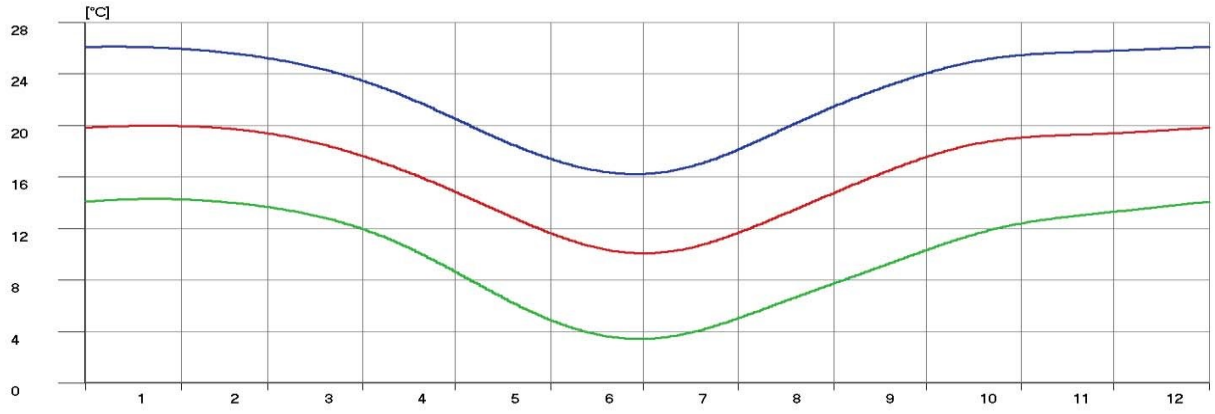
FIGURE 3: CLIMATOGRAM OF THE SUBJECT PROPERTY



2.2.1.2 Temperature

The area experiences severe frost, which occurs frequently from mid-May to August. The summers are mild where temperatures above 32^{0}C are seldom reached. The highest average maximum temperature of 27,09^{0}C occurs in December. The average minimum temperature of 8,37^{0}C occurs in June and July.

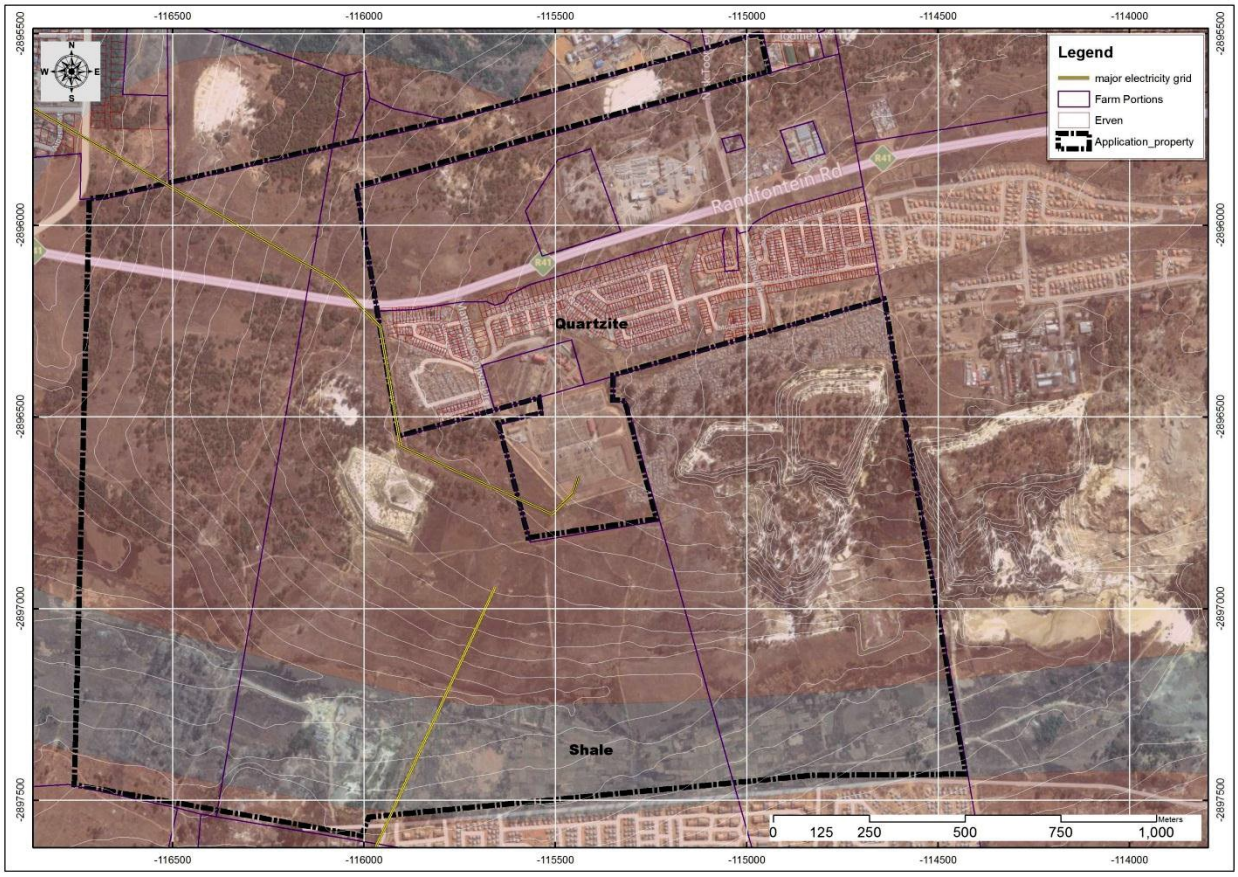
FIGURE 4 MEAN TEMPERATURES FOR ROODEPOORT



