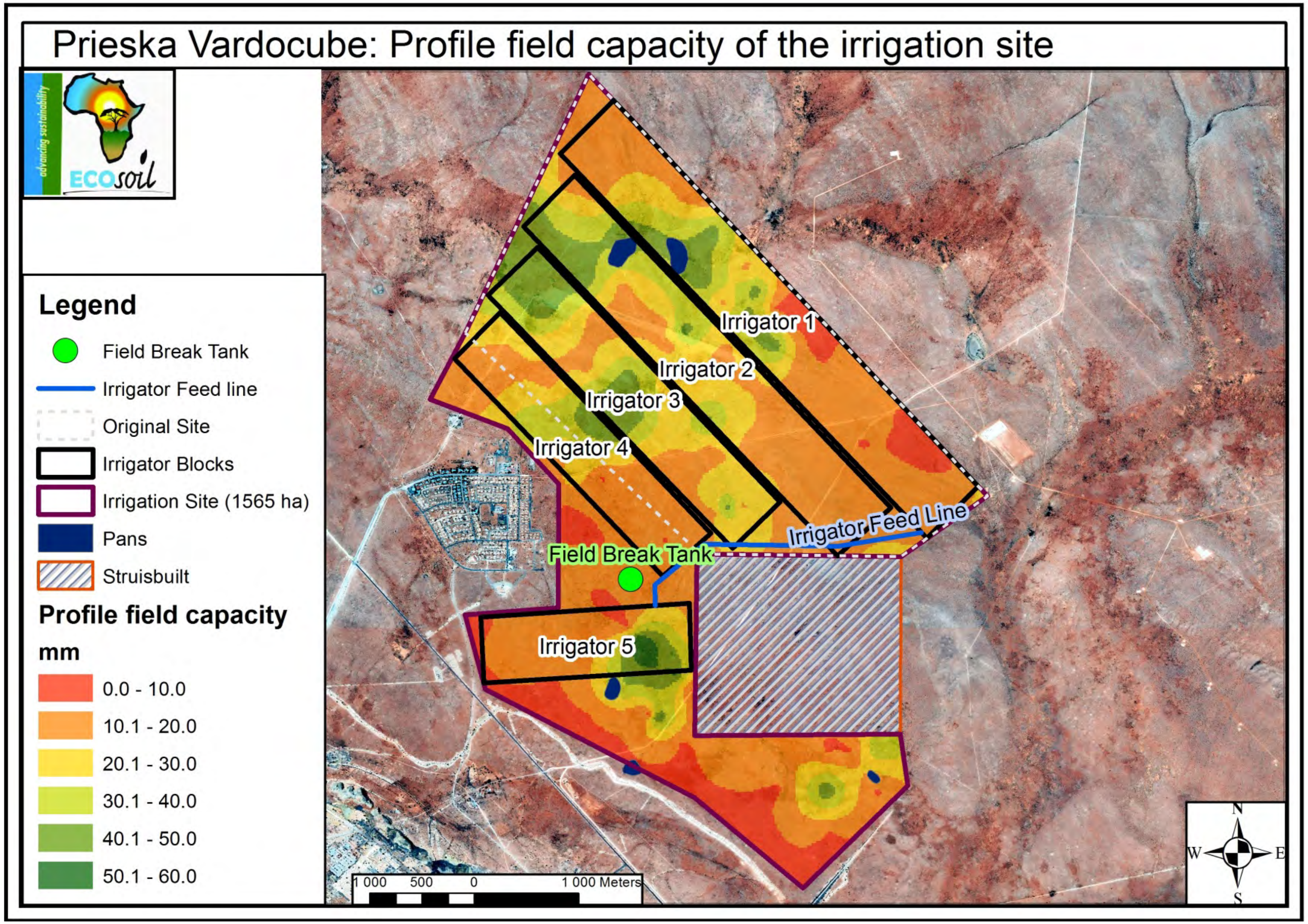

Figure 10. Profile water content at field capacity at the PCZM-Vardocube proposed irrigation site

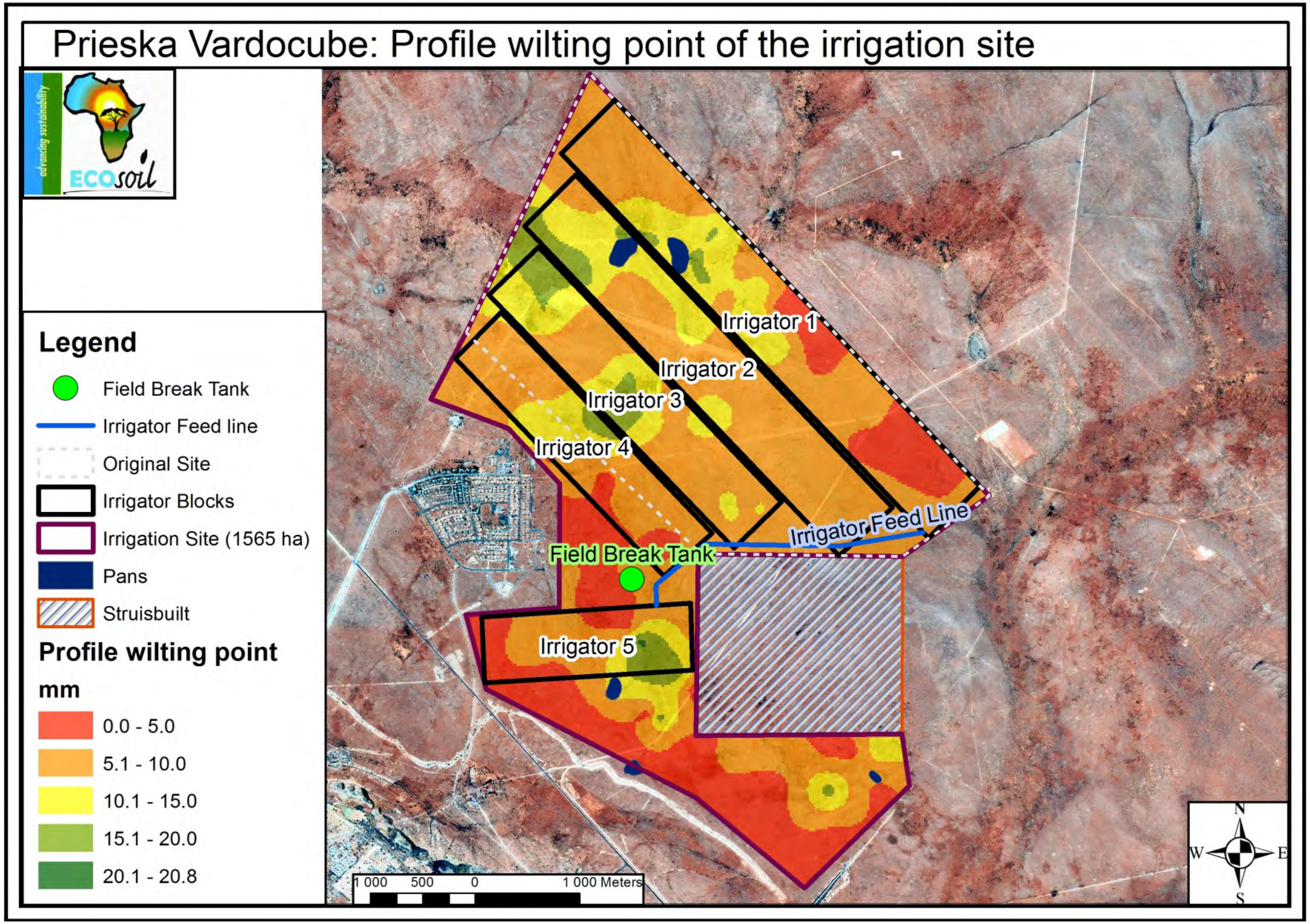

Figure 11. Profile water content at wilting point at the PCZM-Vardocube proposed irrigation site

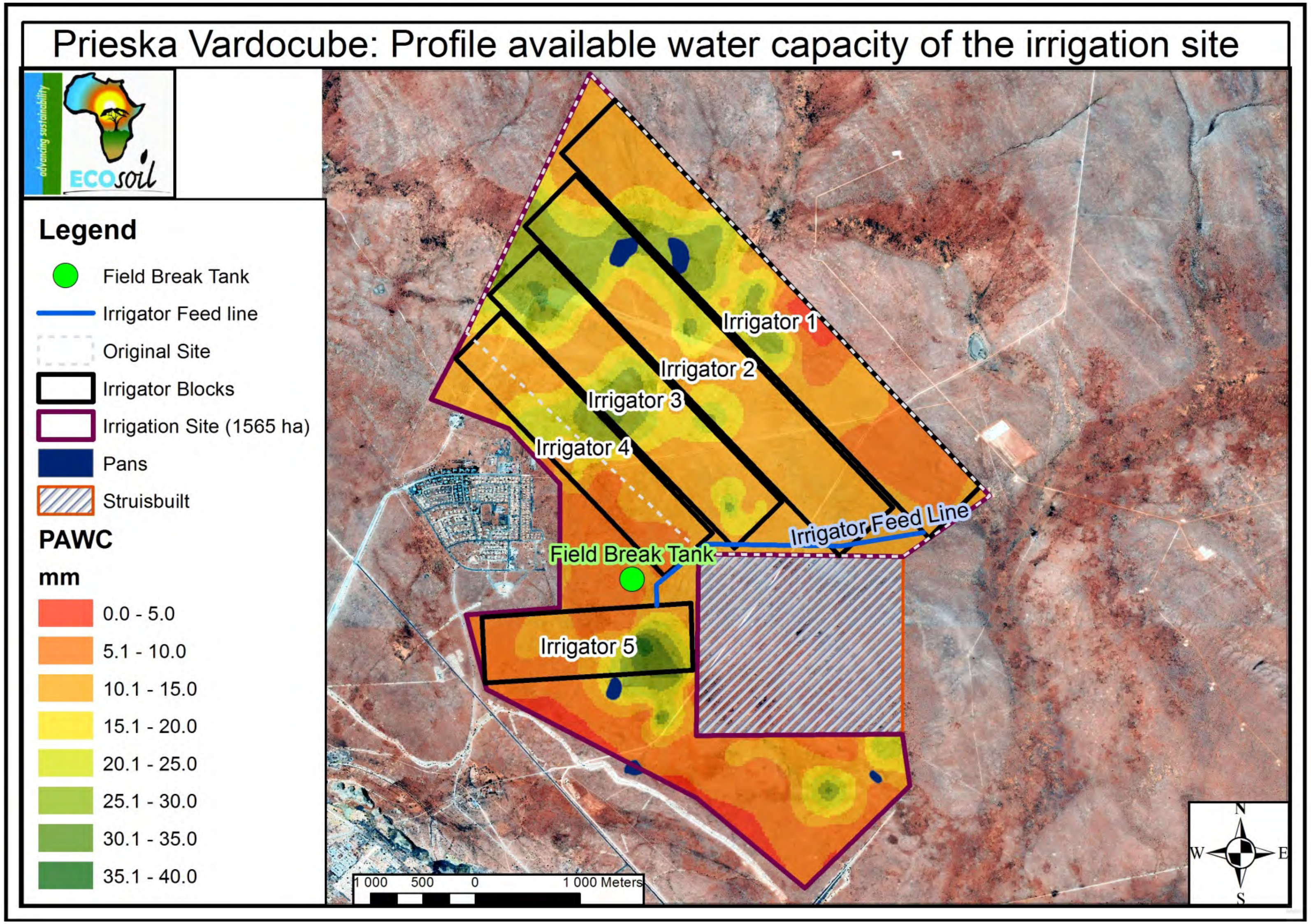

Figure 12. Profile available water holding capacity at the PCZM-Vardocube proposed irrigation site

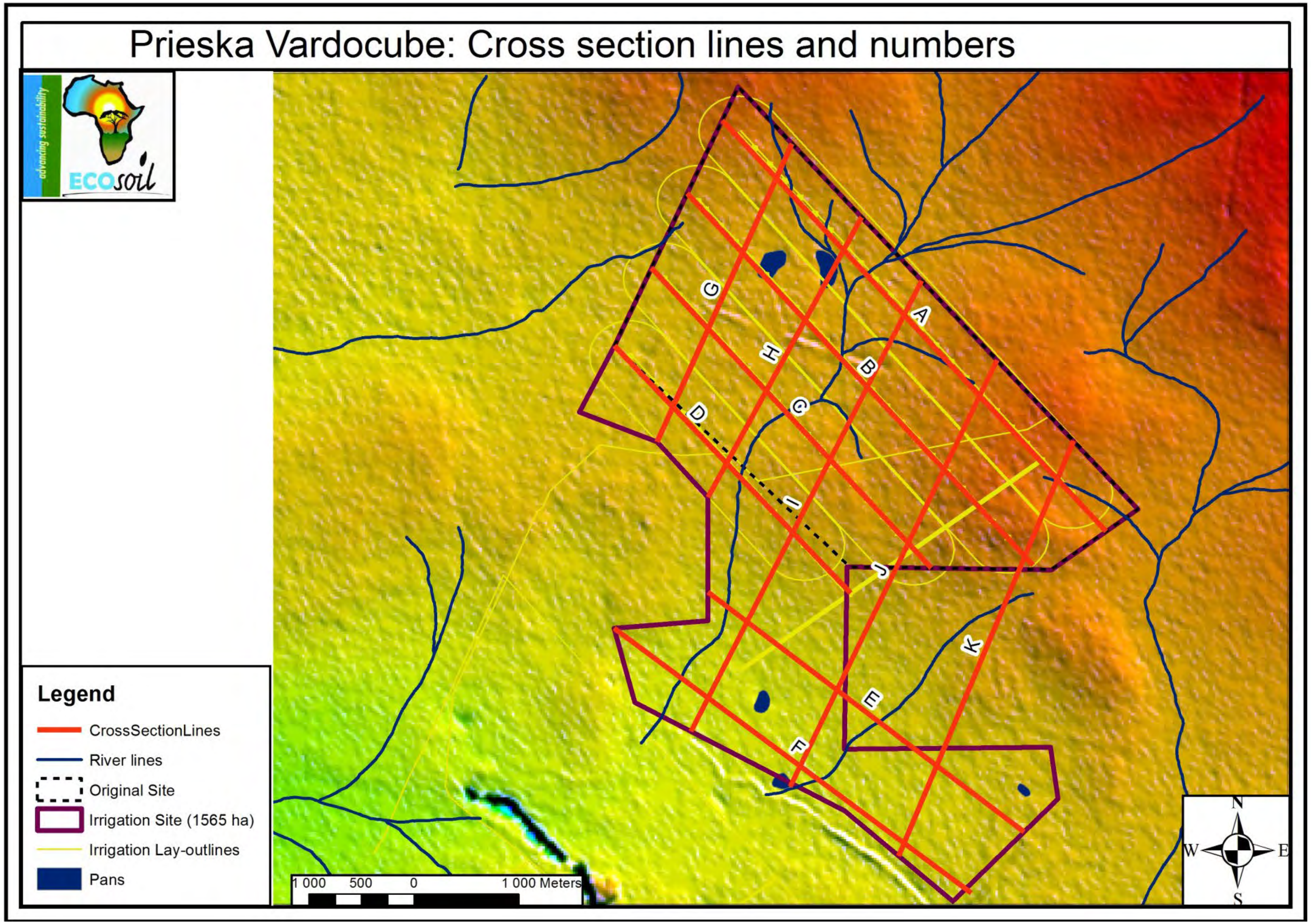

Figure 13. Positions of the topographic cross sections illustrated in Figures 14 to 17

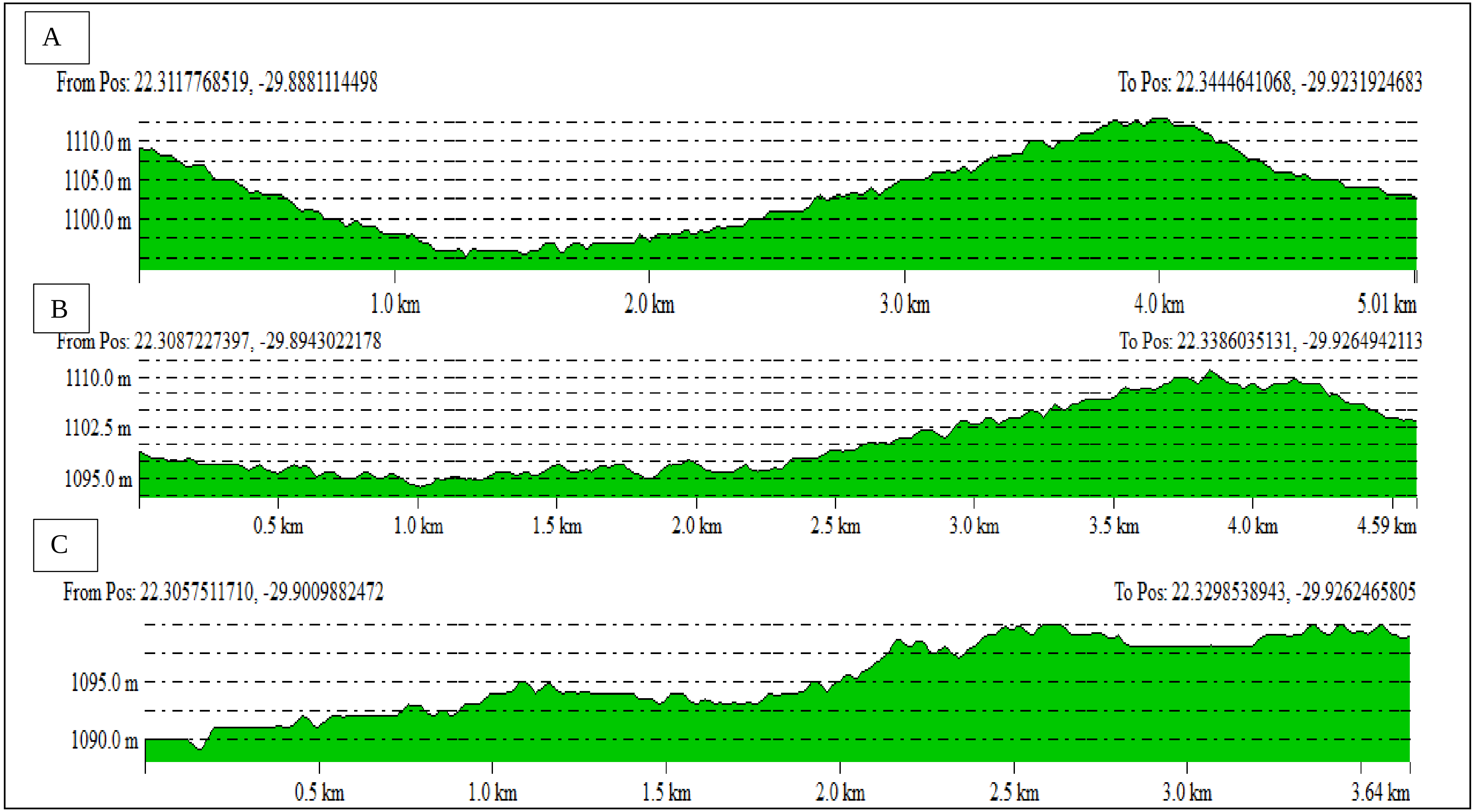

Figure 14. Topographic cross sections of respectively lines A, B and C at positions illustrated in Figure 13

