C2 Site 1 Key Intersection Analysis Results

C2.1 AM Peak

A node	B node	C node	Ref	Intersection Name	Approach	Movement	Turn Volume	Turn Delay	Turn V/C	Turn Capacity	Turn LOS	Approach Volume	Approach Delay	Approach V/C	Approach Capacity	Approach LOS	Intersection Delay	Intersection V/C	Intersection LOS
1382	1359	1385	1382-1359-1385	Kassier Road/MR559	Kassier Road	Left	286	0.00	18.39	1559.85	A	426	8.03	10.55	4820	A	2.93	10.18	A
1382	1359	1310	1382-1359-1310	Kassier Road/MR559	Kassier Road	Thru	136	0.00	9.67	1409.96	A								
1382	1359	1337	1382-1359-1337	Kassier Road/MR559	Kassier Road	Right	3	3.54	0.30	1060.42	A								
1385	1359	1310	1385-1359-1310	Kassier Road/MR559	MR559	Left	21	4.49	4.02	518.80	A	595	5.62	31.38	1896	A			
1385	1359	1337	1385-1359-1337	Kassier Road/MR559	MR559	Thru	0	5.66	0.07	402.19	A								
1385	1359	1382	1385-1359-1382	Kassier Road/MR559	MR559	Right	574	5.66	58.85	975.41	A								
1310	1359	1337	1310-1359-1337	Kassier Road/MR559	J B Mcintosh Drive	Left	0	0.00	0.01	1545.76	A	145	0.34	3.58	4058	A			
1310	1359	1382	1310-1359-1382	Kassier Road/MR559	J B Mcintosh Drive	Thru	135	0.00	8.03	1680.62	A								
1310	1359	1385	1310-1359-1385	Kassier Road/MR559	J B Mcintosh Drive	Right	10	4.90	1.23	831.14	A								
1337	1359	1382	1337-1359-1382	Kassier Road/MR559	Access	Left	2	5.82	0.36	561.09	A	2	6.50	0.16	1503	A			
1337	1359	1385	1337-1359-1385	Kassier Road/MR559	Access	Thru	0	11.73	0.10	291.81	B								
1337	1359	1310	1337-1359-1310	Kassier Road/MR559	Access	Right	0	4.92	0.02	650.08	A								
1339	1344	1349	1339-1344-1349	Kassier Road/N3 westbound	Kassier Road (north)	Thru	398	5.59	32.10	1240.00	A	398	5.59	22.87	1741	A	15.62	35.75	B
1339	1344	1332	1339-1344-1332	Kassier Road/N3 westbound	Kassier Road (north)	Right	0	15.61	0.01	500.72	B								
1363	1344	1349	1363-1344-1349	Kassier Road/N3 westbound	N3 westbound off-slip	Left	28	25.27	5.16	536.67	C	372	29.49	34.68	1073	C			
1363	1344	1339	1363-1344-1339	Kassier Road/N3 westbound	N3 westbound off-slip	Right	344	29.83	64.19	536.67	C								
1349	1344	1339	1349-1344-1339	Kassier Road/N3 westbound	Kassier Road (south)	Thru	596	13.97	65.84	904.50	B	711	13.97	53.50	1329	B			
1349	1344	1332	1349-1344-1332	Kassier Road/N3 westbound	Kassier Road (south)	Left	116	13.97	27.21	424.46	B								
1319	1328	1342	1319-1328-1342	Kassier Road/N3 eastbound	Kassier Road (north)	Left	783	6.15	60.24	1300.00	A	1103	5.58	34.26	3218	A	8.13	31.38	A
1319	1328	1335	1319-1328-1335	Kassier Road/N3 eastbound	Kassier Road (north)	Thru	319	4.17	16.66	1917.83	A								
1336	1328	1319	1336-1328-1319	Kassier Road/N3 eastbound	Kassier Road (south)	Thru	734	1.35	24.06	3049.18	A	940	5.27	26.71	3520	A			
1336	1328	1342	1336-1328-1342	Kassier Road/N3 eastbound	Kassier Road (south)	Right	206	19.20	43.82	470.67	B								
1306	1328	1319	1306-1328-1319	Kassier Road/N3 eastbound	N3 eastbound off-slip	Left	103	38.73	58.88	175.00	D	182	38.48	51.89	350	D			
1306	1328	1335	1306-1328-1335	Kassier Road/N3 eastbound	N3 eastbound off-slip	Right	79	38.16	44.91	175.00	D								
