AGRO-ECOSYSTEM ASSESSMENT FOR PROPOSED RESIDENTIAL TOWNSHIP DEVELOPMENT ON PORTION 8 OF THE FARM RIETSPRUIT 152

PREPARED FOR

ISQUARE INFORMATION SYSTEMS CC

SEPTEMBER 2021

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SPECIALIST CV

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EDUCATION

PhD Soil Science	University of the Free State	2018
M.Sc. Soil Science	University of the Free State	2013
B.Sc. Soil Science (Hon)	University of the Free State	2009
B.Sc. Soil Science	University of the Free State	2008
Matric certificate	Queens College	2005

PROFESSIONAL AFFILIATIONS

- SACNASP- Pri Nat Sci 400081/16
- Member of the Soil Science Society of South Africa
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WORK EXPERIENCE

- **Digital Soils Africa** / Soil Scientist - May 2012 – Present
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- **University of the Free State**/ Assistant Researcher- January 2011- December 2015

PUBLICATIONS

Total Consultancy reports: 97
Total peer reviewed publications: 5

Most relevant:

Bouwer, D. & van Tol, J. J., 2020. Identification of hydropedological flowpaths in Stevenson-Hamilton catena from soil morphological, chemical, and hydraulic properties. Koedoe, Vol 62 No 2.

Bouwer, D., Le Roux, P. A., van Tol, J. J., & van Huyssteen, C. W., 2015. Using ancient and recent soil properties to design a conceptual hydrological response model. Geoderma, 241, 1–11.

PROF JOHAN VAN TOL

EDUCATION

PhD Soil Science	University of the Free State	2011
M.Sc. Agric Soil Science	University of the Free State	2008
B.Sc. Agric (Hon)	University of the Free State	2007
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Matric certificate	Transvalia High School	2002

PROFESSIONAL AFFILIATIONS

- SACNASP- Pri Nat Sci 400274/13
- Council Member of the Soil Science Society of South Africa
- Member of the Soil Classification Work Group
- Member of South African Soil Surveyors Organisation

WORK EXPERIENCE

- **University of the Free State** / Associate Professor: 2016 - Present
- **Digital Soils Africa** / Soil Scientist: 2015 – Present
- **University of Fort Hare** / Senior Lecturer: 2011 - 2016
- **University of the Free State** / Researcher: 2007 - 2011
- **University of the Free State**/ Assistant Researcher- January 2011- December 2015

MOST RELEVENT PUBLICATIONS

Total peer reviewed publications: 55

Van Tol, J.J., 2020. Hydropedology in South Africa: advances, applications and research opportunities. *South African Journal of Plant and Soil.* https://doi.org/10.1080/02571862.2019.1640300

Van Tol, J.J. & Lorentz, S.A., 2018 Hydropedological interpretation of soil distribution patterns to characterise groundwater/surface-water interactions. *Vadose Zone Journal.* https://doi:10.2136/vzj2017.05.0097

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SPECIALIST DECLARATION

I, Darren Bouwer, declare that –

- I act as the independent specialist in this application;
- I regard the information contained in this report to be true and correct;
- I do not have a conflict of interest in this project;
- I will conduct the work relating to the project in an objective manner.

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I, Johan van Tol, declare that –

- I act as the independent specialist in this application;
- I regard the information contained in this report to be true and correct;
- I do not have a conflict of interest in this project;
- I will conduct the work relating to the project in an objective manner.

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PhD Soil Science
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BACKGROUND TO THE STUDY

Digital Soils Africa (Pty) LTD (DSA) were tasked by Isquare Information Systems CC to undertake an Agro-Ecosystem Assessment for the Application of an Environmental Authorisation in terms of the National Environmental Management Act, 1998 (Act No. 107 of 1998) ("NEMA"), Environmental Impact Assessment ("EIA") Regulations, 2014. As per GN960 of 2019, read with Section 24(5)(a) of the NEMA, an Environmental Screening Report (ESR) was generated for the application using the National Web-based Screening Tool. The ESR classifies the area as being of a very high sensitivity for the *Agricultural* theme. The Agro-Ecosystem Assessment is reported according to the protocol for the specialist assessment and minimum report content requirements for the environmental impacts on agricultural resources (GN320 of 2020).

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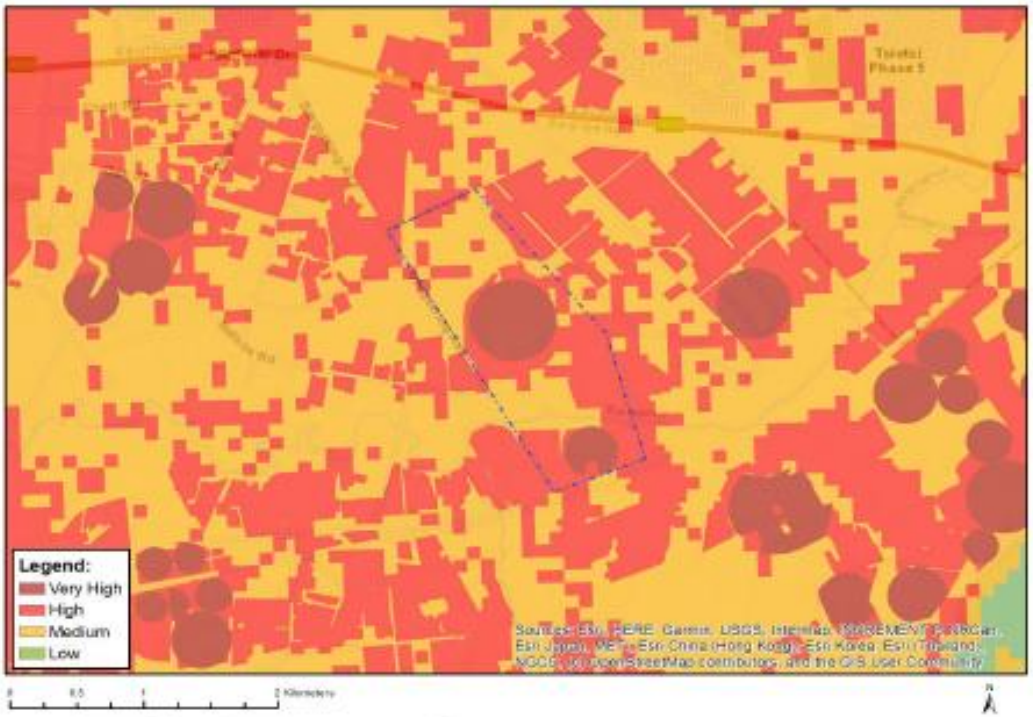
The proposed development is for the township development on approximately 170 hectares, and it is located south of the R550, within the City of Ekurhuleni Metropolitan Municipality, Gauteng Province (Figure 1).

FIGURE 1: LOCATION OF THE STUDY AREA IN THE GAUTENG PROVICE.

ENVIRONMENTAL SCREENING TOOL

From the ESR, the area ranges from medium Agricultural sensitivity to very high Agricultural sensitivity. The area is classified as having moderate to high land capability with two pivots classified as very high due to the land use.

The new Land capability (DAFF, 2016) has fifteen classes, as opposed to the eight classes described by Schoeman et al. (2002). Classes 1 to 7 are of low land capability and only suitable for wilderness or grazing. Classes 8 to 15 are considered to have arable land capability with the potential for high yields increasing with the land capability class number.



Very High sensitivity	High sensitivity	Medium sensitivity	Low sensitivity
X			

Sensitivity Features:

Sensitivity	Feature(s)
High	Land capability;09. Moderate-High/10. Moderate-High
High	Annual Crop Cultivation / Planted Pastures Rotation;Land capability;09. Moderate-High/10. Moderate-High
High	Annual Crop Cultivation / Planted Pastures Rotation;Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate
Medium	Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate
Very High	Pivot Irrigation;Land capability;09. Moderate-High/10. Moderate-High
Very High	Pivot Irrigation;Land capability;06. Low-Moderate/07. Low-Moderate/08. Moderate

FIGURE 2: RESULTS OF THE SCREENING TOOL.

DATA LIMITATIONS, ASSUMPTIONS AND STUDY GAPS

1. It was also assumed that the desktop grazing capacity (DAFF, 2016) is correct.
2. No wetland data was available.

INTRODUCTION

Agriculture is a large contributor to the economy and food security of South Africa. Notably, a large portion of the employment is in the Agricultural Sector. Therefore, it is extremely important that valuable agricultural land is protected from being developed in an unsustainable way and appropriate soil and land capability assessments must forego all developments.

METHODOLOGY

DESKTOP STUDY

A desktop study was be conducted to determine the climate, agricultural potential, soil erosion sensitivity, topography, vegetation, and land use from the best available sources.

TABLE 1: LIST OF DATA USED TO AGRICULTURAL ASSESSMENT STATEMENT

Land type	Land Type Survey Staff, 1972 – 2002
Climate	Schulze (2007)
South African Nation Land Cover 2018	Department of Environmental Sciences (2018)
Long Term Grazing Capacity Map for South Africa	Department of Agriculture, Forestry and Fisheries (2016)
Vegetation Map of South Africa	Mucina and Rutherford, 2010

FIELD VISIT

A field survey was conducted on the 17th July 2021. Observations were made with a hand auger and each observation was:

- Described and classified according to the Soil Classification Working Group (2018).
- Observed for visual indications of land degradation.
- The data was compared to the soils data from the land type survey and the agricultural capability was refined.

