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Irrigation Suitability Report for three portions of land near Douglas, Northern Cape Province

For

Idstone Farming

June 2016

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Executive summary

A soil survey was done for three portions of land for Idstone farming to assess the suitability of the area for irrigation. The entire soil survey comprised 3 749 ha, of which Lorraine is 1 734 ha, Bloubos 611 ha and Zulani 1 404 ha. The soils of the study site are mostly deep (> 2 000 mm), with small shallower areas (< 1 000 mm) occurring in all three sites, where rock, hardpan carbonate of soft carbonate might restrict drainage. At Lorraine the shallower parts are both in the North and South of the site, as well as a strip running from the south Eastern corner roughly to the middle of the site. For Bloubos and Zulani the shallower soils areas are scattered in the South as well as the middle of the sites. Soil forms encountered include Hutton, Plooysburg, Kimberley, Prieska, Clovelly, Addo, Augrabies, Coega and Mispah. Hutton soils though account for more than 90% of the profile observations. For the largest area, impermeable material was not reached. Figures A-C show the areas suitable for irrigation for the three sites. At Lorraine this comprises 1 494 ha, at Bloubos 594 ha and at Zulani 1 262 ha.

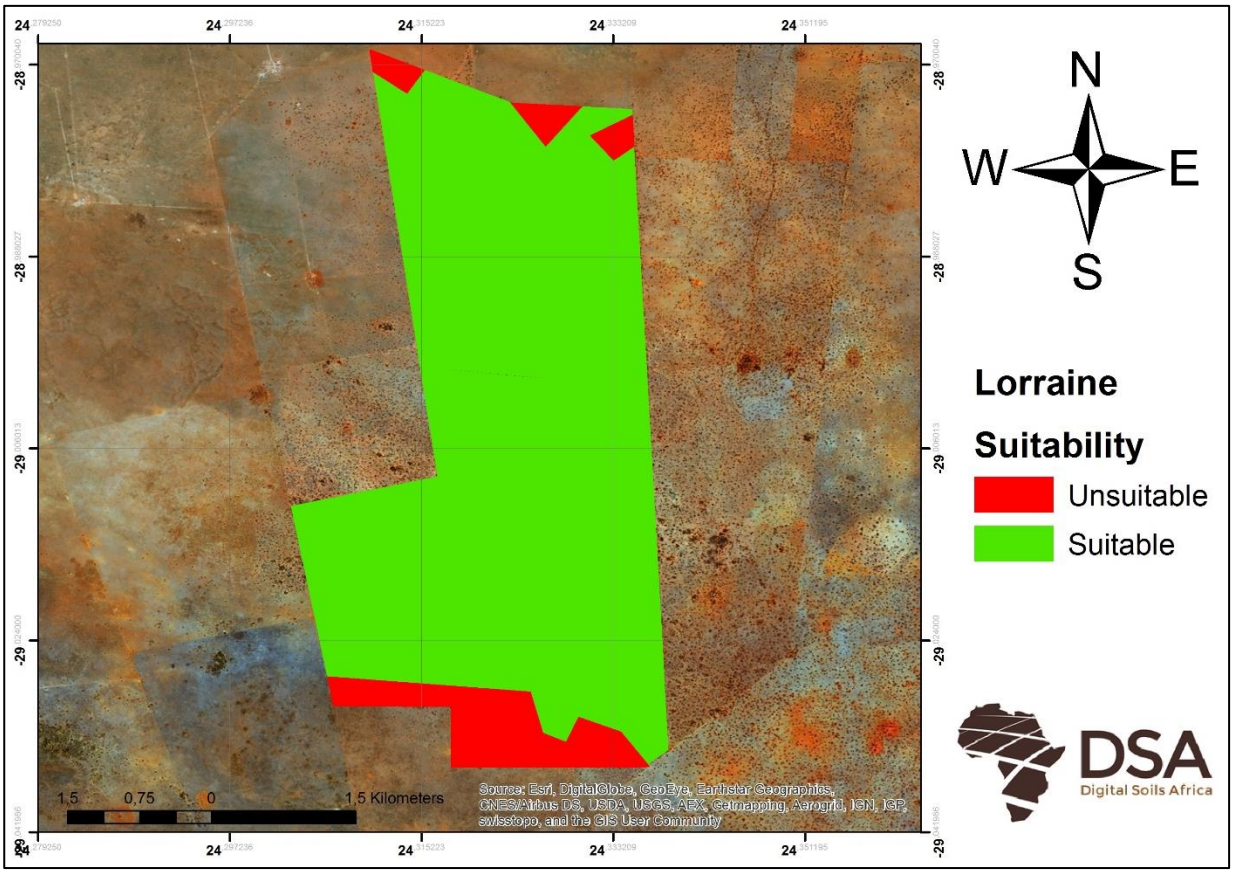

Figure A: Area suitable for irrigation on the Lorraine site

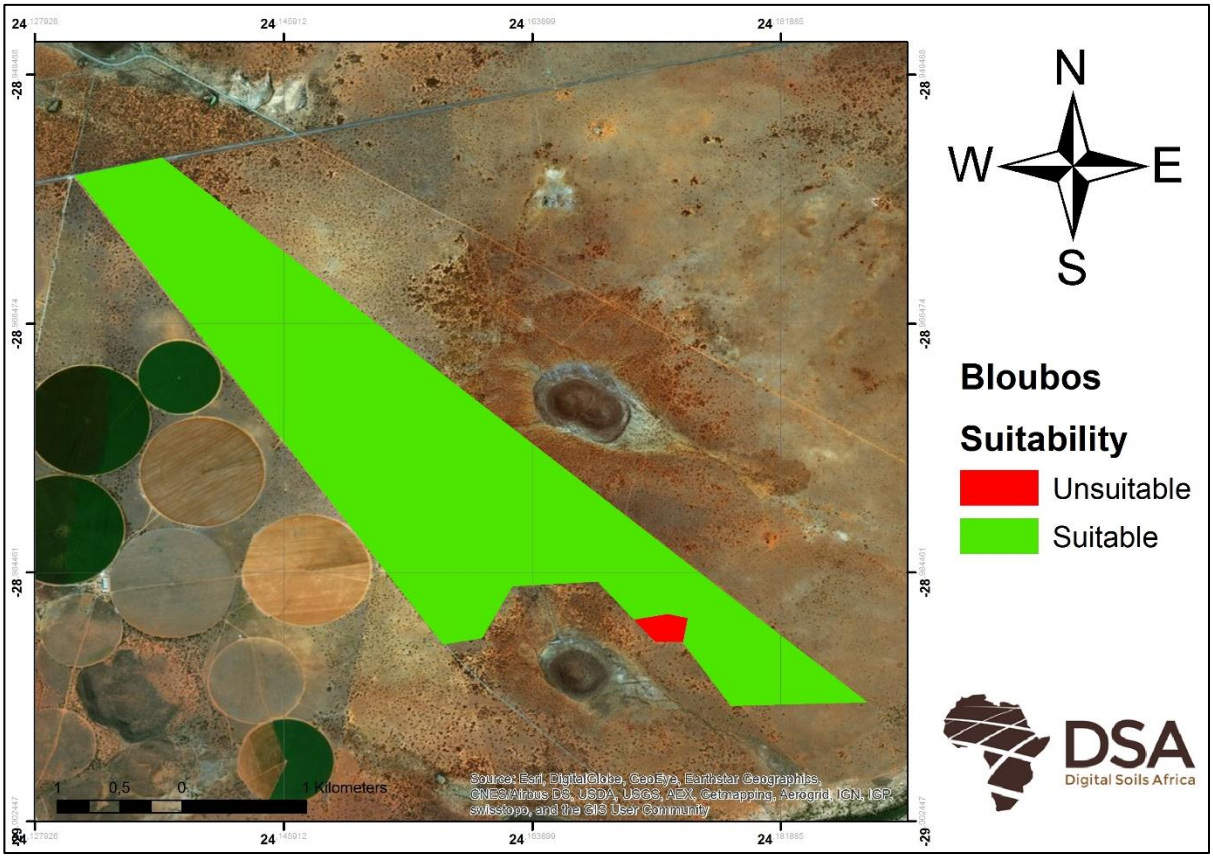

Figure B: Area suitable for irrigation on the Bloubos site

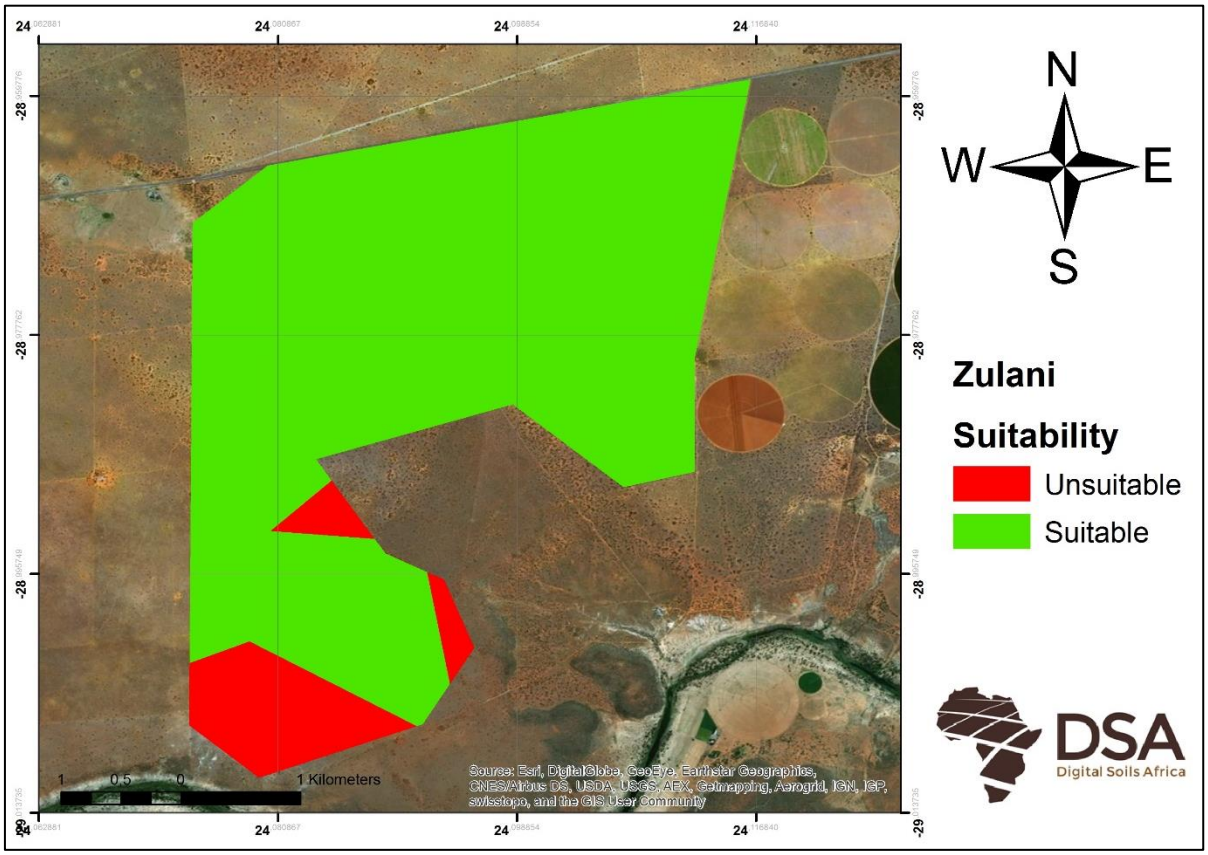

Figure C: Area suitable for irrigation on the Zulani site

1. Introduction

Digital Soils Africa conducted an irrigation potential soil survey on three portions of land, comprising approximately 3 749 ha for Idstone Farming to determine the suitability of the soils for irrigation. The three portions of land differ in size and cover approximately the following areas: Zulani 1 404 ha, Bloubos 611 ha and Lorraine 1 734 ha.

For sustainable irrigation of land the soils need to have specific properties to prevent water logging and salinization. When irrigation water is applied, large amounts of salts are applied with the water, but plants only remove the water through transpiration. The result is that salt builds up in the soil and can reach levels which will amount to crop losses. In extreme cases, salinization will reach the extent that the soil cannot be vegetated anymore. These effects can be negated with proper management on soils with certain properties. For this reason, the Department of Agriculture, Northern Cape, has provided guidelines to which soil properties must adhere before a ploughing license can be granted. These properties are related to the water infiltration of the soil, and well as salt and sodium built up. With this project the properties of the soils were investigated and areas where irrigation can be managed sustainable identified.

2. Location

The three sites are located near the Riet river, between Kimberley and Douglas. Tables 1 - 3 give the co-ordinates of the perimeter of the three sites, while Figure 1 shows their locations.

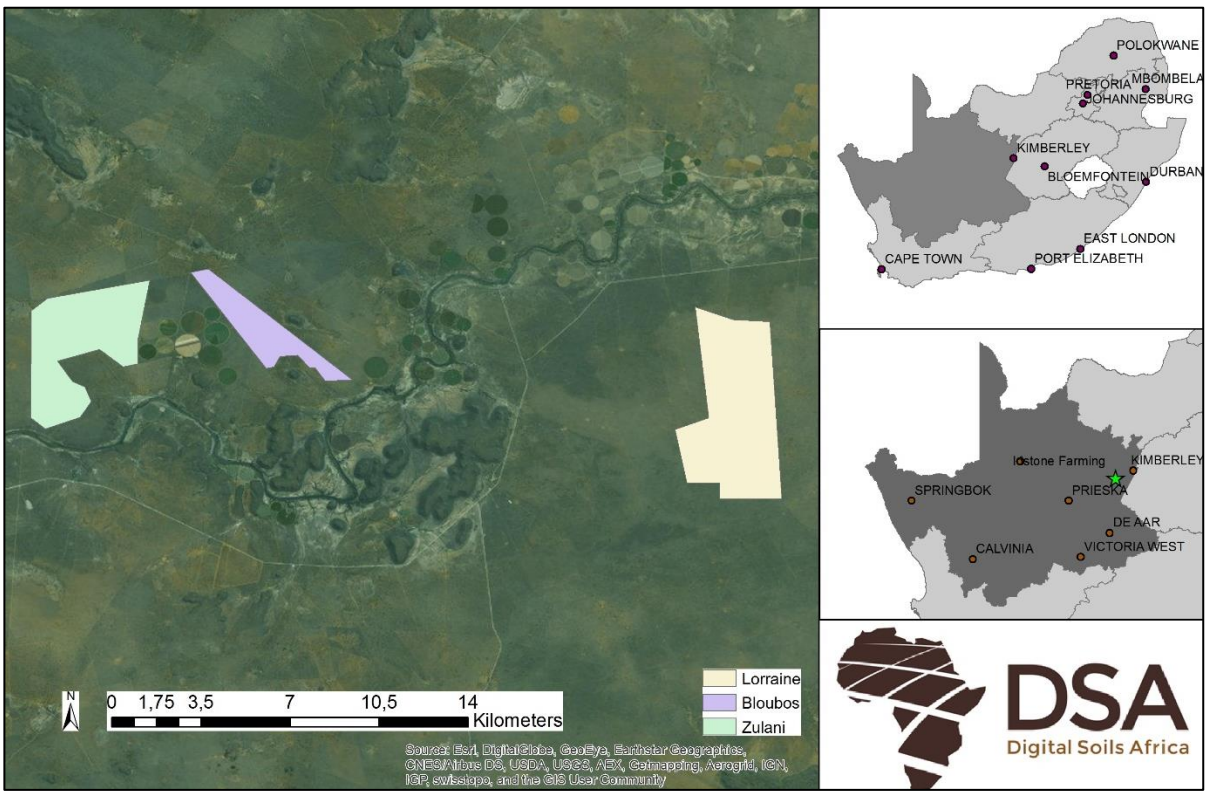

Figure 1: The location of the three sites.

Table 1: The perimeter points of the Lorraine site

Nr	X	Y
1	24.3103140	-28.9685099
2	24.3236719	-28.9735795
3	24.3350181	-28.9741830
4	24.3383978	-29.0342937
5	24.3365470	-29.0358226
6	24.3179586	-29.0359836
7	24.3180390	-29.0302300
8	24.3068538	-29.0301093
9	24.3029912	-29.0114001
10	24.3167113	-29.0085435

Table 2: The perimeter points of the Bloubos site

Nr	X	Y
1	24.1310214	-28.9559669
2	24.1373466	-28.9547158
3	24.1880877	-28.9937794
4	24.1783565	-28.9941270
5	24.1748116	-28.9894699
6	24.1727959	-28.9894699
7	24.1687644	-28.9851604
8	24.1625086	-28.9853689
9	24.1602844	-28.9891919
10	24.1575040	-28.9896089

Table 3: The perimeter points of the Zulani site

Nr	X	Y
1	24.1164592	-28.9585212
2	24.1122119	-28.9795727
3	24.1121196	-28.9880672
4	24.1070414	-28.9891752
5	24.0984546	-28.9830813
6	24.0836815	-28.9871439
7	24.0891291	-28.9943457
8	24.0931917	-28.9961000
9	24.0955000	-29.0013629
10	24.0917144	-29.0069028
11	24.0795266	-29.0110577
12	24.0742637	-29.0069951
13	24.0745407	-28.9692316
14	24.0802653	-28.9649844

3. **Methodology**

Soil profile pits were dug on a 200 m grid to a depth of up to 2000 mm or to hard carbonate or rock layer using a TLB. Soils were classified according to the Taxonomic Soil Classification System (Soil Classification Working Group, 1991). Soil depth, freely drainable depth and limiting material were noted and mapped. Samples of modal profiles were taken for chemical and physical analysis. Texture was measured with the hydrometer method (Gee and Bauder, 1979), basic cations from a 1:10 NH4OAc extract (White 2006), soil pH in a 1:2.5 KCl extract and electrical conductivity in a saturated paste extract. Figures 2-4 shows the locations of the soil observations, while Appendix 1 gives the GPS coordinates of the observations.