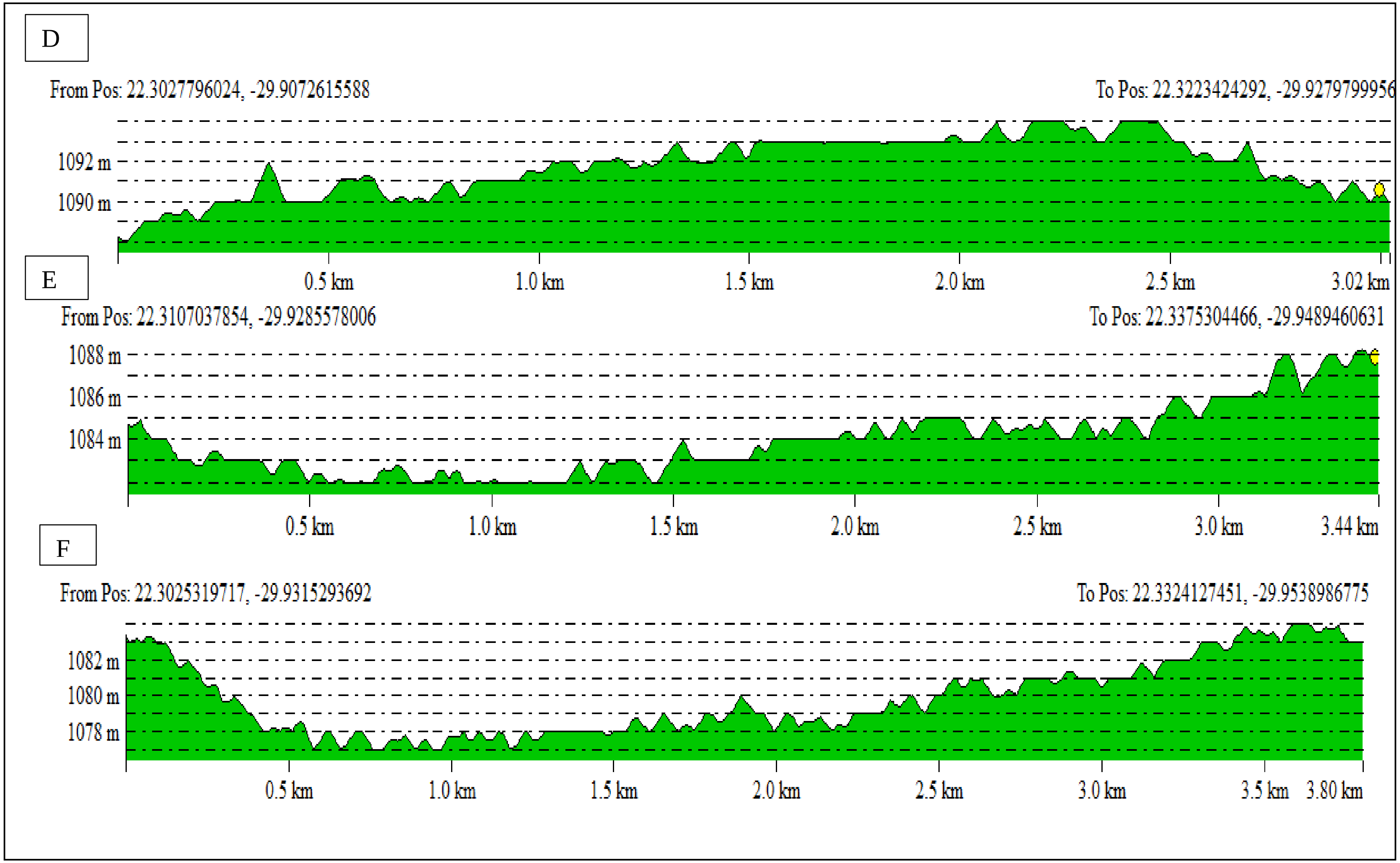

Figure 15. Topographic cross sections of respectively lines D, E and F at positions illustrated in Figure 13

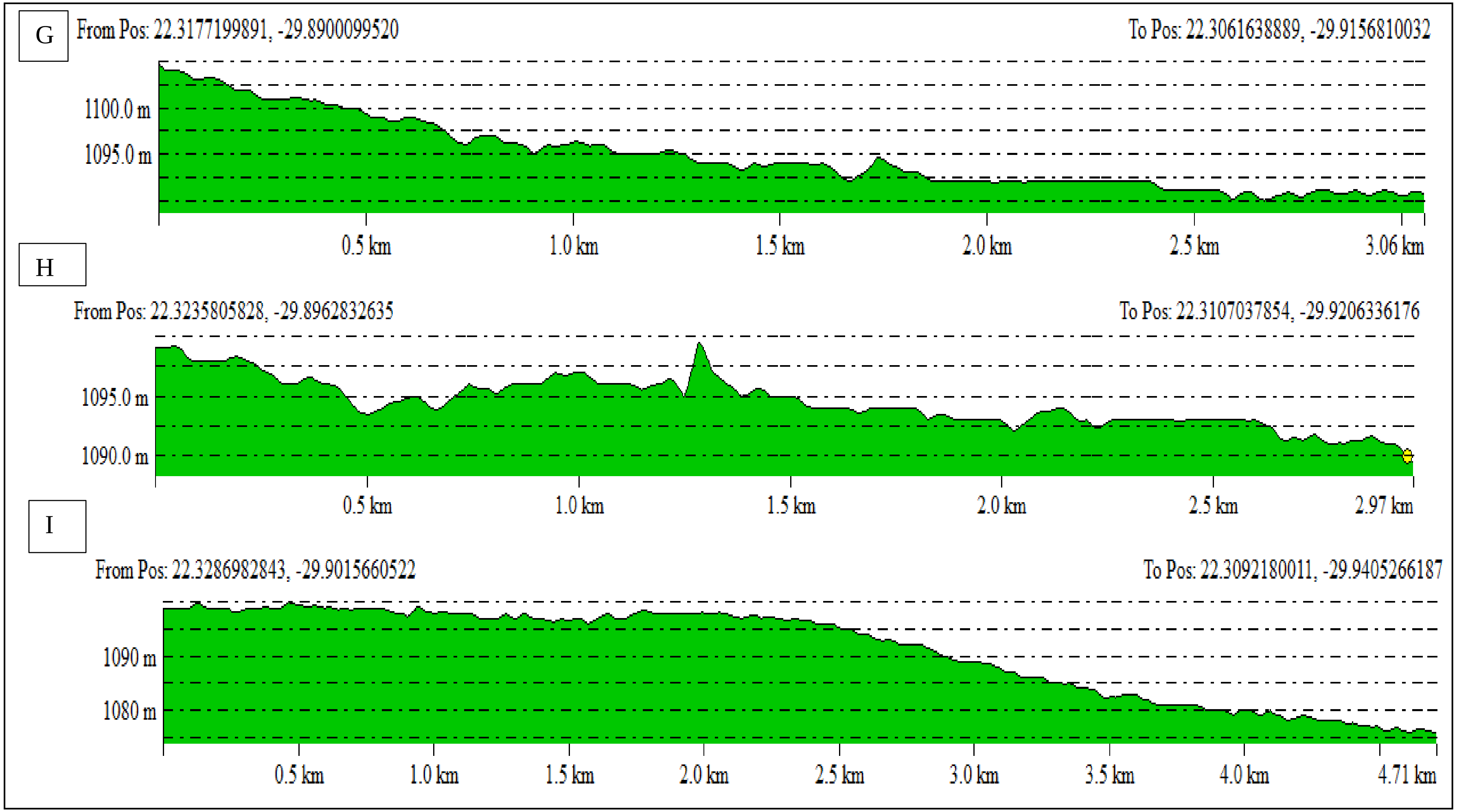

Figure 16. Topographic cross sections of respectively lines G, H and I at positions illustrated in Figure 13

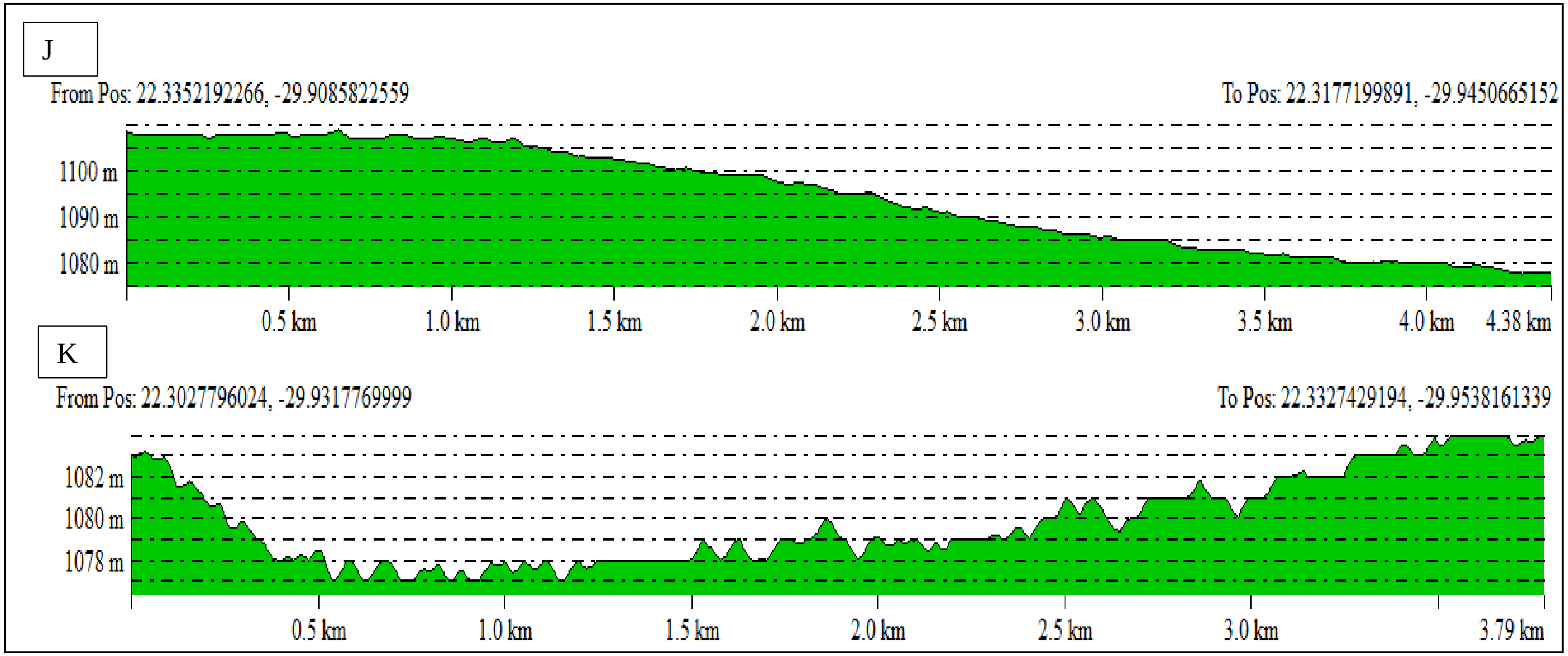

Figure 17. Topographic cross sections of respectively lines J and K as positions illustrated in Figure 13

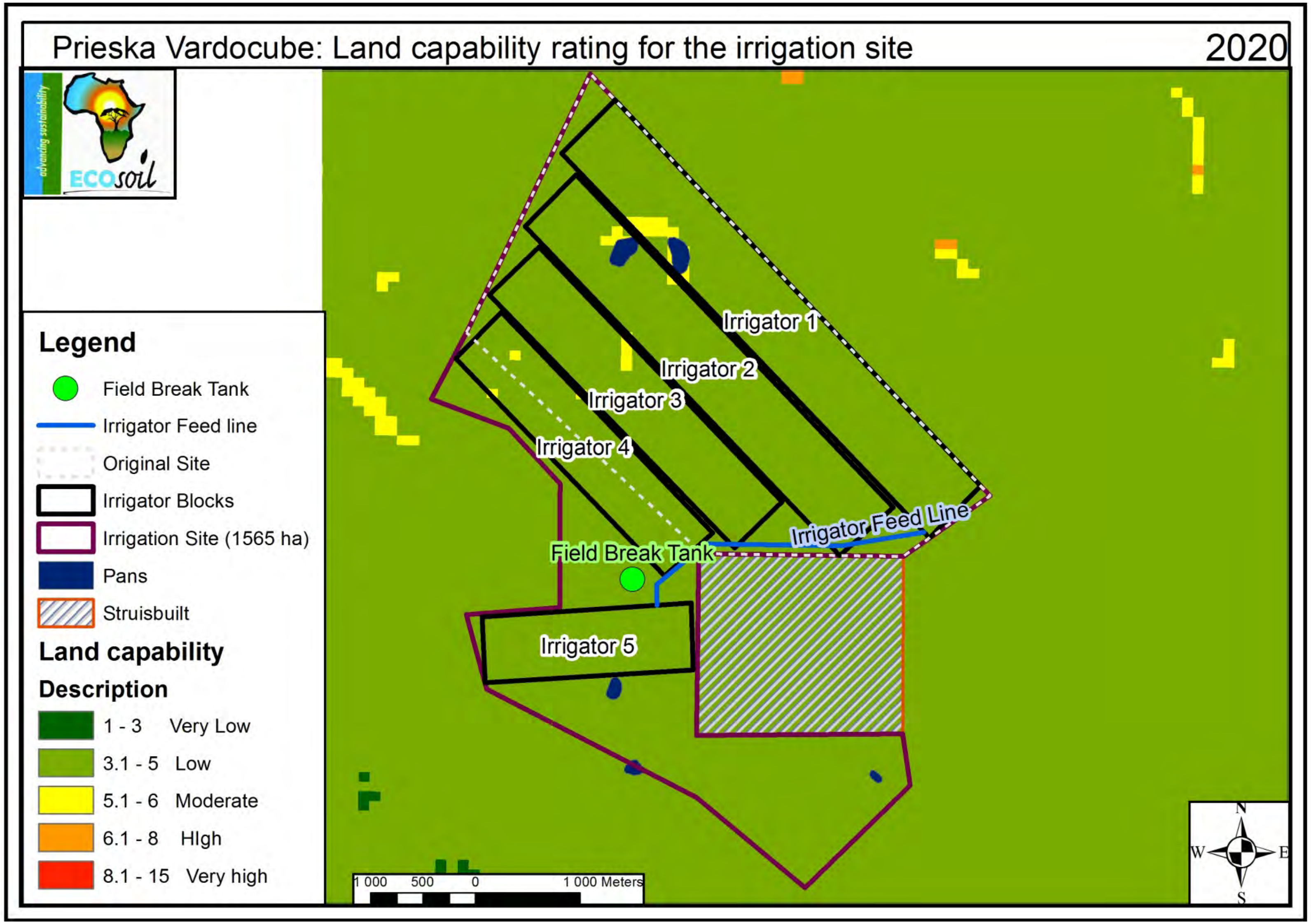

Figure 18. Land capability rating of the PCZM-Vardocube proposed irrigation site

APPENDIX 2: SOIL OBSERVATIONS RESULTS

ObjectID	Latitude	Longitude	SampleID	Form	Code	Tsd	Esd	Ltn	Hor1	Hor2	Hor3	klei_a	klei_b	Notes
1	-29.914292	22.3397716		Coega	Cg	10	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
2	-29.91687	22.336655		Coega	Cg	10	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
3	-29.917952	22.3406866		Coega	Cg	10	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
4	-29.918867	22.3441267		Coega	Cg	10	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
5	-29.92905	22.3491566	ES1524	Plooysburg	Py	40	40	Hard Carbonate layer	Orthic	Red apedal	Hard Carbonate layer	6	14	
6	-29.924053	22.3505484		Plooysburg	Py	40	40	Hard Carbonate layer	Orthic	Red apedal	Hard Carbonate layer	6	14	
7	-29.924582	22.34518	ES1525	Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
8	-29.924665	22.342355		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
9	-29.924183	22.3419484		Glenrosa	Gs	20	10	Rock Layer	Orthic	Rock layer		6		Surface Rock
10	-29.923228	22.3409284		Glenrosa	Gs	20	10	Rock Layer	Orthic	Rock layer		6		Surface Rock
11	-29.922423	22.3398366		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
12	-29.921695	22.33889		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
13	-29.920742	22.3374534		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
14	-29.920098	22.336185		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
15	-29.919492	22.3351617		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
16	-29.914682	22.3372084	ES1526	Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
17	-29.915053	22.3353533		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
18	-29.915552	22.3327967		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
19	-29.916127	22.3297816		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
20	-29.916657	22.3270466		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
21	-29.917298	22.3237033		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
22	-29.917888	22.3206182		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
23	-29.9185	22.3175183		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
24	-29.923638	22.320235	ES1527	Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
25	-29.923237	22.3224183		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
26	-29.922838	22.3241033		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
27	-29.922423	22.3252284		Plooysburg	Py	40	40	Hard Carbonate layer	Orthic	Red apedal	Hard Carbonate layer	6	14	
28	-29.922305	22.32645		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
29	-29.922553	22.3278916		Plooysburg	Py	40	40	Hard Carbonate layer	Orthic	Red apedal	Hard Carbonate layer	6	14	
30	-29.923057	22.3293917		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
31	-29.92352	22.33058		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
32	-29.923917	22.3318833		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
33	-29.913552	22.338425	ES1528	Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
34	-29.91289	22.3368334		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
35	-29.912138	22.3348234		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock

ObjectID	Latitude	Longitude	SampleID	Form	Code	Tsd	Esd	Ltn	Hor1	Hor2	Hor3	klei_a	klei_b	Notes
36	-29.911295	22.3352033		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
37	-29.911042	22.3365366		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
38	-29.910045	22.3356884		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
39	-29.909752	22.333635		Coega	Cg	10	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
40	-29.90842	22.3321866		Coega	Cg	10	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
41	-29.906813	22.3307417		Coega	Cg	10	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
42	-29.90524	22.3293499		Coega	Cg	10	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		Surface Rock
43	-29.903763	22.3277051		Plooysburg	Py	40	40	Hard Carbonate layer	Orthic	Red apedal	Hard Carbonate layer	6	14	
44	-29.906238	22.3267484		Plooysburg	Py	40	40	Hard Carbonate layer	Orthic	Red apedal	Hard Carbonate layer	6	14	
45	-29.907203	22.32807		Plooysburg	Py	40	40	Hard Carbonate layer	Orthic	Red apedal	Hard Carbonate layer	6	14	
46	-29.908513	22.329505		Plooysburg	Py	40	40	Hard Carbonate layer	Orthic	Red apedal	Hard Carbonate layer	6	14	
47	-29.910058	22.3309649		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
48	-29.891125	22.3161767	ES1530	Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
49	-29.89212	22.3178417	ES1531	Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
50	-29.893482	22.3194434		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
51	-29.894538	22.3210533		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
52	-29.89592	22.3213334		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
53	-29.89651	22.3232734		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
54	-29.89858	22.324015		Brandvlei	Br	40	40	Soft carbonate horizon	Orthic	Soft carbonate horizon		6	12	Surface Rock
55	-29.904807	22.3248318		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
56	-29.900158	22.3249884		Brandvlei	Br	40	40	Soft carbonate horizon	Orthic	Soft carbonate horizon		6	12	Surface Rock
57	-29.901928	22.326705		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
58	-29.903112	22.3234067		Brandvlei	Br	40	40	Soft carbonate horizon	Orthic	Soft carbonate horizon		6	12	Surface Rock
59	-29.901183	22.3211983		Pan								0	0	
60	-29.899372	22.3185633		Brandvlei	Br	40	40	Soft carbonate horizon	Orthic	Soft carbonate horizon		6	12	Surface Rock
61	-29.898285	22.3159384		Brandvlei	Br	40	40	Soft carbonate horizon	Orthic	Soft carbonate horizon		6	12	Surface Rock
62	-29.895938	22.3141034		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
63	-29.894905	22.3111851		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
64	-29.896868	22.3087116		Brandvlei	Br	40	40	Soft carbonate horizon	Orthic	Soft carbonate horizon		6	12	Surface Rock
65	-29.897905	22.3063199		Plooysburg	Py	40	40	Hard Carbonate layer	Orthic	Red apedal	Hard Carbonate layer	6	14	
66	-29.900548	22.3069399		Brandvlei	Br	40	40	Soft carbonate horizon	Orthic	Soft carbonate horizon		6	12	Surface Rock
67	-29.902008	22.309015		Brandvlei	Br	40	40	Soft carbonate horizon	Orthic	Soft carbonate horizon		6	12	Surface Rock
68	-29.903112	22.3132733		Brandvlei	Br	40	40	Soft carbonate horizon	Orthic	Soft carbonate horizon		6	12	Surface Rock
69	-29.903352	22.316045		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
70	-29.905765	22.3175517		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		

ObjectID	Latitude	Longitude	SampleID	Form	Code	Tsd	Esd	Ltn	Hor1	Hor2	Hor3	klei_a	klei_b	Notes
71	-29.90658	22.3198916		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
72	-29.907208	22.3215816		Plooysburg	Py	40	40	Hard Carbonate layer	Orthic	Red apedal	Hard Carbonate layer	6	14	
73	-29.908575	22.325265		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
74	-29.899993	22.3167017		Pan								0	0	
75	-29.905637	22.3093217		Plooysburg	Py	40	40	Hard Carbonate layer	Orthic	Red apedal	Hard Carbonate layer	10	14	
76	-29.905998	22.3134999		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
77	-29.907108	22.3163533		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
78	-29.908522	22.3204251		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
79	-29.909862	22.324185		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
80	-29.910993	22.32712		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
81	-29.912467	22.3300133		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
82	-29.915	22.3234666		Brandvlei	Br	40	40	Soft carbonate horizon	Orthic	Soft carbonate horizon		6	12	Surface Rock
83	-29.913617	22.3205666		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
84	-29.914215	22.3177151		Brandvlei	Br	40	40	Soft carbonate horizon	Orthic	Soft carbonate horizon		6	12	Surface Rock
85	-29.916557	22.315445		Brandvlei	Br	40	40	Soft carbonate horizon	Orthic	Soft carbonate horizon		6	12	Surface Rock
86	-29.915422	22.31316		Brandvlei	Br	40	40	Soft carbonate horizon	Orthic	Soft carbonate horizon		6	12	Surface Rock
87	-29.91334	22.31323		Brandvlei	Br	40	40	Soft carbonate horizon	Orthic	Soft carbonate horizon		6	12	Surface Rock
88	-29.910498	22.3132416		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
89	-29.910968	22.3166932		Brandvlei	Br	40	40	Soft carbonate horizon	Orthic	Soft carbonate horizon		6	12	Surface Rock
90	-29.911857	22.3099199		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
91	-29.908737	22.3061183		Coega	Cg	20	10	Hard Carbonate layer	Orthic	Hard Carbonate layer		6		
92	-29.903322	22.3081567		Plooysburg	Py	40	40	Hard Carbonate layer	Orthic	Red apedal	Hard Carbonate layer	6	14	
93	-29.913145	22.300355		Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		
94	-29.913787	22.302323		Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		
95	-29.909858	22.302368		Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		
96	-29.911298	22.303483		Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		
97	-29.912722	22.304865	ES1524	Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		
98	-29.914092	22.306577		Coega	Cg	30	30	Hard Carbonate	Orthic	Hard Carbonate		6		
99	-29.91523	22.308055	ES1525	Plooysburg	Py	40	40	Hard Carbonate	Orthic	Red Apedal	Hard Carbonate	6	12	
100	-29.91659	22.309448		Plooysburg	Py	40	40	Hard Carbonate	Orthic	Red Apedal	Hard Carbonate	6	12	
101	-29.917475	22.309957		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
102	-29.91791	22.310972		Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		
103	-29.919818	22.31209		Coega	Cg	30	30	Hard Carbonate	Orthic	Hard Carbonate		6		
104	-29.919867	22.314433		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
105	-29.921487	22.31614		Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		