RESULTS

DESKTOP

TOPOGRAPHY

The site is relatively flat, with a slight slope towards the river, which is the lowest point of the study area (Figure 3). The general direction of water flow is the north-western to south-eastern direction. Most of the survey area has a slope of less than 4°. The steepest slopes are towards the river (Figure 4). An elevation and slope profile across the site further illustrate the flat topography (Figure 5).

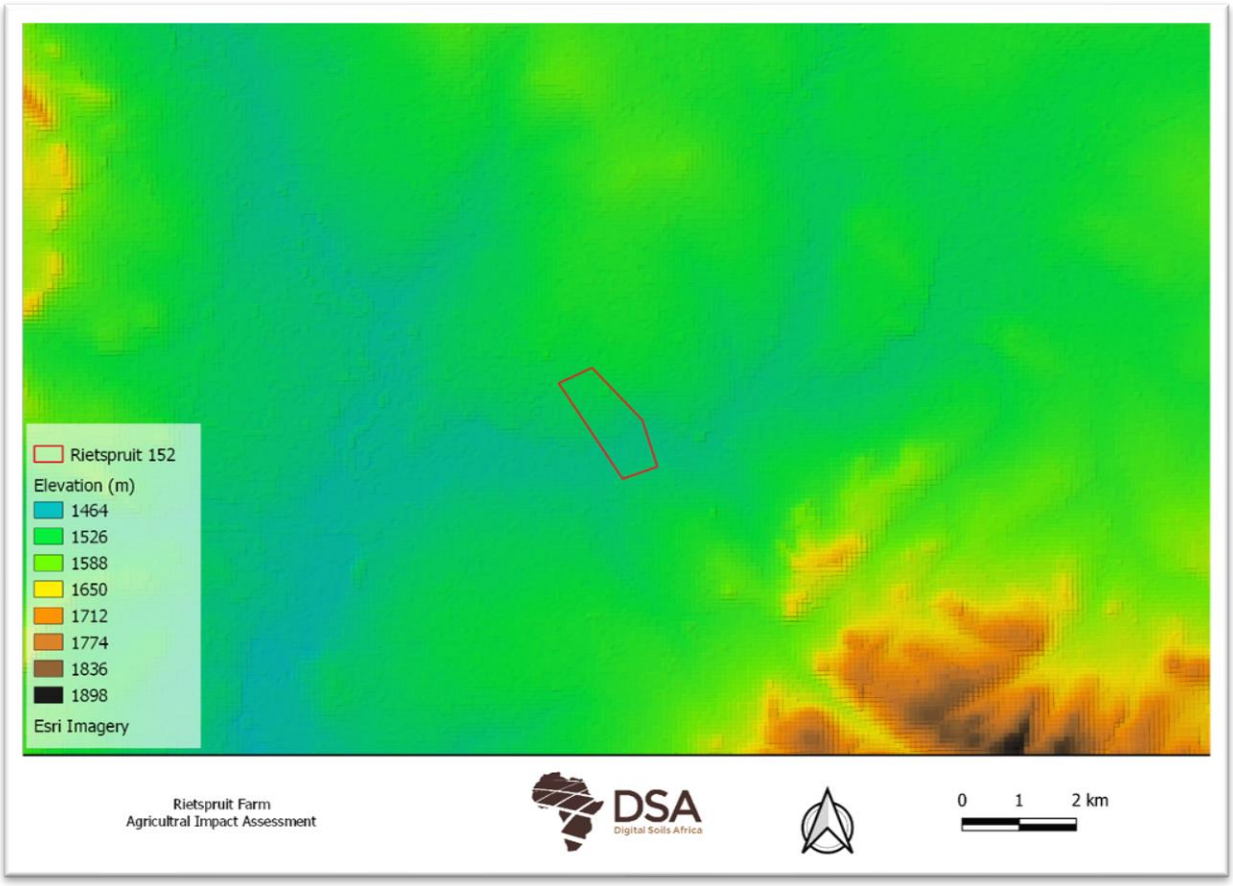


FIGURE 3: ELEVATION OF THE STUDY AREA.

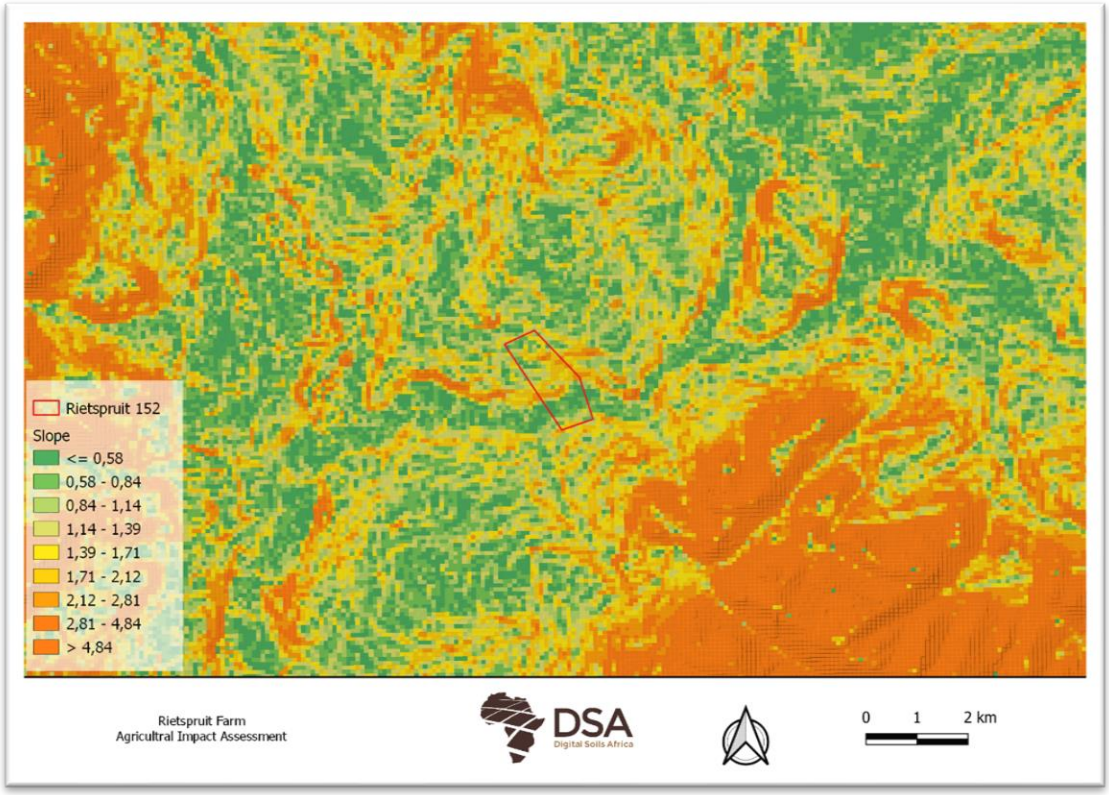


FIGURE 4: SLOPE OF THE SURVEY AREA.

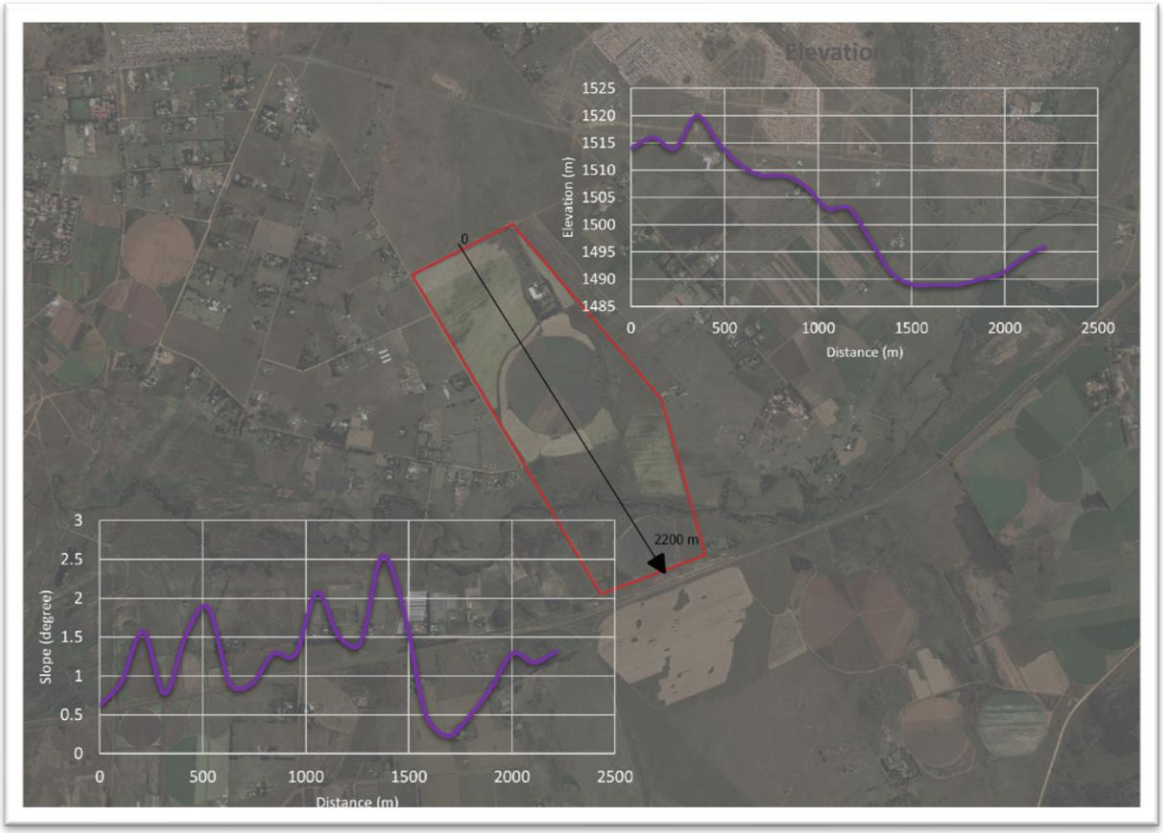


FIGURE 5: SLOPE AND ELEVATION PROFILE OF THE STUDY AREA.