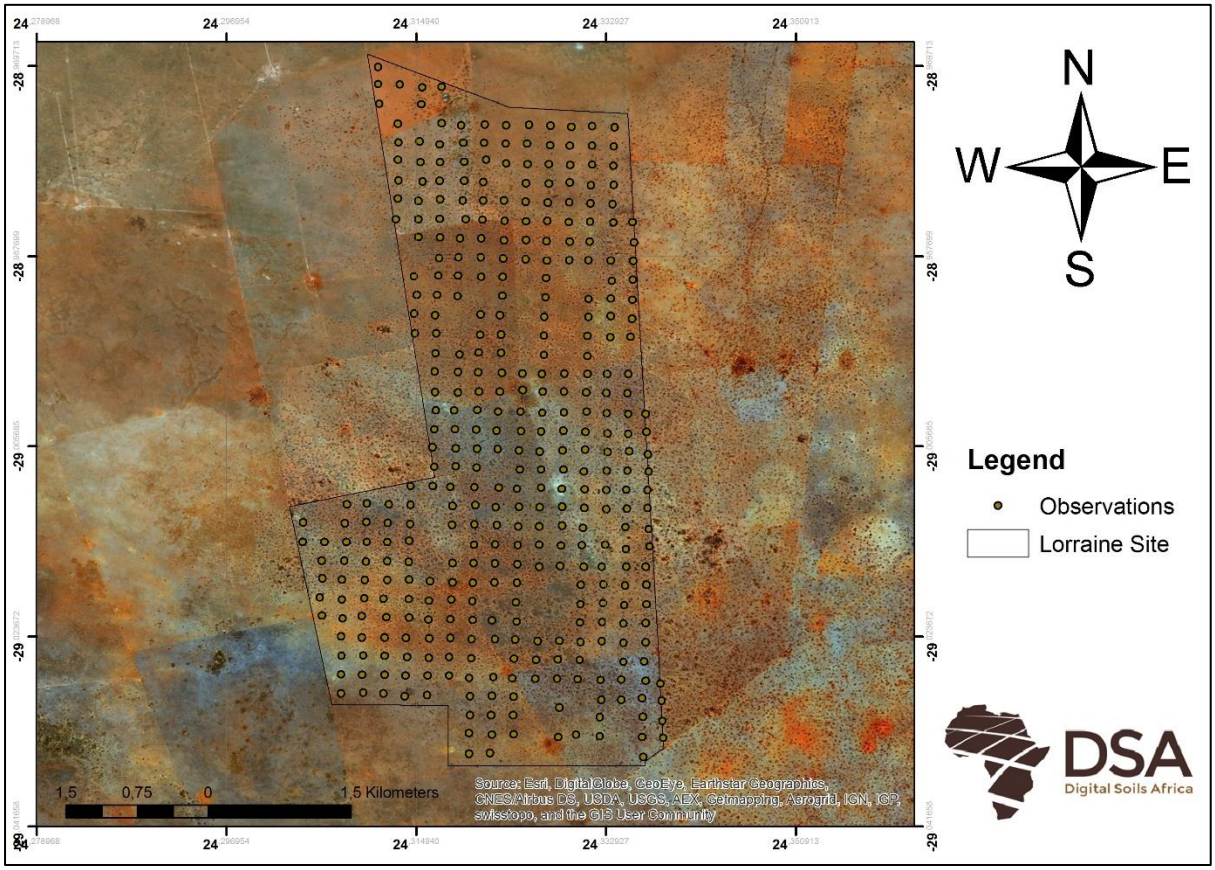

Figure 2: Soil observation locations for the Lorraine site.

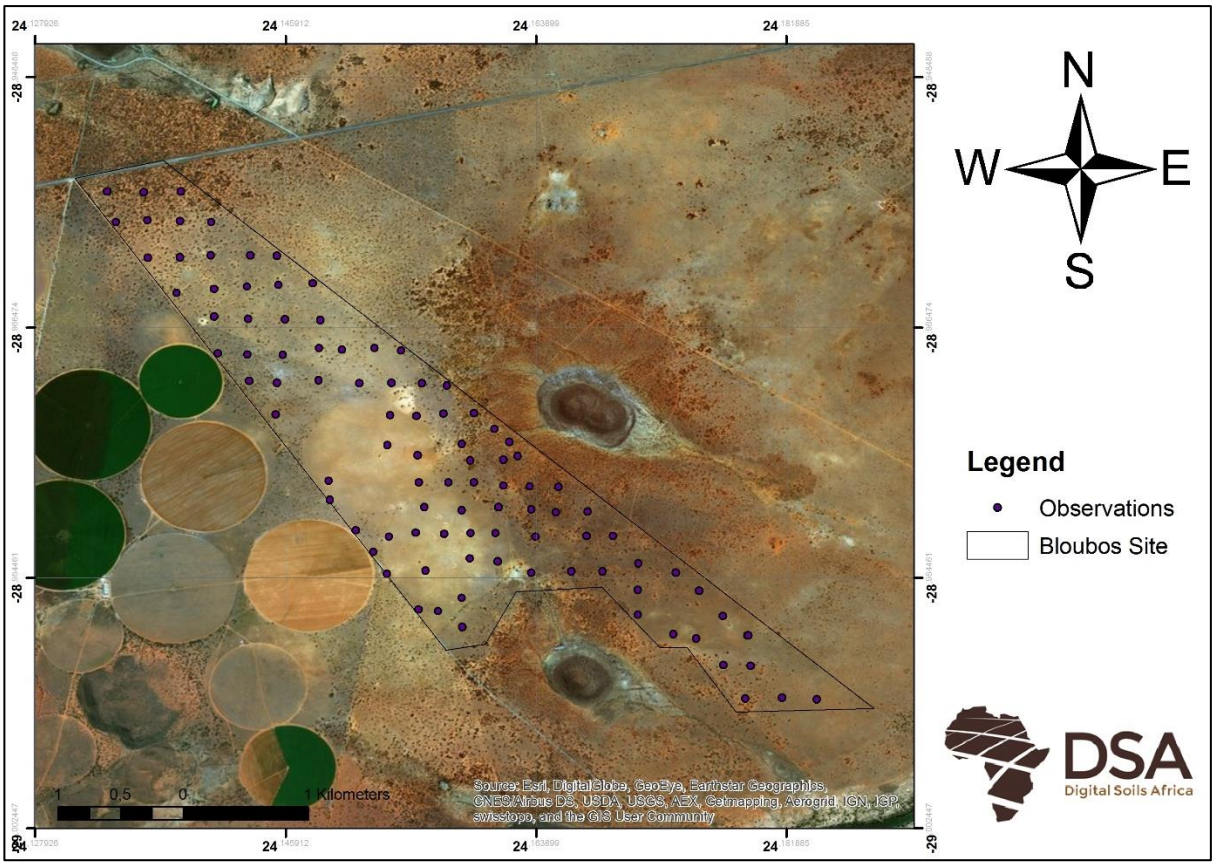

Figure 3: Soil observation locations for the Bloubos site.

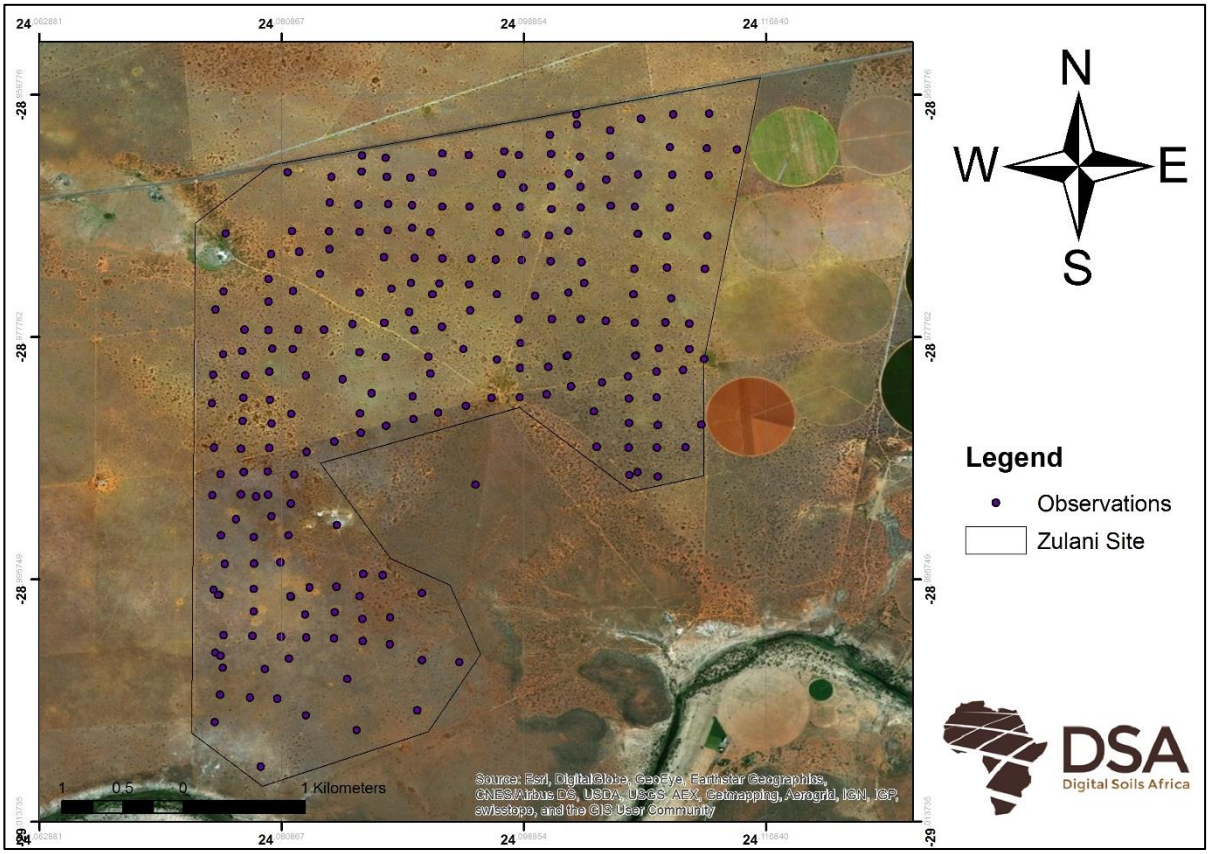

Figure 4: Soil observation locations for the Zulani site.

4. Results

4.1. Soils forms

The soils encountered during the survey are presented in Table 4, while descriptions of the various diagnostic horizons follow in text. Examples of the soil forms are shown in Figure 5, while the soil form distribution is shown in Figures 6-8. Figures 9-11 show the distribution of layers potentially impeding water movement. Modal profile descriptions are presented in Appendix 2.

The Hutton soil form is the most abundant, being found in 635 profiles across the three sites. At Lorraine, it covers the largest area, except in the far north and south, where Plooysburg soils forms also occur. There is also a strip of shallower soils starting in the south-east moving up to the middle of the site, where shallower soils occur. Depending on character, and the depth to the carbonate layer, one could find Plooysburg, Augrabies, Bloemdal, Kimberley and Prieska soil forms within this strip.

The Bloubos site is nearly completely covered with the Hutton soil form, except for small areas where the Plooysburg and Kimberley soil forms appear, in the middle and south of the site respectively.

At Zulani, the Hutton soil form covers the largest part of the site, but gives way to Plooysburg, Addo and Prieska soils in the south. Small parts of the Prieska and Plooysburg soil forms are also present near the middle of the site.

Table 4: Soil forms encountered

Soil form	A Horizon	B Horizon	B2/C Horizon	Nr of observations		
				Lorraine	Bloubos	Zulani
Addo	Orthic A	Neocarbonate B	Soft Carbonate			2
Augrabies	Orthic A	Neocarbonate B	Unspecified	3		
Bloemdal	Orthic A	Red Apedal B	Unspecified material with signs of wetness	1		
Clovelly	Orthic A	Yellow Brown Apedal B	Unspecified	3		
Coega	Orthic A	Hardpan Carbonate				1
Hutton	Orthic A	Red Apedal B	Unspecified	322	91	222
Kimberley	Orthic A	Red Apedal B	Soft Carbonate	5	4	
Mispah	Orthic A	Rock				1
Plooysburg	Orthic A	Red Apedal B	Hardpan Carbonate	41	3	11
Prieska	Orthic A	Neocarbonate B	Hardpan Carbonate	3		1

4.2. Horizon descriptions

Orthic A Horizon:

The orthic A is sandy (approximately 10% clay) apedal, and poorly developed, typical of arid environments. Transitions to the red apedal B, neocarbonate B and yellowbrown apedal B horizons are generally diffuse, as the orthic A horizon exhibits the same character (colour and carbonate content) of the B horizon. Transitions to hardpan carbonate and rock are abrupt.

Red Apedal B:

Within this landscape this is a red, sandy (approximately 10% clay), apedal horizon. It is freely drainable with high water infiltration rates and generally low salinity, which makes it excellent for irrigation, provided this horizon is deep enough. It occurs in 700 profiles across the three sites, making it the most abundant soil horizon.

Yellow Brown Apedal B

Morphologically very similar to the red apedal B, the only difference being a yellowing in colour. In this study the soils were very sandy, (approximately 10% clay). As the red apedal B horizon it is freely drained and associated with very high water infiltration rates and generally low salinity. It only occurs in three profiles on the Lorraine site.

Neocarbonate B:

Neocarbonate B horizons contain enough dispersed free carbonates to effervesce with cold 10% HCl, but the morphology is not dominated by lime. The colour is reddish brown and the clay content around 10%. The carbonate accumulation indicates that some salts do wash into this horizon, which could be attributed to a water impenetrable deeper layer or natural accumulation of salts in this area, due to

the low natural leaching factor. This horizon is regarded to drain fairly well, and the excess carbonates could wash out with irrigation. It's small locality (only nine profiles across the Zulani and Lorraine sites means it will have a small effect on the irrigation potential of these portions of land.

Hard Carbonate:

Within this horizon carbonates have accumulated to the point that it hardened and impedes water movement. The transition from the above lying horizon if often abrupt, indicating the natural leaching depth. This horizon occurs reasonably frequently, in 70 profiles on all three sites. If present shallow enough, its presence does render the profile unsuitable for irrigation.

Soft Carbonate:

Within this horizon lime has accumulated to the extent that it dominates the morphology of the horizon, but it has not hardened to the point where it cannot be cut with a spade. Soft carbonate horizons are products of carbonate rich water that evaporates and the carbonates precipitate. This is associated with inadequate leaching due to impermeable layers restricting deep drainage. The impermeable layer was however not reached within observation depth. The hydraulic conductivity of the soft carbonates is determined by the permeability and depth of the underlying horizon. Two hundred millimetres were added to the freely drained depth to achieve the drainable depth for observations containing this horizon. It only occurs in 11 profiles across the three sites, and have therefore a very limited impact on the irrigation potential.

Unspecified material with signs of wetness

This horizon is characterized by grey, yellow and orange mottles indication times of water saturation. As it has a sandy texture, the mottles indicate that a lower lying horizon determines the water infiltration rate within this horizon. The depth of this horizon (deeper than 2 000 mm) and its small locality (present in only one observation) means that it will not impede on the potential for irrigation.

5. **Soil Depth**

The freely drainable depth (Figure 12-14) is the depth up to where the water can freely drain. It includes the depth of the orthic A, red apedal B, yellow brown apedal B and neocarbonate B horizons. The drainable depth is the same as the freely drained depth, with the exception of 200 mm added when a soft carbonate is the limiting layer, to accommodate potential infiltration into the soft carbonate horizon. Where no limiting layer was reached, the freely drainable depth and drainable depth was regarded as greater than 2 000 mm. The freely drainable depth and drainable depth soil maps are the same for the Bloubos and Zulani sites, but differs only for one small area for the Lorraine site. Therefore, only the Lorraine drainable depth map is shown (Figure 15). In general, the soils of all three portions of land are very deep, and is good for irrigation. At Lorraine ,there are shallower

portions to the north and south, as well as the strip reaching from the south-east to the middle of the area. Bloubos has shallower areas near the edges, to the south and along the western edge. The soil at Zulani is shallower in the south of the site, as well as at a few spots near the middle of the site.

a. Hutton

b. Plooysburg

c. Prieska

d. Kimberley

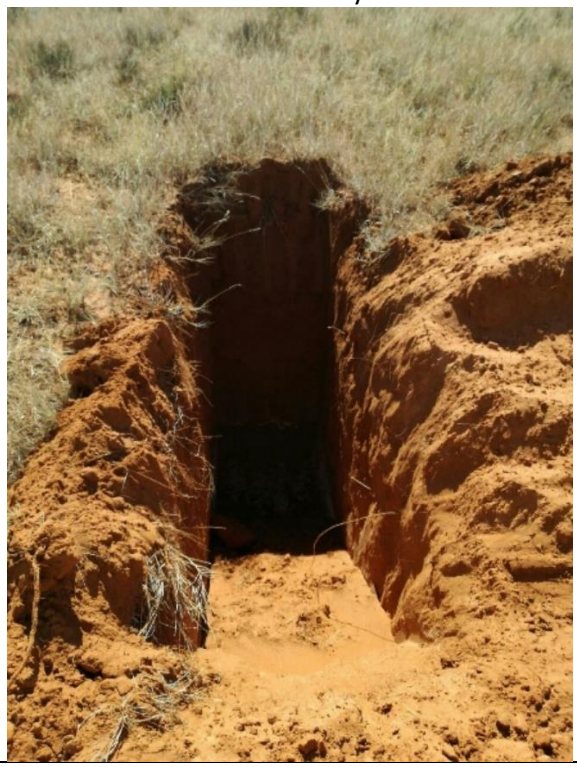

Figure 5: The most abundant soil forms encountered during the project.