ObjectID	Latitude	Longitude	SampleID	Form	Code	Tsd	Esd	Ltn	Hor1	Hor2	Hor3	klei_a	klei_b	Notes
106	-29.922502	22.317292		Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		
107	-29.925183	22.319945		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
108	-29.927075	22.321815	ES1526	Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		
109	-29.932805	22.32233		Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		
110	-29.930388	22.319557		Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		
111	-29.927733	22.317037		Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		
112	-29.925258	22.31416		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
113	-29.922478	22.311338		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
114	-29.925318	22.311288		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
115	-29.927512	22.311057		Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		
116	-29.929968	22.313862	ES1527	Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
117	-29.932587	22.316577		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
118	-29.933852	22.317632		Plooysburg	Py	60	60	Hard Carbonate	Orthic	Red Apedal	Hard Carbonate	6	12	
119	-29.935372	22.319205		Plooysburg	Py	50	50	Hard Carbonate	Orthic	Red Apedal	Hard Carbonate	6	12	
120	-29.936723	22.320735		Brandvlei	Br	50	50	Hard Carbonate	Orthic	Soft Carbonate	Hard Carbonate	6	10	
121	-29.93802	22.321983		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
122	-29.940428	22.31911		Plooysburg	Py	50	50	Hard Carbonate	Orthic	Red Apedal	Hard Carbonate	6	12	
123	-29.940157	22.318402		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
124	-29.938002	22.316095		Plooysburg	Py	40	40	Hard Carbonate	Orthic	Red Apedal	Hard Carbonate	6	12	
125	-29.935222	22.313418	ES1528	Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		
126	-29.932495	22.310737		Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		
127	-29.932298	22.304638		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
128	-29.937232	22.304788		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
129	-29.934717	22.307522		Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		
130	-29.937468	22.31032		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
131	-29.940272	22.31304		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
132	-29.942717	22.315963		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
133	-29.944508	22.3172		pan								6		
134	-29.942735	22.321273		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
135	-29.953113	22.33152		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
136	-29.950393	22.334047		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
137	-29.950648	22.329358		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
138	-29.947048	22.325325		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
139	-29.946595	22.329718		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
140	-29.946688	22.333747	ES1530	Py5c	Py	50	50	Hard Carbonate	Orthic	Red Apedal	Hard Carbonate	6	8	
141	-29.946678	22.338072	ES1531	Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
142	-29.943113	22.337983		Py4c	Py	40	40	Hard Carbonate	Orthic	Red Apedal	Hard Carbonate	6	8	
143	-29.943293	22.33584		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
144	-29.943265	22.333832		Coega	Cg	10	10	Hard Carbonate	Orthic	Hard Carbonate		6		
145	-29.943518	22.32987		Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		
146	-29.944832	22.329845		pan										
147	-29.944003	22.325502		Coega	Cg	20	20	Hard Carbonate	Orthic	Hard Carbonate		6		

APPENDIX 3: PHOTOS

Photo 1. Shallow Coega with surface rock

Photo 2. Shallow Coega with hard Calcrete and surface rock

Photo 3. Deeper Coega poor basal cover

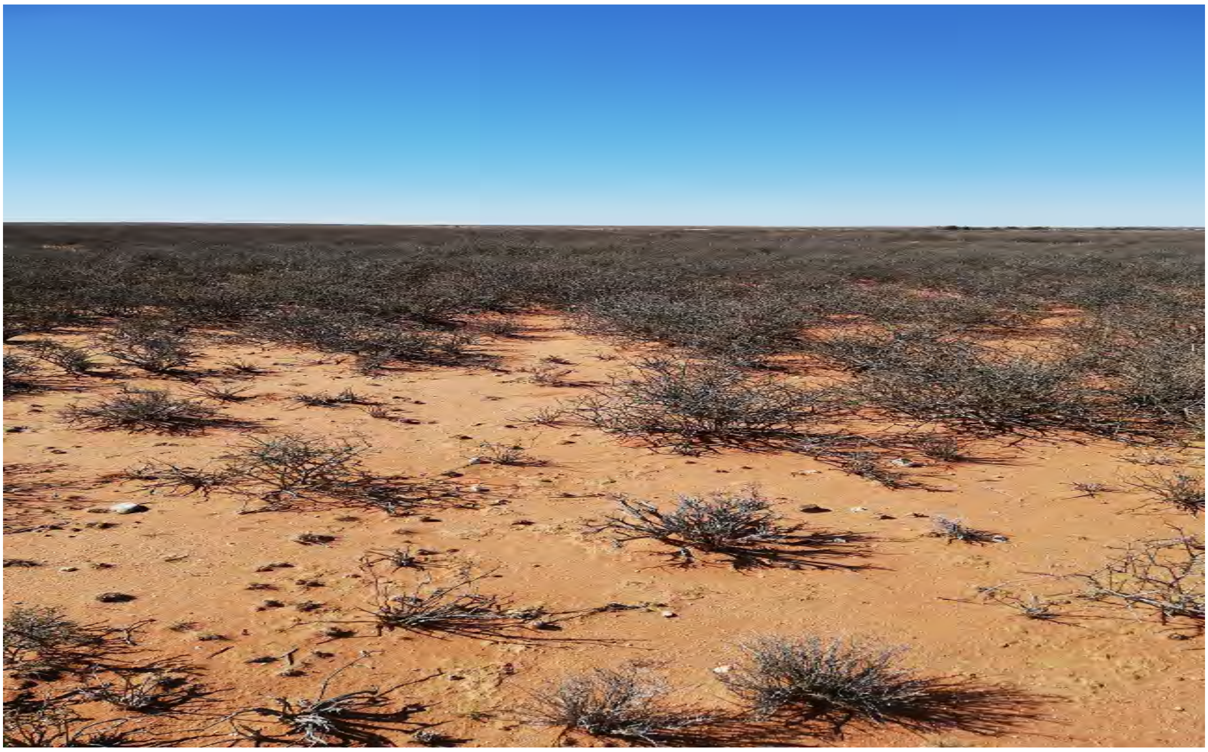

Photo 4. Deeper soil with denser basal cover

Photo 5. Plooysburg, Deeper soil in background with more biomass

Photo 6. Brandvlei with surface rock

Photo 7. Derelict windmill and dam for sheep

Photo 8. Building rubble in pan

Photo 9. Pan with water, note steep sides in background

Photo 10. Steep edge of pan

Photo 11. Sheep in the background

Photo 12. Topsoil loss due to wind erosion

APPENDIX 4: SITE SENSITIVITY VERIFICATION REQUIREMENTS

26 No. 43110 GOVERNMENT GAZETTE, 20 MARCH 2020

SITE SENSITIVITY VERIFICATION REQUIREMENTS WHERE A SPECIALIST ASSESSMENT IS REQUIRED BUT NO SPECIFIC ASSESSMENT PROTOCOL HAS BEEN PRESCRIBED

1. SITE SENSITIVITY VERIFICATION AND MINIMUM REPORT CONTENT REQUIREMENTS

Prior to commencing with a specialist assessment, the current use of the land and the environmental sensitivity of the site under consideration identified by the national web based environmental screening tool (screening tool), where determined, must be confirmed by undertaking a site sensitivity verification.

The screening tool can be accessed at: **https.//screening.environment.gov.za/screening tool.**

2. SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS

Where a specialist assessment is required and no specific environmental theme protocol has been prescribed, the required level of assessment must be based on the findings of the site sensitivity verification and must comply with Appendix 6 of the EIA Regulations.

Agriculture

Protocols for the specialist assessment and minimum content report requirements for impact on agricultural resources

1. SCOPE

This protocol provides the criteria for the specialist assessment and minimum report content requirements for impacts on agricultural resources for activities requiring environmental authorisation. This protocol replaces the requirements of Appendix 6 of the Environmental Impact Assessment Regulations2.

The assessment and reporting requirements of this protocol are associated with a level of environmental sensitivity identified by the national web based environmental screening tool (screening tool) for agricultural resources, which is based on the land capability evaluation values provided by the department responsible for agriculture 3

The screening tool can be accessed at: https.//screening.environment.gov.za/screening tool.

2. Site sensitivity verification and minimum report content requirements

2.1 The site sensitivity verification must be undertaken by an environmental assessment practitioner or a specialist

2.2 The site sensitivity verification must be undertaken through the use of:

(a) A desk top analysis, using satellite imagery;

(b) A preliminary on -site inspection; and

(c) Any other available and relevant information.

2.3. The outcome of the site sensitivity verification must be recorded in the form of a report that:

(a) Confirms or disputes the current use of the land and the environmental sensitivity as identified by the screening tool, such as new developments or infrastructure, the change in vegetation cover or status etc.;

(b) Contains a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity; and

(c) Is submitted together with the relevant assessment report

Table 2 Site verification requirements

GN320	**Report section**
1. The site sensitivity verification must be undertaken by an environmental assessment practitioner or a specialist	
2. The site sensitivity verification must be undertaken through the use of: (a) A desk top analysis, using satellite imagery; (b) A preliminary on -site inspection; and (c) Any other available and relevant information.	
3. The outcome of the site sensitivity verification must be recorded in the form of a report that-	
(a) Confirms or disputes the current use of the land and the environmental sensitivity as identified by the screening tool, such as new developments or infrastructure, the change in vegetation cover or status	
(b) Contains a motivation and evidence (e.g. photographs) of either the verified or different use of the land and environmental sensitivity; and	
(c) Is submitted together with the relevant assessment report prepared requirements of the in accordance with the Environmental Impact Assessment Regulations1 (EIA Regulations).	

SPECIALIST ASSESSMENT AND MINIMUM REPORT CONTENT REQUIREMENTS

TABLE 3: ASSESSMENT AND REPORTING OF IMPACTS ON AGRICULTURAL RESOURCES

1. General Information

1.1. An applicant intending to undertake an activity identified in the scope of this protocol on a site identified on the screening tool as being of "very high" or "high" sensitivity for agricultural resources must submit an Agricultural Agro- Ecosystem Specialist Assessment unless:

1.1.1. The application is for a linear activity for which impacts on the agricultural resource are temporary and the land in the opinion of the soil scientist or agricultural specialist, based on the mitigation and remedial measures, can be returned to the current land capability within two years of the completion of the construction phase;
1.1.2. The impact on agricultural resources is from an electricity pylon; or
1.1.3. Information gathered from the site sensitivity verification differs from the designation of "very high" or "high" agricultural sensitivity, and it is found to be of a "medium" or "low" sensitivity.

1.2. Should paragraphs 1.1.1; 1.1.2; or 1.1.3 apply, an Agricultural Compliance Statement must be submitted.

1.3. An applicant intending to undertake an activity identified in the scope of this protocol on a site identified by the screening tool as being of "medium" or "low" sensitivity for agricultural resources must submit an Agricultural Compliance Statement, unless:

1.3.1. The information gathered from the site sensitivity verification differs from that identified as having a "medium" or "low" agricultural sensitivity and it is found to be of a "very high" or "high" sensitivity; or
1.3.2. If any part of the proposed development footprint falls within an area of "very high" or "high" sensitivity, the assessment and reporting requirements prescribed for the "very high" or "high" sensitivity apply to the entire footprint, except in the case of 1.1.1 in which case an Agricultural Compliance Statement applies. Development footprint in the context of this protocol means the area High sensitivity areas on which the proposed development will take place and includes any are that will be disturbed.

VERY HIGH SENSITIVITY RATING - Land capability evaluation values of 11 - 15; all irrigated land; horticulture and viticulture; demarcated high value agricultural areas with a priority rating of A and/or B.

These areas are potentially unsuitable for development owing to:
- high agricultural value and preservation importance;
- high production capability;
- high capital investment made; or
- unique agricultural land attributes.

HIGH SENSITIVITY RATING - Land capability evaluation values of 8 – 10 including all cultivated areas 4 including sugar cane areas and demarcated high value agricultural areas with a priority rating of C and /or D.

2. Agricultural Agro-Ecosystem Specialist Assessment

2.1. The assessment must be undertaken by a soil scientist or agricultural specialist registered with the South African Council for Natural Scientific Professionals (SACNASP).

2.2. The assessment must be undertaken on the preferred site and within the proposed development footprint.

2.3. The assessment must be undertaken based on a site inspection as well as an investigation of the current production figures, where the land is under cultivation or has been within the past 5 years, and must identify:

2.3.1. the extent of the impact of the proposed development on the agricultural resources; and
2.3.2. Whether or not the proposed development will have an unacceptable impact on the agricultural production capability of the site, and in the event where it does, whether such a negative impact is outweighed by the positive impact of the proposed development on agricultural resources.

2.4. The status quo of the site must be described, including the following aspects which must be considered as a minimum in the baseline description of the agroecosystem:

2.4.1. The soil form /s, soil depth (effective and total soil depth), top and sub –soil clay percentage, terrain unit and slope;
2.4.2. Where applicable, the vegetation composition, available water sources as well as agro- climatic information;
2.4.3. The current productivity of the land based on production figures for all agricultural activities undertaken on the land for the past 5 years, expressed as an annual figure and broken down into production units;
2.4.4. The current employment figures (both permanent and casual) for the land E for the past 3 years, expressed as an annual figure; and
2.4.5. Existing impacts on the site, located on a map (e.g. erosion, alien vegetation, non-agricultural infrastructure, waste, etc.).

2.5. Assessment of impacts, including the following aspects which must be considered as a minimum in the predicted impact of the proposed development on the agroecosystem:

2.5.1. Change in productivity for all agricultural activities based on the figures of the past 5 years, expressed as an annual figure and broken down into production

	units; 2.5.2. Change in employment figures (both permanent and casual) for the past 5 years expressed as an annual figure; and 2.5.3. Any alternative development footprints within the preferred site which would be of "medium" or "low" sensitivity for agricultural resources as identified by the screening tool and verified through the site sensitivity verification. 2.6. The findings of the Agricultural Agro- Ecosystem Specialist Assessment must be written up in an Agricultural Agro- Ecosystem Specialist Report. 2.7. This report must contain the findings of the agro- ecosystem specialist assessment and the following information, as a minimum: 2.7.1. Details and relevant experience as well as the SACNASP registration number of the soil scientist or agricultural specialist preparing the assessment including a curriculum vitae; 2.7.2. A signed statement of independence by the specialist; 2.7.3. The duration, date and season of the site inspection and the relevance of the season to the outcome of the assessment; 2.7.4. A description of the methodology used to undertake the on –site assessment inclusive of the equipment and models used, as relevant; 2.7.5. A map showing the proposed development footprint (including supporting infrastructure) with a 50m buffered development envelope, overlaid on the agricultural sensitivity map generated by the screening tool; 2.7.6. An indication of the potential losses in production and employment from the change of the agricultural use of the land as a result of the proposed development; 2.7.7. An indication of possible long term benefits that will be generated by the project or relation to the benefits of the agricultural activities on the affected land; 2.7.8. Additional environmental impacts expected from the proposed development based on the current status quo of the land including erosion, alien vegetation, waste, etc.; 2.7.9. Information on the current agricultural activities being undertaken on adjacent land parcels; 2.7.10. An identification of any areas to be avoided, including any buffers; 2.7.11. A motivation must be provided if there were development footprints identified as per paragraph 2.5.3 above that were identified as having a "medium" or "low" agriculture sensitivity and that were not considered appropriate; 2.7.12. Confirmation from the soil scientist or agricultural specialist that all reasonable measures have been considered in the micro- siting of the proposed development to minimise fragmentation and disturbance of agricultural activities; 2.7.13. A substantiated statement from the soil scientist or agricultural specialist with regards to agricultural resources on the acceptability or not of the proposed development and a recommendation on the approval or not of the proposed development; 2.7.14. Any conditions to which this statement is subjected; 2.7.15. Where identified, proposed impact management outcomes or any monitoring requirements for inclusion in the Environmental Management Programme (EMPr); and 2.7.16. A description of the assumptions made and any uncertainties or gaps in knowledge or data. 2.8. The findings of the Agricultural Agro- Ecosystem Specialist Assessment must be incorporated into the Basic Assessment Report or Environmental Impact Assessment Report, including the mitigation and monitoring measures as identified, which are to be contained in the EMPr. 2.9. A signed copy of the assessment must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.

<table>
<tr>
<td>MEDIUM SENSITIVITY RATING - Land capability evaluation values of 6 - 7. Medium sensitivity areas are
likely to be very marginal arable land.</td>
<td rowspan="2">3. Agricultural Compliance Statement

3.1. The compliance statement must be prepared by a soil scientist or agricultural specialist registered with the SACNASP.

3.2. The compliance statement must:
3.2.1. Be applicable to the preferred site and proposed development footprint;
3.2.2. Confirm that the site is of "low" or "medium" sensitivity for agriculture; and
3.2.3. Indicate whether or not the proposed development will have an unacceptable impact on the agricultural production capability of the site.

3.3. The compliance statement must contain, as a minimum, the following information:
3.3.1. contact details and relevant experience as well as the SACNASP registration number of the soil scientist or agricultural specialist preparing the assessment including a curriculum vitae;
3.3.2. a signed statement of independence;
3.3.3. a map showing the proposed development footprint (including supporting infrastructure) with a 50m buffered development envelope, overlaid on the agricultural sensitivity map generated by the screening tool;
3.3.4. confirmation from the specialist that all reasonable measures have been taken through micro- siting to avoid or minimise fragmentation and disturbance of agricultural activities;
3.3.5. a substantiated statement from the soil scientist or agricultural specialist on the acceptability, or not, of the proposed development and a recommendation on the approval, or not, of the proposed development;
3.3.6. any conditions to which the statement is subjected;
3.3.7. in the case of a linear activity, confirmation from the agricultural specialist or soil scientist, that in their opinion, based on the mitigation and remedial measures proposed, the land can be returned to the current state within two years of completion of the construction phase;
3.3.8. where required, proposed impact management outcomes or any monitoring requirements for inclusion in the EMPr; and
3.3.9. a description of the assumptions made as well as any uncertainties or gaps in knowledge or data.

3.4. A signed copy of the compliance statement must be appended to the Basic Assessment Report or Environmental Impact Assessment Report.</td>
</tr>
<tr>
<td>LOW SENSITIVITY RATING - Land capability evaluation values of 1 - 5. Low sensitivity areas are likely to be non -arable land, and is therefore land onto which most development should be steered</td>
</tr>
</table>

APPENDIX 5: NATIONAL NORMS AND STANDARDS FOR THE REMEDIATION OF CONTAMINATED LAND AND SOIL QUALITY IN THE REPUBLIC OF SOUTH AFRICA.

No. 37603 GOVERNMENT GAZETTE, 2 MAY 2014

1. Definitions

In these norms and standards, unless the context indicates otherwise, word or expression that is defined in the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008) and the National Environmental Management Act, 1998, has the same meaning-

"Contaminant" means any substance present in an environmental medium at concentrations in excess of natural background concentrations that has a potential to cause harm to human health or the environment;

"Informal Residential" means an unplanned settlement on land which has not been zoned as a residential consisting mainly of makeshift structure not erected according to approved architectural plans;

"Remediation" means the management of a contaminated site to prevent, minimise, or mitigate harm to human health or the environment;

"Soil Screening Value 1" means soil quality values that are protective of both human health and ecotoxicological risk for multi-exposure pathways, inclusive of contaminant migration to the water resource;

"Soil Screening Value 2" means soil quality values that are protective of risk to human health in the absence of a water resource;

"Standard Residential" means settlement that is formally zoned and serviced, and generally developed according to approved building plans, including land parcels such as plots or erven.