1251	1255	1262	1251-1255-1262	Kassier Road/Cliffdale Road	Kassier Road (north)	Left	69	10.89	13.87	498.28	B	2162	9.75	53.82	4018	A	11.42	34.09	B
1251	1255	1258	1251-1255-1258	Kassier Road/Cliffdale Road	Kassier Road (north)	Thru	1970	9.72	61.68	3194.07	A								
1251	1255	1249	1251-1255-1249	Kassier Road/Cliffdale Road	Kassier Road (north)	Right	123	10.04	37.79	325.84	B								
1262	1255	1258	1262-1255-1258	Kassier Road/Cliffdale Road	Access	Left	18	30.16	9.57	188.71	C	83	38.81	15.21	547	D			
1262	1255	1249	1262-1255-1249	Kassier Road/Cliffdale Road	Access	Thru	0	30.12	0.18	170.83	C								
1262	1255	1251	1262-1255-1251	Kassier Road/Cliffdale Road	Access	Right	65	40.98	34.69	187.14	D								
1258	1255	1249	1258-1255-1249	Kassier Road/Cliffdale Road	Kassier Road (south)	Left	8	6.23	0.95	884.67	A	780	7.64	21.37	3649	A			
1258	1255	1251	1258-1255-1251	Kassier Road/Cliffdale Road	Kassier Road (south)	Thru	759	7.56	31.59	2402.25	A								
1258	1255	1262	1258-1255-1262	Kassier Road/Cliffdale Road	Kassier Road (south)	Right	13	13.27	3.49	362.67	B								
1249	1255	1251	1249-1255-1251	Kassier Road/Cliffdale Road	Cliffdale Road	Left	169	33.38	59.78	282.86	C	199	32.99	16.00	1246	C			
1249	1255	1262	1249-1255-1262	Kassier Road/Cliffdale Road	Cliffdale Road	Thru	0	29.61	0.12	198.79	C								
1249	1255	1258	1249-1255-1258	Kassier Road/Cliffdale Road	Cliffdale Road	Right	30	30.81	3.91	764.02	C								
1246	1250	1251	1246-1250-1251	Kassier Road/M13 westbound	Kassier Road (north)	Thru	1640	4.31	58.96	2781.28	A	1868	5.51	55.66	3338	A	10.01	45.07	B
1246	1250	1240	1246-1250-1240	Kassier Road/M13 westbound	Kassier Road (north)	Right	218	14.50	39.17	557.14	B								
1257	1251	1255	1257-1251-1255	Kassier Road/M13 westbound	M13 westbound off-slip	Left	522	0.00	31.67	1650.00	A	886	13.83	38.71	2290	B			
1257	1250	1246	1257-1250-1246	Kassier Road/M13 westbound	M13 westbound off-slip	Right	364	33.84	56.86	640.00	C								
1251	1250	1240	1251-1250-1240	Kassier Road/M13 westbound	Kassier Road (south)	Left	114	12.63	14.17	806.67	B	993	14.98	37.26	2664	B			
1251	1250	1246	1251-1250-1246	Kassier Road/M13 westbound	Kassier Road (south)	Thru	879	15.29	47.29	1857.78	B								
1239	1243	1253	1239-1243-1253	Kassier Road/M13 eastbound	Kassier Road (north)	Left	518	11.74	79.93	655.92	B	2239	11.59	83.32	2687	B	13.50	61.60	B
1239	1243	1246	1239-1243-1246	Kassier Road/M13 eastbound	Kassier Road (north)	Thru	1721	11.54	84.74	2030.99	B								
1246	1243	1239	1246-1243-1239	Kassier Road/M13 eastbound	Kassier Road (south)	Thru	975	2.16	36.47	2674.17	A	1242	10.20	41.05	3027	B			
1246	1243	1253	1246-1243-1253	Kassier Road/M13 eastbound	Kassier Road (south)	Right	267	39.06	75.76	352.64	D								
1237	1243	1239	1237-1243-1239	Kassier Road/M13 eastbound	M13 eastbound off-slip	Left	214	38.08	84.29	253.33	D	351	37.43	69.23	507	D			
1237	1243	1246	1237-1243-1246	Kassier Road/M13 eastbound	M13 eastbound off-slip	Right	137	36.43	54.16	253.33	D								
1230	1218	1222	1230-1218-1222	Kassier Road/Alverstone Road	Kassier Road (north)	Left	66	10.47	20.19	325.59	B	2035	10.31	60.51	3363	B	13.11	42.12	B