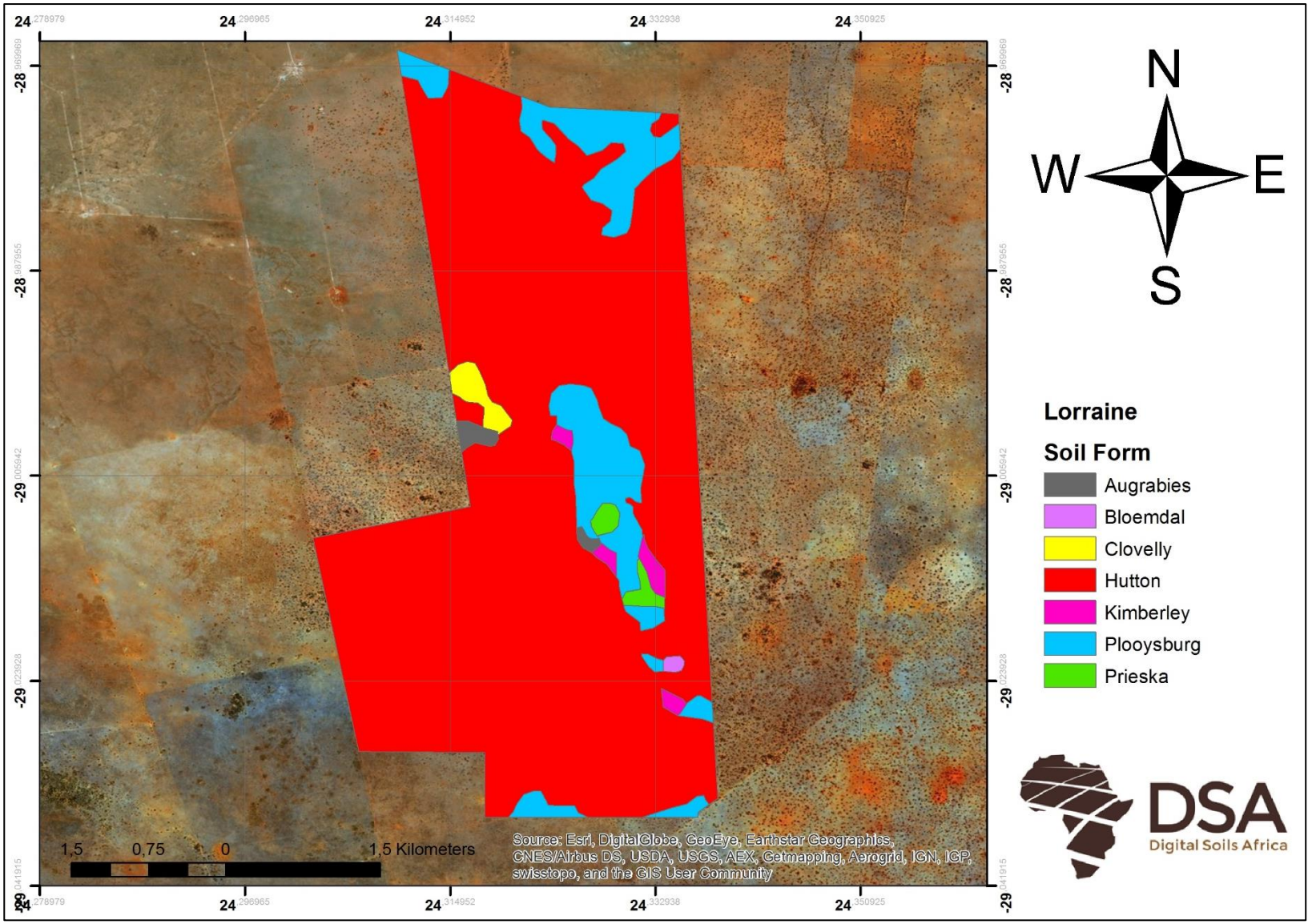

Figure 6: Soil map of the Lorraine site.

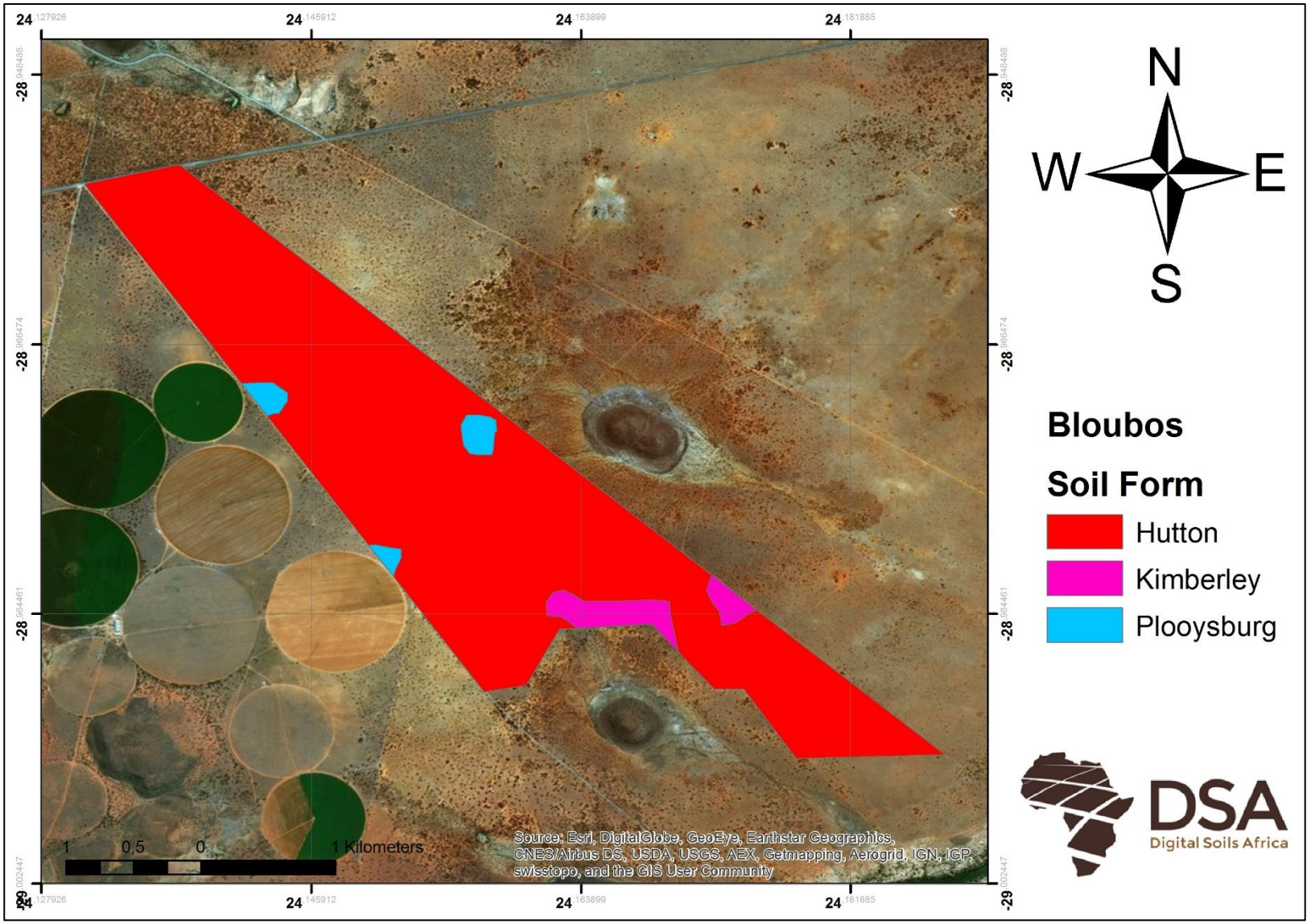

Figure 7: Soil map of the Bloubos site.

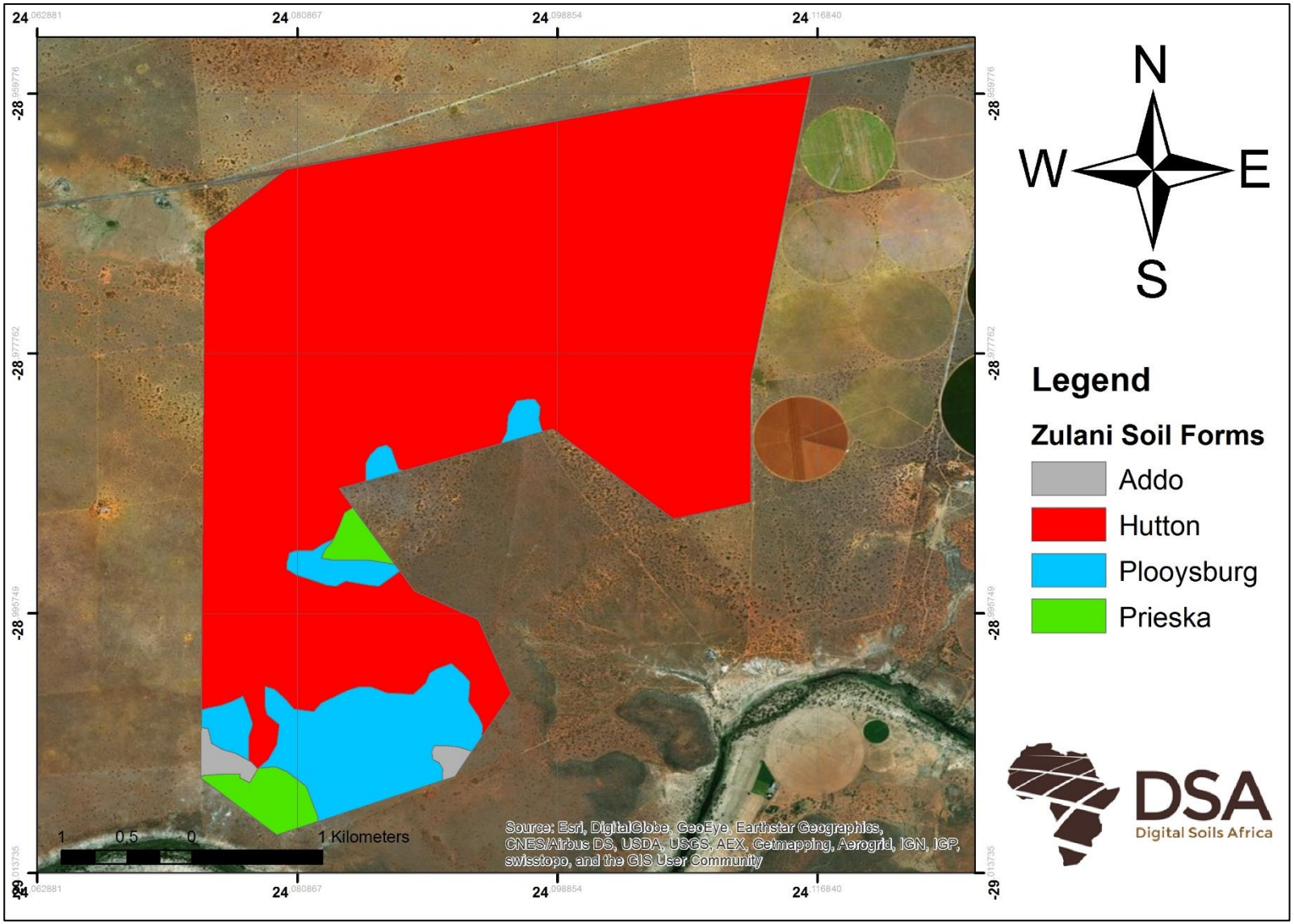

Figure 8: Soil map of the Zulani site.

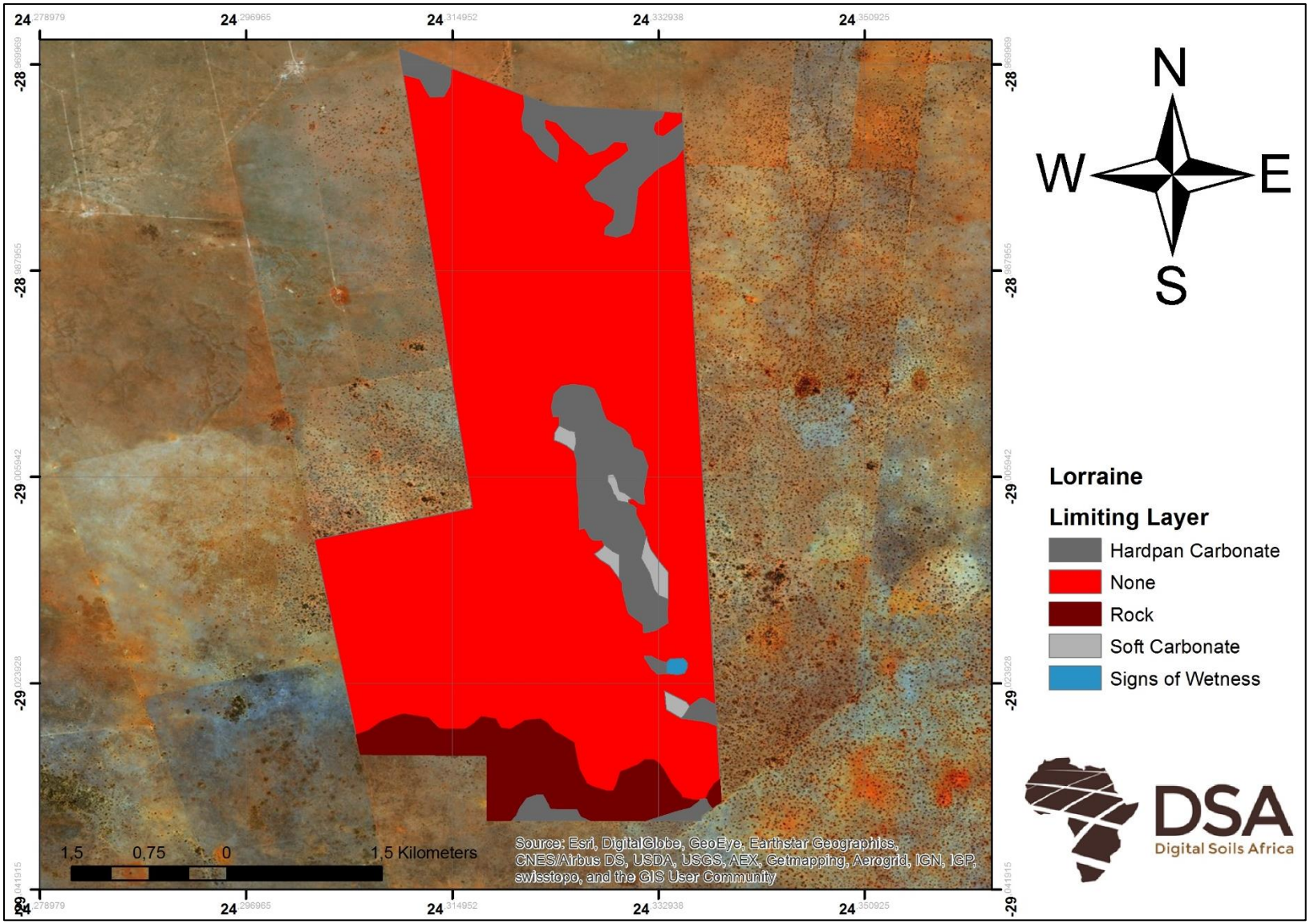

Figure 9: Water impeding material distribution of the Lorraine site.

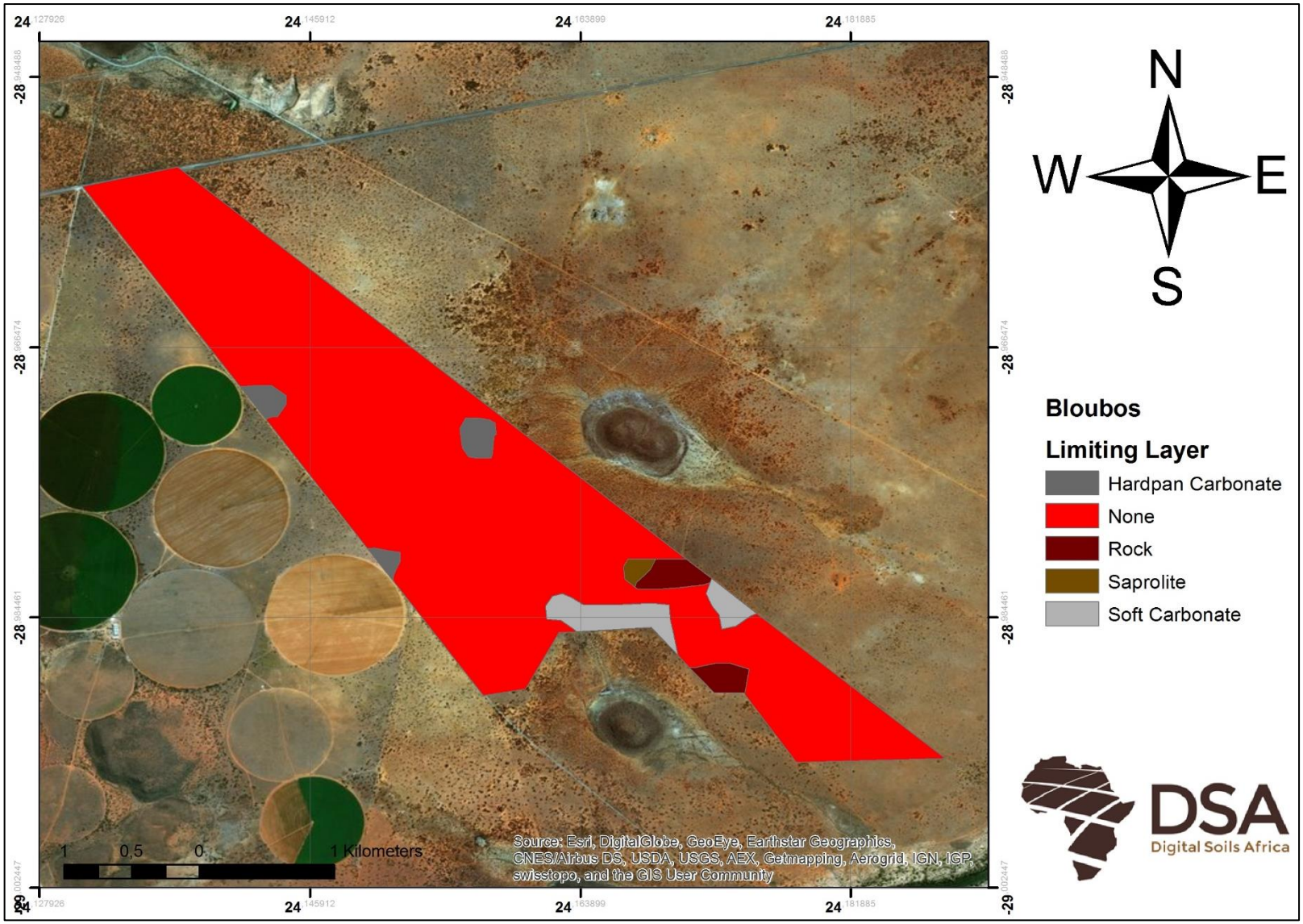

Figure 10: Water impeding material distribution of the Bloubos site.