2. Purpose

The purpose of these norms and standards is to-

Provide a uniform national approach to determine the contamination status of an investigation area;

Limit uncertainties about the most appropriate criteria and method to apply in the assessment of contaminated land; and

Provide minimum standards for assessing necessary environmental protection measures for remediation activities.

3. Application

The requirements set out in these norms and standards apply to an owner of land or any person who undertakes site assessment and remediation activity in terms of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008).

4. Scope of this Norms and Standards

(1) These norms and standards must be used for the screening of a site after a site Assessment report is required as a result of declaration of an investigation area as contemplated in section 36 of the National Environmental Management Act, 2008 (Act No. 59 of 2008).

(2) Where a contaminant is not listed in Table 1 or Table 2, values which are Scientifically validated for the contaminants of interest may be used.

(3) The Soil Screening Values in Table 1 and Table 2 must not be seen as-

(i) Absolute minimum values; or

(ii) Default remediation values.

5. Soil Screening Values

(4) The Soil Screening Values in Table 1 and Table 2 below are for screening purpose.

Table 1. Soil screening tools for metal and organics

Parameter	Units	SSV1 All Land-Uses Protective of the Water source	SSV2 Informal Residential	SSV2 Standard Residential	SSV2 Commercial Industrial
Metals and metalloids					
Arsenic	mg/kg	5.80	23	48	150
Cadmium	mg/kg	7.50	15	32	260
Chromium (III)	mg/kg	46 000	46 000	96 000	790 000
Chromium (VI)	mg/kg	6.50	6.50	13	40
Cobalt mg/kg	mg/kg	300	**300**	630	5 000
Copper	mg/kg	16	1 100	2 300	19 000
Lead	mg/kg	20	110	230	1 900
Manganese	mg/kg	740	740	1 500	12 000
Mercury	mg/kg	0.30	0.30	1.00	6.50
Nickel	mg/kg	91	620	1 200	10 000
Vanadium	mg/kg	150	150	320	2 600
Zinc	mg/kg	240	9 200	19 000	150 000
Alkanes					
C7-C9	mg/kg	2300	2300	24000	23000
C10-C14	mg/kg	440	440	500	4400
C15-C36	mg/kg	45000	45000	91000	740000
Monocyclic Aromatic Hydrocarbons					
Benzene	mg/kg	0.03	1.30	1.40	10.00
Toluene	mg/kg	25	120	120	1200
Ethylbenzene	mg/kg	26	57	60	540
Xylenes	mg/kg	45	51	95	890
Aromatics					
Naphthalene	mg/kg	28	28	33	290
Pyrene	mg/kg	5.3	920	1 900	15 000
Benzo(a)pyrene	mg/kg	0.34	0.34	0.71	1.70
MTBE	mg/kg	0.0036	360	370	800
Organics					
Chloroform	mg/kg	0.11	0.11	0.11	1.70
2 Chlorophenol	mg/kg	140	150	320	2600
1,2 Dichlorobenzene	mg/kg	89	2700	5800	47000
1,4-Dichlorobenzene	mg/kg	26	1100	1200	19000
1,2-Dichloroethane	mg/kg	0.23	0.23	0.24	3.70
1,1 Dichloroethene	mg/kg	10	10	10	150
1,2,3 Trimethylbenzene	mg/kg	0.28	53	55	860
1,2 Dichloroethene	mg/kg	0.4	620	1 200	10 000
Trichlorobenzenes	mg/kg	0.069	310	650	5 300
Nitrobenzene	mg/kg	2.8	3	3	45
1,1,2,2 Tetrachloroethane	mg/kg	0.32	0.32	0.34	5.00
2,4,6 Trichlorophenol	mg/kg	4	210	320	1800
Vinyl Chloride	mg/kg	0.0037	0.10	0.11	1.50
PCBs	mg/kg	0.61	1.70	3.60	11.00
Cyanide	mg/kg	14	620	1 200	10 000

Table 2 Soil screening tools for anions

Anions	Units	Soil screening level
Chlorides	mg/kg	12 000
Florides	mg/kg	30
Nitrates-Nitrite	mg/kg	120
Sulphates	mg/kg	4 000

6. Transitional Arrangements

(1) Any person who is remediating contaminated land in compliance with a directive or compliance notice issued in terms of any legislation applicable to land remediation before coming into effect of these norms and standards, must comply with the conditions set out in the directive or compliance notice.

(2) Any person who is remediating contaminated land in terms of a waste management licence issued in terms of the National Environmental Management: Waste Act, 2008 (Act No. 59 of 2008), before coming into effect of these norms and standards, must comply with the conditions set out in the waste management licence.

7. Short Title

These norms and standards are called the National Norms and Standards for the Remediation of Contaminated Land and Soil Quality in the Republic of South Africa.

APPENDIX 6: REHABILITATION OF OPENCAST MINING SOILS

Introduction

Global agriculture is facing a trend in yield decline for most crops. This is specifically applicable to crops that are practised under a mono-cropping system. It is a well-known scientific fact that monoculture has a negative impact on soil fertility and potential.

With mono cropping and overuse of land, it has become necessary for farmers to resort to more drastic measures to maintain yields. One such practise is to increase N, P and K chemical fertilisers at ever increasing costs, because the perception is that the higher the fertiliser levels the higher the yield.

This same mind-set is prevalent with the rehabilitation of opencast mining areas. The impact of mining operations is just so much amplified as the whole soil profile with all the integrated soil physical, chemical and biological processes is destroyed. This is often the result of a lack of understanding that soil is a living eco-system and that there is a difference between soil fertility and plant nutrition. There is also a difference in understanding the term topsoil from a soil science and mining perspective.

A distinction must be made between restoring soils to previous inherent potential for crop production and sustainable rehabilitation. As previously mentioned soils form over a long period of time with various processes involved. The opencast mining operations totally disturb these process and soil forming factors.

It is not possible to restore the soil potential and initial characteristics to its original state but huge improvements can be made in the methodology of stripping and re-dressing of soil material to ensure sustainability of rehabilitation. Over time these soils can produce proper vegetation and grazing of cattle and arable crop production at lower yields then the initial soil potential.
To achieve this it is necessary to understand the soil forming factors and processes and the difference between soil fertility and plant nutrition.

Definition of soil
Soil is an open living ecosystem and can therefore be defined as a function of physical, chemical and biological processes.

Soil forming processes

The following factors are involved in soil formation:

- Parent Material (geology, e.g. sedimentary rock (sandstone), acid igneous (granite) or basic rock dolerite) etc.)
- Topography (slope of landscape)
- Climate (wind, water, temperature etc.)
- Microbial Activity and microbial diversity
- Time (soil formation occurs over a long time period, e.g. 1cm of topsoil is formed over 100yrs)

These factors with different physical, chemical and biological processes combine under specific conditions to form specific soil diagnostic horizons with a unique character and inherent soil fertility.

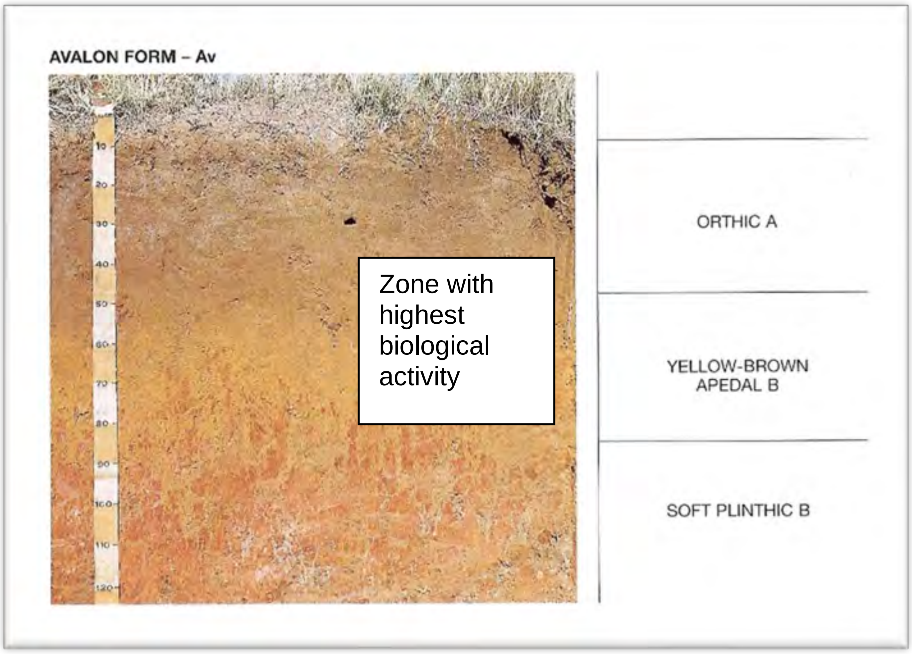

Figure: Avalon soil showing different horizons.

Fertility / plant nutrition

Fertility refers to the inherent capacity of a soil to supply nutrients to plants in adequate amounts and in suitable proportions as well as oxygen and moisture to maintain a healthy soil bio-diversity (active micro-biology, immune system). Te focus here is soil health.

Plant nutrition refers to the soils ability to supply nutrients to the plant so it can complete its reproductive cycle. The nutrient status of the soil can be manipulated by adding organic and inorganic fertilisers according to the crop's need. The focus here is on the crop's needs.

It can now be summarised that different soils have different levels of soil fertility according to the combination of the soil forming factors and soil processes involved under specific conditions. All these factors and processes are interlinked and no single soil type has all these factors in the ideal combination, therefore the yield potential and use of soils varies.

Unfortunately soil fertility and nutrition was relegated to a simple recipe of four elements provided through chemical fertilisers e.g. nitrogen (n), phosphorous (p), potassium (k) and zinc (Zn) to meet only the crop needs at the expense of soil fertility. Very little attention was given to the important role of bio-diversity and active microbiology in plant nutrition. It is only in the last couple of years that there is a serious interest on this matter.

The role of biodiversity

Active and healthy soil microbiology is able to:

- Mineralise nitrogen, phosphorous and sulphur
- Suppress nematodes, bacterial and fungal diseases
- Actively decompose organic material
- Improve root development with the result of better nutrient and water uptake
- Recycle and keep nutrients available for plants, especially micro-nutrients
- Improve soil physical and chemical conditions by increasing the humus content
- Improve water holding capacity of soil
- Less KWa power needed for soil tillage

The role of compost and other humic substances in restoring biodiversity in disturbed soils

Compost is a great and fairly quick way in restoring soil fertility although it must be made clear that it is a long term approach that is necessary. Organic and humic products can overcome to some degree the practical and logistical problems posed of importing large volumes of organic matter.

APPENDIX 7: CURRICULUM VITAES

CURRICULUM VITAE OF F. BOTHA

PERSONAL DETAILS

- **Name:** Botha, F
- **Date of Birth:** 9 June 1959
- **ID Number:** 59 06095074087
- **Marital Status:** Married
- **Cell number:** 0849005933
- **Email address:** fbecosoil@gmail.com

FORMAL QUALIFICATIONS

- B.Sc (Pedology) from PU for CHE, 1984
- B.Sc (Hon) Pedology) from PU for CHE, 1988
- B. Comm. (Economics and Business Economics) from UNISA, 2001.

PROFFESIONAL AFFILIATIONS

- Soil Science Society of South Africa
- South African Soil Surveyors association
- Land Rehabilitation Association of SA (formation in process)
- SA Irrigation Institute

EMPLOYMENT HISTORY

- 1984-1988, Trans-Agric, College of Agriculture, Senior Lecturer in Soil Science.
- 1988-1991, ICI-Kynoch Agrochemicals, Training Co-coordinator
- 1991-1996, Lowveld College of Agriculture, Senior Lecturer in Soil Science.
- 1997-2004, SA Sugar Association, Senior Extension Officer, Malelane region.
- 2004-2007, Advanced Nutrients SA, Technical Director.
- 2007-Present, Private Consultancy and Director of Eco Soil.

WORK EXPERIENCE AND PROJECTS

- 8 years' experience as an extension officer, with the focus on sugarcane production under irrigation in the Malelane region.
- Initiated and Assisted SASRI research Dept with various trials related to sugarcane production.
- Involvement in pedological and geological surveys for Forestek (35 000ha's), ARC and private individuals for forestry, game ranching, farming enterprises and new agricultural developments (150 000ha).
- Functioned as project leader on a number of large scale soil survey projects, e.g. Donkerhoek Agricultural project, Mpumalanga
- Pedological specialist studies for environmental impact assessments (EIA's) as well as a number of economic and agronomic feasibility studies for new agricultural developments.
- 13 Years lecturing experience in soil science at agricultural colleges.
- Consultation on biological and soil health principles on various agricultural projects
- At present consulting on Precision farming sampling and helping in the maize and sugar industry
- Feasibility studies on new sugarcane and agricultural projects under irrigation in Southern Africa
- Environmental Impact Assessments for mining and new projects
- Rehabilitation of opencast mining soils

CURRICULUM VITAE OF A.M. HATTINGH

PERSONAL DETAILS

- **Name:** Hattingh, A. M.
- **Date of Birth:** 9 December 1956
- **ID Number:** 5612090077089
- **Marital Status:** Married
- **Cell number:** 0828536228
- **Email address:** astridhattingh@yahoo.com

FORMAL QUALIFICATIONS

- BSc Soil Science, PU for CHE, 1977

- BSc (Hon) Soil Science, PU for CHE, 1978
- MSc Soil Science, PU for CHE, 1983
- PhD Soil Science, Free State University, 2018

MEMBERSHIP

- Soil Science Society of South Africa.
- International Soil Science Society.

EMPLOYMENT HISTORY

- 1979 –1993 Dept. of Agriculture (Highveld Region) as Researcher.
- 1993-1996 Assistant Director Soil Science.
- 1997-1998 Part time lecturer at PU for CHE in clay mineralogy, soil physics, irrigation, drainage, soil chemistry and part time Trans-Agric, College of Agriculture, Senior Lecturer in Soil Science
- 1997 Part time at REHAB. Soil consultant
- 1998-2002 Own business: Handrid Flora: Seedlings and vegetable production.
- 2002- 2003 Own Business in participation with Africa Plus Projects and Geoquip. Irrigation scheduling and soil consultant.
- 2004 Consultant Techniland. Precision farming.
- 2006 GCI- ARC. Researcher
- 2007 –2008 Africa Geo Environmental Services (AGES) GIS specialist, Soil Scientist
- 2009-2010 Part time Lecturer at Potchefstroom University and Agricultural College Potchefstroom. Private consultation.
- 2011-present. Precision Farming Own Business. EIA's for agricultural potential, Africa and mine Projects with GIS interpretation of soil and land capability studies.

WORK EXPERIENCE AND PROJECTS

- Reports and GIS work for Africa (Tanzania, Mozambique) Projects: Basanza/Lugufu, Kigoma, Kilombero, Kasulu, Mopeia, Rufiji.
- Management Plan for Vredefort World Heritage Site: GIS and agriculture
- Geotechnical reports and GIS work.

- Planning and research of various projects
- Research: Water holding capacity – Influence of clay content and mineralogy
- Determination of field capacity and wilting point.
- Water conservation practices
- Stubble mulching
- Evaluation of cultivation practices
- Recompaction rate of soils with different clay contents.
- Cone penetrometer studies.
- Water consumption of maize at different plant densities.
- Calibration of neutron water meters and gamma density meters.
- "Basin cultivation"
- Handling of research plots: plant, herbicides and pesticides, cultivation, harvesting, soil water and compaction monitoring etc.
- Nitrogen transfer
- Organic growing of vegetables
- Fertilisation of vegetables
- Water conservation and irrigation for small-scale vegetable farming.
- Soil acidity
- Fertilisation of pasture
- Phosphorus studies.
- Head of soil analysis laboratory:

Soil, plant, water, lime, in vitro analysis --- supervisor
Interpretation and approval of results
Fertiliser recommendations- grain, pasture and vegetables.

POSITIONS HELD AND COMMITTEE PARTICIPATION

- Assistant Director Soil Science. Dept. Of Agriculture Northwest Province (Administration, supervision of junior researchers, technicians and head of laboratory).
- WRC steering committee projects.
- 1994 Secretary of SSSSA Congress organising committee.
- Member of research steering committee Highveld Region.
- Soil interest group of Western Transvaal: Founder member and Secretary and Chairlady-several times.

- Combined Soil, Crop Science, Crop protection Congress: Organizing committee 1996 and 2012
- Organizing convenor: Precision Farming Congress from 2013 to 2019

APPENDIX 8: SACNASP REGISTRATION

SACNASP

South African Council for Natural Scientific Professions

herewith certifies that

Francois Botha

Registration number: 400063/15

is registered as a

Professional Natural Scientist

in terms of section 20(3) of the Natural Scientific Professions Act, 2003
(Act 27 of 2003)
in the following field(s) of practice (Schedule I of the Act)

Soil Science **28 January 2015**

28 January 2015

Pretoria	President	Executive Director

HERITAGE IMPACT ASSESSMENT

(REQUIRED UNDER SECTION 38(8) OF THE NHRA (No. 25 OF 1999)

For the Prieska Copperton - Copper and Zinc Mine Irrigation Project in the Northern Cape Province

Type of development:

Mine Dewatering Project

Client:

ABS Africa (Pty) Ltd

Developer:

Orion Minerals Limited

HCAC - Heritage Consultants

Private Bag X 1049

Suite 34

Modimolle

0510

Tel: 082 373 8491

Fax: 086 691 6461

E-Mail: jaco.heritage@gmail.com

Report Author:

Mr. J. van der Walt

Project Reference:

2048

Report date:

August 2020

Revised October 2020.

Approval Page

Project Name	**Prieska Copper-Zinc Project – Irrigation Project**
Report Title	Heritage Impact Assessment Prieska Copper-Zinc Project – Irrigation Project Northern Cape Province
Authority Reference Number	To be allocated
Report Status	Draft Report
Applicant Name	Orion Minerals Limited

	Name	Qualifications and Certifications	Date
Archaeologist	Jaco van der Walt	MA Archaeology ASAPA #159 APHP #114	Aug 2020
Palaeontologist	Marion Bamford	PhD Palaeobotany	Aug 2020

DOCUMENT PROGRESS

Distribution List

Date	Report Reference Number	Document Distribution	Number of Copies
25 August 2020	2048	ABS Africa (Pty) Ltd	Electronic Copy

Amendments on Document

Date	Report Reference Number	Description of Amendment
21 October 2020	2048	Lay out changes and correction of coordinates.

REPORT OUTLINE

Appendix 6 of the GNR 326 EIA Regulations published on 7 April 2017 provides the requirements for specialist reports undertaken as part of the environmental authorisation process. In line with this, Table 1 provides an overview of Appendix 6 together with information on how these requirements have been met.

Table 1. Specialist Report Requirements.

Requirement from Appendix 6 of GN 326 EIA Regulation 2017	Chapter
(a) Details of - (i) the specialist who prepared the report; and (ii) the expertise of that specialist to compile a specialist report including a curriculum vitae	Section a Appendices – CV
(b) Declaration that the specialist is independent in a form as may be specified by the competent authority	*Declaration of Independence*
(c) Indication of the scope of, and the purpose for which, the report was prepared	Section 1
(cA)an indication of the quality and age of base data used for the specialist report	Section 3.4 and 6.1.
(cB) a description of existing impacts on the site, cumulative impacts of the proposed development and levels of acceptable change;	9
(d) Duration, Date and season of the site investigation and the relevance of the season to the outcome of the assessment	Section 3.4
(e) Description of the methodology adopted in preparing the report or carrying out the specialised process inclusive of equipment and modelling used	Section 3
(f) details of an assessment of the specific identified sensitivity of the site related to the proposed activity or activities and its associated structures and infrastructure, inclusive of a site plan identifying site alternative;	Section 7 and 8
(g) Identification of any areas to be avoided, including buffers	Section 8 and 9
(h) Map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers	Section 7 and 9
(I) Description of any assumptions made and any uncertainties or gaps in knowledge	Section 3.6
(j) a description of the findings and potential implications of such findings on the impact of the proposed activity including identified alternatives on the environment or activities;	Section 8
(k) Mitigation measures for inclusion in the EMPr	Section 8 and 9
(I) Conditions for inclusion in the environmental authorisation	Section 8 and 9
(m) Monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8 and 9
(n) Reasoned opinion - (i) as to whether the proposed activity, activities or portions thereof should be authorised; (iA) regarding the acceptability of the proposed activity or activities; and (ii) if the opinion is that the proposed activity, activities or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	Section 9.2
(o) Description of any consultation process that was undertaken during the course of preparing the specialist report	Section 6.2
(p) A summary and copies of any comments received during any consultation process and where applicable all responses thereto; and	Refer to BA report
(q) Any other information requested by the competent authority	Appendices

Executive Summary

HCAC was appointed to conduct a Heritage Impact Assessment (HIA) of the proposed irrigation area of Prieska Copper-Zinc Project located in the Northern Cape Province, approximately 60km south-west of the town of Prieska at Copperton. An area of 1250 hectares was identified (85% of the identified area will be utilised) for the proposed irrigation of natural veld of approximately 8.5 million cubic meters of water that must be pumped out from the underground mine which has become flooded since its closure approximately 30 years ago.