2.2.2 Geology

The geological map published by the Council for Geoscience shows that the site is underlain by quartzite and shale. The quartzite is hard and resistant to erosion. It has resulted in the quartzite ridges with rock outcrops. The shale is less resistant to erosion and has produced the clayey soils to the south of the water course.

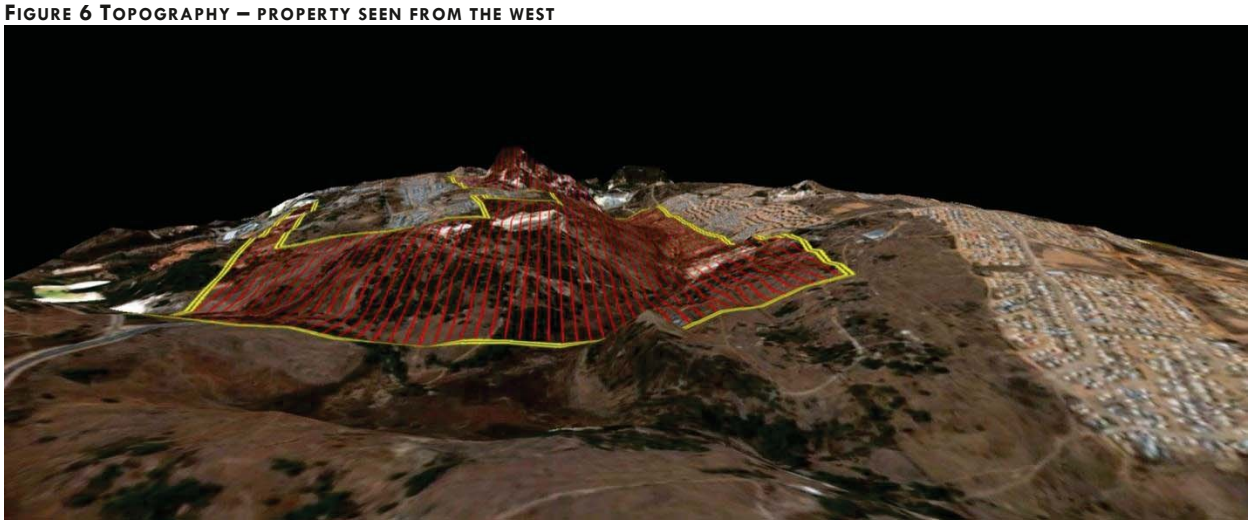
FIGURE 5: GEOLOGY



2.2.3 Topography and drainage

The topography is determined by the erosion resistant quartzite that formed the ridge with streams incising the softer shale to the north and south. The quartzite ridge forms the water shed with drainage towards the south, west and the north.

FIGURE 6 TOPOGRAPHY – PROPERTY SEEN FROM THE WEST



2.2.4 Soil

Observations were made through soil auger and probe. The survey concentrated on the areas around the water courses, supplemented with observations on the remainder of the property. The areas further away were delineated by interpreting satellite imagery and by ground truthing and should be considered approximate and not absolute.

The underlying rock is quartzite or shale of the Johannesburg Supergroup. The soil on the quartzite is either poorly developed and described as Mispah; or is rock outcrops.

The land below (south) of the ESKOM switch yard is fed by stormwater that accumulates in the switch yard and is discharged into the quartzite ridge. Whilst water seeps out between the rock outcrops, there is no soil. It can therefore not be considered wetland.

FIGURE 7 MISPAH SOIL SOUTH OF THE ESKOM SWITCH YARD

FIGURE 8 ROCK OUTCROPS IN AREAS WITH QUARTZITE

FIGURE 9 AREAS SEASONALLY WET AS A RESULT OF THE STORMWATER FROM THE ESKOM SWITCHYARD

FIGURE 10 MISPAH SOIL BETWEEN ROCK OUTCROPS IN THE WEST OF THE SURVEY AREA

The soil on the shale is either wetland with Katspruit or dry with Avalon soil. Soil depth ranges from deeper than 800mm to less than 200mm deep:

The wetland soil along the lower lying area dominates the central portion of the property. The stream feeding it flows from east to west. Near the centre of this stream is a large earth dam that is partially silted up. These areas have gleyed sub-soils with reeds, and sedges as vegetation, and are wetlands.