LAND TYPE INFORMATION

There is only one land type occurring in the study area, namely Ab7 (Figure 6) (Appendix 1). Ab land types are freely drained, with red and yellow, dystrophic/mesotrophic soils occupying more than 40% of the area (yellow soils <10%).

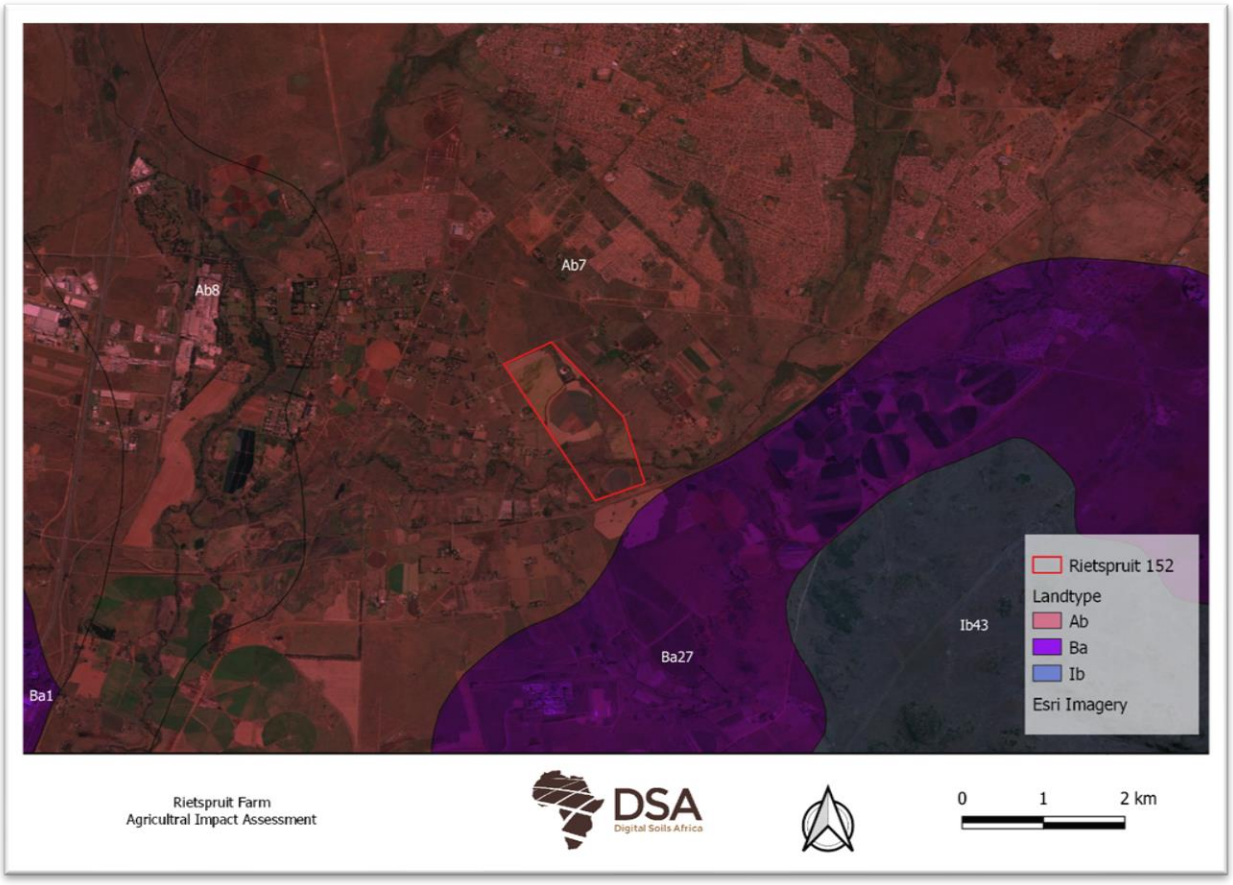


FIGURE 6: THE AB7 LAND TYPE COVER THE ENTIRE THE STUDY AREA (LAND TYPE SURVEY STAFF, 1972 – 2002).

GEOLOGY

The geology of the surveyed area is dominated by basalt of the Klipriviersberg Group which forms part of the Ventersdorp Supergroup (Figure 7).

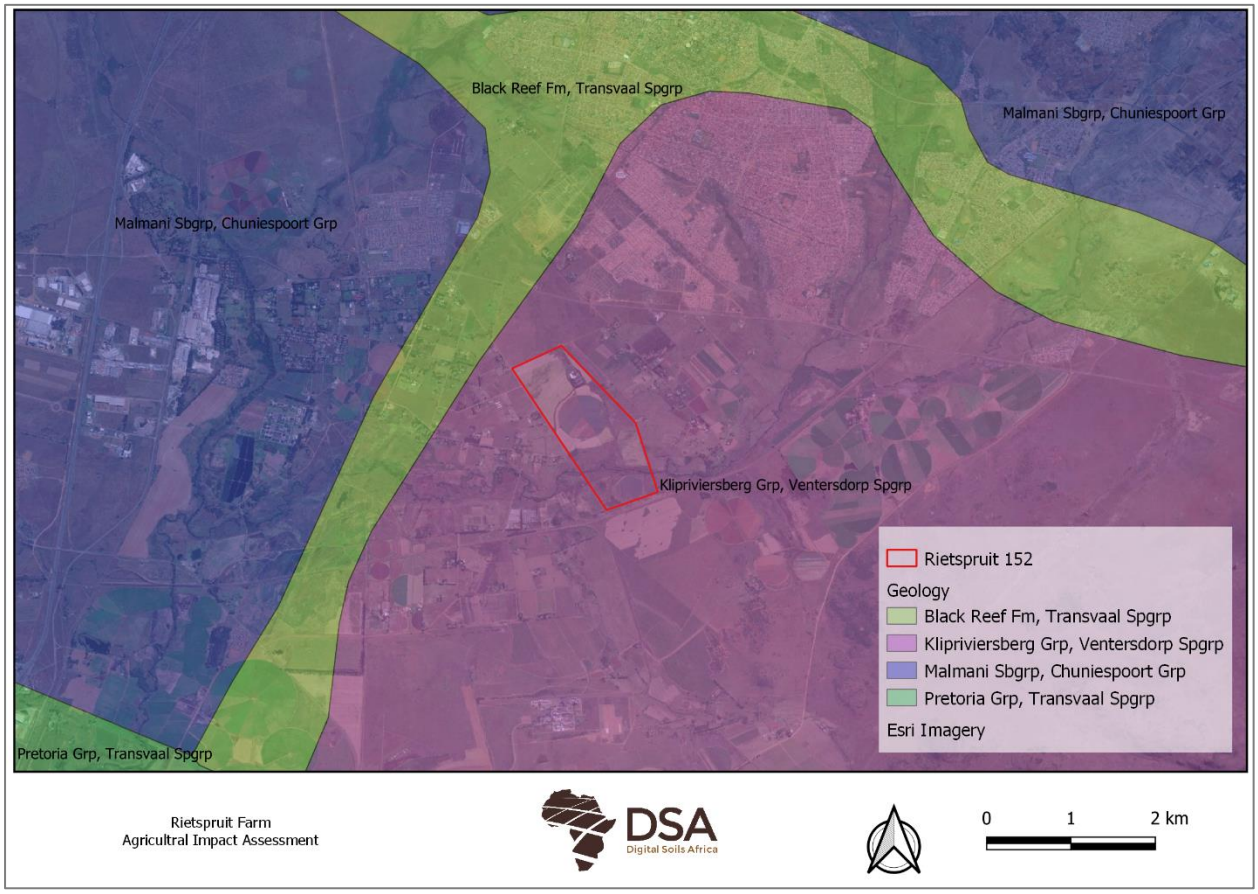


FIGURE 7: GEOLOGICAL MAP OF THE SURVEY AREA (COUNCIL FOR GEOSCIENCE, 2007).