The final lay out of the irrigation area was not available at the time of the fieldwork and on writing this report and the aim of the assessment is to provide a high-level overview of the heritage character of the area and to assess the anticipated impact of the proposed irrigation project on heritage resources.

The study area is currently undeveloped and there are no structures on site. Use of the landscape by Stone Age people is evident with lithics dating from the ESA to the LSA found scattered in varying densities, within the area earmarked for the irrigation project. According to Beaumont et al (1995) “thousands of square kilometres of Bushmanland are covered by a low-density lithic scatter”. These artefacts are referred to as background scatter (Orton 2016) and of low heritage significance. Various assessments in the area recorded these occurrences (e.g., Kaplan 2010; Kaplan & Wiltshire 2011; Orton 2011, 2012, 2014, 2015; Orton & Webley 2013; Webley 2016, Van der Walt 2012, 2013, 2017, 2018, and Van Ryneveld (2006). They do not reflect actual occupation sites and have little potential to inform our understanding of the past. Two distinct sites were recorded close to pans and should be avoided.

According to the SAHRA paleontological sensitivity map, the area is of moderate paleontological sensitivity and an independent study was conducted and concluded that it is extremely unlikely that any fossils would be preserved in the Aeolian sands of the Quaternary aged Gordonia Formation but that a Fossil Chance Find Protocol for Quaternary fossils should be added to the EMPr.

A formal burial site was recorded during the survey with distinct headstone and the grave of a child. Graves are of high social significance and the site should be retained in situ with a 50 m buffer.
In anticipation of mining and renewable energy projects several heritage surveys were conducted in the area (e.g., Kaplan 2010; Kaplan & Wiltshire 2011; Orton 2011, 2012, 2014, 2015; Orton & Webley 2013; Webley 2016, Van der Walt 2012, 2013, 2017, 2018, and Van Ryneveld 2006) that recorded sites and lithic scatters from the Early Stone Age (ESA), Middle Stone Age (MSA) to the Later Stone Age (LSA). According to Beaumont *et al* (1995) “thousands of square kilometres of Bushmanland are covered by a low-density lithic scatter”. These artefacts are referred to as background scatter (Orton 2016) and of low heritage significance. Various assessments in the area recorded these occurrences (e.g., Kaplan 2010; Kaplan & Wiltshire 2011; Orton 2011, 2012, 2014, 2015; Orton & Webley 2013; Webley 2016, Van der Walt 2012, 2013, 2017, 2018, and Van Ryneveld (2006). They do not reflect actual occupation sites and have little potential to inform on our understanding of the past. The archaeological importance of pans in the area are now well documented (Kiberd 2006, Kaplan & Wiltshire 2011, Orton 2012) and the findings of this study concurred recording two distinct stone age sites close to pans as well as a knapping site.

The area earmarked for the irrigation project is undeveloped and used as grazing apart from a runway strip in the western portion of the study area. The area was surveyed on foot and by vehicle, key findings include:

- Widespread background scatters of mainly MSA and to a lesser extent ESA & LSA lithics were found in a deflated context. This background scatter (Orton 2016) is generally of low heritage significance;
- Two pans (Blomsdampan & Valspan) occur in the area and is characterised by a high density of lithics and are of high significance;
- Knapping and quarrying sites were recorded and are of medium significance;
- A cemetery was recorded but is located outside of the area earmarked for irrigation;
- According to the SAHRA paleontological sensitivity map, the area is of moderate paleontological sensitivity and an independent study (Bamford 2020) was conducted that concluded that it is extremely unlikely that any fossils would be preserved in the area;
- Anticipated impacts by the irrigation is minimal because the project aims to irrigate the natural vegetation at 20 mm per month for a 10-month period in a regular and controlled manner to avoid erosion and promote natural vegetation growth. Water will be irrigated with flexible pipes above surface.

The impact of the proposed irrigation project on heritage resources is considered to be low and can be mitigated to an acceptable level with the correct mitigation measures in place. It is therefore recommended that the proposed project can commence provided that the recommendations in this report are adhered to as part of the EMPr and based on the approval of SAHRA.

Recommendations:

- No infrastructure must occur surrounding Blombospan and Valspan (Waypoint 145, 146 and 150) with a 30 m buffer;
- Irrigation must be done in a way that will not accelerate sheet erosion in the impact area or result in silting up of Blombospan and Valspan. This must be monitored by the ECO.
- No infrastructure must occur surrounding the knapping and quarrying site (Waypoint 169) with a 30 m buffer;
- Implementation of a chance find procedure that include a Fossil Chance Find Protocol for Quaternary fossils.
  .

Declaration of Independence

Specialist Name	Jaco van der Walt
Declaration of Independence	I declare, as a specialist appointed in terms of the National Environmental Management Act (Act No 108 of 1998) and the associated 2014 Environmental Impact Assessment (EIA) Regulations (as amended), that I: • I act as the independent specialist in this application; • I will perform the work relating to the application in an objective manner, even if this results in views and findings that are not favourable to the applicant; • I declare that there are no circumstances that may compromise my objectivity in performing such work; • I have expertise in conducting the specialist report relevant to this application, including knowledge of the Act, Regulations and any guidelines that have relevance to the proposed activity; • I will comply with the Act, Regulations and all other applicable legislation; • I have no, and will not engage in, conflicting interests in the undertaking of the activity; • I undertake to disclose to the applicant and the competent authority all material information in my possession that reasonably has or may have the potential of influencing - any decision to be taken with respect to the application by the competent authority; and - the objectivity of any report, plan or document to be prepared by myself for submission to the competent authority; • All the particulars furnished by me in this form are true and correct; and • I realise that a false declaration is an offence in terms of regulation 48 and is punishable in terms of section 24F of the Act.
Signature	
Date	25/08/2020

a) Expertise of the specialist

Jaco van der Walt has been practising as a CRM archaeologist for 15 years. He obtained an MA degree in Archaeology from the University of the Witwatersrand focussing on the Iron Age in 2012 and is a PhD candidate at the University of Johannesburg focussing on Stone Age Archaeology with specific interest in the Middle Stone Age (MSA) and Later Stone Age (LSA). Jaco is an accredited member of ASAPA (#159) and have conducted more than 500 impact assessments in Limpopo, Mpumalanga, North West, Free State, Gauteng, KZN as well as he Northern and Eastern Cape Provinces in South Africa.

Jaco has worked on various international projects in Zimbabwe, Botswana, Mozambique, Lesotho, DRC Zambia, Guinea and Tanzania. Through this he has a sound understanding of the IFC Performance Standard requirements, with specific reference to Performance Standard 8 – Cultural Heritage.

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ABBREVIATIONS

AIA: Archaeological Impact Assessment
APHP: Association of Professional Heritage Practitioners
ASAPA: Association of South African Professional Archaeologists
BGG Burial Ground and Graves
BIA: Basic Impact Assessment
CFPs: Chance Find Procedures
CMP: Conservation Management Plan
CRR: Comments and Response Report
CRM: Cultural Resource Management
DEA: Department of Environmental Affairs
EA: Environmental Authorisation
EAP: Environmental Assessment Practitioner
ECO: Environmental Control Officer
EIA: Environmental Impact Assessment*
EIA: Early Iron Age*
EIA Practitioner: Environmental Impact Assessment Practitioner
EMP: Environmental Management Programme
ESA: Early Stone Age
ESIA: Environmental and Social Impact Assessment
GIS: Geographical Information System
GPS: Global Positioning System
GRP Grave Relocation Plan
HIA: Heritage Impact Assessment
LIA: Late Iron Age
LSA: Late Stone Age
MEC: Member of the Executive Council
MIA: Middle Iron Age
MPRDA: Mineral and Petroleum Resources Development Act
MSA: Middle Stone Age
NEMA National Environmental Management Act, 1998 (Act No. 107 of 1998)
NHRA National Heritage Resources Act, 1999 (Act No. 25 of 1999)
NID Notification of Intent to Develop
NoK Next-of-Kin
PRHA: Provincial Heritage Resource Agency
SADC: Southern African Development Community
SAHRA: South African Heritage Resources Agency

**Although EIA refers to both Environmental Impact Assessment and the Early Iron Age both are internationally accepted abbreviations and must be read and interpreted in the context it is used.*

GLOSSARY

Archaeological site (remains of human activity over 100 years old)
Early Stone Age (~ 2.6 million to 250 000 years ago)
Middle Stone Age (~ 250 000 to 40-25 000 years ago)
Later Stone Age (~ 40-25 000, to recently, 100 years ago)
The Iron Age (~ AD 400 to 1840)
Historic (~ AD 1840 to 1950)
Historic building (over 60 years old)

1 Introduction and Terms of Reference:

This report focuses on the area identified for the irrigation project that will facilitate pumping out approximately 8.5 million cubic meters of water from the underground mine which has become flooded since its closure approximately 30 years ago. The report forms part of the Basic Assessment (BA) and Environmental Management Programme Report (EMPR) for the project located in the Northern Cape Province (Figure 1.1 – 1.4).

The aim of the study is to survey the proposed development footprint to understand the heritage character of the study area. It serves to assess the impact of the proposed project on non-renewable heritage resources and to submit appropriate recommendations with regard to the responsible cultural resources management measures that might be required to assist the developer in managing the discovered heritage resources in a responsible manner. It is also conducted to protect, preserve, and develop such resources within the framework provided by the National Heritage Resources Act of 1999 (Act No 25 of 1999). The report outlines the approach and methodology utilised before and during the survey, which includes: Phase 1, review of relevant literature; Phase 2, the physical surveying of the area on foot and by vehicle; Phase 3, reporting the outcome of the study.

During the study Stone Age lithics and a cemetery were recorded. General site conditions and features on sites were recorded through photographs, GPS locations, and site descriptions. Possible impacts were identified, and mitigation measures are proposed in the following report. SAHRA as a commenting authority under section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) requires all environmental documents, complied in support of an Environmental Authorisation application as defined by NEMA EIA Regs section 40 (1) and (2), to be submitted to SAHRA. As such, the Basic Assessment report and its appendices must be submitted to the case as well as the EMPr, once it is completed by the Environmental Assessment Practitioner (EAP).

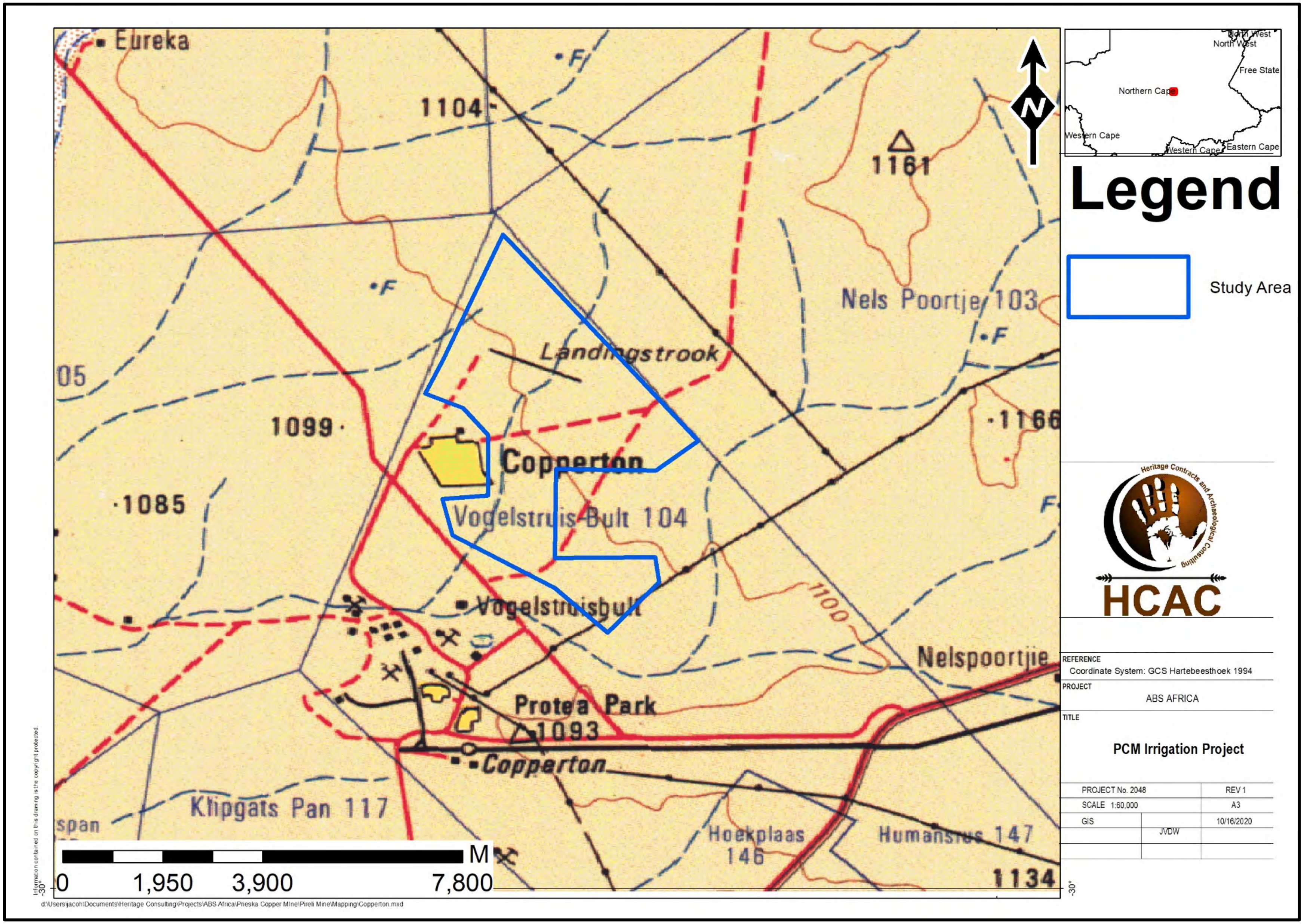


Figure 1-1. Regional Setting of project (1: 250 000 topographical map).

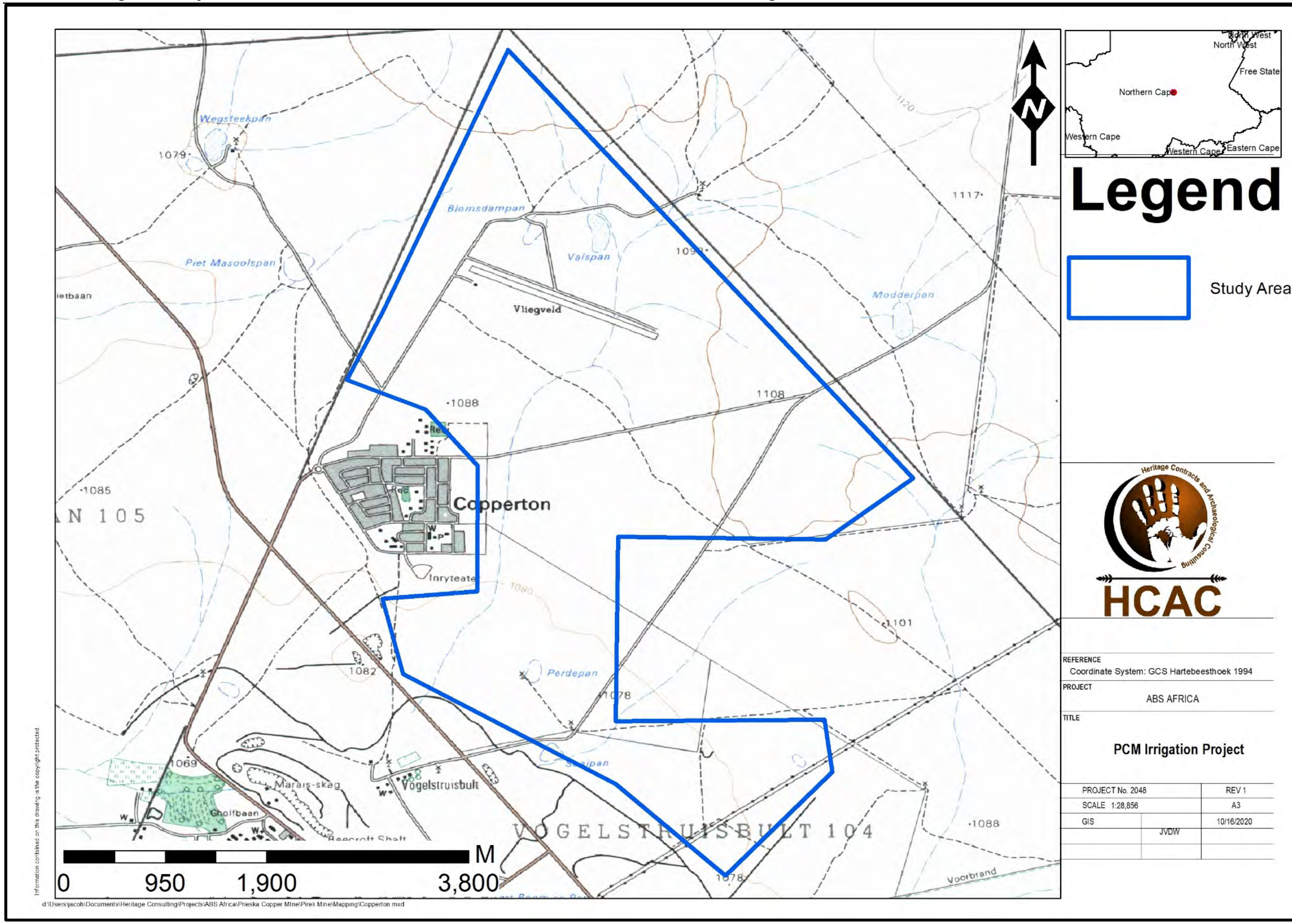


Figure 1-2. Local setting of project (1: 50 000 topographical map).

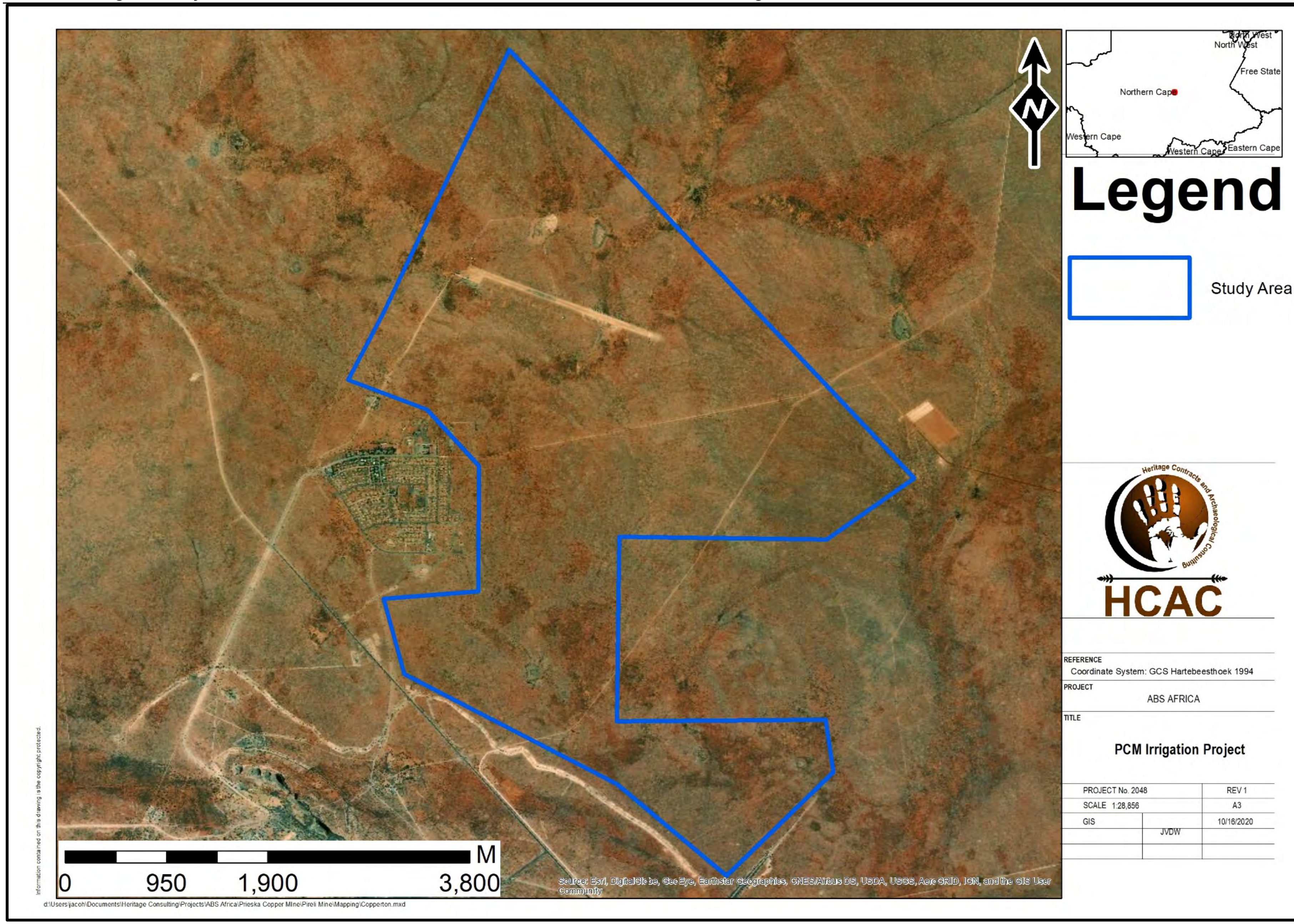


Figure 1-3. Aerial image of the irrigation project.