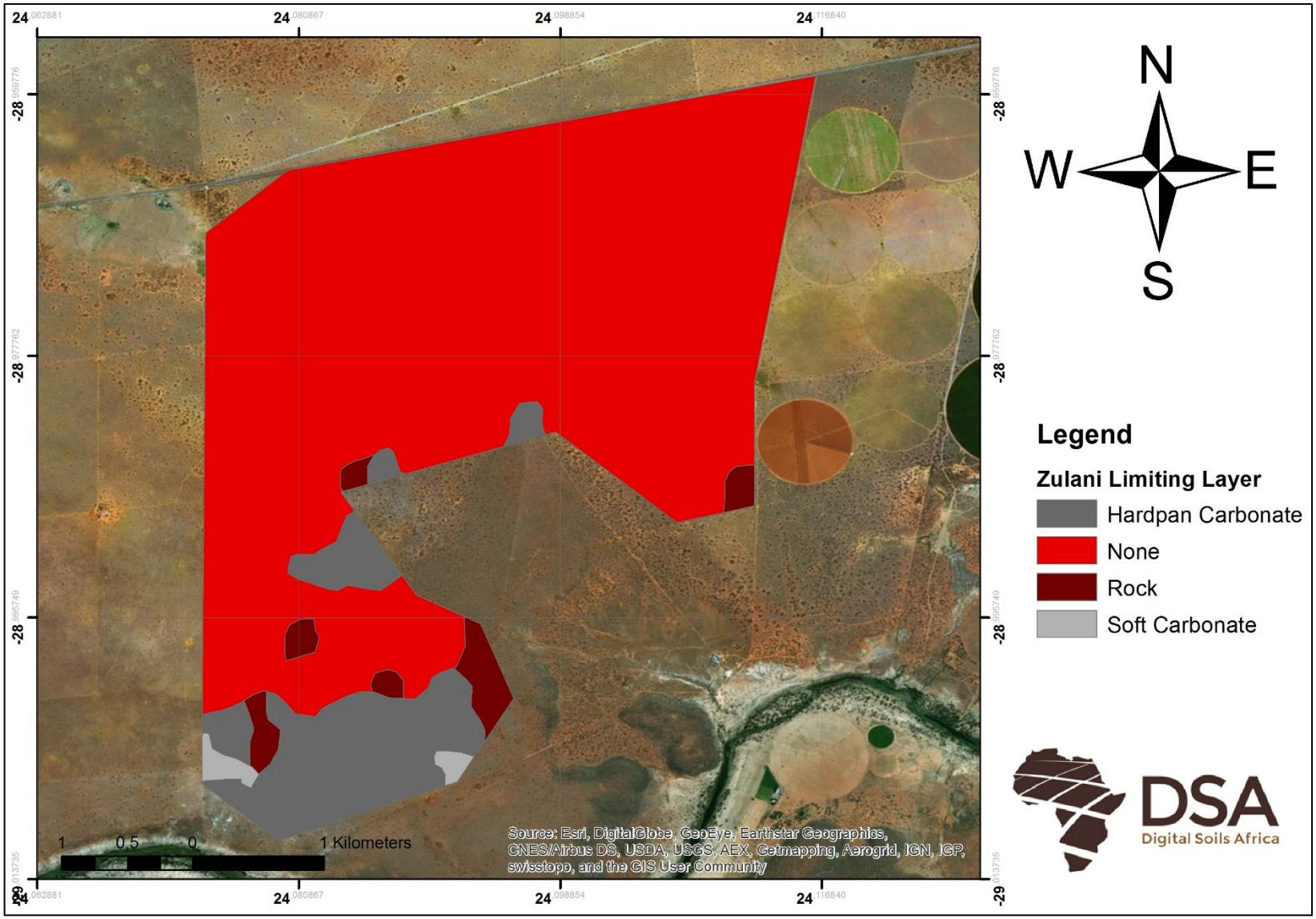

Figure 11: Water impeding material distribution of the Zulani site.

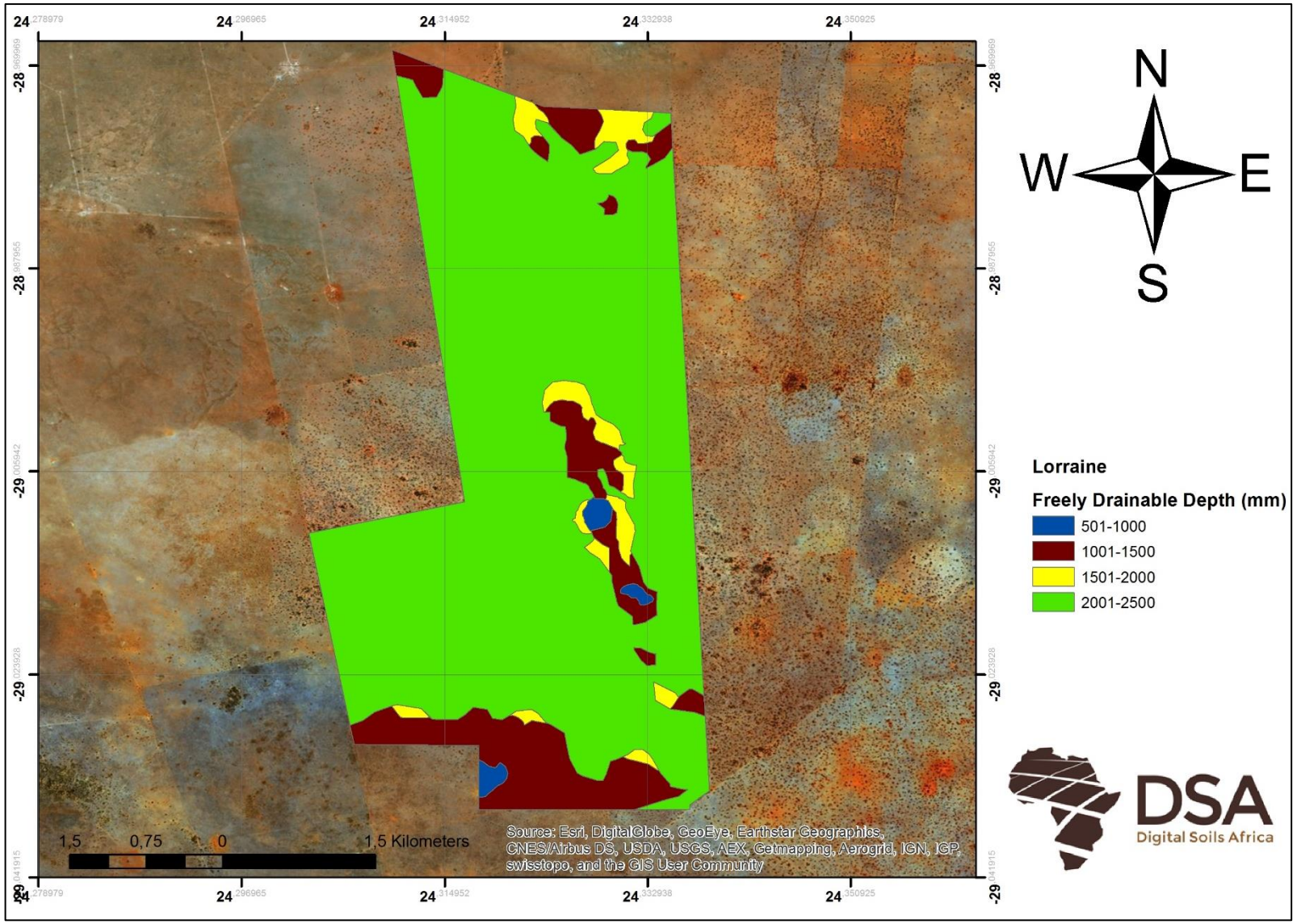

Figure 12: Freely drainable depth (mm) of the soils of the Lorraine site

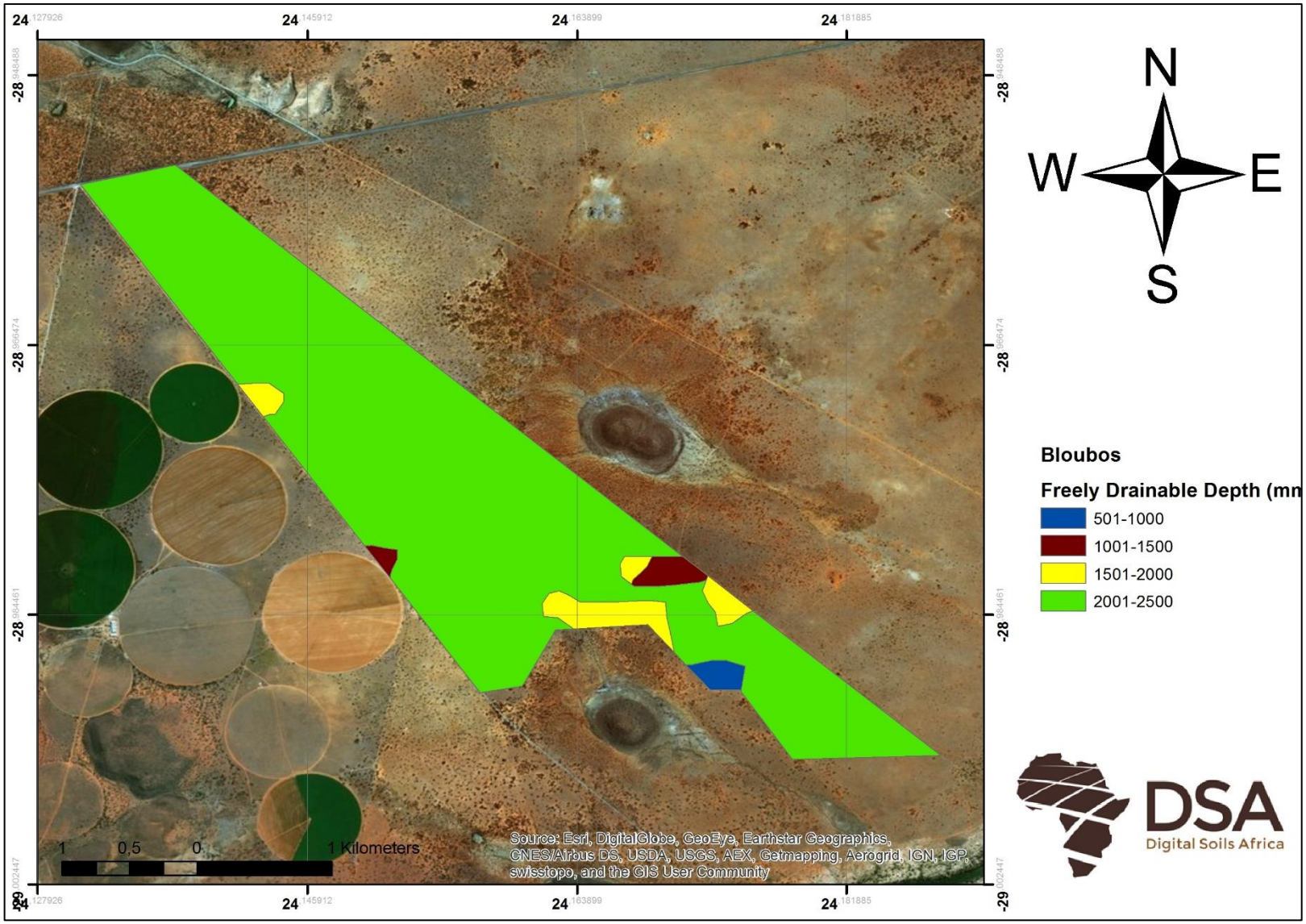

Figure 13: Freely drainable depth (mm) of the soils of the Bloubos site

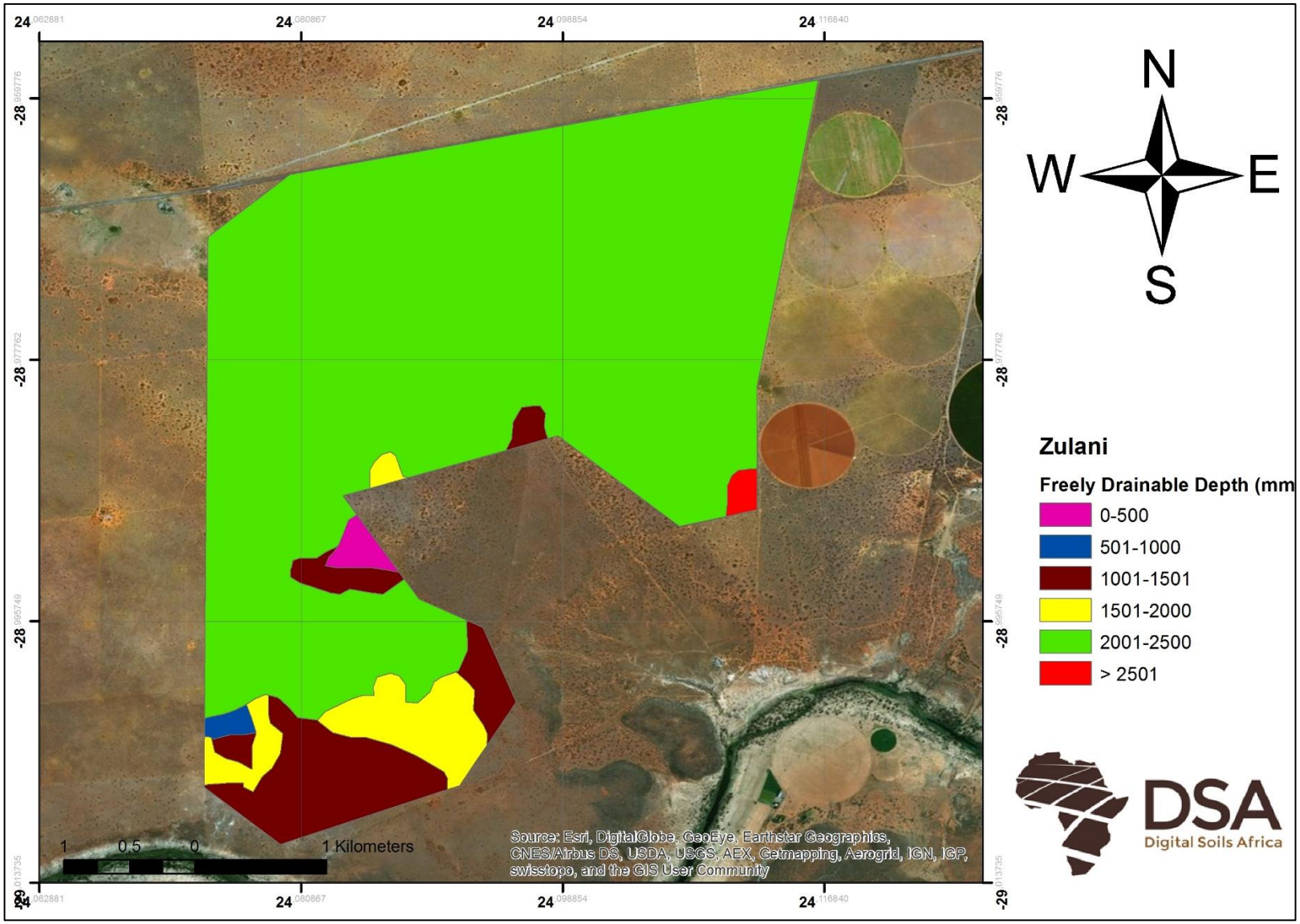

Figure 14: Freely drainable depth (mm) of the soils of the Zulani site

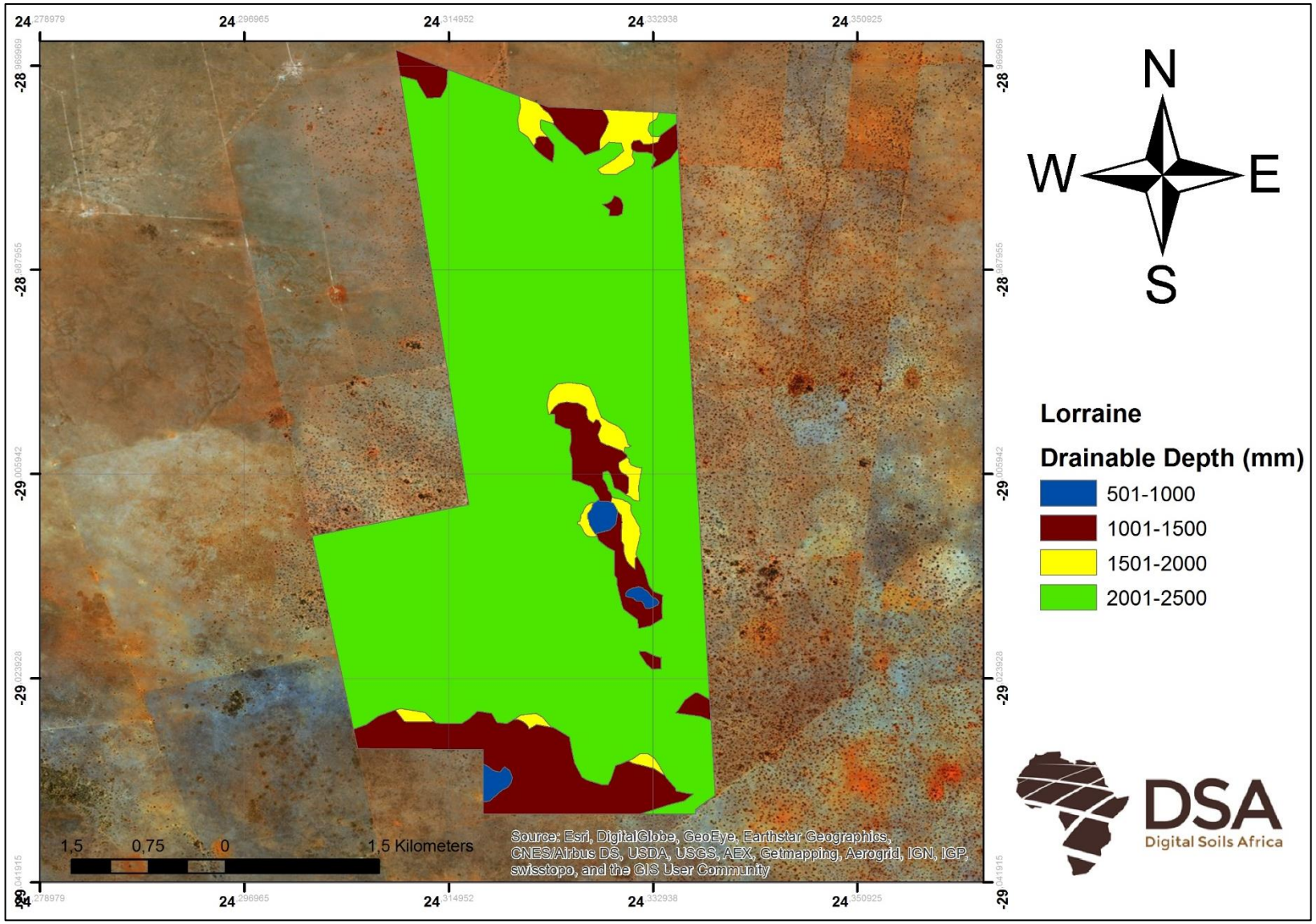

Figure 15: Drainable depth (mm) of the soils of the Lorraine site.