CLIMATE

Climatic information for the site was obtained from the South African Atlas of Climatology and Agrohydrology (Schulze, 2007). Selected climatic parameters are presented in

Table 2. The site falls into the Koppen climatic classification subgroup of Cwb (Köppen, 1931), which means that winters are long, dry and cool. This is reflected in the high average summer and low average winter temperatures of the area. The annual average rainfall is 755 mm with

the driest month (July = 4 mm) and the most precipitation received in December, averaging 136 mm.

TABLE 2: SELECTED CLIMATOLOGICAL ATTRIBUTES FOR THE STUDY SITE, FROM CLIMATE-DATA.ORG

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Avg. Temp	19.7 °C	19.5 °C	18.2 °C	15.5 °C	12.5 °C	9.8 °C	9.5 °C	12.8 °C	16.6 °C	18.4 °C	18.9 °C	19.6 °C
Min. Temp	14.7 °C	14.5 °C	13 °C	10 °C	6.3 °C	3.4 °C	2.6 °C	5.4 °C	8.8 °C	11.4 °C	12.8 °C	14.4 °C
Max. Temp	24.9 °C	24.8 °C	23.7 °C	21.2 °C	19.2 °C	17 °C	17 °C	20.5 °C	24.2 °C	25.5 °C	25.1 °C	25.1 °C
Precipitation mm	132	108	90	44	17	8	4	11	24	79	102	136
Humidity	68%	66%	65%	62%	53%	50%	44%	37%	35%	45%	56%	64%
Rainy days	12	10	9	5	2	1	1	2	3	8	10	13
avg. Sun hours	8.9	8.8	8.5	8.1	8.8	8.6	8.9	9.4	9.8	9.8	9.6	9.5

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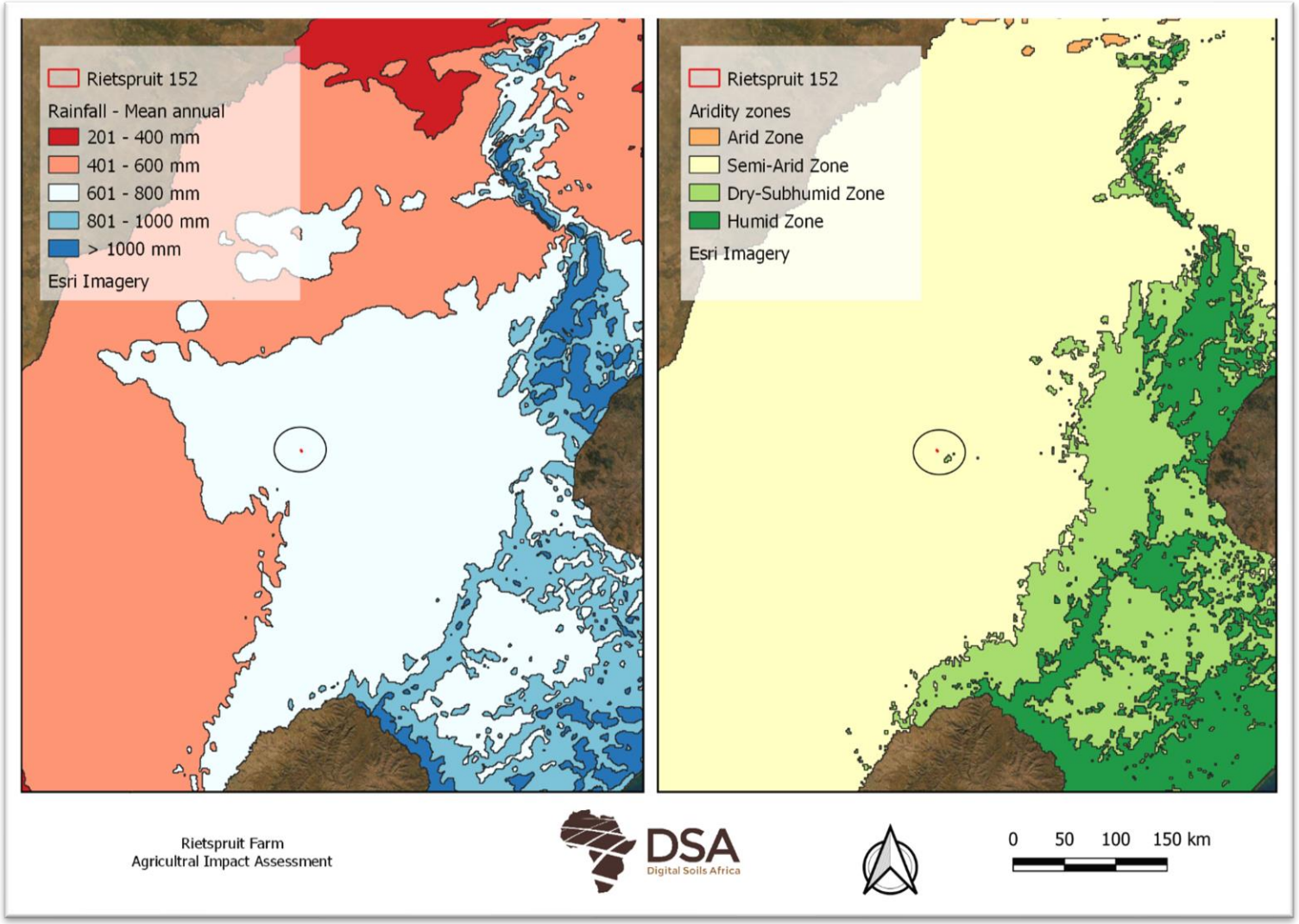

FIGURE 8: ARIDITY ZONES OF THE SITE AND SURROUNDING AREA (SCHULZE, 2007).

VEGETATION, CURRENT LAND USE AND AGRICULTURAL ACTIVITIES

The vegetation according to Mucina and Rutherford (2010) (Figure 9), is dominated by Carltonville Dolomite Grassland in the terrestrial and Eastern Temperate Freshwater Wetlands along the wetlands. The unit used in the grazing capacity is hectares per large stock unit (ha/LSU), therefore the site falls in a high grazing capacity of 5.5 ha/LSU (Figure 10).

The unit ha/LSU, is a homogeneous unit of vegetation expressed as the area of land required (in hectares) to maintain a single animal unit (LSU) over an extended number of years without deterioration to vegetation or soil. Where an LSU = An animal with a mass of 450 kg and which gains 0,5 kg per day on forage with a digestible energy of 55% (Trollope et. Al., 1990).

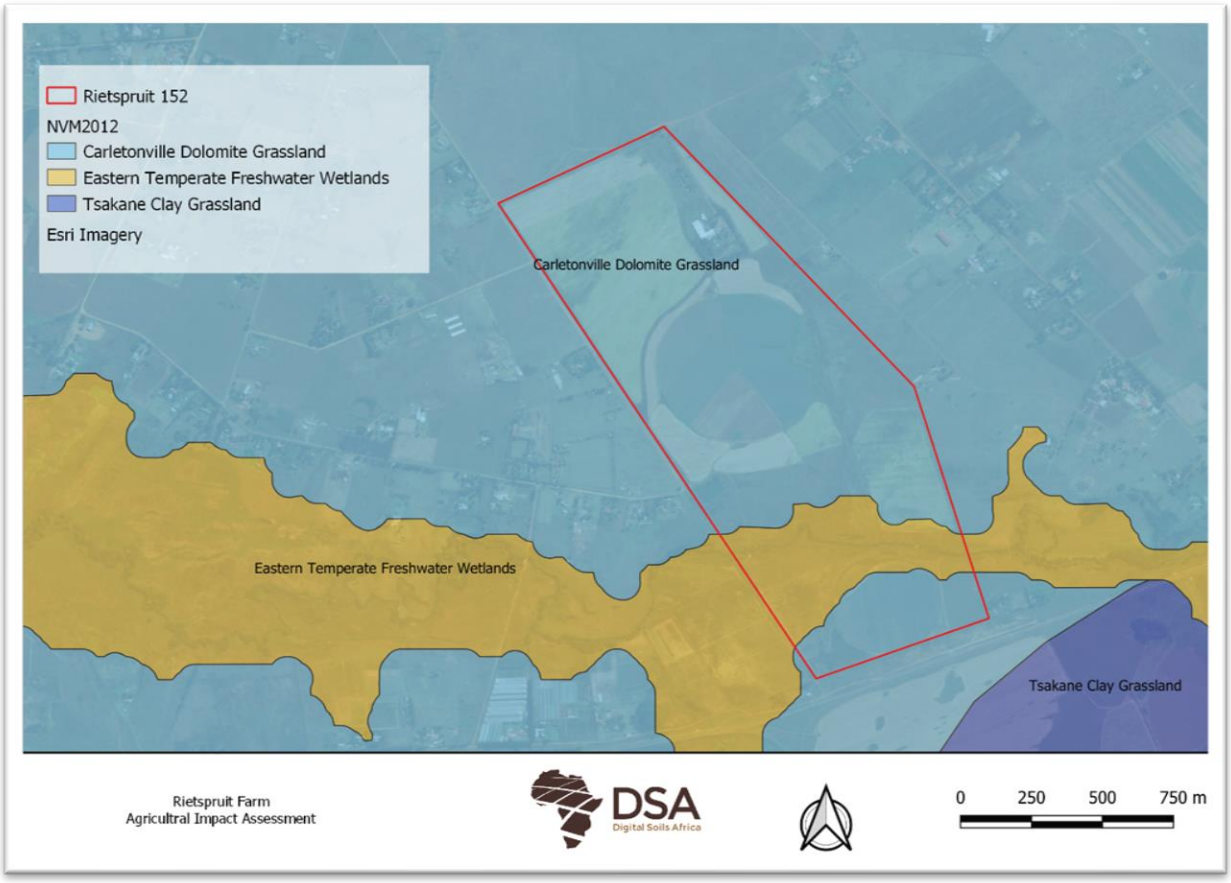

FIGURE 9: VEGITATION MAP OF THE SITE (MUCINA AND RUTHERFORD 2010).