1.1 Terms of Reference

Field study

Conduct a high-level field assessment to: (a) understand the heritage character of the study area; b) record GPS points of sites/areas identified as significant areas; c) determine the levels of significance of the various types of heritage resources affected by the proposed development.

Reporting

Report on the anticipated impacts the proposed irrigation may have on heritage resources. Consider alternatives, should any significant sites be impacted adversely by the proposed project. Ensure that all studies and results comply with the relevant legislation, SAHRA minimum standards and the code of ethics and guidelines of ASAPA. To assist the developer in managing the discovered heritage resources in a responsible manner, and to protect, preserve, and develop them within the framework provided by the National Heritage Resources Act of 1999 (Act No 25 of 1999).

1.2 Project Description

The project comprises an irrigation project for the Prieska Copper-Zinc Mine utilising pivot irrigation. The linear pivot is a large area of approximately 1250 ha. The linear pivot will be used to irrigate natural vegetation at a rate that is similar to the annual rainfall in the area. Copperton typically receives an average of 20 mm per month of rainfall, with February, March and April averaging 40 mm/month in rainfall. The proposal is to irrigate the natural vegetation at 20 mm per month for a 10-month period in a regular and controlled manner to avoid erosion and promote natural vegetation growth. The system moves along with the driven wheels. The additional wheels align and are also driven and match the speed and location of the main driven wheel set. The main header system also houses the inlet feed for the water. This is either delivered by a flooded channel running parallel to the linear pivot or by a flexible pipeline. In the application for the Orion Prieska Copperton Mine, the linear pivot will be connected to a parallel running pipeline, which will have take-off points every 200m. Each of the four headers will be periodically stopped as the feed flexible pipeline is switched from the aft feeding take-off point to the forward feeding take-off. As such the flexible pipeline will be approximately 100 m long. Project details are indicated in Figure 1.1 – 1.4 as well as Table 2 and 3.

Table 2: Infrastructure and project activities

Type of development	Irrigation project for the Prieska Copper and Zinc Mine
Project size	Irrigation area of 1250 hectares of which 85% of the area will be utilised.
Project Description:	As a component of the overall dewatering strategy for the Orion Copperton – Zinc Copper mine, a portion of the underground water will be evaporated, while a portion will be treated and then irrigated onto local land. The irrigation system is made up of four linear pivots that are all fed from the same irrigation water break tank and will irrigate natural vegetation.

Table 3: Project Description

Size of farm and portions	The project is located on Vogelstruisbult 104 and the total area comprises 1250 hectares.
Magisterial District	Siyathemba Municipality
1: 50 000 map sheet number	2922 CD
Central co-ordinate of the development	-29.913406° 22.321525°

2 LEGISLATIVE REQUIREMENTS

The HIA, as a specialist sub-section of the EIA, is required under the following legislation:

- National Heritage Resources Act (NHRA), Act No. 25 of 1999)
- National Environmental Management Act (NEMA), Act No. 107 of 1998 - Section 23(2)(b)
- Mineral and Petroleum Resources Development Act (MPRDA), Act No. 28 of 2002 - Section 39(3)(b)(iii)

A Phase 1 HIA is a pre-requisite for development in South Africa as prescribed by SAHRA and stipulated by legislation. The overall purpose of heritage specialist input is to:

- Identify any heritage resources, which may be affected;
- Assess the nature and degree of significance of such resources;
- Establish heritage informants/constraints to guide the development process through establishing thresholds of impact significance;
- Assess the negative and positive impact of the development on these resources; and
- Make recommendations for the appropriate heritage management of these impacts.

The HIA should be submitted, as part of the impact assessment report or EMPr, to the PHRA if established in the province or to SAHRA. SAHRA will ultimately be responsible for the professional evaluation of Phase 1 AIA reports upon which review comments will be issued. 'Best practice' requires Phase 1 AIA reports and additional development information, as per the impact assessment report and/or EMPr, to be submitted in duplicate to SAHRA after completion of the study. SAHRA accepts Phase 1 AIA reports authored by professional archaeologists, accredited with ASAPA or with a proven ability to do archaeological work.

Minimum accreditation requirements include an Honours degree in archaeology or related discipline and 3 years post-university CRM experience (field supervisor level). Minimum standards for reports, site documentation and descriptions are set by ASAPA in collaboration with SAHRA. ASAPA is based in South Africa, representing professional archaeology in the SADC region. ASAPA is primarily involved in the overseeing of ethical practice and standards regarding the archaeological profession. Membership is based on proposal and secondment by other professional members.

Phase 1 AIA's are primarily concerned with the location and identification of heritage sites situated within a proposed development area. Identified sites should be assessed according to their significance. Relevant conservation or Phase 2 mitigation recommendations should be made. Recommendations are subject to evaluation by SAHRA.

Conservation or Phase 2 mitigation recommendations, as approved by SAHRA, are to be used as guidelines in the developer's decision-making process.

Phase 2 archaeological projects are primarily based on salvage/mitigation excavations preceding development destruction or impact on a site. Phase 2 excavations can only be conducted with a permit, issued by SAHRA to the appointed archaeologist. Permit conditions are prescribed by SAHRA and includes (as minimum requirements) reporting back strategies to SAHRA and deposition of excavated material at an accredited repository.

In the event of a site conservation option being preferred by the developer, a site management plan, prepared by a professional archaeologist and approved by SAHRA, will suffice as minimum requirement.

After mitigation of a site, a destruction permit must be applied for with SAHRA by the applicant before development may proceed.

Human remains older than 60 years are protected by the National Heritage Resources Act, with reference to Section 36. Graves older than 60 years, but younger than 100 years fall under Section 36 of Act 25 of 1999 (National Heritage Resources Act), as well as the Human Tissues Act (Act 65 of 1983), and are the jurisdiction of SAHRA. The procedure for Consultation Regarding Burial Grounds and Graves (Section 36[5]) of Act 25 of 1999) is applicable to graves older than 60 years that are situated outside a formal cemetery administrated by a local authority. Graves in this age category, located inside a formal cemetery administrated by a local authority, require the same authorisation as set out for graves younger than 60 years, in addition to SAHRA authorisation. If the grave is not situated inside a formal cemetery, but is to be relocated to one, permission from the local authority is required and all regulations, laws and by-laws, set by the cemetery authority, must be adhered to.

Human remains that are less than 60 years old are protected under Section 2(1) of the Removal of Graves and Dead Bodies Ordinance (Ordinance No. 7 of 1925), as well as the Human Tissues Act (Act 65 of 1983), and are the jurisdiction of the National Department of Health and the relevant Provincial Department of Health and must be submitted for final approval to the office of the relevant Provincial Premier. This function is usually delegated to the Provincial MEC for Local Government and Planning; or in some cases, the MEC for Housing and Welfare. Authorisation for exhumation and reinternment must also be obtained from the relevant local or regional council where the grave is situated, as well as the relevant local or regional council to where the grave is being relocated. All local and regional provisions, laws and by-laws must also be adhered to. To handle and transport human remains, the institution conducting the relocation should be authorised under Section 24 of Act 65 of 1983 (Human Tissues Act).

3 METHODOLOGY

3.1 Literature Review

3.1.1 Background information

A brief survey of available literature was conducted to extract data and information on the area in question to provide general heritage context into which the development would be set. This literature search included published material, unpublished commercial reports and online material.

3.1.2 SAHRIS

CRM reports sourced from the South African Heritage Resources Information System (SAHRIS) are also reviewed to contextualize the heritage resources in the area.

3.1.3 Genealogical Society of South Africa

The database of the Genealogical Society was consulted to collect data on any known graves in the area.

3.2 Public Consultation and Stakeholder Engagement:

Stakeholder engagement is a key component of any EIA process, it involves stakeholders interested in, or affected by the proposed development. Stakeholders are provided with an opportunity to raise issues of concern (for the purposes of this report only heritage related issues will be included). The aim of the public consultation process was to capture and address any issues raised by community members and other stakeholders' engagement. The process involved:

- Placement of advertisements and site notices
- Stakeholder notification (through the dissemination of information and meeting invitations);
- Stakeholder engagement undertaken with I&APs;
- Authority Consultation
- The compilation of a Basic Assessment Report (BA).
- The compilation of a Comments and Response Report (CRR).

3.3 Site Investigation

Conduct a field study to: a) conduct a high-level scan of the proposed project area to understand the heritage character of the area; b) record GPS points of sites/areas identified as significant areas; c) determine the levels of significance of the various types of heritage resources recorded in the project area.

General site conditions and features on sites were recorded by means of photographs, GPS locations, and site descriptions. Possible impacts were identified and mitigation measures are proposed in the following report.

Table 4: Site Investigation Details

	Site Investigation
Date	The study area was surveyed during the week of the 13th July 2020 over three days. The lay out was changed after the field work was conducted, and although all areas were not surveyed, the changes will not reflect material changes to the impact assessment as the area was sufficiently covered to record the heritage character of the area.
Season	Winter - The study area was sufficiently covered (Figure 3-1) to adequately record the range of heritage resources.

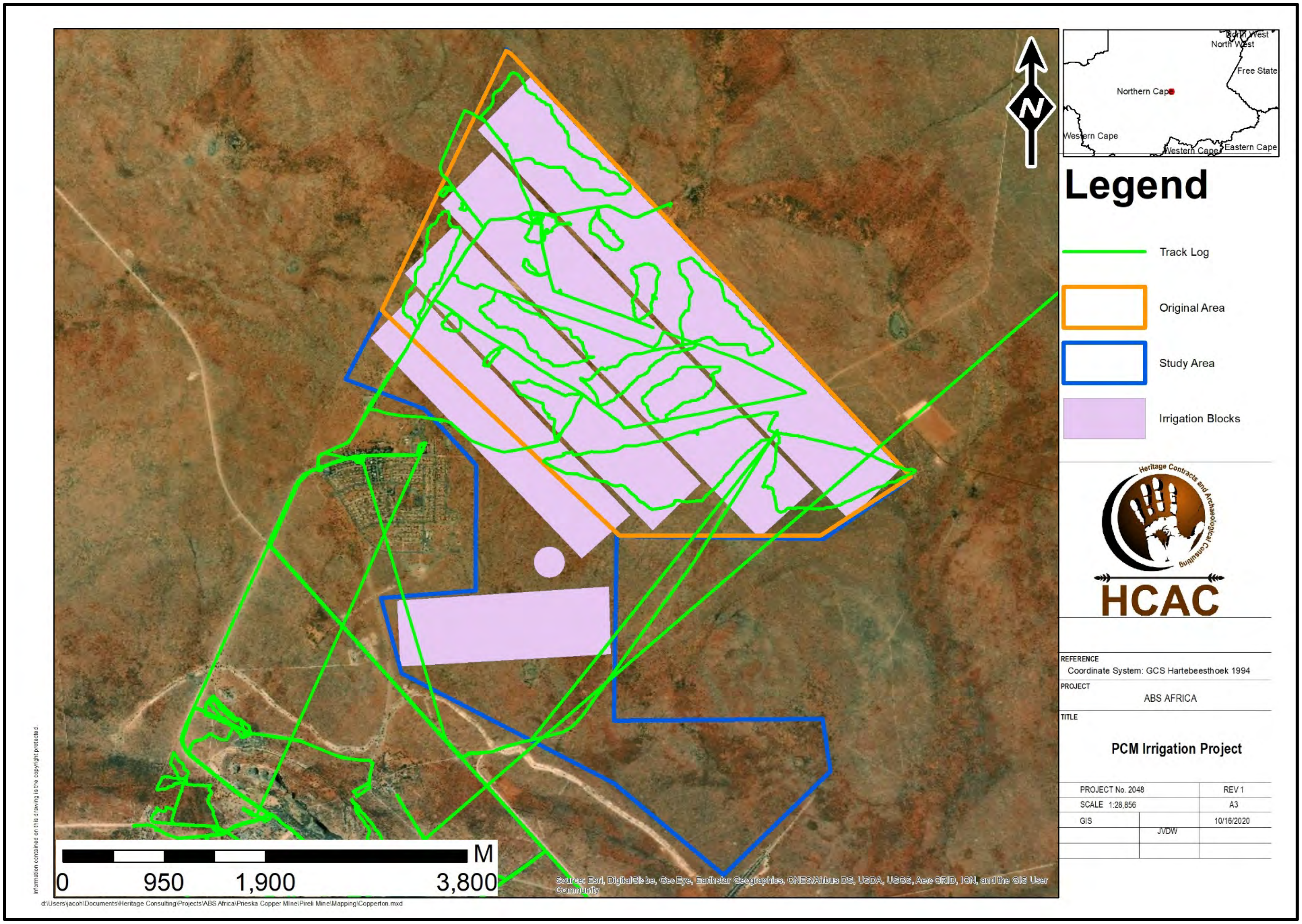


Figure 3-1. Track logs of the survey in green..

3.4 Site Significance and Field Rating

Section 3 of the NHRA distinguishes nine criteria for places and objects to qualify as 'part of the national estate' if they have cultural significance or other special value. These criteria are:

- » Its importance in/to the community, or pattern of South Africa's history;
- » Its possession of uncommon, rare or endangered aspects of South Africa's natural or cultural heritage;
- » Its potential to yield information that will contribute to an understanding of South Africa's natural or cultural heritage;
- » Its importance in demonstrating the principal characteristics of a particular class of South Africa's natural or cultural places or objects;
- » Its importance in exhibiting particular aesthetic characteristics valued by a community or cultural group;
- » Its importance in demonstrating a high degree of creative or technical achievement at a particular period;
- » Its strong or special association with a particular community or cultural group for social, cultural or spiritual reasons;
- » Its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa;
- » Sites of significance relating to the history of slavery in South Africa.

- » The presence and distribution of heritage resources define a 'heritage landscape'. In this landscape, every site is relevant. In addition, because heritage resources are non-renewable, heritage surveys need to investigate an entire project area, or a representative sample, depending on the nature of the project. In the case of the proposed project the local extent of its impact necessitates a representative sample and only the footprint of the areas demarcated for development were surveyed. In all initial investigations, however, the specialists are responsible only for the identification of resources visible on the surface. This section describes the evaluation criteria used for determining the significance of archaeological and heritage sites. The following criteria were used to establish site significance with cognisance of Section 3 of the NHRA:
  - The unique nature of a site;
  - The integrity of the archaeological/cultural heritage deposits;
  - The wider historic, archaeological and geographic context of the site;
  - The location of the site in relation to other similar sites or features;
  - The depth of the archaeological deposit (when it can be determined/is known);
  - The preservation condition of the sites; and
  - Potential to answer present research questions.
- » In addition to this criteria field ratings prescribed by SAHRA (2006), and acknowledged by ASAPA for the SADC region, were used for the purpose of this report. The recommendations for each site should be read in conjunction with section 10 of this report.

FIELD RATING	*GRADE*	*SIGNIFICANCE*	*RECOMMENDED MITIGATION*
National Significance (NS)	Grade 1	-	Conservation; national site nomination
Provincial Significance (PS)	Grade 2	-	Conservation; provincial site nomination
Local Significance (LS)	Grade 3A	High significance	Conservation; mitigation not advised
Local Significance (LS)	Grade 3B	High significance	Mitigation (part of site should be retained)
Generally Protected A (GP. A)	-	High/medium significance	Mitigation before destruction
Generally Protected B (GP. B)	-	Medium significance	Recording before destruction
Generally Protected C (GP. C)	-	Low significance	Destruction

3.5 Impact Assessment Methodology

The criteria below are used to establish the impact rating on sites:

- The **nature**, which shall include a description of what causes the effect, what will be affected and how it will be affected.
- The **extent**, wherein it will be indicated whether the impact will be local (limited to the immediate area or site of development) or regional, and a value between 1 and 5 will be assigned as appropriate (with 1 being low and 5 being high):
- The **duration**, wherein it will be indicated whether:
  - the lifetime of the impact will be of a very short duration (0-1 years), assigned a score of 1;
  - the lifetime of the impact will be of a short duration (2-5 years), assigned a score of 2;
  - medium-term (5-15 years), assigned a score of 3;
  - long term (> 15 years), assigned a score of 4; or
  - permanent, assigned a score of 5;
  - The **magnitude**, quantified on a scale from 0-10 where; 0 is small and will have no effect on the environment, 2 is minor and will not result in an impact on processes, 4 is low and will cause a slight impact on processes, 6 is moderate and will result in processes continuing but in a modified way, 8 is high (processes are altered to the extent that they temporarily cease), and 10 is very high and results in complete destruction of patterns and permanent cessation of processes.
  - The **probability of occurrence**, which shall describe the likelihood of the impact actually occurring. Probability will be estimated on a scale of 1-5 where; 1 is very improbable (probably will not happen), 2 is improbable (some possibility, but low likelihood), 3 is probable (distinct possibility), 4 is highly probable (most likely) and 5 is definite (impact will occur regardless of any prevention measures).
  - The **significance**, which shall be determined through a synthesis of the characteristics described above and can be assessed as low, medium or high; and
  - the **status**, which will be described as either positive, negative or neutral.
  - the degree to which the impact can be reversed.
  - the degree to which the impact may cause irreplaceable loss of resources.
  - the *degree* to which the impact can be mitigated.

The **significance** is calculated by combining the criteria in the following formula:
S=(E+D+M) P
S = Significance weighting
E = Extent
D = Duration
M = Magnitude
P = Probability
The **significance weightings** for each potential impact are as follows:

- < 30 points: Low (i.e., where this impact would not have a direct influence on the decision to develop in the area),
- 30-60 points: Medium (i.e., where the impact could influence the decision to develop in the area unless it is effectively mitigated),
- 60 points: High (i.e., where the impact must have an influence on the decision process to develop in the area).

3.6 Limitations and Constraints of the study

The authors acknowledge that the brief literature review is not exhaustive on the literature of the area. Due to the subsurface nature of archaeological artefacts, the possibility exists that some features or artefacts may not have been discovered/recorded during the survey. Similarly, the occurrence of graves and other cultural material not identified during the survey cannot be excluded. This study did not assess the impact on medicinal plants and intangible heritage as it is assumed that these components would have been highlighted through the public consultation process if relevant. It is possible that new information could come to light in future, which might change the results of this Impact Assessment.

4 DESCRIPTION OF SOCIO ECONOMIC ENVIRONMENTAL

According to the Integrated Development Plan 2015/16 Siyathemba Municipality " *the population of Siyathemba declined from just over 21,370 people in 2000 to about 21,330 in 2010. ……..Total employment in Siyathemba has been in fluctuating over the last ten years. Moreover, employment in the Study Area declined marginally from some 4,800 jobs during 2000 to just below 4,700 in 2010. Over a ten-year period, this could be translated to an average annual decline of 0.2%......Most workers in Siyathemba are employed in the Government Services Sector (around 1,700 workers), followed by Agriculture (about 1,100 workers) and the Trade (about 670 workers) sectors….*"

Challenges include infrastructure provision (water, sanitation as well as electricity) as well as unemployment.

5 DESCRIPTION OF THE PHYSICAL ENVIRONMENT:

The project is located approximately 60 km south-west of the town Prieska in the Siyathemba Municipality, Northern Cape Province of South Africa, on the farm Vogelstruisbult 104. The site can be accessed by an existing secondary gravel road, branching off the R357 that services Copperton town. The site is located at a moderate elevation with an undulating topography (Figure 5-1 and 5-2). The vegetation is predominantly Bushmanland Arid Grassland vegetation in the Nama-Karoo biome (Mucina & Rutherford 2006) which consists of Karoo scrub and grass and a few isolated *Acacia Karoo* trees.

Figure 5-1. Elevation map of the study area.

Figure 5-2. Panorama view of general site conditions.