6. Chemical and soil texture analysis

Tables 5 (chemical) and 6 (texture) present selected soil properties of samples taken from modal profiles. Based on the laboratory analysis, all the soils are suitable for irrigation, provided the soil morphology indicates the same.

The pH of the soils is slightly basic to slightly acidic (pH = 5.3- 7.5). The free carbonate containing soil samples pH is as expected above 7. All the pH values are conducive to irrigation. The resistance values of between 900 and 7380 Ohms are all well above the irrigation threshold of 300 Ohms, indicating that there is currently little salt build up in the soil. The EC vaues confirm this, with the highest value being 18, much lower than the 400mS/m threshold for irrigation. The Exchangeable Sodium Percentage (ESP) lies between 0.42 and 1.74, which indicates that Na has not accumulated to a large extent, and therefore there is a low risk of clay dispersion and the accompanying negative effects on soil structure. The T-value is generally low to medium (between 2.85 and 7 $cmol.kg^{-1}$), which means that fertilization management is critical for optimal production. The three carbonate containing samples had a higher T-value of 12.94 – 22.02, as they contain free salts

Table 5: Chemical soil properties for modal soil profiles

Nr	Soil Form	Horizon	pH KCl	Resistance Ohm	EC mS/m	ESP %	T-Value cmol/kg
DSA 160	Hutton	Orthic A	5.3	3310	5	1.55	3.3
DSA 161		Red Apedal B	5.5	3780	5	1.42	3.56
DSA 162		Red Apedal B	5.6	2380	7	1.21	4.06
DSA 163	Hutton	Orthic A	5.6	2330	6	1.13	5.11
DSA 164		Red Apedal B	5.9	1360	9	1.1	6.3
DSA 165		Red Apedal B	5.8	4010	5	1.74	2.85
DSA 166	Plooysburg	Orthic A	5.8	4040	4	1.03	4.82
DSA 167		Red Apedal B	5.7	3230	4	0.93	5.17
DSA 168	Plooysburg	Orthic A	5.8	3830	5	1.17	4.28
DSA 169		Red Apedal B	5.9	4260	2	1.23	4.34
DSA 170		Neocarbonate B	7.1	2200	8	0.56	12.94
DSA 171	Kimberley	Orthic A	6.4	3110	3	1.1	5.25
DSA 172		Red Apedal B	6.4	1740	5	0.83	7
DSA 173		Neocarbonate B	7.1	1510	11	0.42	17.11
DSA 174		Soft Carbonate	7.4	900	18	0.52	22.02
DSA 175	Hutton	Orthic A	7.5	2440	9	0.81	6
DSA 176		Red Apedal B	7.2	2040	7	1	6.85
DSA 177	Hutton	Orthic A	6.5	7380	3	1.44	2.82
DSA 178		Red Apedal B	6.4	4260	2	1.14	4.48

The soils have a coarse texture, with clay percentages around 10% (9-13%). Thus, water infiltration will be rapid and no water logging or salinization problems are expected.

Table 6: Texture analysis for modal soil profiles

Nr	Soil Form	Horizon	Clay	Silt	Sand	Class
			%	%	%	
DSA 160	Hutton	Orthic A	9	2	89	LmSa
DSA 161		Red Apedal B	9	2	89	LmSa
DSA 162		Red Apedal B	11	2	87	LmSa
DSA 163	Hutton	Orthic A	11	0	89	LmSa
DSA 164		Red Apedal B	9	2	89	LmSa
DSA 165		Red Apedal B	9	0	91	Sa
DSA 166	Plooysburg	Orthic A	9	2	89	LmSa
DSA 167		Red Apedal B	11	0	89	LmSa
DSA 168	Plooysburg	Orthic A	9	2	89	LmSa
DSA 169		Red Apedal B	11	2	87	LmSa
DSA 170		Neocarbonate B	11	2	87	LmSa
DSA 171	Kimberley	Orthic A	11	0	89	LmSa
DSA 172		Red Apedal B	13	0	87	LmSa
DSA 173		Neocarbonate B	13	0	87	LmSa
DSA 174		Soft Carbonate	11	8	81	SaLm
DSA 175	Hutton	Orthic A	11	0	89	LmSa
DSA 176		Red Apedal B	11	2	87	LmSa
DSA 177	Hutton	Orthic A	11	0	89	LmSa
DSA 178		Red Apedal B	13	0	87	LmSa

7. Suitability

Based on soil morphology and laboratory analysis, the following areas are considered suitable for irrigation (Figures 16, 18 and 20). For ease of monitoring, the areas are created in right shapes as seen in Figures 17, 19 and 21. Perimeter points of these suitable areas are given in Tables 7-9. The suitable areas cover the following areas: Lorraine 1 568 ha, Bloubos 605 ha and Zulani 1 266 ha. The shallower strip at Lorraine reaching from the south-east corner to the middle was included as a suitable area, as it comprises only 63 ha of the possible 1 734 ha. Running through the site it will disrupt the layout of centre pivots of the whole south east corner of the site, and the largest part of this strip is deeper than 1 000 mm. We advise the farmer to use this strip sparingly.

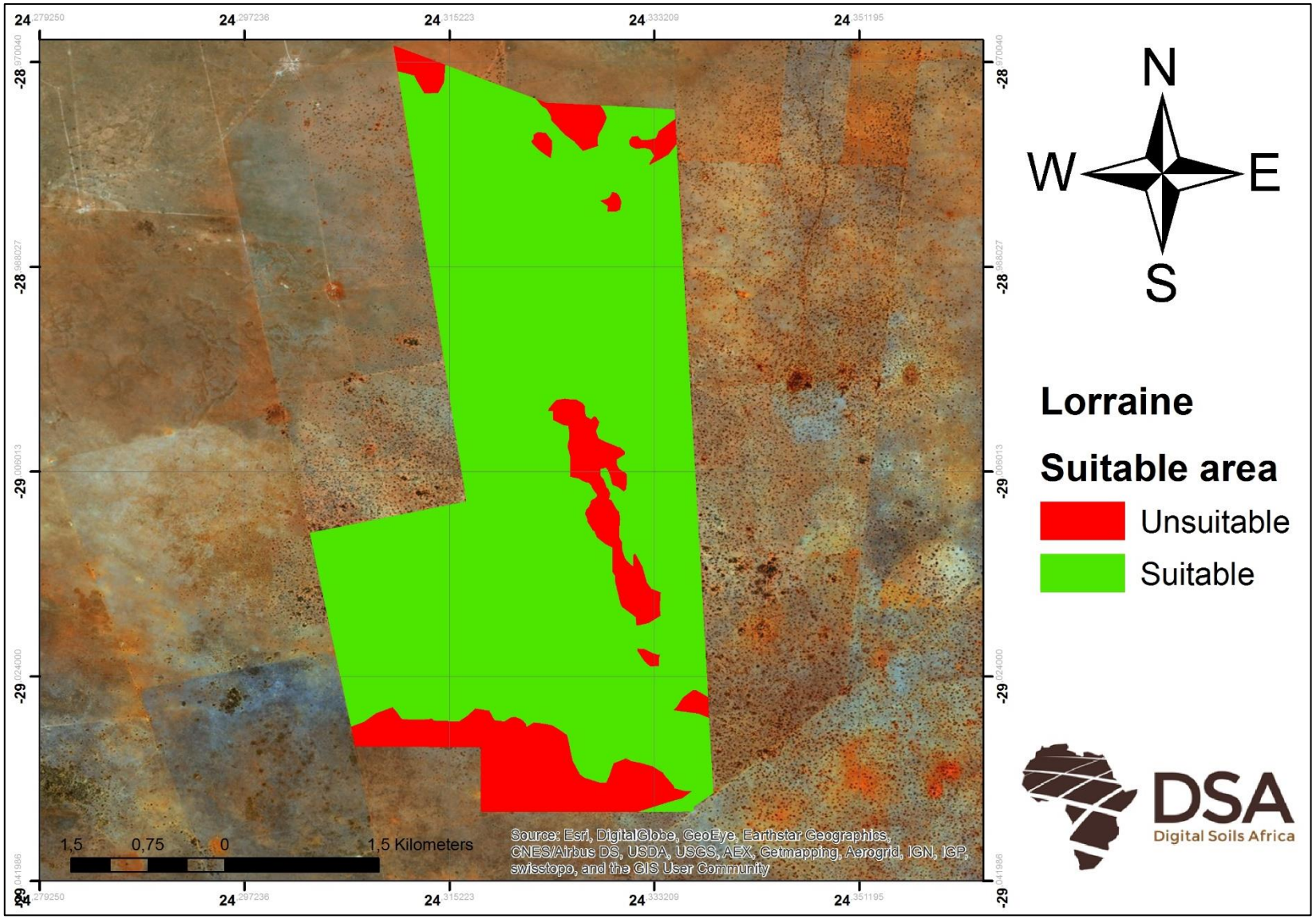

Figure 16: Suitable areas for irrigation on the Lorraine site.

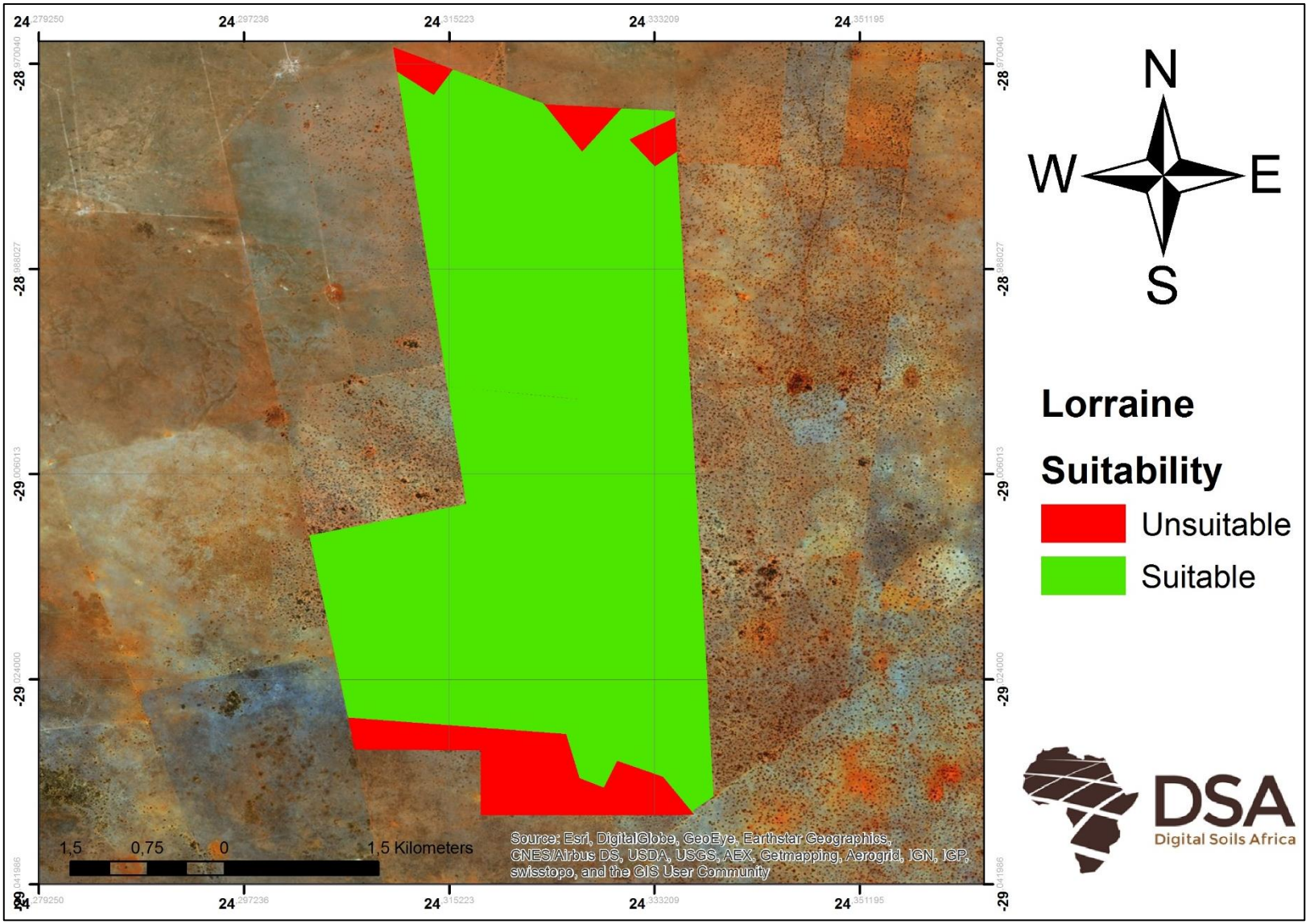

Figure 17: Final suitable areas for irrigation on the Lorraine site.

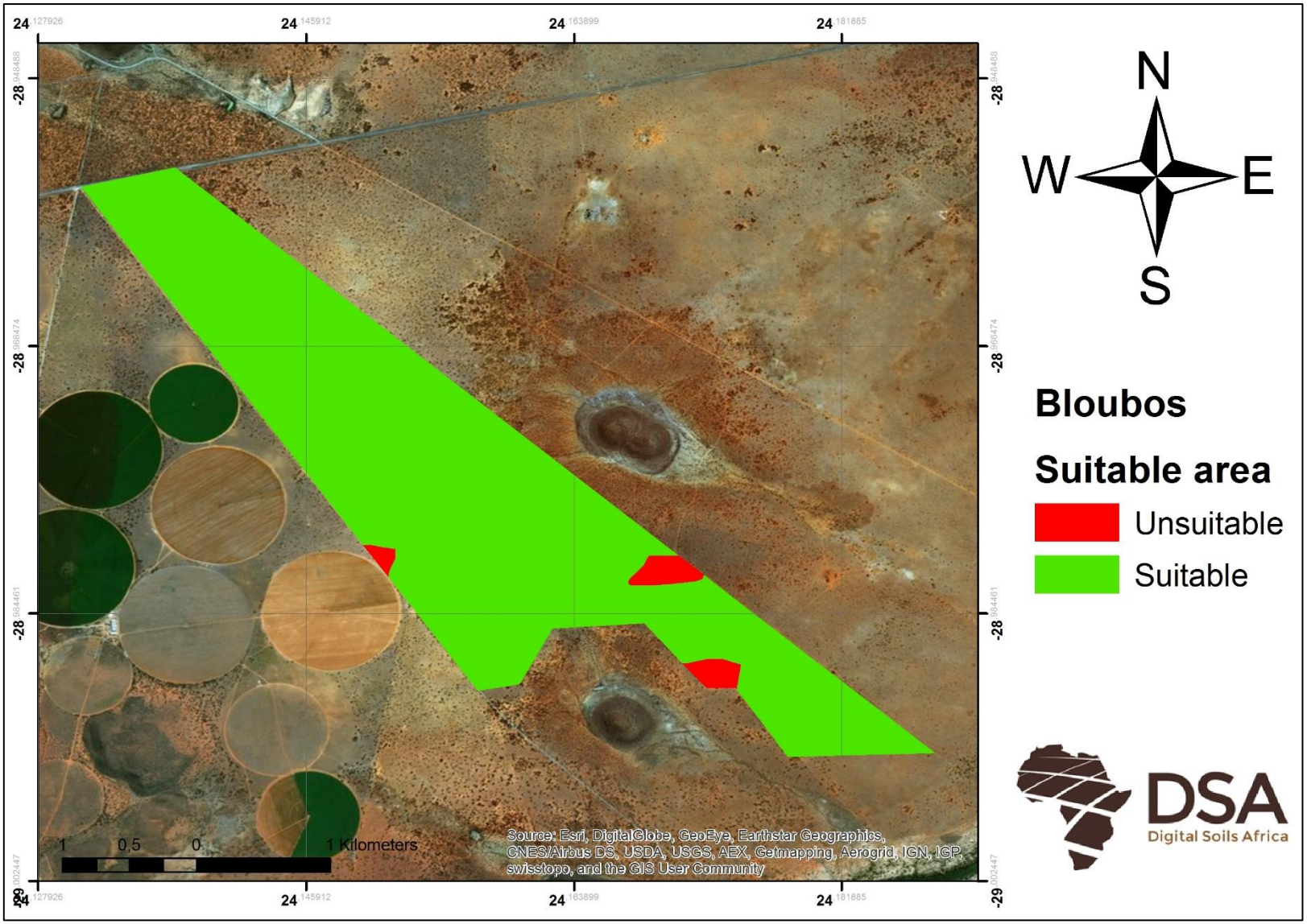

Figure 18: Suitable areas for irrigation on the Bloubos site.