FIGURE 11 THE DAM CONSTRUCTED WITHIN THE WETLAND

FIGURE 12WETLAND VEGETATION

The Avalon soil in the extreme south of the property can be described as an orthic, non-structured topsoil, overlying yellow-brown non structured subsoil with some mottling, on soft plinthite. The clay content varies between 18 to 25 % clay in the top soil and becomes slightly higher in clay content deeper in the subsoil. This section is situated between the wetland and the formal housing area. This section is characterized by deeper soils and less rocky outcrops.

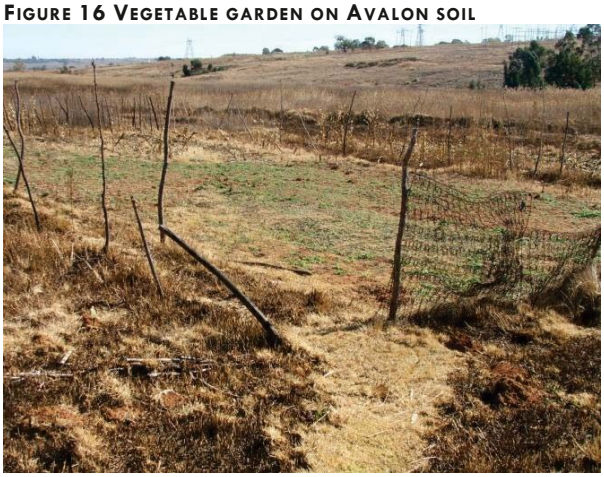
There are several drainage lines emanating from the stormwater culverts from the adjacent township to the south.

FIGURE 13 CULVERT

FIGURE 14 WETLAND DEVELOPMENT BELOW THE CULVERT

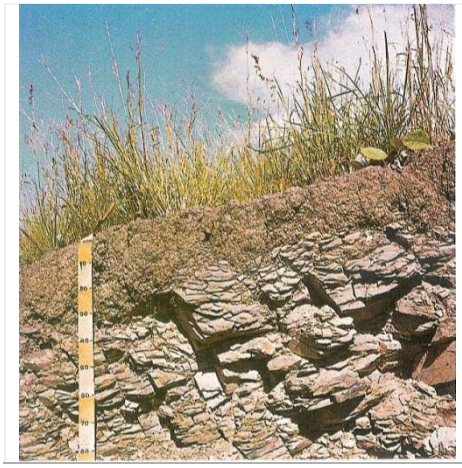
FIGURE 15 CULVERT

FIGURE 16 VEGETABLE GARDEN ON AVALON SOIL



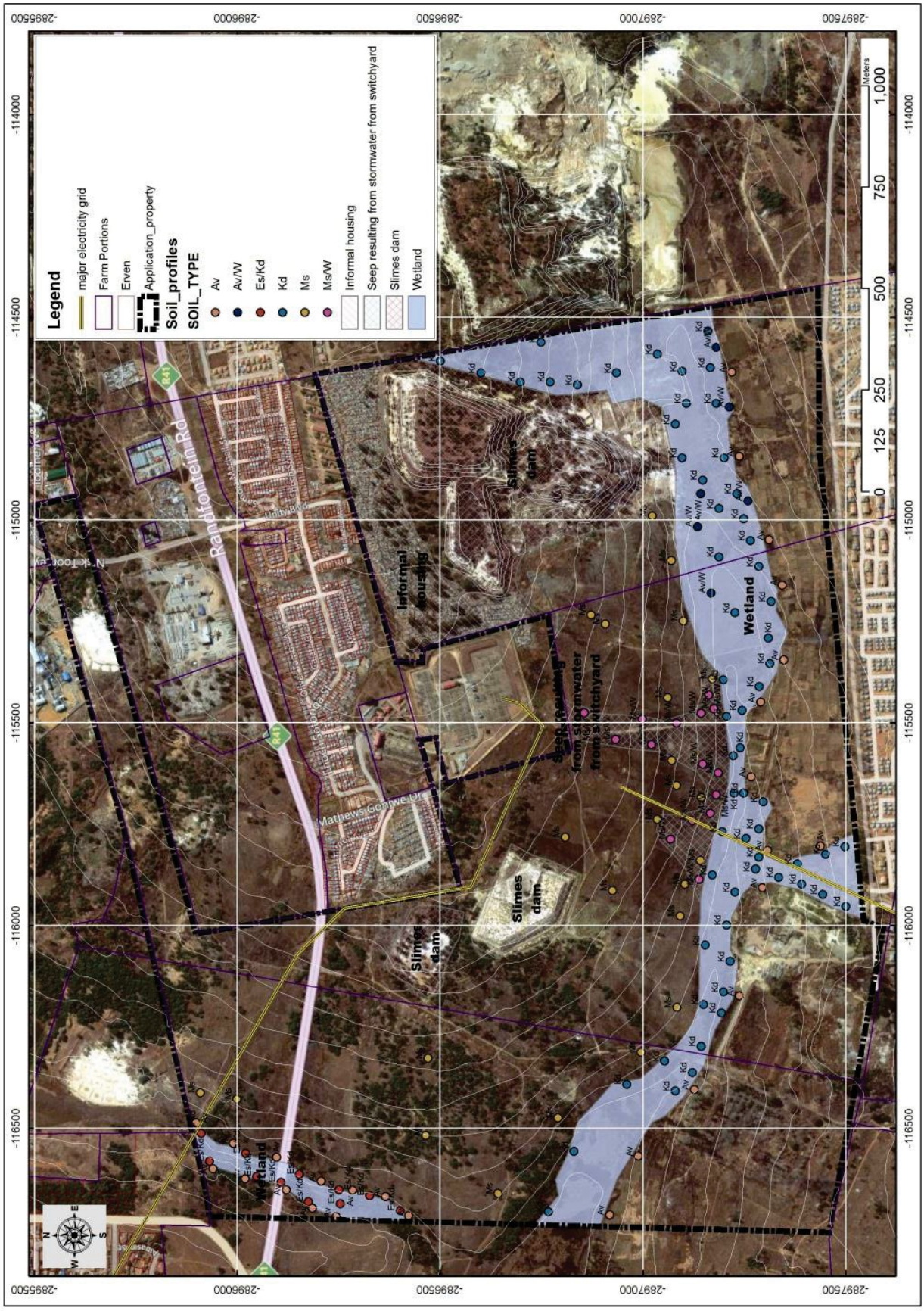
In more detail, the following was found:

TABLE 2: PROPERTIES OF SOIL TYPES ENCOUNTERED

Soil Type	Description	Depth (mm)	
Mispah and rock outcrops	Greyish orthic topsoil overlying partially weathered granite. The soil profile is absent (rock outcrop) or varies between 200 and 400 mm with an abundance of loose rock (mispah). The clay content is 18% to 25%.	0 to 200	
Katspruit	The soil is greyish brown and overlies grey and olive coloured mottled subsoil. The texture: sandy clay loam (20 - 30% clay) topsoil on clay.	400	
Avalon	Greyish brown orthic, sandy loam A horison with moderately developed blocky structure overlying lithocutanic B horizon. The deeper subsoil is partially weathered shale. The soil has 18 to 20% clay. The colour of the subsoil is very dark grey (10YR3/1). There are no mottles.	400 - 600	

Soils units were then grouped and a soil map generated. Soil properties of individual survey points are attached as appendix.

FIGURE 17: SOIL SURVEY RESULTS



2.2.5 Vegetation

2.2.5.1 Regional vegetation patterns

The regional vegetation according to Mucina and Rutherford is Soweto Highveld Grassland: Gm8.

TABLE 3 VEGETATION ACCORDING TO MUCINA AND RUTHERFORD

Name of vegetation type	Soweto Highveld Grassland
Conservation Target (percent of area) from NSBA	24%
Protected (percent of area) from NSBA	0,2%
Remaining (percent of area) from NSBA	52,7%
Description of conservation status from NSBA	Endangered
Description of the Protection Status from NSBA	Hardly protected
Area (sqkm) of the full extent of the Vegetation Type	14513.32

Distribution

Mpumalanga, Gauteng (and to a very small extent also in neighbouring Free State and North-West) Provinces: In a broad band roughly delimited by the N17 road between Ermelo and Johannesburg in the north, Perdekop in the southeast and the Vaal River (border with the Free State) in the south. It extends further westwards along the southern edge of the Johannesburg Dome (including part of Soweto) as far as the vicinity of Randfontein. In southern Gauteng it includes the surrounds of Vanderbijlpark and Vereeniging as well as Sasolburg in the northern Free State.

Conservation

Endangered. Target 24%. Only a handful of patches statutorily conserved (Waldrift, Krugersdorp, Leeuwkuil, Suikerbosrand, Rolfe's Pan Nature Reserves) or privately conserved (Johanna Jacobs, Tweefontein, Gert Jacobs, Nikolaas and Avalon Nature Reserves, Heidelberg Natural Heritage Site). Almost half of the area already transformed by cultivation, urban sprawl, mining and building of road infrastructure. Some areas have been flooded by dams (Grootdraai, Leeukuil, Trichardtsfontein, Vaal, Willem Brummer). Erosion is generally very low (93%).

2.2.5.2 Site specific vegetation

Two vegetation types were found on site:

- Riparian vegetation comprising mainly of bush. Dominant tree species that were found are exotics: *Populis spp; Eucalyptus spp,* and a few indigenous shrubs*: Tarchonanthus camphoratus* and *Grevia flava*. The grass species encountered include: *Cymbopogon plurinodis, Eragrostis curvula, Themeda triandera, Digitaria eriantha, Heteropogon contortus* and *Panicum coloratum*. No wetland species were identified.
- The floodplain classified as wetlands. Grass species include *Setaria sphacelata, Pennisetum thunbergii, Paspalum urvillei, Paspalum distichum, Phragmites australis, Aristida junciformis, Leersia hexandra , Miscanthus capensis, Cyperus spp.* and *Typha capensis. Phragmites australis* dominates.