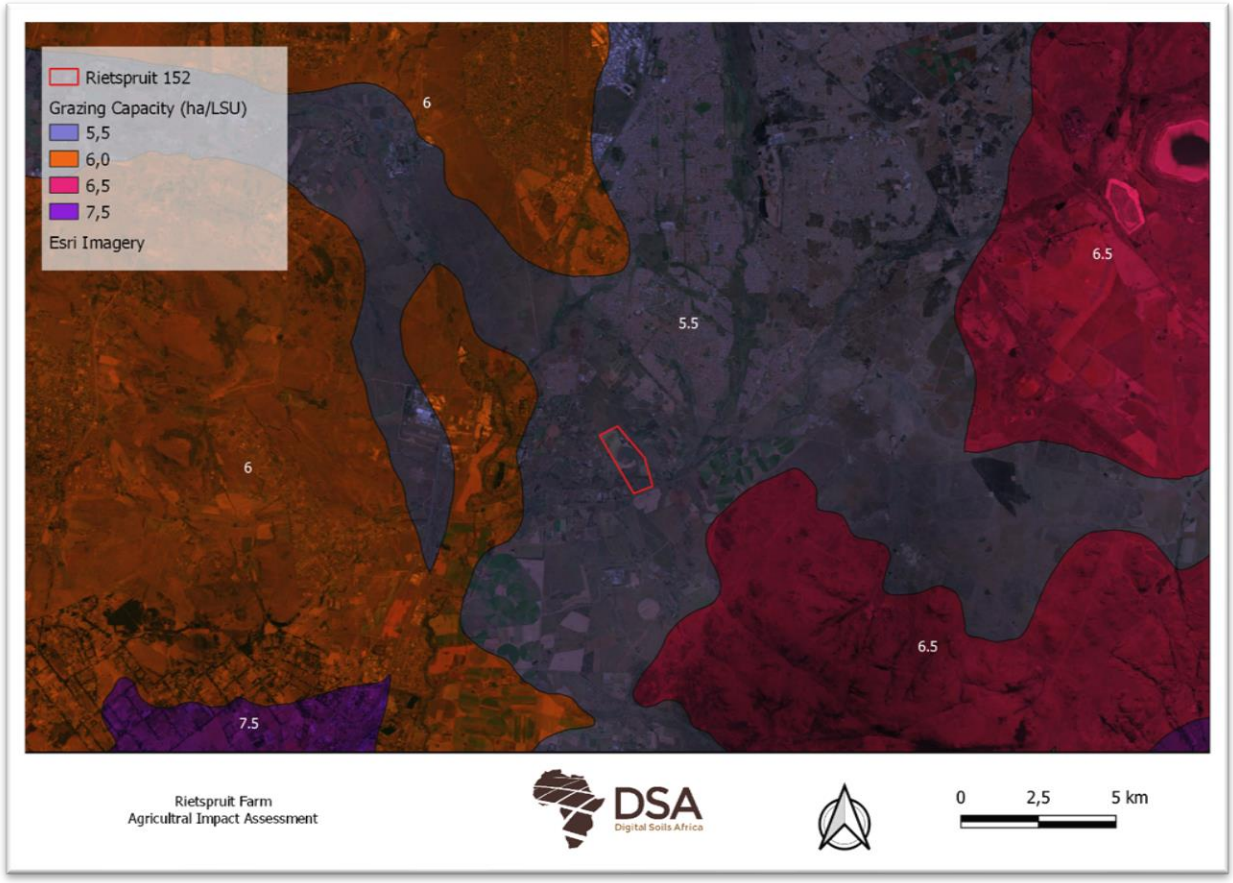

FIGURE 10: LONG TERM GRAZING CAPACITY OF THE SITE AND SURROUNDING AREA.

South African National Land-Cover 2018 (SANLC 2018) (Figure 11) was used as a guide and verified with field observations. The main land uses are grazing (domestic animals) and cultivation with irrigation. Currently, beans (10 t/ha) and Gem Squash (25 t/ha) are produced on the irrigated lands.

TABLE 3:LEGEND TO FIGURE 12

No.	Class Name	Class Definition
13	Natural Grassland	Natural and/or semi-natural indigenous grasslands, typically devoid of any significant tree or bush cover, and where the grassland component is typically dominant over any adjacent bare ground exposure. Typically, representative of low, grass-dominated vegetation communities in the Grassland and Savanna Biomes.
22	Herbaceous Wetlands	Natural or semi-natural wetlands covered in permanent or seasonal herbaceous vegetation. The mapped wetland extent represents the surface wetland extent detectable from image detectable surface vegetation characteristics, (which may differ from soil-profile based wetland delineations). This wetland class represents wetlands identified in the current national land-cover modelling. The class represents primarily riparian wetland areas but can also include emergent aquatic vegetation in pans.

38	Cultivated Commercial Annuals Pivot Irrigated	Active or recently active cultivated lands used for the production of agricultural crops, in this case specifically associated with commercial annual crops, although occasionally (undetected) permanent crops. The plants only remain in the field for one growing season and one harvest and are grown in pivot irrigated fields. Note that with certain crops, for example potatoes, the pivot structures are rotated cyclically through specific field locations; with the result that the depicted pivot locations in the NLC dataset can represent both current, active pivots, as well as image-detectable pivot patterns from recent, but currently in-active or over-planted pivots, that will be re-established as pivots in 2 – 3 years.
40	Cultivated Commercial Annuals Non-Pivot / Non-Irrigated	Active or recently active cultivated lands used for the production of agricultural crops, in this case specifically associated with commercial annual crops. The plants only remain in the field for one growing season and one harvest, and are grown non-irrigated, rainfed fields.
49	Residential Formal (low veg / grass)	Built-up areas primarily containing formally planned and constructed residential structures and associated utilities. The dominant vegetation (in gardens etc) is grass and/or low shrub based.

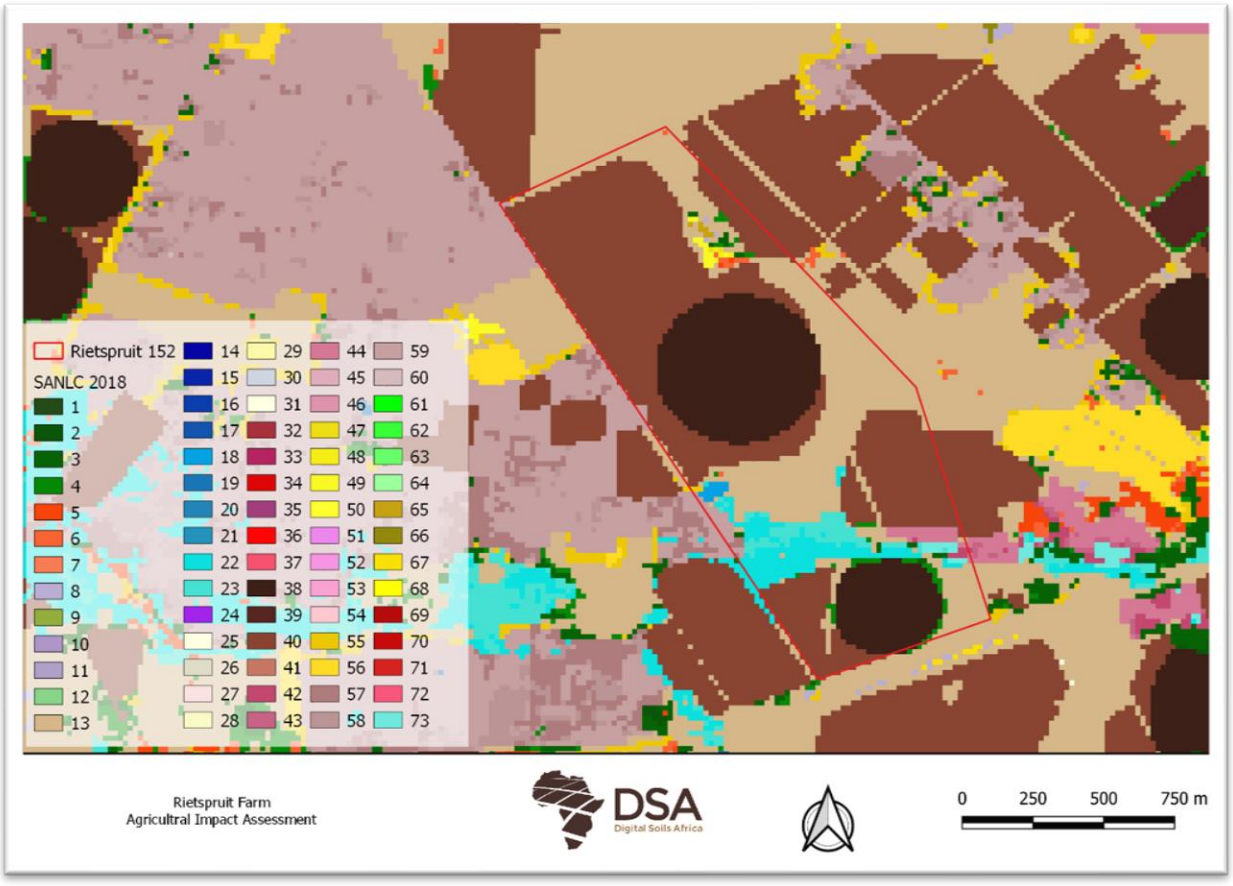

FIGURE 11: SOUTH AFRICAN NATIONAL LAND-COVER 2018 (SANLC 2018).