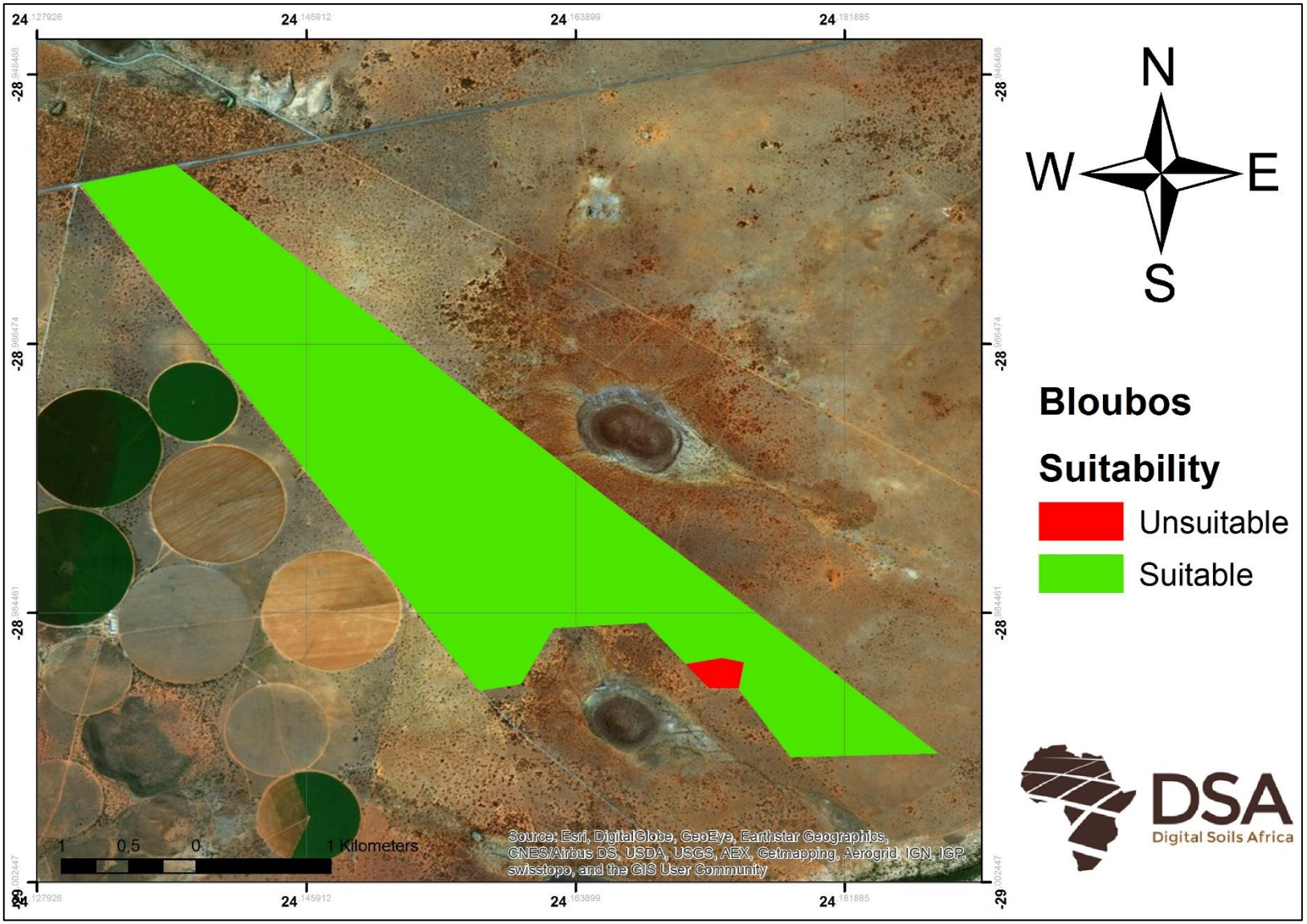

Figure 19: Final suitable areas for irrigation on the Bloubos site.

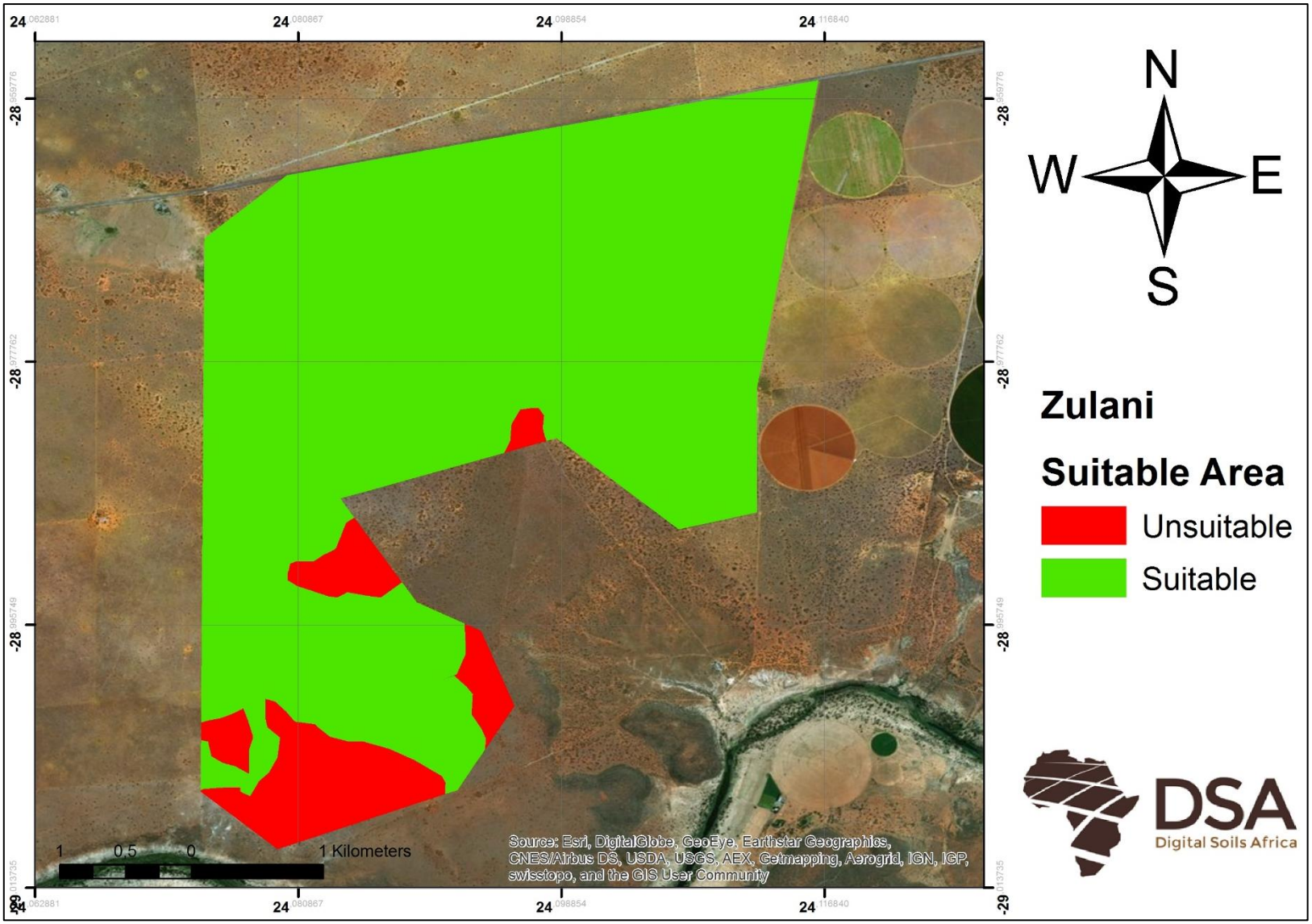

Figure 20: Suitable areas for irrigation on the Zulani site.

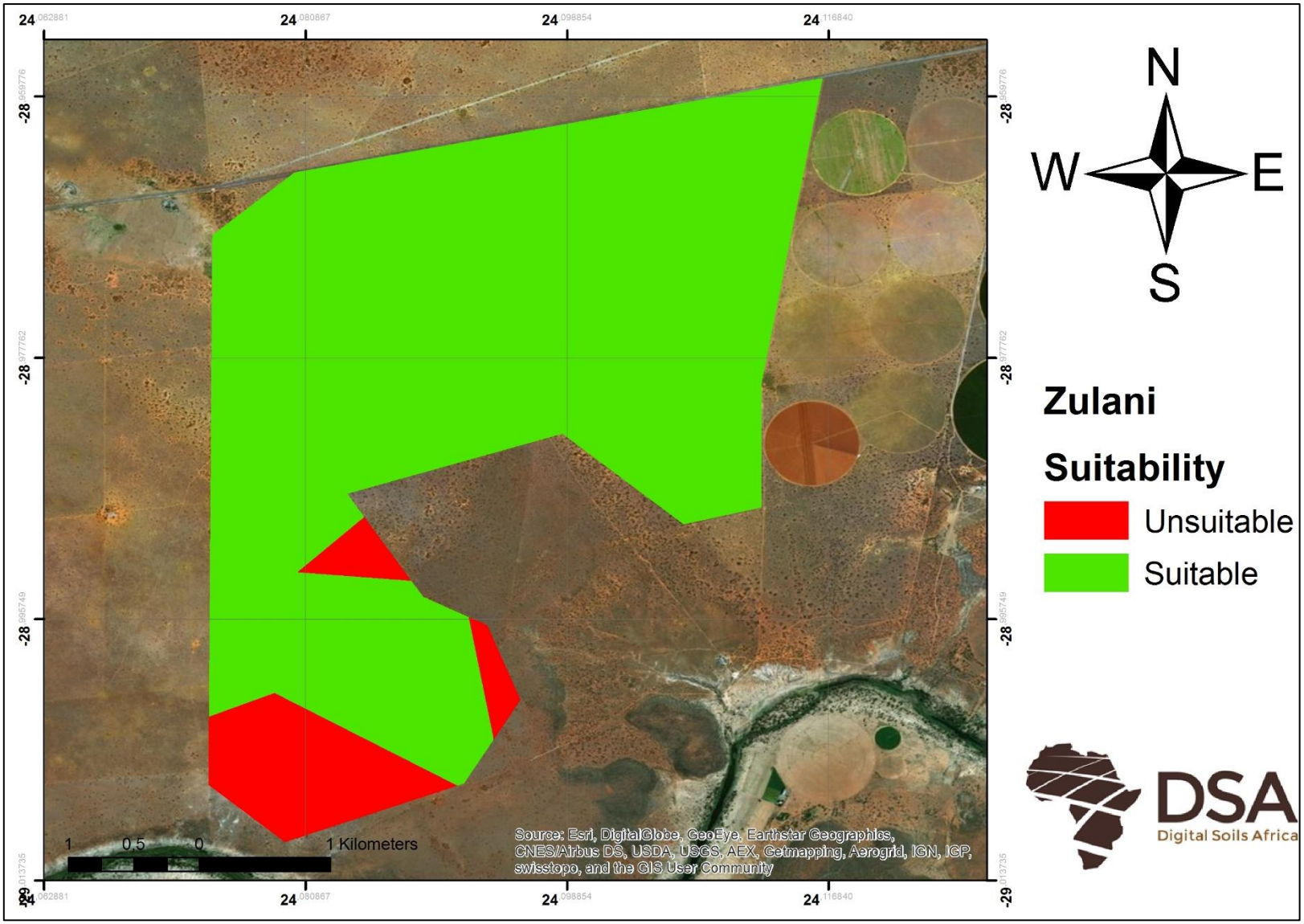

Figure 21: Final suitable areas for irrigation on the Zulani site.

Table 7: Perimeter points of the suitable area from Figure 17 for the Lorraine site

Nr	X	Y
1	24.3109238	-28.9709729
2	24.3138788	-28.9727459
3	24.3155336	-28.9706183
4	24.3235712	-28.9736915
5	24.3267626	-28.9777104
6	24.3300722	-28.9739279
7	24.3350367	-28.9741643
8	24.3312542	-28.9764102
9	24.3331454	-28.9787742
10	24.3352731	-28.9780650
11	24.3384645	-29.0342101
12	24.3366915	-29.0355104
13	24.3340910	-29.0327917
14	24.3299540	-29.0313733
15	24.3288902	-29.0336191
16	24.3268808	-29.0326735
17	24.3253442	-29.0287729
18	24.3065504	-29.0273545
19	24.3028861	-29.0115157
20	24.3164792	-29.0083243

Table 8: Perimeter points of the suitable area from Figure 19 for the Bloubos site

Nr	X	Y
1	24.1308824	-28.9556889
2	24.1370686	-28.9545072
3	24.1880877	-28.9937794
4	24.1783565	-28.9939880
5	24.1748116	-28.9895394
6	24.1752287	-28.9876627
7	24.1738385	-28.9873847
8	24.1713362	-28.9878017
9	24.1685559	-28.9852299
10	24.1624391	-28.9854384
11	24.1602844	-28.9891224
12	24.1575040	-28.9897480

Table 9: Perimeter points of the suitable area from Figure 21 for the Zulani site

Nr	X	Y
1	24.1163207	-28.9584288
2	24.1120734	-28.9793881
3	24.1123504	-28.9880672
4	24.1070875	-28.9894522
5	24.0984084	-28.9830813
6	24.0837277	-28.9871439
7	24.0849280	-28.9886212
8	24.0804961	-28.9924068
9	24.0884366	-28.9931454
10	24.0889906	-28.9942534
11	24.0919452	-28.9954537
12	24.0936072	-29.0038559
13	24.0915759	-29.0071798
14	24.0788341	-29.0009013
15	24.0741252	-29.0023786
16	24.0744022	-28.9693239
17	24.0801268	-28.9648920

8. Conclusion

Pedological results indicate that 1 494 ha of Lorraine, 594 ha of Bloubos and 1 262 ha of Zulani is suitable for irrigation. Maps showing these areas are presented in the report.

9. References

Gee GW and Bauder JW, 1979. Particle size analysis by hydrometer: a simplified method for routine textural analysis and a sensitivity test of measured parameters. Soil Science Society of America Journal 43:1004-1007.

Soil Classification Working Group, 1991. Soil classification – a Taxonomical System for South Africa. Department of Agriculture, Pretoria.

White R E, 2006. Principles and Practice of Soil Science: The soil as a Natural Resource. 4th ed. Blackwell Science, Oxford, UK.

10. Appendices

Appendix 1a: Soil observation positions for the Lorraine site

Nr	X	Y	Nr	X	Y	Nr	X	Y	Nr	X	Y
1	24.3370729	-29.0151471	96	24.3171667	-28.9805528	191	24.3255056	-28.9789667	286	24.3123683	-29.0111500
2	24.3348353	-29.0154171	97	24.3172028	-28.9787833	192	24.3234861	-28.9789000	287	24.3102700	-29.0110950
3	24.3328487	-29.0150178	98	24.3171639	-28.9771194	193	24.3215917	-28.9785639	288	24.3083617	-29.0111533
4	24.3306450	-29.0150580	99	24.3152694	-28.9768111	194	24.3214556	-28.9752194	289	24.3183667	-29.0185367
5	24.3307438	-29.0133890	100	24.3132750	-28.9769167	195	24.3234833	-28.9752778	290	24.3162400	-29.0184217
6	24.3348086	-29.0133244	101	24.3132139	-28.9785444	196	24.3256556	-28.9752417	291	24.3142567	-29.0182933
7	24.3369935	-29.0135061	102	24.3153333	-28.9787917	197	24.3276639	-28.9753417	292	24.3122217	-29.0183067
8	24.3368946	-29.0114983	103	24.3155750	-28.9806278	198	24.3296611	-28.9754250	293	24.3100733	-29.0183317
9	24.3349366	-29.0115887	104	24.3132750	-28.9805000	199	24.3316167	-28.9753583	294	24.3078983	-29.0182650
10	24.3329625	-29.0116227	105	24.3132139	-28.9822278	200	24.3154028	-28.9733194	295	24.3181833	-29.0220450
11	24.3308783	-29.0115015	106	24.3151472	-28.9824389	201	24.3114583	-28.9732500	296	24.3161017	-29.0220667
12	24.3287639	-29.0113941	107	24.3172028	-28.9823000	202	24.3113250	-28.9713833	297	24.3161400	-29.0256850
13	24.3287280	-29.0097082	108	24.3193778	-28.9824222	203	24.3133806	-28.9714278	298	24.3160350	-29.0273933
14	24.3309166	-29.0097327	109	24.3196361	-28.9841806	204	24.3155111	-28.9717000	299	24.3180617	-29.0273950
15	24.3329473	-29.0098091	110	24.3171528	-28.9841583	205	24.3173500	-28.9716750	300	24.3223883	-29.0185417
16	24.3348847	-29.0097844	111	24.3151361	-28.9841833	206	24.3113500	-28.9697750	301	24.3221100	-29.0221550
17	24.3369027	-29.0098073	112	24.3130250	-28.9841861	207	24.3194081	-28.9769731	302	24.3262850	-29.0258783
18	24.3370060	-29.0080679	113	24.3151556	-28.9858694	208	24.3173383	-28.9750814	303	24.3264633	-29.0240967
19	24.3349956	-29.0080066	114	24.3171889	-28.9859000	209	24.3211064	-28.9859881	304	24.3284933	-29.0240633
20	24.3330087	-29.0079954	115	24.3191056	-28.9859806	210	24.3231800	-28.9879031	305	24.3305450	-29.0241717
21	24.3308321	-29.0080860	116	24.3232472	-28.9861778	211	24.3189631	-28.9877681	306	24.3325450	-29.0241200
22	24.3288863	-29.0078835	117	24.3210917	-28.9877611	212	24.3189214	-28.9895317	307	24.3346100	-29.0242383
23	24.3288085	-29.0060564	118	24.3171250	-28.9878417	213	24.3231247	-28.9896367	308	24.3367083	-29.0242367
24	24.3309406	-29.0059797	119	24.3147306	-28.9896167	214	24.3230947	-28.9914233	309	24.3367617	-29.0206233
25	24.3330702	-29.0061977	120	24.3170639	-28.9895278	215	24.3149831	-28.9913667	310	24.3367850	-29.0187800
26	24.3351402	-29.0061380	121	24.3211278	-28.9896556	216	24.3210150	-28.9951314	311	24.3347633	-29.0188550
27	24.3369219	-29.0064303	122	24.3188861	-28.9914694	217	24.3229980	-28.9951038	312	24.3346683	-29.0207100
28	24.3367906	-29.0043210	123	24.3169417	-28.9913389	218	24.3208450	-28.9968183	313	24.3326600	-29.0205100
29	24.3350553	-29.0044916	124	24.3147750	-28.9931250	219	24.3148567	-28.9949883	314	24.3305533	-29.0187783
30	24.3330635	-29.0044540	125	24.3167444	-28.9932417	220	24.3168667	-28.9949864	315	24.3326933	-29.0187417