FIGURE 18: GRASSLAND

FIGURE 19: WETLAND VEGETATION

3. *Wetland delineation*

3.1 Background

'Wetland' denotes a variety of ecosystems, ranging from rivers, springs, seeps and mires in the upper catchment, to midlands marshes, pans and floodplains to coastal lakes, mangrove swamps and estuaries at the bottom of the catchment. In common they experience prolonged water saturated conditions that in turn manifests in specific soil characteristics and plant and animal species composition.

Wetlands is defined by the National Water Act 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 land in normal circumstances supports or would support vegetation typically adapted to life in saturated soil.*'

Accordingly, a wetland must have one or more of the following attributes:

- Wetland (hydromorphic) soils that display characteristics resulting from prolonged saturation
- The presence, at least occasionally, of water-loving plants (hydrophytes)
- A high water table that results in saturation at or near the surface, leading to anaerobic conditions developing in the top 50 cm of the soil.

The object of the delineation procedure is to identify the outer edge of the temporary zone. This outer edge marks the boundary between the wetland and adjacent terrestrial areas. Occurrence of standing water and hydrophilic plants and finally, soil conditions were used as the determinant for this assessment. In more detail, the following:

3.2 Criteria

Soil condition is the primary criterion that signifies that a soil is waterlogged. These conditions manifest itself through plant communities that can tolerate hydromorphic soils. They are hydrophytes that are adapted to stresses imposed on plants through temporary or permanent waterlogged conditions.

The importance of retaining and maintaining functional wetlands are well established - the process of establishing the boundaries less so. The following criteria discussed in *A Practical Field Guide for the Identification and Delineation of Wetlands and Riparian Areas*, published by DWAF are used as baseline information. According to these guidelines the main indicators are the following:

3.2.1 Terrain morphology

- Wetlands predominantly occur on valley bottoms and on seep in other terrain forms.

3.2.2 Soil form

- Soils that are gleyed or organic soils indicate permanently saturated zones;
- Forms that are heavily mottled and that have a grey matrix in the subsoil indicate seasonally and temporary waterlogged conditions.

3.2.3 Soil wetness

- Soil colour is markedly influenced by the oxidation statues of manganese and iron. Yellow, red and reddish brown soil form under well-oxidised conditions and greyish colours when aeration is poorer. Prolonged periods of water saturation producing gleysation, where grey and blue mottles are formed and are a condition in which hydrophilic plants flourish.
- Qualifying colours, according to the Munsell colour chart are indicated in the addenda.

3.2.4 Vegetation

- Vegetation is a normally a reflection of the soil conditions and is, therefore, an important visual method of finding areas where a wetland can occur;

- Large proportion of hydrophytes; emergent plans: reeds, sedges, and floating or submerged aquatic plants indicate permanently saturated wetlands;
- Hydrophilic sedges and a variety of grass and hydrophilic woody plants are dominant on seasonally waterlogged soils;
- A variety of water tolerant grasses and woody species that may also occur on non-wetland areas can be indicative of temporarily waterlogged conditions.

3.3 Process used for the delineation of wetlands

- Soils are classified in accordance with the Binomial classification system for Southern Africa (Soil Classification Working Group, 1991). Initial delineation of the soil forms will take into account the following: vegetation type, terrain form, colour and texture of the soil. The boundaries are then refined through soil auger and or soil probe. All qualifying soil forms are then investigated in more detail;
- River and streams are delineated in different components, i.e., base flow and riparian areas. Uplands water saturated areas are mapped (normally belonging to soil forms with gleyed subsoil). These boundaries indicate *permanently saturated zones*;
- Matrix colours and mottle of the subsoil at a depth less than 500 mm are then measured against the criteria indicated above and the areas of *Temporary* and *Seasonal waterlogged* conditions mapped;
- Positions of observation points are taken with GPS and placed on a base map, and combined with texture and colour on aerial photographs the final boundary of the wetland is then delineated.

3.4 Research findings

3.4.1 The Present Ecological State (PES) of the site

A Present Ecological State assessment of the wet area within the study area was conducted to compare the existing state with that of the original state, or reference condition. The scoring system as described in the document "Resource Directed Measures for Protection of Water Resources, Volume 4. Wetland Ecosystems" (DWAF, 1999) was used for the determination of the PES.