6 RESULTS OF LITERATURE / BACKGROUND STUDY:

6.1 Background study

6.1.1 Archaeology of the area

Beaumont et al. (1995: 240) observed that "thousands of square kilometres of Bushmanland are covered by a low-density lithic scatter". These artefacts are generally very well weathered and mostly pertain to the ESA and MSA. Occasional LSA artefacts are also noted. What is noteworthy of the Northern Cape archaeological record is the presence of pans which frequently display associated archaeological material. Of interest, is the work of Kiberd (2001, 2005, 2006) who excavated Bundu Pan, some 25 to 30 km northwest of Copperton. The site yielded ESA, MSA and LSA horizons and the artefacts were accompanied by warthog and equid teeth to name a few (Beaumont et al. 1995).

Orton (2011) noted that to the northwest, west and southwest of Copperton sites have been investigated by Beaumont and colleagues (1995), Smith (1995) and Parsons (2003, 2004, 2007, 2008) yielding LSA deposits. Work on these sites led to a distinction between hunter-gatherer and herder sites, based on stone artefact assemblages (Beaumont et al. 1995). All these Later Stone Age sites have very few, if any, organic items on them. The only organic material found on sites like these is fragments of ostrich eggshell probably belonging to broken water containers. Such flasks have been widely recorded across the Northern Cape (Morris 1994).

The archaeological importance of pans in the area are now well documented (Kiberd 2006, Kaplan & Wiltshire 2011, Orton 2012) and if any occur in the study area they could be of significance. Van der Walt (2012) recorded low densities of ESA, MSA and LSA scatters just east of the current study area and were given a field rating of low archaeological significance. However, several discrete MSA and LSA sites were also documented.

Most of the material expected for the study area is MSA in nature consisting of large flakes, radial and bipolar cores, points, end scrapers, large utilized and retouched blade tools, and utilized and retouched flakes. Raw material is expected to be predominantly in fine grained quartzite, hornfels, banded ironstone, chert and vein quartz based on the results of the 2012 study by the author of this report.

6.1.2 Historical Information

In an article in the Patriot, dated December 1995, some background information is given on the history of the town of Copperton. This town is not very old, as it was only developed in 1972 with the establishment of a copper mine in the area. The mine closed in 1992, and Copperton was sold to a private person, on the condition that the houses in the town would be demolished. About 300 houses were broken down, when it was decided that some homes would be kept in order to develop a retirement town. These houses were apparently solidly built, with stone walls and corrugated roofs. It was noted that the area was very sparsely populated, and that the farmers in the area farmed with sheep. Next to the Orange River, maize and grapes were planted. It was noted that the closest hospitals were located at Prieska, some 35 to 40 minutes' drive from Copperton, and linked with a tarred road (Anon 1995: 4).

6.1.3 Anglo-Boer War

The discovery of diamonds and gold in the Northern provinces had very important consequences for South Africa. After the discovery of these resources, the British, who at the time had colonized the Cape and Natal, had intensions of expanding their territory into the northern Boer republics. This eventually led to the Anglo-Boer War, which took place between 1899 and 1902 in South Africa, and which was one of the most turbulent times in South Africa's history. Even before the outbreak of war in October 1899 British politicians, including Sir Alfred Milner and Mr. Chamberlain, had declared that should Britain's differences with the Z.A.R. result in violence, it would mean the end of republican independence. This decision was not immediately publicized, as a consequence, republican leaders based their assessment of British intentions on the more moderate public utterances of British leaders. Consequently, in March 1900, they asked Lord Salisbury to agree to peace on the basis of the status quo ante bellum. Salisbury's reply was a clear statement of British war aims. (Du Preez 1977).

In March 1900 Boer forces had taken Prieska, Kenhardt, Kakamas and Upington, attracting rebel support in the process. British columns were able to recapture the towns and the invasion had ended by June 1900. Local militias, including the Border Scouts (Upington), Bushmanland Borderers (Kenhardt) and Namaqualand Border Scouts (from the west) were established and patrolled the area.

6.2 Review of CRM reports (SAHRIS)

Previous heritage studies were conducted on the farm under investigation by Van Ryneveld (2006) and Orton (2015). Orton (2012) also conducted a study to the east on the farm Hoekplaas and Kaplan and Wiltshire (2011) on portion 3 and 4 of the farm Nelspoortjie (now called Vogelstruisfontein). All the studies recorded ESA, MSA and LSA artefacts scattered over the landscape with MSA and LSA sites centred on pans and watercourses. The Kaplan and Wiltshire (2011) study on the farm under investigation recorded a Stone Age site at Modderpan as well as two kraals and various Stone Age scatters and knapping sites.

Studies by Van der Walt (2012, 2013, 2017 & 2018) concurred with these findings and also recorded widespread Stone Age scatters and some discreet MSA and LSA sites. Orton (2012) also recorded stone walled enclosures.

6.3 Genealogical Society

No known grave sites are indicated close to the study area, but burial sites (especially pre-colonial burial sites) can be expected anywhere on the landscape.

6.4 Results of Public Consultation and Stakeholder Engagement:

Adjacent landowners and the public at large were informed of the proposed activity as part of the EIA process. Site notices and advertisements notifying interested and affected parties were placed at strategic points and in local newspapers as part of the process.

7 FINDINGS OF THE SURVEY

It is important to note that only the development footprint was surveyed relating to the irrigation project. During the survey, co-ordinates (labelled consecutively as waypoints) were taken where either diagnostic tools were observed or areas of higher density scatters. Low density Stone Age scatters (between 3 - 5 artefacts per m²) were recorded as observation points. Scatters higher than 5 artefacts per m² and knapping sites are labelled as features. Scatters with densities less than 2 artefacts per m² were not recorded as they occur throughout the study area. Individual occurrences were not point plotted unless they were diagnostic artefacts and were then also recorded as observation points.

Within the area earmarked for the irrigation project numerous ESA, MSA and to a lesser extent LSA lithics as well as a formal burial site located outside of the impact area were recorded. Observations were recorded (Figure 7.1) that characterise the heritage signature of the study area and are described below.

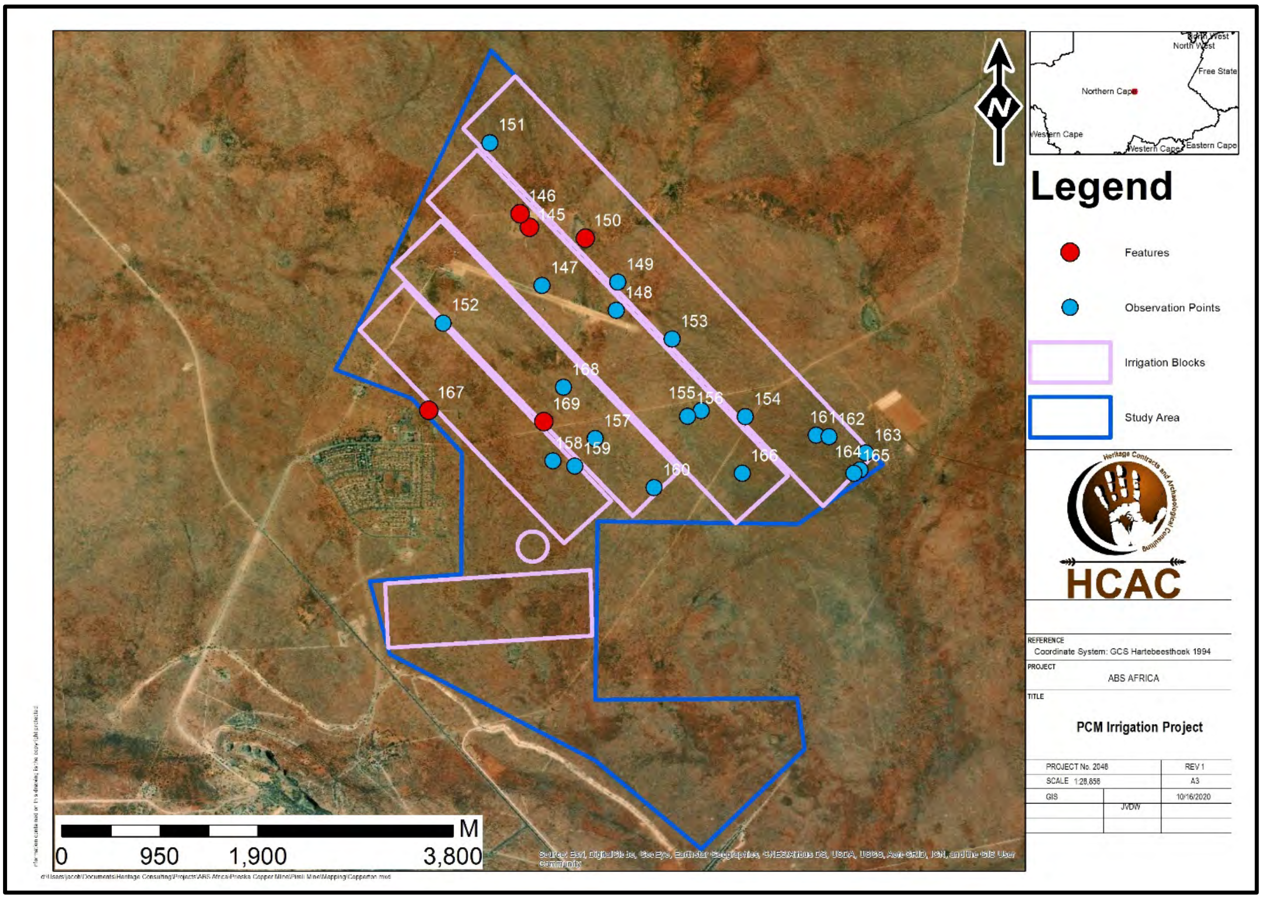


Figure 7-1. Recorded heritage points in relation to the irrigation area.

7.1 Built Environment

The irrigation area is largely undeveloped and no structures occur on site apart from a landing strip.

Waypoint Number	Description	Heritage Feature or Observation Point	Significance	Field Rating	Longitude	Latitude
145,146	Wide scatter of MSA and LSA artefacts around Blomsdampan. Sheet erosion. Blades and scrapers and a few cores. Slightly higher concentrations at recorded Waypoints. Artefacts are characterised by blade cores on quartzite, platform thinning flake on quartz and prepared cores. Levallois quartzite points	Feature	Medium Significance	GP B	22° 18' 59.8931" E 22° 18' 56.9125" E	29° 54' 02.4696" S 29° 53' 58.2611" S
147	Low scatter of MSA flakes on widespread Dwyka tillite	Observation Point	Low Significance	GP C	22° 19' 03.8497" E	29° 54' 20.8261" S
148	Large MSA scraper and few flakes. Scattered over a wide area. Discoid core	Observation Point	Low Significance	GP C	22° 19' 27.2497" E	29° 54' 28.5949" S
149	Few LSA flakes and chert core, large MSA prepared core with point removed	Observation Point	Low Significance	GP C	22° 19' 27.6673" E	29° 54' 19.7567" S
150	Valspan with some MSA and LSA scatters around edge. Levallois cores etc	Feature	Medium Significance	GP B	22° 19' 17.4899" E	29° 54' 05.9327" S
151	Higher lying area with widespread Dwyka tillite. Various MSA and LSA flakes and cores. Range if raw material	Observation Point	Low Significance	GP C	22° 18' 47.3977" E	29° 53' 35.8475" S
152	Low density scatter of mostly isolated MSA artefacts. Flakes and double-sided scrapers	Observation Point	Low Significance	GP C	22° 18' 32.6591" E	29° 54' 32.6016" S
153	Ridge with wide scatter of artefacts and suite of raw material from widespread Dwyka Tillite. MSA blades and cores mostly on quartzite and LSA irregular cores on chert. Some Jasper also used for LSA	Observation Point	Low Significance	GP C	22° 19' 44.7960" E	29° 54' 37.6344" S
154	Isolated ESA hand axe	Observation Point	Low Significance	GP C	22° 20' 07.8107" E	29° 55' 02.0929" S
155	LSA flakes on chert and possible ESA large flakes on gneiss. Some MSA flakes in wider area	Observation Point	Low Significance	GP C	22° 19' 53.9653" E	29° 55' 00.1883" S
156	Gravel pavement from Dwyka Tillite on slightly elevated area. Suite of mostly MSA artefacts. Scattered over a wide area with exposed calcrete, in deflated context. Some ESA flakes and isolated hand axes as well as LSA lithics mostly on chert. Lithics scattered in low densities over a large area and artefacts are gravitating down slope.	Observation Point	Low Significance	GP C	22° 19' 49.6415" E	29° 55' 01.9487" S
157	Same as previous description but scattered over a smaller area	Observation Point	Low Significance	GP C	22° 19' 20.5644" E	29° 55' 09.0479" S
158	Lithics in a deflated context scattered over a wide area on exposed calcrete towards a slight rise	Observation Point	Low Significance	GP C	22° 19' 07.2048" E	29° 55' 16.0211" S
159	MSA and LSA lithic scatter on calcrete towards a small rise few formal tools	Observation Point	Low Significance	GP C	22° 19' 14.0880" E	29° 55' 17.6737" S
160	MSA and LSA artefacts scattered over a large area on calcrete in a deflated context. Artefacts gravitating down slope site will extend to higher lying area. ESA material also	Observation Point	Low Significance	GP C	22° 19' 39.1295" E	29° 55' 24.4667" S
161	Isolated ESA LCT on red sands	Observation Point	Low Significance	GP C	22° 20' 30.1739" E	29° 55' 07.8672" S
162	Low density scatter of mainly MSA flakes interestingly some on quartz	Observation Point	Low Significance	GP C	22° 20' 34.1953" E	29° 55' 08.4541" S
163	Low density scatter of MSA lithics, no formal tools	Observation Point	Low Significance	GP C	22° 20' 45.7188" E	29° 55' 13.5084" S
164	Low density of miscellaneous flakes on open area in grass and red sand	Observation Point	Low Significance	GP C	22° 20' 43.9511" E	29° 55' 18.8113" S
165	ESA core/ chopper with a few flakes. MSA blades also present. Located on slight rise	Observation Point	Low Significance	GP C	22° 20' 42.0287" E	29° 55' 19.9091" S

166	ESA core/ chopper with a few flakes. MSA blades also present. Located on slight rise	Observation Point	Low Significance	GP C	22° 20' 06.8532" E	29° 55' 19.9344" S
168	Isolated ESA Acheulian hand axe	Observation Point	Low Significance	GP C	22° 19' 10.5421" E	29° 54' 52.8733" S
169	Knapping site with cores, flakes and blades etc. MSA pointed flakes on quartzite, core on quartzite, flakes scattered over a wide area. Several chert irregular cores and blades possibly LSA. Hammer stone	Feature	Medium Significance	GP B	22° 19' 04.4471" E	29° 55' 03.6841" S

7.2 Archaeological Resources

The archaeological importance of pans in the area are now well documented (Kiberd 2006, Kaplan & Wiltshire 2011, Orton 2012) and the two pans (Blomsdampan & Valspan) also mentioned by Kaplan & Wiltshire that occur in the current study area are considered by the authors to be of high heritage significance (Kaplan & Wiltshire 2011:18). Evidence in the form of widespread lithic scatters attest to the use of the wider landscape from the ESA, MSA and the LSA. Raw material from the Dwyka Tillites are readily available manifested in gravel pavements and a suite of raw material (e.g., Jasper, quartzite, banded iron stone etc) was available to the knappers. Several lithics recorded have high percentages of cortex and are found with flake debris with little to no retouch, suggesting expedient knapping on the locally available raw material. Lithics are found through most of the study area easily visible in the surrounding landscape where the gravel pavements are exposed, with higher densities in higher lying areas, often in deflated contexts on top of exposed calcrete. Where aeolian sand cover the calcrete and gravel pavements, artefact counts drop drastically suggesting that the aeolian sands have buried most of the MSA and ESA in these zones as found by Kiberd (2002, 2006). The extent of these gravel pavements with lithics were not recorded but waypoints and superficial observations were taken, knapping of exposed outcrops were also noted (Table 5 and Figure 7.1) characterising the heritage signature of the study area and are briefly described below.

Table 5. Archaeological observation points, with heritage significance and field rating

Figure 7-2. Core and flakes from various raw material at Blombospan (Waypoint 145 and 146)

Figure 7-3. General view of Blombospan (Waypoint 145)

Figure 7-4. MSA Levallois core and flake at Waypoint 150

Figure 7-5. General view of Valspan (Waypoint 150)

Figure 7-6. Scatter of lithics at knapping site (Waypoint 169)

Figure 7-7.Hammerstone at Waypoint 169

Figure 7-8. Artefacts from Waypoint 169

Figure 7-9. Large quarts flake at Waypoint 169

Figure 7-10. Core and flakes at Waypoint 151

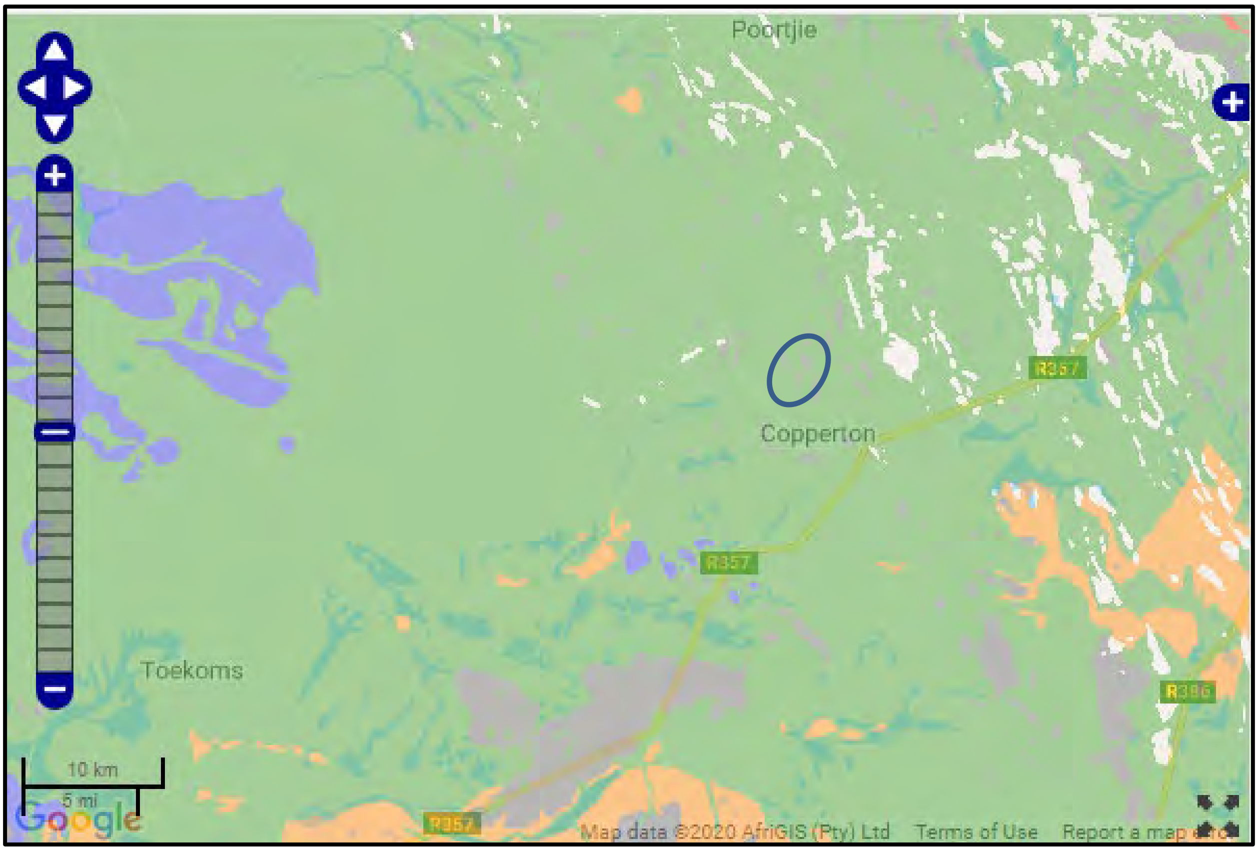
Figure 7-11. General site conditions at Waypoint 153.

Figure 7-12. Range of raw material and lithics at Waypoint 153

Figure 7-13. ESA Handaxe at point 154

7.3 Palaeontology

According to the SAHRA paleontological sensitivity map, the area is of moderate sensitivity (Figure 7-14). The paleontological component was addressed in an independent study (Bamford 2020). The proposed site lies on the Aeolian sands of the Gordonia Formation (Kalahari Group, Quaternary age), and not on the Dwyka Group. Windblown sands seldom preserve fossils and then only in such features as springs or palaeo-pans but no such features are evident. The study concluded that a site visit prior to construction is not required but a Fossil Chance Find Protocol should be added to the EMPr.