EMPLOYMENT

A total of 10300 work opportunities are calculated to be generated by the proposed development (Cosmopolitan Projects, 2021). The calculation is done on 70 000 work opportunities per R10 billion development. The work opportunities are divided as follows: direct (48.2%), indirect (28.7%) and induced (28.10%).

SOIL SURVEY

The soil map was created using soil observations and continuous soil covariate data, including terrain derivatives from the 30 m SRTM DEM and satellite imagery. The descriptions of the soil characteristics are found in Table 4 and a description of the observations are found in Appendix 2. The soils in the survey area varied with a large area of shallow shallows, in addition to soils with a plinthic subsoil were present.

FIGURE 12: OBSERVATIONS MADE DURING THE STUDY.

TABLE 4: DESCRIPTION OF SOIL ASSOCIATION UNITS

SOIL FORMS	SOIL FAMILY	SOIL CHARACTERISTICS	HORIZON AND DEPTH	DRYLAND POTENTIAL	LAND CAPABILITY CLASS
Nkonkoni	3120	Weak structure, with rooting depth deeper than 1200 mm	ot-200 re-700 lc -800	Moderate high	9
Rensburg	3110	Strong structure and a gleyed subsoil. Signs of periodic saturation	ve-300 gh-1500	Very low to low	3
Glenrosa	1320	Shallow soils with a Saprolithic lithic horizon	ot -200 lc-350	Very low to low	4
Avalon	3100	Apedal structure, high water retention in the subsoil	ot -200 ye-800 sp-1500	Moderate high	9
Clovelly	3121	Apedal structure, good drainage	ot -200 ye-700 lc -1100	Moderate high	9
Mispah	1000	Shallow and found on the midslope	ot -150 rock	Very low to low	4
Westleigh	1000	Poor drainage, signs of wetness close to the surface.	ot -200 sp-800 gc-1500	Low	5
Glen	2210	Strong structure through the profile	ve -300 vp-1500	Low	5

The land capability is classified as moderate (8) to moderate high (9) by DAFF (2016) (Figure 14). The land capability was refined after the soil survey that found many of the soils are shallow, which would negatively influence water holding capacity, or, had signs of water saturation which indicates poor drainage. Large areas of the farm are classified from a class 3 (Very low to low) to class 5 (Low), while small areas are classified as class 9 (Moderate high).

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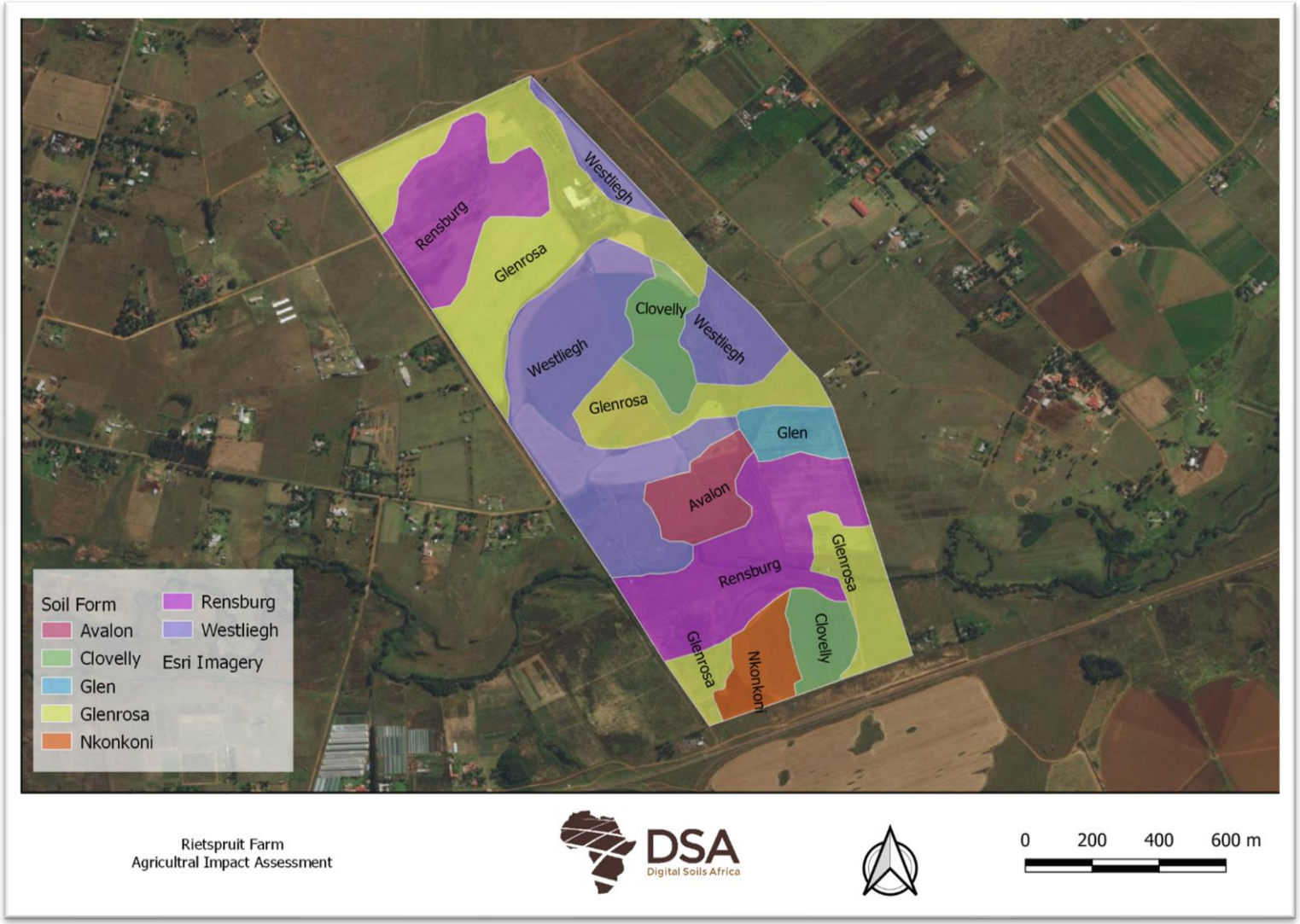

FIGURE 13: SOIL TYPES FOUND IN THE STUDY AREA.