TABLE 4: TABLE EXPLAINING THE SCORING SYSTEM USED FOR THE PES ASSESSMENT

Mean	Category	Explanation
Within generally acceptable range		
>4	A	Unmodified; or approximate natural condition.
Between 3 and 4	B	Largely natural with few modifications, but with some loss of natural habitats
Between 2,5 and 2.9	C	Moderately modified, but with some loss of natural habitats
Between 1,4 and 2,4	D	Largely modified. A large loss of natural habitat and basic ecosystem function has occurred.
Outside generally acceptable range		
Between 0,1 and 1,3	E	Seriously modified. The losses of natural habitat and ecosystem functions are extensive
0	F	Critically modified. Modification has reached a critical level and the system has been modified completely with almost complete loss of natural habitat

All of the wetlands within the study area have been impacted upon by previous land uses, mainly by mining residue. No pristine wetlands were found to occur within the study area. For the greater part of the study area, the land is not used (the area north of the wetland) while the area to the south of the wetland is cultivated by the neighbouring land owners, especially during dry seasons when the moist conditions were favourable for crop production. The PES rating varies between 4 (the riparian zone, especially on the ridge) and 0 (the zone where mining activities occurred and the areas under cultivation).

3.4.2 Findings

3.4.2.1 Terrain morphology

- The landscape is typical of a broad floodplain that has developed where the stream incised into the more resistant quartzite;
- The dam wall build in the stream has divided the wetland onto two sections; a flatter eastern portion with a slope of less than 1% and a western section with a steeper gradient of up to 3%;

- Sediments from the mining activities accumulated in the stream and elevated the erodation base of the stream. The wetland vegetation, especially the *Phragmites* reduced the velocity of the water which further increased the sediment build up and widening the wetland, especially the eastern section;
- The southern boundary of the wetland has migrated and now includes a wet phase of the Avalon soil; which would normally not be considered wetland;
- Some wetlands developed as a result of unnatural drainage channels from the surrounding switchyard and township establishment.

3.4.2.2 Soil form

- The underlying rock is quartzite that erodes to a sandy soil or outcrops; or shale that, when weathered, forms soil that is generally deeper and reddish and dark brown coloured with a sandy clay texture.
- The clay content of the topsoil of the wetland soils is generally high and is gleyed. The wetland soil was classified as Katspruit which are gleyed and typical of wetlands;
- The Mispah and Avalon soil forms are typical of oxidised soils and do not qualify as wetlands.

3.4.2.3 Soil wetness & colour

Permanently wet

The zone next to the drainage line (wetland soils) is waterlogged with a Munsell matrix colour of 2.5YR5/2. The subsoil is gleyed with a matrix colour of 2.5Y3/1 and often with grey and olive coloured mottles and is considered as wetland.

Hillside seep

The storm water that originates from the switch yard that is discharged into the landscape has caused water seeping between the rock outcrops. Where soil occurs, it is Mispah; that does not qualify as wetlands. To remedy this situation, an engineered solution must be sought. The most preferable solution would be to handle the stormwater from the switch yard as part of the stormwater reticulation of the township layout.

3.4.2.4 Vegetation

Vegetation is normally a reflection of the soil conditions and is, therefore, an important visual method of finding areas where a wetland can occur. The riparian zone contains adapted woody plant species or grassland while the flood valley contains hydrophytes; emergent plans: reeds, sedges, and floating or submerged aquatic plants that indicate permanently saturated wet areas.