Appendix 1a: Soil observation positions for the Lorraine site continued

Nr	X	Y	Nr	X	Y	Nr	X	Y	Nr	X	Y
31	24.3309815	-29.0043167	126	24.3210417	-28.9931972	221	24.3189214	-28.9986450	316	24.3245083	-29.0185883
32	24.3288832	-29.0041895	127	24.3228694	-28.9932750	222	24.3230633	-28.9987200	317	24.3041694	-29.0147289
33	24.3268060	-29.0042707	128	24.3229778	-28.9968500	223	24.3208983	-29.0005081	318	24.3062397	-29.0147289
34	24.3268975	-29.0025102	129	24.3190778	-28.9969833	224	24.3167297	-29.0005217	319	24.3083099	-29.0147289
35	24.3289688	-29.0024703	130	24.3167833	-28.9968806	225	24.3168333	-29.0022833	320	24.3102583	-29.0147289
36	24.3310938	-29.0024140	131	24.3166861	-28.9985833	226	24.3185347	-29.0022764	321	24.3122068	-29.0147289
37	24.3330189	-29.0025385	132	24.3208167	-28.9986528	227	24.3207367	-29.0022397	322	24.3142770	-29.0146071
38	24.3350714	-29.0026080	133	24.3228722	-29.0005056	228	24.3227333	-29.0023917	323	24.3311810	-28.9988103
39	24.3367058	-29.0026114	134	24.3189139	-29.0005722	229	24.3248700	-29.0023983	324	24.3330384	-28.9988103
40	24.3240462	-29.0276447	135	24.3166778	-29.0040806	230	24.3267781	-29.0078714	325	24.3350532	-28.9988103
41	24.3222708	-29.0275447	136	24.3186083	-29.0040639	231	24.3247731	-29.0078714	326	24.3349903	-29.0006362
42	24.3199833	-29.0276131	137	24.3206389	-29.0041306	232	24.3206500	-29.0076947	327	24.3329754	-29.0006047
43	24.3200466	-29.0293050	138	24.3225861	-29.0041917	233	24.3186717	-29.0075800	328	24.3310550	-29.0005732
44	24.3221123	-29.0292823	139	24.3248750	-29.0042278	234	24.3166550	-29.0076300	329	24.3289772	-29.0005103
45	24.3220289	-29.0311103	140	24.3247111	-29.0060583	235	24.3205664	-29.0112247	330	24.3269309	-29.0005103
46	24.3220992	-29.0329704	141	24.3266611	-29.0061750	236	24.3225100	-29.0114400	331	24.3201614	-29.0257467
47	24.3219319	-29.0346928	142	24.3226750	-29.0059500	237	24.3246083	-29.0132364	332	24.3202083	-29.0239017
48	24.3199469	-29.0347490	143	24.3206972	-29.0059028	238	24.3246933	-29.0113981	333	24.3203250	-29.0221397
49	24.3199577	-29.0328378	144	24.3187000	-29.0058611	239	24.3266214	-29.0132331	334	24.3159967	-29.0292150
50	24.3200509	-29.0311059	145	24.3164750	-29.0057417	240	24.3286650	-29.0150664	335	24.3138317	-29.0293297
51	24.3241869	-29.0293448	146	24.3204778	-29.0095417	241	24.3266097	-29.0150150	336	24.3118331	-29.0290647
52	24.3241376	-29.0310962	147	24.3227722	-29.0096056	242	24.3245681	-29.0150450	337	24.3099150	-29.0289864
53	24.3241514	-29.0329275	148	24.3245250	-29.0097028	243	24.3224567	-29.0149797	338	24.3078297	-29.0290400
54	24.3364747	-29.0350736	149	24.3268139	-29.0096139	244	24.3226231	-29.0131533	339	24.3078331	-29.0272500
55	24.3363598	-29.0332110	150	24.3266583	-29.0114361	245	24.3204700	-29.0130681	340	24.3098133	-29.0273147
56	24.3364164	-29.0312808	151	24.3287806	-29.0131889	246	24.3204517	-29.0149879	341	24.3119278	-29.0273170
57	24.3382928	-29.0316670	152	24.3285861	-29.0169972	247	24.3289917	-28.9987800	342	24.3139250	-29.0273900
58	24.3383739	-29.0332939	153	24.3265972	-29.0170472	248	24.3270664	-28.9952083	343	24.3140750	-29.0256417
59	24.3181911	-29.0095306	154	24.3245556	-29.0168444	249	24.3311567	-28.9952297	344	24.3119583	-29.0255100
60	24.3165264	-29.0094497	155	24.3224250	-29.0167556	250	24.3333397	-28.9953350	345	24.3099350	-29.0254700
61	24.3144267	-29.0094408	156	24.3203861	-29.0167139	251	24.3354531	-28.9918264	346	24.3078700	-29.0255300
62	24.3041961	-29.0128678	157	24.3203250	-29.0186000	252	24.3333731	-28.9917147	347	24.3078367	-29.0236600

Appendix 1a: Soil observation positions for the Lorraine site continued

Nr	X	Y	Nr	X	Y	Nr	X	Y	Nr	X	Y
63	24.3081856	-29.0129486	158	24.3250472	-29.0003250	253	24.3312897	-28.9917364	348	24.3097917	-29.0237667
64	24.3102497	-29.0128314	159	24.3268861	-28.9988333	254	24.3272233	-28.9915647	349	24.3119617	-29.0237533
65	24.3122517	-29.0128933	160	24.3250056	-28.9987667	255	24.3272431	-28.9897397	350	24.3139747	-29.0237847
66	24.3143667	-29.0130325	161	24.3270639	-28.9970167	256	24.3335047	-28.9900164	351	24.3142781	-29.0219081
67	24.3183419	-29.0131167	162	24.3311778	-28.9971361	257	24.3354731	-28.9899100	352	24.3120783	-29.0218447
68	24.3183881	-29.0167286	163	24.3352556	-28.9952972	258	24.3355750	-28.9863583	353	24.3097864	-29.0217547
69	24.3142164	-29.0165958	164	24.3353944	-28.9936111	259	24.3314056	-28.9862785	354	24.3079947	-29.0219700
70	24.3122194	-29.0165194	165	24.3334000	-28.9933250	260	24.3294831	-28.9862764	355	24.3059864	-29.0217117
71	24.3101894	-29.0165683	166	24.3312778	-28.9934056	261	24.3272800	-28.9862450	356	24.3058300	-29.0199737
72	24.3081222	-29.0164994	167	24.3270917	-28.9934000	262	24.3253533	-28.9861367	357	24.3079081	-29.0201647
73	24.3059572	-29.0164853	168	24.3252972	-28.9879694	263	24.3233267	-28.9843567	358	24.3100400	-29.0200500
74	24.3060514	-29.0181703	169	24.3273361	-28.9880667	264	24.3212964	-28.9823964	359	24.3118464	-29.0201081
75	24.3182614	-29.0201736	170	24.3294556	-28.9880556	265	24.3232464	-28.9824097	360	24.3142114	-29.0201417
76	24.3161292	-29.0203031	171	24.3313000	-28.9880611	266	24.3253147	-28.9825250	361	24.3262431	-29.0277014
77	24.3161772	-29.0238406	172	24.3333694	-28.9880917	267	24.3274067	-28.9826117	362	24.3283081	-29.0276983
78	24.3181969	-29.0238106	173	24.3355083	-28.9881028	268	24.3294681	-28.9825650	363	24.3302767	-29.0277217
79	24.3180839	-29.0256392	174	24.3354278	-28.9844750	269	24.3314881	-28.9826697	364	24.3324214	-29.0278150
80	24.3202753	-29.0203419	175	24.3336611	-28.9845028	270	24.3335817	-28.9827431	365	24.3343581	-29.0277433
81	24.3224303	-29.0239239	176	24.3314417	-28.9844361	271	24.3336847	-28.9772997	366	24.3365431	-29.0260350
82	24.3242081	-29.0257733	177	24.3294194	-28.9844778	272	24.3316150	-28.9772300	367	24.3346000	-29.0260897
83	24.3243264	-29.0239608	178	24.3273500	-28.9843333	273	24.3294814	-28.9772150	368	24.3366985	-29.0278759
84	24.3244800	-29.0222644	179	24.3253306	-28.9843722	274	24.3276450	-28.9771850	369	24.3381000	-29.0281281
85	24.3243978	-29.0204414	180	24.3212194	-28.9842361	275	24.3254564	-28.9770447	370	24.3382233	-29.0297247
86	24.3283592	-29.0258653	181	24.3213222	-28.9806667	276	24.3234547	-28.9770317	371	24.3363567	-29.0295233
87	24.3304467	-29.0259019	182	24.3253472	-28.9807694	277	24.3213764	-28.9769533	372	24.3343750	-29.0296517
88	24.3366781	-29.0224028	183	24.3275056	-28.9807917	278	24.3337717	-28.9754733	373	24.3325264	-29.0296683
89	24.3346178	-29.0224397	184	24.3295167	-28.9807111	279	24.3132200	-28.9751400	374	24.3323364	-29.0313183
90	24.3325886	-29.0223275	185	24.3315194	-28.9809722	280	24.3308388	-29.0170426	375	24.3323497	-29.0331447
91	24.3305356	-29.0206328	186	24.3336972	-28.9809139	281	24.3325437	-29.0170426	376	24.3301083	-29.0329750
92	24.3305058	-29.0223381	187	24.3336444	-28.9791444	282	24.3348575	-29.0170426	377	24.3284067	-29.0332047
93	24.3192083	-28.9753028	188	24.3316472	-28.9790333	283	24.3366842	-29.0170426	378	24.3285064	-29.0303864
94	24.3194833	-28.9787417	189	24.3295472	-28.9790389	284	24.3183783	-29.0113167			
95	24.3194778	-28.9805472	190	24.3275306	-28.9789917	285	24.3144100	-29.0111783			

Appendix 1b: Soil observation positions for the Bloubos site

Nr	X	Y	Nr	X	Y	Nr	X	Y	Nr	X	Y
1	24.1522171	-28.9826114	26	24.1478661	-28.9633060	51	24.1532330	-28.9749310	76	24.1712133	-28.9871033
2	24.1554466	-28.9867225	27	24.1542034	-28.9681413	52	24.1534360	-28.9727890	77	24.1591433	-28.9830683
3	24.1568835	-28.9868457	28	24.1523102	-28.9679590	53	24.1585830	-28.9748280	78	24.1609883	-28.9812350
4	24.1611404	-28.9832573	29	24.1499664	-28.9680729	54	24.1535250	-28.9704440	79	24.1592133	-28.9812300
5	24.1815776	-28.9930647	30	24.1407749	-28.9656612	55	24.1512000	-28.9704690	80	24.1573017	-28.9813067
6	24.1756280	-28.9853848	31	24.1407815	-28.9636971	56	24.1483060	-28.9679580	81	24.1552617	-28.9812183
7	24.1712141	-28.9853249	32	24.1380849	-28.9640016	57	24.1483940	-28.9659280	82	24.1554733	-28.9776183
8	24.1712677	-28.9833992	33	24.1531940	-28.9841670	58	24.1458560	-28.9658810	83	24.1576183	-28.9776033
9	24.1694462	-28.9814515	34	24.1559860	-28.9839440	59	24.1432440	-28.9658360	84	24.1594467	-28.9775983
10	24.1675342	-28.9814429	35	24.1585750	-28.9858860	60	24.1431560	-28.9635250	85	24.1625950	-28.9757100
11	24.1653335	-28.9797304	36	24.1586080	-28.9879830	61	24.1433780	-28.9612810	86	24.1615450	-28.9759550
12	24.1676030	-28.9796766	37	24.1635860	-28.9840860	62	24.1405500	-28.9612890	87	24.1619967	-28.9746867
13	24.1655222	-28.9779213	38	24.1664190	-28.9839890	63	24.1383250	-28.9614250	88	24.1609117	-28.9737583
14	24.1634582	-28.9779029	39	24.1789440	-28.9931030	64	24.1383140	-28.9588170	89	24.1452900	-28.9704433
15	24.1615591	-28.9778426	40	24.1840920	-28.9931720	65	24.1383890	-28.9566970	90	24.1457133	-28.9684333
16	24.1591687	-28.9760168	41	24.1790940	-28.9885860	66	24.1357110	-28.9567560	91	24.1431833	-28.9684233
17	24.1553082	-28.9728420	42	24.1737830	-28.9884970	67	24.1331060	-28.9566860	92	24.1490050	-28.9774767
18	24.1557046	-28.9704654	43	24.1739530	-28.9840640	68	24.1432940	-28.9702860	93	24.1553850	-28.9756267
19	24.1575020	-28.9706367	44	24.1686970	-28.9839940	69	24.1482890	-28.9702560	94	24.1509417	-28.9810550
20	24.1572545	-28.9726686	45	24.1638580	-28.9814970	70	24.1491100	-28.9788400	95	24.1360197	-28.9614517
21	24.1594372	-28.9726297	46	24.1635640	-28.9795470	71	24.1773483	-28.9907167	96	24.1405850	-28.9589281
22	24.1452020	-28.9727145	47	24.1612030	-28.9793670	72	24.1793133	-28.9907883	97	24.1359997	-28.9587800
23	24.1410485	-28.9683431	48	24.1585690	-28.9796030	73	24.1791450	-28.9885817	98	24.1337200	-28.9589014
24	24.1452855	-28.9613087	49	24.1559000	-28.9793670	74	24.1754250	-28.9888250			
25	24.1453924	-28.9634158	50	24.1533470	-28.9815000	75	24.1773350	-28.9871833			

Appendix 1c: Soil observation positions for the Zulani site

Nr	X	Y	Nr	X	Y	Nr	X	Y	Nr	X	Y
1	24.0765611	-28.9743833	61	24.0927938	-28.9719049	121	24.1073250	-28.9877733	181	24.0985967	-28.9800367
2	24.0767056	-28.9700750	62	24.0907438	-28.9718818	122	24.1042533	-28.9858983	182	24.0996867	-28.9746983
3	24.0758167	-28.9965028	63	24.0884646	-28.9718286	123	24.1111450	-28.9786300	183	24.1008433	-28.9721217
4	24.0813194	-28.9655083	64	24.0844252	-28.9712156	124	24.1098200	-28.9748650	184	24.1031233	-28.9721867
5	24.0920667	-28.9655583	65	24.0821716	-28.9713981	125	24.1123200	-28.9726717	185	24.1007450	-28.9702167
6	24.0972000	-28.9656361	66	24.0801077	-28.9715909	126	24.1125983	-28.9657417	186	24.1030750	-28.9665767
7	24.1122639	-28.9793806	67	24.0798990	-28.9734382	127	24.1146883	-28.9638267	187	24.1030867	-28.9665800
8	24.1126417	-28.9611556	68	24.0798911	-28.9751199	128	24.1124583	-28.9637367	188	24.1049717	-28.9660550
9	24.1073556	-28.9656778	69	24.0798999	-28.9772191	129	24.1005530	-28.9819860	189	24.1030550	-28.9643733
10	24.1075583	-28.9615528	70	24.0801987	-28.9786160	130	24.1023670	-28.9814170	190	24.1008767	-28.9641683
11	24.1073694	-28.9700806	71	24.0799493	-28.9802919	131	24.1046890	-28.9811080	191	24.0985150	-28.9642533
12	24.1033528	-28.9737389	72	24.0800022	-28.9824152	132	24.1066000	-28.9806640	192	24.0974217	-28.9639767
13	24.1072111	-28.9791306	73	24.0801321	-28.9841631	133	24.1087330	-28.9803080	193	24.0947683	-28.9642517
14	24.1020472	-28.9791750	74	24.0799566	-28.9859754	134	24.1106970	-28.9801940	194	24.0928183	-28.9641350
15	24.1021944	-28.9744444	75	24.0778337	-28.9860324	135	24.1087310	-28.9822330	195	24.0886050	-28.9644550
16	24.1022028	-28.9699000	76	24.0779741	-28.9839893	136	24.1040530	-28.9832670	196	24.0868267	-28.9642750
17	24.1022139	-28.9656250	77	24.0780305	-28.9822543	137	24.0985750	-28.9822360	197	24.0844517	-28.9677350
18	24.1028167	-28.9619500	78	24.0781794	-28.9805869	138	24.1125190	-28.9702530	198	24.0865833	-28.9679000
19	24.0970889	-28.9699778	79	24.0779259	-28.9787952	139	24.1027810	-28.9612110	199	24.0887850	-28.9678633
20	24.0968694	-28.9745833	80	24.0781036	-28.9771803	140	24.0867970	-28.9654750	200	24.0905800	-28.9679433
21	24.0762444	-28.9969083	81	24.0757953	-28.9805342	141	24.0919140	-28.9699750	201	24.0928100	-28.9680750
22	24.0920611	-28.9745806	82	24.0757381	-28.9894834	142	24.0866530	-28.9699360	202	24.0948167	-28.9680667
23	24.0885972	-28.9792278	83	24.0778440	-28.9894165	143	24.0816470	-28.9698810	203	24.0968717	-28.9681067
24	24.0861639	-28.9767611	84	24.0789806	-28.9895731	144	24.0837250	-28.9730670	204	24.0986300	-28.9681100
25	24.0867000	-28.9834250	85	24.0798662	-28.9894465	145	24.0866610	-28.9744690	205	24.0948017	-28.9738433
26	24.0815667	-28.9900944	86	24.0807787	-28.9944804	146	24.0890250	-28.9741580	206	24.0925967	-28.9737750
27	24.0765278	-28.9790361	87	24.0788359	-28.9945649	147	24.0917690	-28.9792170	207	24.0904767	-28.9737333
28	24.0817194	-28.9743333	88	24.0766536	-28.9945786	148	24.0943920	-28.9786360	208	24.0840283	-28.9771983
29	24.0759472	-29.0011806	89	24.0787925	-28.9981106	149	24.0968810	-28.9794030	209	24.0821333	-28.9771800
30	24.0761611	-28.9969056	90	24.0826380	-28.9983647	150	24.0919030	-28.9804420	210	24.0884967	-28.9766717
31	24.0763639	-28.9924722	91	24.0848234	-28.9981648	151	24.0875470	-28.9819060	211	24.0903433	-28.9758750
32	24.0818111	-28.9879806	92	24.0868833	-28.9986892	152	24.0866500	-28.9788810	212	24.0948700	-28.9757550