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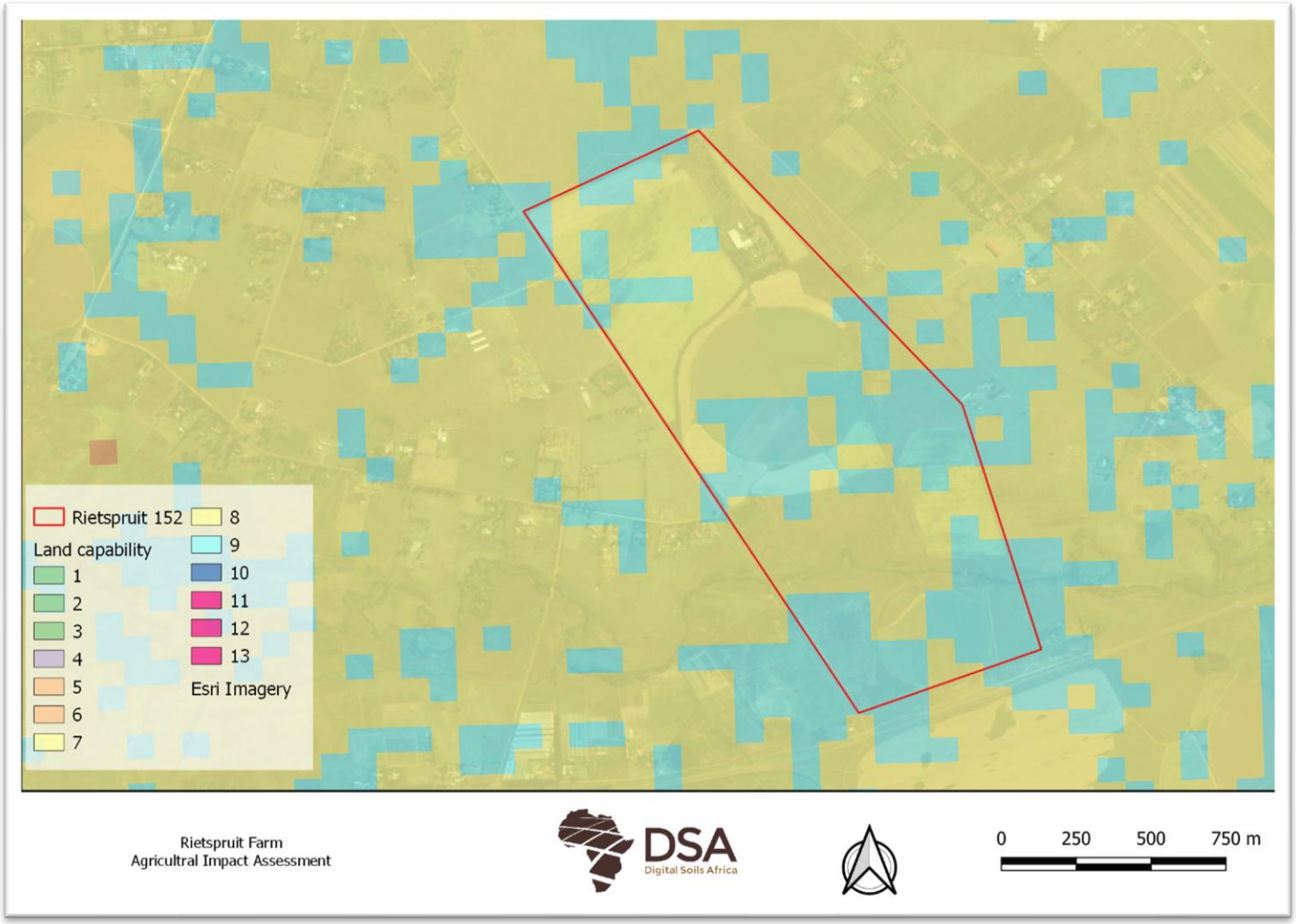

FIGURE 14: LAND CAPABILITY CLASS MAP OF THE AREA ACCORDING TO DAFF (2016).

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FIGURE 15: REFINED LAND CAPABILITY CLASS MAP OF THE AREA CALCULATED FROM SOIL OBSERVATIONS.

CHEMICAL AND TEXTURAL ANALYSIS

The chemical properties of the soils regarded as representative were sampled and analysed (Appendix 3). The pH_{KCl} is neutral at 6.4 and 6.6, indicating that salinity is not a high risk according to the pH values. The pH values can be altered from a fertility perspective.

The Cation Exchange Capacity (CEC) is relatively low, indicating that the clay present in the samples is more likely a 1:1 clay. This will facilitate good internal drainage. The Exchangeable Sodium Percentage (ESP) is relatively high in both samples. Therefore, the soils can be classified as slightly saline.

TABLE 2: SELECTED CHEMICAL PROPERTIES FOR MODAL SOIL PROFILES

Observation	Soil Form	Landuse	pH	P	CEC	ESP	ECe
			KCl	*mg/kg*	*cmol (+)/kg*	*%*	*mS/m*
R10	Clovelly	Pivot	6.6	84.7	12.3	3.8	295
R28	Glenrosa	Old land	6.4	36.4	9.9	4.3	170

TABLE 5: GENERAL CLASSIFICATION OF SALINE AND SODIC SOILS (CHHABRA, 1996)

Classification	**pH_w**	**EC (mS m^{-1})**	**SAR**	**ESP (%)**
Slightly saline	< 8.5	200 – 400	< 13	< 15
Saline	< 8.5	> 400	< 13	< 15
Sodic	> 8.5	< 400	> 13	> 15
Saline-Sodic	< 8.5	> 400	> 13	> 15

Clay percentages are relatively high, but the chemical properties indicate that 1:1 clay minerals are most likely present. Therefore, most soils will have a good internal drainage and external drainage will be determined by the underlying material.

TABLE 3: PARTICLE SIZE DISTRIBUTION OF MODAL SOIL PROFILES

Observation	Texture		
	% Clay	% Silt	% Sand
R10	24.9	18.7	43.6
R28	34.2	12.6	46.8

FINDINGS AND RECCOMENDATIONS

The medium Agricultural sensitivity to very high Agricultural sensitivity identified from the screening tool, is largely based on the land capability which is classified as moderate (Class 7-8) to moderate high (Class 9) by DAFF (2016). Results from the soil survey indicated land capability was low (Class 3-5) or moderate high (Class 9), i.e., the moderate (Class 7-8) land capability class was not observed on the site.

Areas classified as moderate to high consisted of the Clovelly (7.5 ha), Nkonkoni (6.4 ha) and Avalon soils (12.5 ha) (Class 9). These soils have a good water holding capacity and are generally at a low risk of waterlogging. This substantiates the higher-level mapping used for the screening of highly sensitive agricultural areas. Therefore, these soils are suitable for both dryland cultivation and irrigation.

Areas classified as Very low to low land capability (Class 3-5) consisted of shallow, strong structured or signs of water saturation in the subsoils. The Glenrosa soils (53.3 ha) will have a low water holding capacity and shallow rooting depth because of the limited depth. The Glen soil (4.9 ha) is strongly structured and will prohibit root development. When the soils are dry, root penetration will be minimal. The Westleigh soil (44.7 ha) has a soft plinthic subsoil, indicating saturated conditions. The Rensburg soil (40.4 ha) is both strongly structured and has a saturated subsoil. This results in poor internal and external drainage combined with the negative impacts discussed with the Glen soil. All the above soils should not be cultivated but rather used for grazing, and in the case of the Rensburg, which is often classified as wetland, be treated as environmentally sensitive.

Two areas under pivot irrigation are classified as highly sensitive. The larger pivot (north) is dominated by Westleigh and Glenrosa soil forms, which are generally not suitable for irrigation. Waterlogging is associated with these soils under irrigation. The deep Clovelly soils are highly suitable for irrigation. The smaller pivot (south) is dominated by Nkonkoni soil form which is highly suitable for irrigation.

CONCLUSIONS

This report describes the Agro-Ecosystem Assessment study of the proposed development on Portion 8 of the Farm Rietspruit 152, located south of the R550, within the City of Ekurhuleni Metropolitan Municipality, Gauteng Province.

The medium Agricultural sensitivity to very high Agricultural sensitivity is largely based on the land capability which is classified as moderate (Class 7-8) to moderate high (Class 9) by DAFF (2016). The soil survey found that the land capability was rather either a low (Class 3-5) or moderate high (Class 9) land capability, i.e., the land capability on the site is either low or moderate high.

It is the specialist's opinion that the proposed development will not significantly impact agriculture north of the river since the land capability is low and most of the soils currently irrigated are at high risk of waterlogging. Therefore, the area north of the river has a small impact on agriculture. The area south of the river has a high agricultural potential, but since the area is small in comparison to the entire development, the impact is considered satisfactory.

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APPENDIX 1: LANDTYPE

LAND TYPE / *LANDTIPE* : **Ab7**
CLIMATE ZONE / *KLIMAATSONE* : 24S
Area / *Oppervlakte* : 118853 ha
Estimated area unavailable for agriculture
Beraamde oppervlakte onbeskikbaar vir landbou : 8000 ha

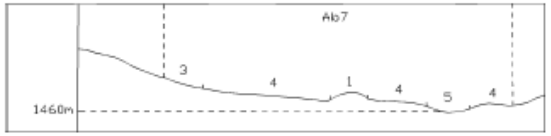
Occurence (maps) and areas / *Voorkoms (kaarte) en oppervlakte* :
2626 Wes-Rand (86780 ha) 2628 East Rand (32073 ha)

Inventory by / *Inventaris deur* :
R.W Bruce & J L Schoeman
Modal Profiles / *Modale profiele* :
P224

Terrain unit / *Terreineenheid*	1	3	4	5
% of land type / *% van landtipe*	2	10	82	6
Area / *Oppervlakte (ha)*	2377	11885	97459	7131
Slope / *Helling (%)*	0 - 2	3 - 6	1 - 3	0 - 1
Slope length / *Hellingslengte (m)*	400 - 600	500 - 1000	1000 - 2000	100 - 300
Slope shape / *Hellingsvorm*	Y	Z-X	Z	X
MB0, MB1 (ha)	357	8082	95510	5919
MB2 - MB4 (ha)	2021	3803	1949	1212

Soil series or land classes / *Grondseries of landklasse*	**Depth** / *Diepte* (mm)	MB	1 ha	1 %	3 ha	3 %	4 ha	4 %	5 ha	5 %	**Total** / *Totaal* ha	**Total** / *Totaal* %	**Clay content %** / *Klei-inhoud %* A	E	B21	Hor	**Texture** / *Tekstuur* Class / *Klas*	**Depth limiting material** / *Diepte-beperkende materiaal*
Soil-rock complex		:																
Grond-rotskompleks:		:																
Rock/Rots		4	357	15	238	2	975	1	71	1	1640	1.4						
Mispah Ms10, Klipfontein Ms11, Platt Gs14, Trevanian Gs17, Williamson Gs16	100-200	3	1664	70	3566	30	975	1	1141	16	7345	6.2	8-20			A	LmmeSa-SaLm	R,hp
Msinga Hu26, Clansthal Hu24, Lichtenburg Hu23, Hutton Hu16, Middelburg Hu14	700-800	0	357	15	8082	68	94535	97	3566	50	106540	89.6	6-20		10-25	B	meSaLm-SaClLm	R
Rensburg Rg20, Killarney Ka20, Jozini Oa36, Longlands Lo21	400-700	0							2353	33	2353	2.0	6-25			A	LmmeSa-SaClLm	G,R
Strathrae Gc23, Glencoe Gc26, Bergville Av27, Ofazi Cv23, Springfield Cv24	600-700	0					975	1			975	0.8	10-25		10-40	B	LmmeSa-SaCl	hp,R

Terrain type / *Terreintipe* : A2
Terrain form sketch / *Terreinvormskets*



For an explanation of this table consult LAND TYPE INVENTORY (table of contents)
Ter verduideliking van hierdie tabel kyk LANDTIPE - INVENTARIS (inhoudsopgawe)

Geology: Dolomite and chert of the Chuniespoort Group; sporadic occurrence of Black Reef quartzite and shale, Ecca shale and sandstone, Ventersdorp lava and Karoo dolerite.