4. Delineation of wetlands

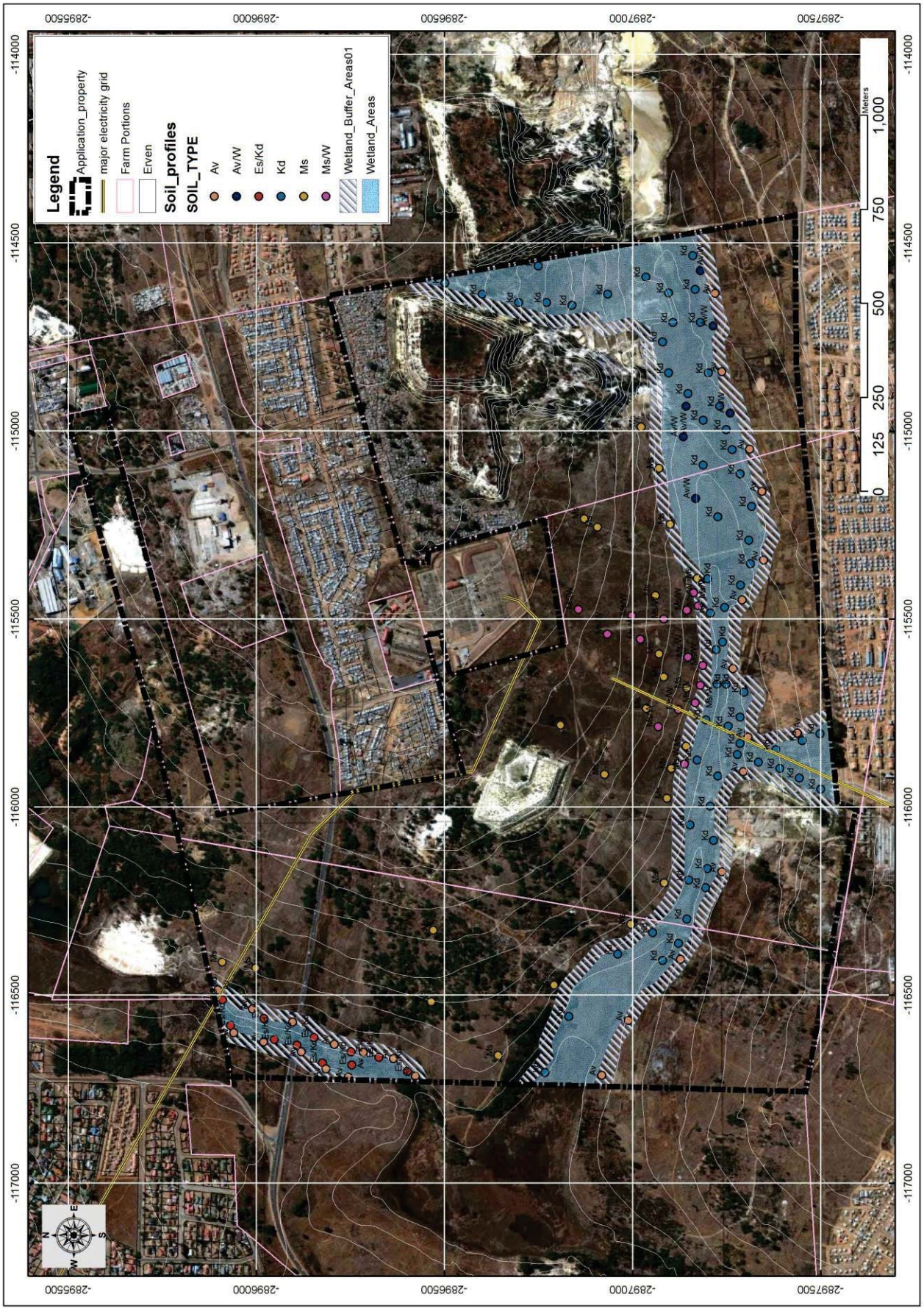
Areas with typical hydrophyte plant communities confirmed by soils with qualifying colours were mapped after boundaries were determined by soil auger and plotted by GPS and the interpolation of the individual augur holes. Although not typical wetland, the areas with riparian vegetation that are seasonally inundated and forms part of the floodplain system were included in the wetland zone.

5. Buffer zone

In terms of legislation, wetlands and riparian zones are defined in the Water Act as a water resource and any activities that are contemplated that could affect the wetlands requires authorisation (Section 21 of the National Water Act of 1998).

GDACE, in the guidelines for biodiversity assessments requires that wetlands are indicated as sensitive habitats. In addition, GDACE also requires that an additional 30m inside the urban edge, or 50m outside the urban edge, beyond the wetland boundaries should be reserved as a buffer zone and regarded as sensitive. The buffer is presumed to protect the wetland and/or the biodiversity associated with the wetland. The application site falls within the urban edge and a buffer of 30m have been applied.

FIGURE 20: WETLAND BUFFER



6. References

Department of Water Affairs and Forestry, 2005. A practical field procedure for identification and delineation of wetland and riparian areas. DWAF, Pretoria.

Mucina, L. & Rutherford, M. C. (Eds) 2006. The vegetation of South Africa, Lesotho and Swaziland. Strelitzia 19. South African National Biodiversity Institute, Pretoria.

Dlamini, B. & Batchelor, 2008. Wetland assessment on various portions of the Farm Olievenhoutbosch 398-JR (Portions 322, 325, 326 and 243), Wetland Consulting Services (Pty) Ltd.

ADDENDA

Criteria for the delineation of wetlands

Soil condition is the primary criterion that signifies waterlogged conditions. These conditions manifest itself through plants communities that can tolerate hydromorphic soils. These plants are hydrophytes that are adapted to tresses imposed on plants through temporary or permanent waterlogged conditions.

The importance of retaining and maintaining functional wetlands are well established - the process of establishing the boundaries less so. The following criteria discussed in *A Practical Field Guide for the Identification and Delineation of Wetlands and Riparian Areas*, published by DWAF are used as baseline information.

CRITERIA FOR THE IDENTIFICATION OF WETLANDS

According to DWAF, the main indicators are:

1) Terrain – Valley bottom and seep on slopes
2) Soil form indicator –
3) Soil wetness indicator
    a. Hue 2.5YR
        i. >5 value and <2 chroma, or
        ii. >6 value and <4 chroma
    b. Hue 10YR
        i. 4 value and <2 chroma, or
        ii. 5 value and <3 chroma, or
        iii. 6 value and <4 chroma
    c. Hue 7.5YR
        i. 5 value and <2 chroma, or
        ii. >6 value and <4 chroma
    d. Hue 5YR
        i. 5 value and <2 chroma, or
        ii. >6 value and <4 chroma
    e. Hue 5Y
        i. >5 value and <2 chroma, or
4) Vegetation indicator – Will contain hydrophyte plants

There are three wetland vegetation indicators, each associated with specific soil properties.

Permanently waterlogged conditions are grey coloured or organic soils.