Appendix 1c: Soil observation positions for the Zulani site continued

Nr	X	Y	Nr	X	Y	Nr	X	Y	Nr	X	Y
33	24.0866611	-28.9970028	93	24.0889447	-28.9985784	153	24.0817060	-28.9786470	213	24.0927900	-28.9769667
34	24.0814028	-29.0016167	94	24.0805424	-29.0045925	154	24.0826690	-28.9806060	214	24.0907250	-28.9772300
35	24.0815500	-28.9970389	95	24.0785333	-29.0044891	155	24.0815860	-28.9834470	215	24.0905950	-28.9821617
36	24.0849694	-28.9917167	96	24.0763144	-29.0042984	156	24.0759690	-28.9757080	216	24.0854017	-28.9808717
37	24.1120500	-28.9842444	97	24.0845776	-28.9658380	157	24.0763420	-28.9879310	217	24.0758633	-28.9859333
38	24.1021188	-28.9791304	98	24.1087939	-28.9842723	158	24.0813860	-28.9924860	218	24.0757017	-28.9826683
39	24.0986245	-28.9782100	99	24.1087413	-28.9859562	159	24.0883920	-28.9954190	219	24.0798450	-28.9877433
40	24.1070724	-28.9726795	100	24.1087939	-28.9881137	160	24.0913060	-28.9967640	220	24.0780600	-28.9877633
41	24.1073341	-28.9700875	101	24.1108988	-28.9859036	161	24.0952640	-28.9886940	221	24.0780500	-28.9877983
42	24.1071091	-28.9680726	102	24.1088992	-28.9785890	162	24.0964530	-28.9822670	222	24.0774883	-28.9912717
43	24.1052944	-28.9680067	103	24.1111619	-28.9767472	163	24.0945440	-28.9828690	223	24.0788050	-28.9925900
44	24.1030969	-28.9681355	104	24.1093728	-28.9766420	164	24.0925140	-28.9833560	224	24.0801267	-28.9910483
45	24.1009193	-28.9682411	105	24.1071100	-28.9766946	165	24.0906610	-28.9838530	225	24.0787967	-28.9964667
46	24.1052642	-28.9643056	106	24.1049525	-28.9765368	166	24.0886190	-28.9843440	226	24.0815317	-28.9969967
47	24.1052865	-28.9623931	107	24.1031107	-28.9764315	167	24.0867640	-28.9848470	227	24.0829533	-28.9963283
48	24.1007828	-28.9627411	108	24.1009531	-28.9764315	168	24.0848030	-28.9855030	228	24.0849450	-28.9962717
49	24.1008779	-28.9665464	109	24.0984799	-28.9764315	169	24.0827470	-28.9862830	229	24.0869267	-28.9953333
50	24.0988472	-28.9666497	110	24.1070047	-28.9745897	170	24.0759110	-29.0063440	230	24.0889050	-29.0005583
51	24.0904189	-28.9658945	111	24.1094780	-28.9725901	171	24.0793360	-29.0096440	231	24.0869050	-29.0003250
52	24.0886768	-28.9658555	112	24.1094780	-28.9702747	172	24.0796170	-29.0023940	232	24.0847617	-29.0001017
53	24.0844083	-28.9699147	113	24.1097411	-28.9681698	173	24.0826690	-29.0058250	233	24.0827217	-29.0000567
54	24.0887785	-28.9698391	114	24.1098990	-28.9656965	174	24.0864670	-29.0069310	234	24.0808233	-28.9999750
55	24.0905889	-28.9696410	115	24.1097411	-28.9636442	175	24.0857530	-29.0031250	235	24.0787083	-28.9999333
56	24.0970936	-28.9699654	116	24.1099516	-28.9612236	176	24.0912810	-29.0017330	236	24.0765550	-28.9998667
57	24.0990287	-28.9701439	117	24.1066683	-28.9823117	177	24.0940810	-29.0019030	237	24.0763350	-29.0014000
58	24.0987293	-28.9720382	118	24.1066733	-28.9841383	178	24.0909310	-29.0054440	238	24.0765217	-29.0022933
59	24.0967764	-28.9720026	119	24.1066417	-28.9859417	179	24.1071450	-28.9791500			
60	24.0949852	-28.9719268	120	24.1066867	-28.9879967	180	24.1006833	-28.9799583			

Appendix 2: Modal soil profile descriptions

General Information						
Site:	Lorraine				Soil form:	Hutton
Map/Photo example:	Figure 5a				Soil family:	
GPS Position:	24.336791 -29.004321				Colour	Red
Surface stones:	0%				Occurrence of flooding:	None
Altitude:	1116 m				Wind erosion potential:	Medium
Terrain unit:	Mid slope				Water erosion potential:	Low
Slope:	0%				Vegetation/Land use:	Natural Veld
Slope shape:	Planform	Straight	Profile	Straight	Water table:	None
Aspect:	None					
Micro-relief:	None				Described by:	C du Plessis
Parent material solum:	Aeolian sands				Date described:	2017-05-24
Geological group:	Vertersdorp Supergroup				Weathering of underlying material:	Not reached

Profile Information						
Horizon Depth (mm)	*Diagnostic Horizon*	*Colour*	*Structure*	*Redoximorphic features*	*Lime*	*Transition*
A 300	Orthic A	Red	apedal	None	None	Diffuse
B 2200+	Red Apedal B	Red	apedal	None	None	None

General Information						
Site:	Bloubos				Soil form:	Plooysburg
Map/Photo example:	Figure 5b				Soil family:	
GPS Position:	24.157255 -28.972669				Colour	Red
Surface stones:	0%				Occurrence of flooding:	None
Altitude:	1078 m				Wind erosion potential:	Medium
Terrain unit:	Mid slope				Water erosion potential:	Low
Slope:	0%				Vegetation/Land use:	Natural Veld
Slope shape:	Planform	Straight	Profile	Straight	Water table:	None
Aspect:	None					
Micro-relief:	None				Described by:	C du Plessis
Parent material solum:	Aeolian sands				Date described:	2017-05-24
Geological group:	Vertersdorp Supergroup				Weathering of underlying material:	Not reached

Profile Information

Horizon Depth (mm)	*Diagnostic Horizon*	*Colour*	*Structure*	*Redoximorphic features*	*Lime*	*Transition*
A 300	Orthic A	Red	apedal	None	None	Diffuse
B 1800	Red Apedal B	Red	apedal	None	None	Clear
B1 2100	Neocarbonate B	Red	apedal	None	Present	Abrupt
C 2100	Hard Carbonate	White	Massive	None	Present	None

General Information						
Site:	Zulani				Soil form:	Prieska
Map/Photo example:	Figure 5c				Soil family:	
GPS Position:	24,079336; -29,009644				Colour	Red
Surface stones:	0%				Occurrence of flooding:	None
Altitude:	1113 m				Wind erosion potential:	Medium
Terrain unit:	Mid slope				Water erosion potential:	Low
Slope:	0%				Vegetation/Land use:	Natural Veld
Slope shape:	Planform	Straight	Profile	Straight	Water table:	None
Aspect:	None					
Micro-relief:	None				Described by:	C Du Plessis
Parent material solum:	Aeolian sands				Date described:	2017-05-24
Geological group:	Vertersdorp Supergroup				Weathering of underlying material:	Not reached

Profile Information

Horizon Depth (mm)	*Diagnostic Horizon*	*Colour*	*Structure*	*Redoximorphic features*	*Lime*	*Transition*
A 200	Orthic A	Red	apedal	None	None	Diffuse
B 1200	Neocarbonate B	Red	apedal	None	Yes	Clear
C 1200+	Hard Carbonate	White	Massive	None	Yes	None

General Information						
Site:	Lorraine				Soil form:	Kimberley
Map/Photo example:	Figure 5d				Soil family:	
GPS Position:	24,332849; -29,015018				Colour	Red
Surface stones:	0%				Occurrence of flooding:	None
Altitude:	1119 m				Wind erosion potential:	Medium
Terrain unit:	Mid slope				Water erosion potential:	Low
Slope:	0%				Vegetation/Land use:	Natural Veld
Slope shape:	Planform	Straight	Profile	Straight	Water table:	None
Aspect:	None					
Micro-relief:	None				Described by:	C Du Plessis
Parent material solum:	Aeolian sands				Date described:	2017-05-24
Geological group:	Vertersdorp Supergroup				Weathering of underlying material:	Not reached

Profile Information						
Horizon Depth (mm)	*Diagnostic Horizon*	*Colour*	*Structure*	*Redoximorphic features*	*Lime*	*Transition*
A 200	Orthic A	Red	apedal	None	None	Diffuse
B 1500	Red ApedalB	Red	apedal	None	None	Clear
B1 2000	Neocarbonate B	Red	apedal	None	Yes	Clear
C 2200+	Soft Carbonate	White	Massive	None	Yes	None

Appendix 3: Chemical soil properties

Nr	Soil Form	Horizon	pH	Resistance	H+	Stone	P mg/kg		K	C	Dissolveable S	Acid Saturation
			KCl	Ohm	cmol/kg	(vol%)	Olsen	BrayII	mg/kg	%	mg/kg	%
DSA 160	Hutton	Orthic A	5.3	3310	0.27	1		1	64	0.37	7.27	8.18
DSA 161		Red Apedal B	5.5	3780	0.23	1		0	62	0.3	9.27	6.46
DSA 162		Red Apedal B	5.6	2380	0.2	1		1	60	0.24	9.29	4.93
DSA 163	Hutton	Orthic A	5.6	2330	0.28	1		1	77	0.42	7.11	5.48
DSA 164		Red Apedal B	5.9	1360	0.11	1		1	60	0.4	10.14	1.75
DSA 165		Red Apedal B	5.8	4010	0.24	1		1	38	0.57	7.68	8.41
DSA 166	Plooysburg	Orthic A	5.8	4040	0.2	1		1	100	1.48	7.19	4.15
DSA 167		Red Apedal B	5.7	3230	0.18	1		1	51	0.36	5.74	3.48
DSA 168	Plooysburg	Orthic A	5.8	3830	0.21	1		1	111	0.51	4.9	4.9
DSA 169		Red Apedal B	5.9	4260	0.24	1		1	74	0.35	5.81	5.53
DSA 170		Neocarbonate B	7.1	2200		1	1	2	53	0.76	10.95	0
DSA 171	Kimberley	Orthic A	6.4	3110		1		1	81	0.26	6.28	0
DSA 172		Red Apedal B	6.4	1740		1		0	70	0.28	11.75	0
DSA 173		Neocarbonate B	7.1	1510		1	1	1	67	0.36	9.57	0
DSA 174		Soft Carbonate	7.4	900		11	1	1	80	0.25	27.81	0
DSA 175	Hutton	Orthic A	7.5	2440		1	2	0	95	0.44	7.13	0
DSA 176		Red Apedal B	7.2	2040		1	1	1	83	0.3	7.97	0
DSA 177	Hutton	Orthic A	6.5	7380		1		3	54	0.51	6.2	0
DSA 178		Red Apedal B	6.4	4260		1		1	60	0.25	6.11	0

Appendix 3: Chemical soil properties continued

Nr	Soil Form	Horizon	Exchangeable Cations				Na	K	Ca	Mg	T-Value
			Na	K	Ca	Mg	%	%	%	%	cmol/kg
DSA 160	Hutton	Orthic A	0.05	0.16	1.77	1.04	1.55	4.96	53.72	31.59	3.3
DSA 161		Red Apedal B	0.05	0.16	1.8	1.32	1.42	4.48	50.69	36.96	3.56
DSA 162		Red Apedal B	0.05	0.15	2.03	1.62	1.21	3.81	50.16	39.88	4.06
DSA 163	Hutton	Orthic A	0.06	0.2	2.54	2.04	1.13	3.86	49.63	39.9	5.11
DSA 164		Red Apedal B	0.07	0.15	3.14	2.83	1.1	2.42	49.86	44.87	6.3
DSA 165		Red Apedal B	0.05	0.1	1.12	1.35	1.74	3.38	39.15	47.31	2.85
DSA 166	Plooysburg	Orthic A	0.05	0.26	3.02	1.3	1.03	5.3	62.54	26.99	4.82
DSA 167		Red Apedal B	0.05	0.13	3.54	1.27	0.93	2.5	68.48	24.6	5.17
DSA 168	Plooysburg	Orthic A	0.05	0.28	1.7	2.03	1.17	6.63	39.81	47.49	4.28
DSA 169		Red Apedal B	0.05	0.19	2.14	1.72	1.23	4.36	49.19	39.69	4.34
DSA 170		Neocarbonate B	0.07	0.14	10.46	2.27	0.56	1.06	80.85	17.53	12.94
DSA 171	Kimberley	Orthic A	0.06	0.21	3.31	1.68	1.1	3.94	63.02	31.95	5.25
DSA 172		Red Apedal B	0.06	0.18	4.79	1.97	0.83	2.55	68.43	28.2	7
DSA 173		Neocarbonate B	0.07	0.17	14.77	2.09	0.42	0.99	86.34	12.24	17.11
DSA 174		Soft Carbonate	0.12	0.2	18.37	3.34	0.52	0.92	83.4	15.15	22.02
DSA 175	Hutton	Orthic A	0.05	0.24	4.28	1.43	0.81	4.07	71.32	23.81	6
DSA 176		Red Apedal B	0.07	0.21	3.55	3.02	1	3.09	51.78	44.13	6.85
DSA 177	Hutton	Orthic A	0.04	0.14	1.79	0.85	1.44	4.88	63.64	30.04	2.82
DSA 178		Red Apedal B	0.05	0.15	2.44	1.84	1.14	3.44	54.35	41.06	4.48

Appendix 3: Chemical soil properties continued: Saturated paste extract

Sample	Soil Form	Horizon	pH	EC	P	Na	K	Ca	Mg	Cl	SO4	NH4-N	NO3-N
				mS/m	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
DSA160	Hutton	Orthic A	7.0	5	0.19	0.74	8.52	4.13	2.85	8.55	2.07	0.60	1.13
DSA 161		Red Apedal B	7.1	5	0.35	0.59	8.25	3.51	3.37	8.20	2.20	0.65	0.50
DSA 162		Red Apedal B	6.9	7	0.12	1.45	8.35	5.67	4.17	7.45	9.84	0.53	1.15
DSA 163	Hutton	Orthic A	7.0	6	0.15	0.69	6.66	4.33	3.46	8.20	2.53	0.58	1.62
DSA 164		Red Apedal B	7.0	9	0.14	1.37	3.76	7.74	4.84	9.27	13.17	0.24	1.75
DSA 165		Red Apedal B	7.2	5	0.15	1.23	6.55	2.90	3.03	8.20	3.36	0.48	1.27
DSA 166	Plooysburg	Orthic A	7.6	4	0.22	0.79	7.46	3.99	2.53	14.04	2.42	0.81	0.23
DSA 167		Red Apedal B	7.7	4	0.17	0.42	3.27	4.29	2.47	17.28	1.16	0.63	0.09
DSA 168	Plooysburg	Orthic A	7.3	5	5.81	0.57	8.31	8.85	3.69	10.08	1.59	0.54	0.00
DSA 169		Red Apedal B	7.6	2	0.26	0.52	7.48	3.11	9.17	7.92	1.40	0.76	0.08
DSA 170		Neocarbonate B	7.5	8	0.06	2.20	1.80	12.24	5.42	11.16	9.85	0.14	0.07
DSA 171	Kimberley	Orthic A	7.5	3	0.21	0.30	5.20	3.44	2.96	8.64	1.85	0.79	0.08
DSA 172		Red Apedal B	7.5	5	0.14	0.99	4.01	8.63	3.86	9.72	12.03	0.52	0.71
DSA 173		Neocarbonate B	7.9	11	0.08	2.18	3.71	19.23	4.08	10.08	9.51	0.26	0.83
DSA 174		Soft Carbonate	7.7	18	0.11	5.39	3.05	31.28	8.72	14.40	50.26	0.18	1.27
DSA 175	Hutton	Orthic A	7.9	9	0.25	1.05	10.98	13.06	4.97	6.48	2.16	0.89	0.40
DSA 176		Red Apedal B	7.7	7	0.18	2.47	5.49	7.19	5.46	6.84	7.36	0.78	0.83
DSA 177	Hutton	Orthic A	7.4	3	0.24	1.08	6.91	2.82	2.66	8.64	1.72	2.08	0.31
DSA 178		Red Apedal B	7.2	2	0.62	0.89	22.87	6.04	12.25	5.40	1.27	4.23	0.05

Appendix 4: Agronomical Report

1. General soil requirements for potato production

Potatoes grows optimally in coarse textured soils, with less than 25% clay, which is more than a metre deep. Sand to Sandy-loam soils with a reasonable amount of organic carbon is especially productive. A pH of between 6 – 6.5 is optimal, although potatoes tolerate a wide range of pH values, from acidic to alkaline. Common scab could be suppressed in a soil with a pH value below 5.4. As potatoes grow well in sandy soils, the fertility of the soils need not be high, but fertilization is necessary for optimal production. Fertility corrections a year before planting is ideal, specifically for Calcium. Potatoes can be produced optimally in soils with an ECe value of below 170mS.m^{-1}.

2. Specific Idstone Farming situation.

2.1. Soil Depth

The soil depth of all three the portions which is deemed suitable for irrigation is deeper than 1.5 m, which is suitable for potato production.

2.2. Soil texture

The soil on all three sites has a clay percentage of around 10% (9-13%). This means that the soil will be well aerated and freely drained, which is ideal for potato production. The texture classifications are all within the classes Sand, Loamy Sand and Sandy Loam, which are the most ideal texture classes for potato production.

2.4. pH

The pH values generally are slightly acidic, between 5.3 and 6.4, measured in KCl. This is ideal to slightly acid for potatoes, but can be corrected easily with lime application. The pH of the free carbonate containing soil horizons are alkaline, but they occupy such a small area, that it should not influence potato production much on these sites.

2.5. Fertility

For the non-free carbonate containing soil horizons, the T-value is very low (2.85 – 7 cmol/kg), which means that fertilization management is critical for optimal production. The fertility of the free carbonate containing horizons are as expected higher, but again the area they occupy is too small to influence potato production.

2.6. Salinity and sodicity

The resistivity values of above 900 ohms and EC values below 18 mS/m show that salt build-up is not close to detrimental levels for potatoes. The ESP of between 0.42 and 1.74 is also an indication that sodium will not cause structural breakdown of the soil aggregates.

3. Conclusions

Based on morphological, physical and chemical observations and measurements, the suitable soils on all three sites (Lorraine, Bloubos and Zulani) of Idstone Farming are suitable for potato production.