Colour	Sensitivity	Required Action
RED	VERY HIGH	Field assessment and protocol for finds is required
ORANGE/YELLOW	HIGH	Desktop study is required and based on the outcome of the desktop study; a field assessment is likely
GREEN	MODERATE	Desktop study is required
BLUE	LOW	No palaeontological studies are required however a protocol for finds is required
GREY	INSIGNIFICANT/ZERO	No palaeontological studies are required
WHITE/CLEAR	UNKNOWN	These areas will require a minimum of a desktop study. As more information comes to light, SAHRA will continue to populate the map.

Figure 7-14.Paleontological sensitivity of the approximate study area (indicated in blue) as indicated on the SAHRIS paleontological sensitivity map.

7.4 Burial Grounds and Graves

One formal grave site was recorded at Waypoint 167 but outside of the study area (Table 6 and Figure 7-15 to 7 -17). Four graves were noted as well as a columbarium. The cemetery is located outside of the impact area of the project and no impact is expected. If any additional graves are located in future they should ideally be preserved *in-situ* or alternatively relocated according to existing legislation.

Table 6. Grave recorded

Waypoint Number	Description	Heritage Feature or Observation Point	Significance	Field Rating	Longitude	Latitude
167	Cemetery with 1 double grave and 2 single graves as well as a child's grave. One grave with inscription of Henna van der Westhuizen who passed away in 2009	Feature	High Social Significance	GP A	22° 18' 28.1305" E	29° 55' 00.0625" S

Figure 7-15. General site conditions at cemetery.

Figure 7-16.Columbarium close to cemetery.

Figure 7-17. Formal graves in small cemetery.

7.5 Cultural Landscape

The cultural landscape of the study area is related to agricultural and historical mining activities. The main elements of the cultural landscape are the wide-open spaces bisected by farm tracks and the demolished remains of mining infrastructure. The overall landscape character is changing from a rural landscape to an industrial setting with various power lines, mining infrastructure and several renewable energy facilities. The proposed development is in line with previous land use of the area and will not add a significant impact towards the current landscape use.

8 IMPACT ASSESSMENT

8.1 Potential Impact

The larger area is rich in terms of the number of Stone Age occurrences and similarly archaeological material in the form of lithic scatters that occur throughout the proposed irrigation area. These lithics consist of a widespread surface scatter of MSA material and to a lesser extent ESA and LSA artefacts in deflated contexts. The Stone Age of the area is well recorded (e.g., Kaplan 2010; Kaplan & Wiltshire 2011; Orton 2011, 2012, 2014, 2015; Orton & Webley 2013; Webley 2016, Van der Walt 2012, 2013, 2017, 2018, and Van Ryneveld (2006).The background scatter of artefacts is not unique, according to Beaumont *et al* (1995) "thousands of square kilometres of Bushmanland are covered by a low-density lithic scatter".

The project aims to irrigate the natural vegetation at 20 mm per month for a 10-month period in a regular and controlled manner to avoid erosion and promote natural vegetation growth. Flexible water pipes will be above ground and the impact of the project is considered to be low. Impact will only occur in the indiacted irrigation blocks (Figure 8-1). The recorded graves are located outside of the impact area and no impact is expected on this site.

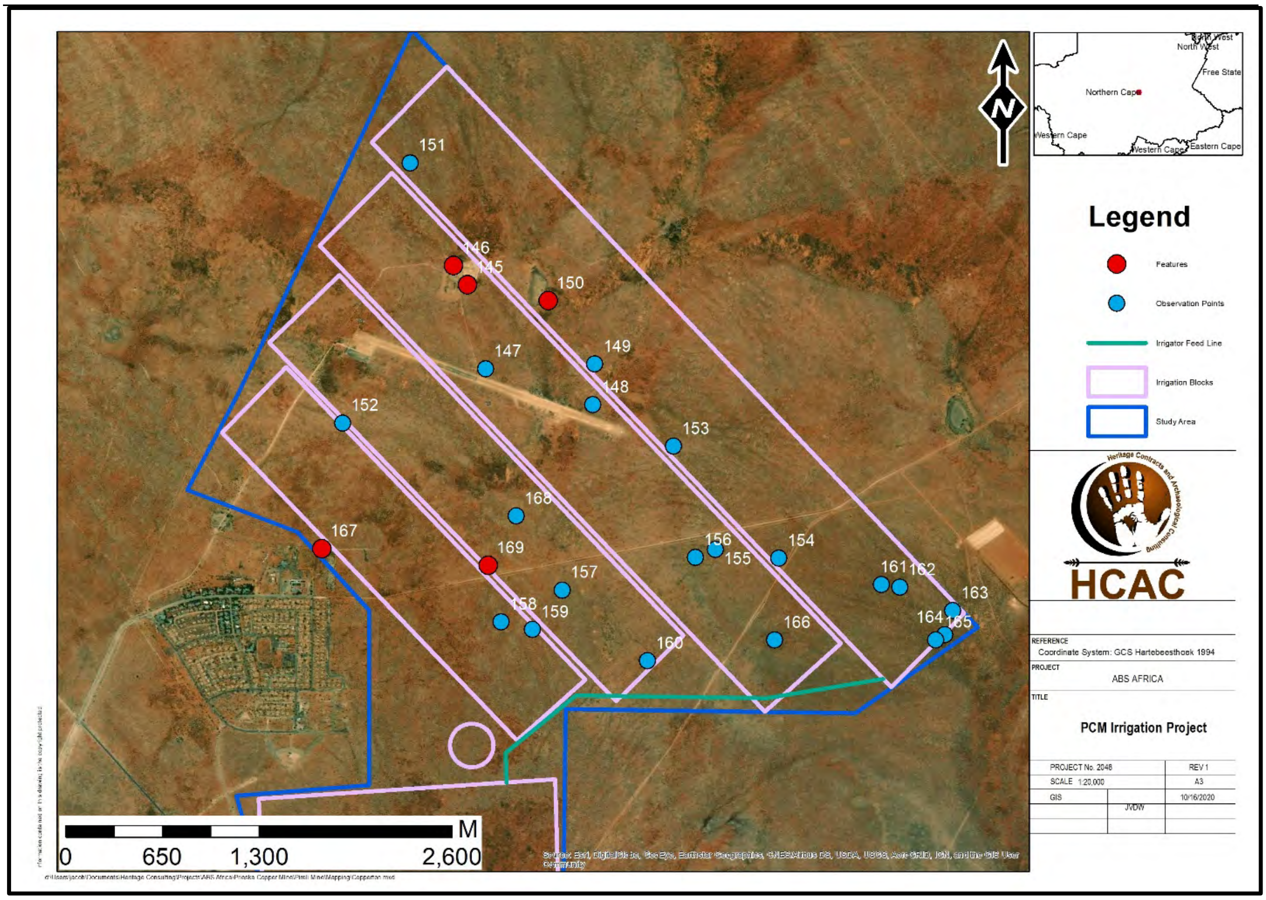


Figure 8-1. Proposed infrastructure in relation to recorded features. The impact area is only the area indicated in pink (irrigation blocks).

Table 7. Impact Assessment of Archaeological Scatters

Nature: During the construction phase activities resulting in disturbance of surfaces and/or sub-surfaces may destroy, damage, alter, or remove from its original position archaeological material or objects.		
	Without mitigation	**With mitigation (Preservation/ recording)**
Extent	Site specific (1)	Site specific (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Minor (2)	Minor (2)
Probability	Improbable (2)	Improbable (2)
Significance	**16 (Low)**	**16 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: Due to the low impact no mitigation is required prior to construction. A Chance Find Procedure should be implemented for the project.		
Residual Impacts: If sites are destroyed this results in the depletion of archaeological record of the area and even though surface features can be avoided or mitigated, there is a chance that completely buried sites would still be impacted but this cannot be quantified. However, if sites are recorded and preserved or mitigated this adds to the record of the area.		

Table 8. Impact of the project on Archaeological Sites

Nature: During the construction phase activities resulting in disturbance of surfaces and/or sub-surfaces may destroy, damage, alter, or remove from its original position archaeological material or objects.		
	Without mitigation	**With mitigation (Preservation/ recording)**
Extent	Site specific (1)	Site specific (1)
Duration	Permanent (5)	Permanent (5)
Magnitude	Moderate (6)	Minor (2)
Probability	Probable (3)	Not Probable (2)
Significance	**36 (Medium)**	**16 (Low)**
Status (positive or negative)	Negative	Negative
Reversibility	Not reversible	Not reversible
Irreplaceable loss of resources?	Yes	Yes
Can impacts be mitigated?	Yes	Yes
Mitigation: • No infrastructure must occur surrounding Blombospan and Valspan (Waypoint 145, 146 and 150) with a 30 m buffer; • Irrigation must be done in a way that will not accelerate sheet erosion in the impact area or result in silting up of Blombospan and Valspan. This must be monitored by the ECO. • No infrastructure must occur surrounding the knapping and quarrying site (Waypoint 169) with a 30 m buffer; • A Chance Find Procedure should be implemented for the project.		
Residual Impacts: If sites are destroyed this results in the depletion of archaeological record of the area and even though surface features can be avoided or mitigated, there is a chance that completely buried sites would still		

be impacted but this cannot be quantified. However, if sites are recorded and preserved or mitigated this adds to the record of the area.

9 CONCLUSION AND RECOMMENDATIONS

The archaeological importance of pans in the area are now well documented (Kiberd 2006, Kaplan & Wiltshire 2011, Orton 2012) and the two pans (Blomsdampan & Valspan) also mentioned by Kaplan & Wiltshire that occur in the current study area are considered by the authors to be of high heritage significance (Kaplan & Wiltshire 2011:18). Evidence in the form of widespread lithic scatters attest to the use of the wider landscape from the ESA, MSA and the LSA. Raw material from the Dwyka Tillites are readily available**,** manifested in gravel pavements and a suite of raw material (e.g., Jasper, quartzite, band**e**d iron stone etc) was available to the knappers. Several lithics recorded have high percentages of cortex and are found with flake debris with little to no retouch, suggesting expedient knapping on the locally available raw material. Lithics are found through most of the study area easily **visible** in the surrounding landscape where the gravel pavements are exposed, with higher densities in higher lying areas, often in deflated contexts on top of exposed calcrete. Where aeolian sand cover the calcrete and gravel pavements, artefact counts drop drastically suggesting that the aeolian sands have buried most of the MSA and ESA in these zones as found by Kiberd (2002, 2006). The extent of these gravel pavements with lithics were not recorded but waypoints and superficial observations were taken, knapping of exposed outcrops were also noted characterising the heritage signature of the study area**.** A formal burial site was recorded during the survey with distinct headstone and the grave of a child but located outside of the study area and will not be impacted on.

According to the SAHRA paleontological sensitivity map, the area is of moderate paleontological sensitivity and an independent study was conducted and concluded that it is extremely unlikely that any fossils would be preserved in the Aeolian sands of the Quaternary aged Gordonia Formation but that a Fossil Chance Find Protocol for Quaternary fossils should be added to the EMPr.

The anticipated impacts by the irrigation is minimal because the project aims to irrigate the natural vegetation at 20 mm per month for a 10-month period in a regular and controlled manner to avoid erosion and promote natural vegetation growth. Irrigation will be conducted with flexible pipes above surface minimising impacts on resources. Irrigation infrastructure is temporary.

The impact of the proposed project on heritage resources can be mitigated to an acceptable level with the correct mitigation measures in place. It is therefore recommended that the proposed project can commence provided that the recommendations in this report are adhered to as part of the EMPr and based on the approval of SAHRA.

Recommendations:

- No infrastructure must occur surrounding Blombospan and Valspan (Waypoint 145, 146 and 150) with a 30 m buffer;
- Irrigation must be done in a way that will not accelerate sheet erosion in the impact area or result in silting up of Blombospan and Valspan. This must be monitored by the ECO.
- No infrastructure must occur surrounding the knapping and quarrying site (Waypoint 169) with a 30 m buffer;
- Implementation of a chance find procedure that include a Fossil Chance Find Protocol for Quaternary fossils.

9.1 Chance Find Procedures

The possibility of the occurrence of additional finds cannot be excluded. Therefore, if during construction any possible finds such as stone tool scatters, artefacts or bone and fossil remains are made, the operations must be stopped and a qualified archaeologist must be contacted for an assessment of the find and therefor chance find procedures should be put in place as part of the EMP. A short summary of chance find procedures is discussed below.

This procedure applies to the developer's permanent employees, its subsidiaries, contractors and subcontractors, and service providers. The aim of this procedure is to establish monitoring and reporting procedures to ensure compliance with this policy and its associated procedures. Staff must be properly inducted to ensure they are fully aware of the procedures regarding chance finds as discussed below.

- If during the pre-construction phase, construction, operations or closure phases of this project, any person employed by the developer, one of its subsidiaries, contractors and subcontractors, or service provider, finds any artefact of cultural significance or heritage site, this person must cease work at the site of the find and report this find to their immediate supervisor, and through their supervisor to the senior on-site manager.
- It is the responsibility of the senior on-site Manager to make an initial assessment of the extent of the find and confirm the extent of the work stoppage in that area.
- The senior on-site Manager will inform the ECO of the chance find and its immediate impact on operations. The ECO will then contact a professional archaeologist for an assessment of the finds who will notify the SAHRA.

9.2 Reasoned Opinion

The impact of the proposed project on heritage resources is considered to be of low significance and can be mitigated to an acceptable level if the recommendations in this report are adhered to and based on the approval of SAHRA. Furthermore, the socio-economic benefits also outweigh the possible impacts of the development with the correct mitigation measures (i.e. chance find procedure) implemented for the project.

9.3 Potential Risk

Potential risks to the proposed project are the occurrence of unknown and unmarked graves. The possibility exists that the study area could contain graves of which surface indicators have been destroyed and subsurface material could be uncovered during earth works. These risks can be mitigated to an acceptable level with monitoring and the implementation of a chance find procedure as outlined in Section 9.1.

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APPENDICES:

Appendix A

Curriculum Vitae of Specialist

Jaco van der Walt
Archaeologist

jaco.heritage@gmail.com
+27 82 373 8491
+27 86 691 6461

Education:

Particulars of degrees/diplomas and/or other qualifications:

Name of University or Institution:		University of Pretoria
Degree obtained	**:**	BA Heritage Tourism & Archaeology
Year of graduation	**:**	2001
Name of University or Institution:		University of the Witwatersrand
Degree obtained	**:**	BA Hons Archaeology
Year of graduation	**:**	2002
Name of University or Institution	**:**	University of the Witwatersrand
Degree Obtained	**:**	MA (Archaeology)
Year of Graduation	:	2012
Name of University or Institution:		University of Johannesburg
Degree	**:**	PhD
Year	:	Currently Enrolled

EMPLOYMENT HISTORY:

2011 – Present:	**Owner – HCAC (Heritage Contracts and Archaeological Consulting CC)**.
2007 – 2010 :	**CRM Archaeologist,** Managed the Heritage Contracts Unit at the University of the Witwatersrand.
2005 - 2007:	**CRM Archaeologist**, Director of Matakoma Heritage Consultants
2004:	**Technical Assistant**, Department of Anatomy University of Pretoria
2003:	**Archaeologist**, Mapungubwe World Heritage Site
2001 - 2002:	**CRM Archaeologists,** For R & R Cultural Resource Consultants, Polokwane
2000:	**Museum Assistant**, Fort Klapperkop.

Countries of work experience include:
Republic of South Africa, Botswana, Zimbabwe, Mozambique, Tanzania, The Democratic Republic of the Congo, Lesotho and Zambia.

SELECTED PROJECTS INCLUDE:

Archaeological Impact Assessments (Phase 1)

Heritage Impact Assessment Proposed Discharge Of Treated Mine Water Via The Wonderfontein Spruit Receiving Water Body Specialist as part of team conducting an Archaeological Assessment for the Mmamabula mining project and power supply, Botswana
Archaeological Impact Assessment Mmamethlake Landfill
Archaeological Impact Assessment Libangeni Landfill

Linear Developments

Archaeological Impact Assessment Link Northern Waterline Project At The Suikerbosrand Nature Reserve
Archaeological Impact Assessment Medupi – Spitskop Power Line,
Archaeological Impact Assessment Nelspruit Road Development

Renewable Energy developments

Archaeological Impact Assessment Karoshoek Solar Project

Grave Relocation Projects

Relocation of graves and site monitoring at Chloorkop as well as permit application and liaison with local authorities and social processes with local stakeholders, Gauteng Province.
Relocation of the grave of Rifle Man Maritz as well as permit application and liaison with local authorities and social processes with local stakeholders, Ndumo, Kwa Zulu Natal.
Relocation of the Magolwane graves for the office of the premier, Kwa Zulu Natal
Relocation of the OSuthu Royal Graves office of the premier, Kwa Zulu Natal

Phase 2 Mitigation Projects

Field Director for the Archaeological Mitigation For Booysendal Platinum Mine, Steelpoort, Limpopo Province. Principle investigator Prof. T. Huffman
Monitoring of heritage sites affected by the ARUP Transnet Multipurpose Pipeline under directorship of Gavin Anderson.
Field Director for the Phase 2 mapping of a late Iron Age site located on the farm Kameelbult, Zeerust, North West Province. Under directorship of Prof T. Huffman.
Field Director for the Phase 2 surface sampling of Stone Age sites effected by the Medupi – Spitskop Power Line, Limpopo Province

Heritage management projects

Platreef Mitigation project – mitigation of heritage sites and compilation of conservation management plan.

MEMBERSHIP OF PROFESSIONAL ASSOCIATIONS:

- Association of Southern African Professional Archaeologists. Member number 159

  Accreditation:
  - Field Director Iron Age Archaeology
  - Field Supervisor Colonial Period Archaeology, Stone Age Archaeology and Grave Relocation
- Accredited CRM Archaeologist with SAHRA
- Accredited CRM Archaeologist with AMAFA
- Co-opted council member for the CRM Section of the Association of Southern African Association Professional Archaeologists (2011 – 2012)

PUBLICATIONS AND PRESENTATIONS

- A Culture Historical Interpretation, Aimed at Site Visitors, of the Exposed Eastern Profile of K8 on the Southern terrace at Mapungubwe.
  - J van der Walt, A Meyer, WC Nienaber
  - Poster presented at Faculty day, Faculty of Medicine University of Pretoria 2003
- ‘n Reddingsondersoek na Anglo-Boereoorlog-ammunisie, gevind by Ifafi, Noordwes-Provinsie. South-African Journal for Cultural History 16(1) June 2002, with A. van Vollenhoven as co-writer.
- Fieldwork Report: Mapungubwe Stabilization Project.
  - WC Nienaber, M Hutten, S Gaigher, J van der Walt
  - Paper read at the Southern African Association of Archaeologists Biennial Conference 2004
- A War Uncovered: Human Remains from Thabantšho Hill (South Africa), 10 May 1864.
  - M. Steyn, WS Boshoff, WC Nienaber, J van der Walt
  - Paper read at the 12th Congress of the Pan-African Archaeological Association for Prehistory and Related Studies 2005
- Field Report on the mitigation measures conducted on the farm Bokfontein, Brits, North West Province .
  - J van der Walt, P Birkholtz, W. Fourie
  - Paper read at the Southern African Association of Archaeologists Biennial Conference 2007
- Field report on the mitigation measures employed at Early Farmer sites threatened by development in the Greater Sekhukhune area, Limpopo Province. J van der Walt
  - Paper read at the Southern African Association of Archaeologists Biennial Conference 2008
- Ceramic analysis of an Early Iron Age Site with vitrified dung, Limpopo Province South Africa.
  - J van der Walt. Poster presented at SAFA, Frankfurt Germany 2008

- Bantu Speaker Rock Engravings in the Schoemanskloof Valley, Lydenburg District, Mpumalanga (*In Prep)*
    - J van der Walt and J.P Celliers
- Sterkspruit: Micro-layout of late Iron Age stone walling, Lydenburg, Mpumalanga. W. Fourie and J van der Walt. A Poster presented at the Southern African Association of Archaeologists Biennial Conference 2011
- Detailed mapping of LIA stone-walled settlements' in Lydenburg, Mpumalanga. J van der Walt and J.P Celliers
    - Paper read at the Southern African Association of Archaeologists Biennial Conference 2011
- Bantu-Speaker Rock engravings in the Schoemanskloof Valley, Lydenburg District, Mpumalanga. J.P Celliers and J van der Walt
    - Paper read at the Southern African Association of Archaeologists Biennial Conference 2011
- Pleistocene hominin land use on the western trans-Vaal Highveld ecoregion, South Africa, Jaco van der Walt.
    - J van der Walt. Poster presented at SAFA, Toulouse, France. Biennial Conference 2016

REFERENCES:

1.	Prof Marlize Lombard	Senior Lecturer, University of Johannesburg, South Africa
		E-mail: mlombard@uj.ac.za
2.	Prof TN Huffman	Department of Archaeology Tel: (011) 717 6040
		University of the Witwatersrand
3.	Alex Schoeman	University of the Witwatersrand
		E-mail:Alex.Schoeman@wits.ac.za