- Valley bottom terrain morphology;
- Champagne, Katspruit, Willowbrook and Rensburg soil form – all forms have gleyed subsoil;
- Wetness - prominent grey matrix, few to no high chromas within 500 mm.
- Vegetation
    - Large proportion of hydrophytes

- Emergent plans: reeds, sedges, etc;
- Floating or submerged aquatic plants.

Seasonally waterlogged soils have a grey matrix with many mottles.

They usually occur just outside the area of normal base flow and are saturated for a significant portion of the rainy season.

- Valley bottom terrain morphology;
- Kroonstad, Longlands, Wasbank, Lamotte, Escourt, Klapmuts, Vilafontes, Kinkelbos, Cartref, Fernwood, Westleigh, Dresden, Avalon, Glencoe, Pinedene, Bainsvlei, Bloemdal, Witfontein, Sepane, Tukulu, Montagu
- Wetness
  - Grey matrix (>10%)
  - Many high chroma mottles
- Vegetation
  - Hydrophilic sedges that are restricted to wetland areas

Temporary waterlogged soils are normally grey-brown on colour with few mottles.

- Valley bottom terrain morphology;
- Inhoek, Tstetsikamma, Houwhoek, Molopo, Kimberley, Jonkersberg, Groenkop, Etosha, Addo, Brandvlei, Glenrosa or Dundee.
- Wetness
  - Minimal grey matrix (>10%)
  - Few high chroma mottles
- Vegetation
  - Predominantly grasses which occur on non-wetland areas and hydrotropic species.
  - Predominantly woody species which occur on non-wetland areas and hydrotropic species.

Outside this zone is the adjacent terrestrial area that is not classified as wetlands.

Process used for the delineation of wetlands

1) Soils are classified in accordance with the Binomial classification system for southern Africa (Soil Classification Working Group, 1991). Initial delineation of the soil forms will take into account the following: vegetation type, terrain form, colour end texture of the soil. The boundaries are then refined through soil auger and or soil probe. All qualifying soil forms are then investigated in more detail;
2) River and streams are then delineated in different components, i.e., base flow and riparian areas. Uplands water saturated areas are mapped (normally belonging to soil forms with gleyed subsoil. These boundaries will indicate the *permanently saturated zone*;
3) Matrix colours and mottle of the subsoil at a depth less than 500 mm are then measured against the criteria indicated above and the areas of Temporary and Seasonal waterlogged conditions mapped;
4) Positions of observation points are taken with GPS and placed on a base map, and combined with texture and colour on aerial photographs; the final boundary of the wetland is then delineated.

Indicator plants where wetlands may occur

Gramineae (Grasses)

1)	*Imperata cylindrica*	Temporary wetness
2)	*Setaria sphacelata*	Temporary and seasonal
3)	*Pennisetum thunbergii*	Temporary and seasonal
4)	*Hemarthria altissima*	Temporary and seasonal
5)	*Paspalum urvillei*	Temporary
6)	*Paspalum dilatatum*	Temporary
7)	*Paspalum distichum*	Seasonal and permanent
8)	*Andropogon appendicularis*	Temporary and seasonal
9)	*Ischaemum fasciculatum*	Seasonal and permanent

10) *Arundinella nepalensis* Temporary and seasonal
11) *Andorpogon eucomis* Temporary and seasonal
12) *Festuca caprina* Temporary and seasonal
13) *Aristida junciformis* Temporary and seasonal
14) *Eragrostis plana* Temporary
15) *Eragrostis planiculmis* Temporary and seasonal
16) *Phragmites australis* Permanent
17) *Leersia hexandra* Temporary and seasonal
18) *Miscanthus capensis* Temporary and seasonal
19) *Miscanthus junceus* Temporary and seasonal

Cyperaceae (Sedges)

1) *Cyperus sexangularis* Temporary and seasonal
2) *Cyperus latifolius* Seasonal and permanent
3) *Cyperus fastigiatus*
4) *Cyperus marginatus*
5) *Fuirena pubescence*
6) *Kyllinga erecta*
7) *Scleria welwitschii*
8) *Eleocharis dregeana*
9) *Eleocharis limosa*
10) *Schoenoplectus brachycerus*
11) *Schoenoplectus corymbosus*

Juncaceae (Rushes)

1) *Typhaceae* (Bullrushes) Permanent
2) *Typha capensis*

Potamogetonaceae (Pondweeds)

1) *Potamogeton thunbergii* Permanent

Asphodelaceae (Red-hot pokers) Wetland and non-wetland

1) *Kniphofia species*
2) *Kniphofia linearfolia*

Amaryllidaceae (Vlei lilies) Wetland and non-wetland

1) *Crinum species*
2) *Crinum macowanii*

Polygonaceae (Knotweeds) Permanent and or seasonal

1) *Persicaria attenuate*

Additional species form other families

1) *Xyris capensis*
2) *Satyrium hallackii*
3) *Ranaculus multifidus*
4) *Sium repandum*
5) *Gunnera repandum*
6) *Mentha aquatica*