Geologie: Dolomiet en chert van die Groep Chuniespoort; sporadiese voorkoms van Swartrifkwartsiet en -skalie, Eccaskalie en -sandsteen, Ventersdorplawa en Karoodoleriet.

APPENDIX 2: OBSERVATIONS

Lat	Long	Obs	Soil type	Depth	Rooting Depth	Agri Potential
-33.68528611	25.57719	DSA 1	Oakleaf	3120	1500	High
-33.69553056	25.50901	DSA 3	Oakleaf	3120	1500	High
-33.69553333	25.5089	DSA 2	Fernwood	3120	1500	Moderate high
-33.69723611	25.50589	DSA 4	Oakleaf	3120	1500	High
-33.69866944	25.50953	DSA 5	Oakleaf	3120	1500	High
-33.69991389	25.5086	DSA 6	Oakleaf	3120	1500	High
-33.69995833	25.50868	DSA 7	Dundee	3110	1500	Moderate high
-33.70093056	25.51384	DSA 8	Oakleaf	3120	1500	High
-33.70128333	25.51293	DSA 9	Oakleaf	3120	1500	
-33.70323611	25.5124	DSA 10	Oakleaf	3120	1500	High
-33.70377222	25.49019	DSA 11	Valsrivier	1320	700	Low to Moderate
-33.70550556	25.49337	DSA 12	Valsrivier	1320	700	Low to Moderate
-33.70741667	25.49546	DSA 13	Coega	3100	300	Low
-33.70915556	25.49819	DSA 14	Kimberley	2200	700	Low to Moderate
-33.71058611	25.50042	DSA 15	Coega	3100	300	Low
-33.68717222	25.57244	DSA 16	Valsrivier	1320	700	Low to Moderate
-33.71424444	25.49888	DSA 17	Pan			Low
-33.62693889	25.7078	DSA 18	Coega	3100	300	Low
-33.71478333	25.50968	DSA 19	Valsrivier	1320	700	Low to Moderate
-33.70601389	25.51759	DSA 20	Quaggafontein	3121	1500	Moderate high
-33.70609722	25.51791	DSA 21	Quaggafontein	3121	1500	Moderate high
-33.70554444	25.51217	DSA 22	Valsrivier	1320	700	Low to Moderate
-33.70261111	25.51348	DSA 23	Oakleaf	3120	1500	High
-33.70261111	25.51348	DSA 24	Oakleaf	3120	1500	High
-33.70193611	25.51881	DSA 25	Valsrivier	1320	600	Low to Moderate
-33.69468611	25.51073	DSA 26	Kimberley	1320	800	Low to Moderate
-33.692275	25.51259	DSA 27	Kimberley	1320	600	Low to Moderate
-33.7257	25.52459	DSA 28	Valsrivier	1320	500	Low to Moderate
-33.72161111	25.51485	DSA 29	Valsrivier	1320	600	Low to Moderate
-33.72160278	25.51486	DSA 30	Valsrivier	1320	700	Low to Moderate
-33.72144444	25.5157	DSA 31	Valsrivier	1320	700	Low to Moderate
-33.72689722	25.53177	DSA 32	Grabouw	1000	200	Low
-33.72665	25.52608	DSA 33	Valsrivier	1320	800	Low to Moderate
-33.71740278	25.50596	DSA 34	Valsrivier	1320	600	Low to Moderate
-33.70079722	25.49039	DSA 35	Valsrivier	1320	600	Low
-33.6991	25.49145	DSA 36	Valsrivier	1320	500	Low to Moderate
-33.69651389	25.4929	DSA 37	Valsrivier	1320	500	Low to Moderate
-33.70168056	25.49655	DSA 38	Valsrivier	1320	600	Low to Moderate
-33.70203056	25.49656	DSA 39	Valsrivier	1320	600	Low to Moderate

-33.71074167	25.50205	DSA 40	Valsrivier	1320	600	Low to Moderate
-33.71000556	25.50223	DSA 41	Coega	3100	300	Low
-33.70545278	25.50432	DSA 42	Valsrivier	1320	600	Low to Moderate
-33.72573395	25.53818	DSA 43	Cullinan	1000	1000	Low
-33.72368057	25.53949	DSA 44	Fernwood	2210	1500	Moderate high
-33.72249308	25.53992	DSA 45	Makgoba	2200	600	Low
-33.7262411	25.54169	DSA 46	Cullinan	1000	1000	Low
-33.72781824	25.5275	DSA 47	Quaggafontein	3121	1500	High
-33.72508398	25.53136	DSA 48	Cullinan	1000	1000	Low
-33.70930997	25.51727	DSA 49	Quaggafontein	3121	1500	Moderate high

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APPENDIX 3: CHEMICAL SOIL PROPERTIES

		Ca				Mg				Na				K			
NP no	Lab nr	mg/l	mg/kg	me/kg	cmol(+)/kg	mg/l	mg/kg	me/kg	cmol(+)/kg	mg/l	mg/kg	me/kg	cmol(+)/kg	mg/l	mg/kg	me/kg	cmol(+)/kg
DSA 2A	1056	111.20	2224.09	111.20	11.12	25.12	502.48	41.19	4.12	2.28	45.67	1.99	0.20	53.77	1075.49	27.58	2.75
DSA 2B	1057	203.76	4075.11	203.76	20.38	52.68	1053.52	86.35	8.64	5.03	100.50	4.37	0.44	20.30	405.95	10.41	1.04
DSA 7A	1058	182.61	3652.25	182.61	18.26	23.05	461.09	37.79	3.78	2.17	43.42	1.89	0.19	35.63	712.62	18.27	1.82
DSA 7A	1059	203.76	4075.17	203.76	20.38	68.12	1362.36	111.67	11.17	3.73	74.52	3.24	0.32	57.72	1154.35	29.60	2.95
DSA 49A	1060	391.80	7835.96	391.80	39.18	57.80	1155.95	94.75	9.48	4.14	82.73	3.60	0.36	83.79	1675.76	42.97	4.29
DSA 49B	1061	148.25	2964.96	148.25	14.82	38.39	767.79	62.93	6.29	6.31	126.10	5.48	0.55	54.81	1096.29	28.11	2.80
DSA 49C	1062	115.44	2308.71	115.44	11.54	54.03	1080.64	88.58	8.86	12.91	258.30	11.23	1.12	54.25	1084.98	27.82	2.77

S		P BRAY 1		pH KCl	Acid Sat %	Ca:Mg	Mg:K	(Ca+Mg)/K	%Ca/BK	%Mg/BK	%Na/BK	%K/BK	BK	KUK
mg/l	mg/kg	mg/l	mg/kg		(norm 5 - 30)	(norm 1.5 - 4.5)	(norm 3 - 4)	(norm 10 - 20)	(norm +-65)	(norm +-25)	(norm <2)	(norm +-10)	cmol(+)/kg	cmol(+)/kg
0.17	3.31	0.923	18.46	5.74	1.27	2.70	1.50	5.54	61.14	22.64	1.09	15.12	18.19	18.42
0.95	18.92	0.263	5.26	6.27	0.00	2.36	8.32	27.94	66.84	28.33	1.43	3.41	30.49	30.49
0.34	6.85	1.686	33.72	6.07	0.00	4.83	2.07	12.09	75.92	15.71	0.78	7.58	24.05	24.05
0.63	12.67	0.719	14.38	6.10	0.00	1.82	3.78	10.68	58.52	32.07	0.93	8.48	34.82	34.82
0.30	6.02	5.675	113.50	6.05	0.00	4.14	2.21	11.35	73.51	17.78	0.67	8.04	53.30	53.30
4.89	97.70	1.585	31.70	6.61	0.00	2.36	2.24	7.53	60.58	25.72	2.24	11.46	24.47	24.47
4.26	85.24	1.948	38.96	6.67	0.00	1.30	3.19	7.35	47.51	36.45	4.62	11.42	24.30	24.30