1230	1218	1212	1230-1218-1212	Kassier Road/Alverstone Road	Kassier Road (north)	Thru	1914	10.46	77.69	2464.01	B								
1230	1218	1204	1230-1218-1204	Kassier Road/Alverstone Road	Kassier Road (north)	Right	55	5.01	9.55	573.36	A								
1222	1218	1212	1222-1218-1212	Kassier Road/Alverstone Road	Hospital Access	Left	92	39.84	70.25	131.01	D	111	39.87	44.87	247	D			
1222	1218	1204	1222-1218-1204	Kassier Road/Alverstone Road	Hospital Access	Thru	2	39.84	6.72	25.13	D								
1222	1218	1230	1222-1218-1230	Kassier Road/Alverstone Road	Hospital Access	Right	17	40.04	18.89	91.10	D								
1212	1218	1204	1212-1218-1204	Kassier Road/Alverstone Road	Kassier Road (south)	Left	0	8.89	0.08	730.91	A	1060	10.17	30.12	3520	B			
1212	1218	1230	1212-1218-1230	Kassier Road/Alverstone Road	Kassier Road (south)	Thru	927	6.61	37.71	2458.48	A								
1212	1218	1222	1212-1218-1222	Kassier Road/Alverstone Road	Kassier Road (south)	Right	133	34.98	40.27	330.20	C								
1204	1218	1230	1204-1218-1230	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Left	45	28.98	14.57	311.32	C	275	34.35	24.25	1136	C			
1204	1218	1222	1204-1218-1222	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Thru	5	28.95	1.97	271.32	C								
1204	1218	1212	1204-1218-1212	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Right	225	35.56	40.63	553.07	D								
1475	1479	2046	1475-1479-2046	Kassier Road/R103	R103 (west)	Thru	886	9.54	39.03	2267.39	A	1498	15.11	43.16	3470	B	15.73	48.65	B
1475	1479	2045	1475-1479-2045	Kassier Road/R103	R103 (west)	Right	613	23.16	50.94	1203.02	C								
2046	2045	1471	2046-2045-1471	Kassier Road/R103	R103 (east)	Left	934	7.69	71.93	1298.14	A	1611	13.45	60.54	2662	B			
2046	1479	1475	2046-1479-1475	Kassier Road/R103	R103 (east)	Thru	678	21.39	49.70	1363.64	C								
2045	1479	1475	2045-1479-1475	Kassier Road/R103	Kassier Road	Left	309	13.04	33.69	918.18	B	818	21.34	42.17	1941	C			
2045	1479	2046	2045-1479-2046	Kassier Road/R103	Kassier Road	Right	509	26.39	49.78	1022.73	C								
1523	1521	1520	1523-1521-1520	Shongweni Road/M13 Westbound	Shongweni Road (north)	Thru	276	18	35	781	B	794	21.66	38.82	2044	C	15.13	34.46	B
1523	1521	1515	1523-1521-1515	Shongweni Road/M13 Westbound	Shongweni Road (north)	Right	517	23	41	1263	C								
1567	1521	1520	1567-1521-1520	Shongweni Road/M13 Westbound	M13 westbound off-slip	Left	164	11	19	880	B	551	12.07	30.39	1813	B			
1567	1521	1523	1567-1521-1523	Shongweni Road/M13 Westbound	M13 westbound off-slip	Right	387	13	41	933	B								
1520	1521	1515	1520-1521-1515	Shongweni Road/M13 Westbound	Shongweni Road (south)	Left	1	25	1	185	C	296	25.50	32.75	901	C			
1520	1521	1523	1520-1521-1523	Shongweni Road/M13 Westbound	Shongweni Road (south)	Thru	294	26	41	716	C								
1533	1543	1548	1533-1543-1548	Shongweni Road/M13 Eastbound	Shongweni Road (north)	left	533	3	38	1763	A	1325	5.60	43.84	3023	A	9.31	41.35	A
1526	1530	1532	1526-1530-1532	Shongweni Road/M13 Eastbound	Shongweni Road (north)	Thru	792	7	63	1260	A								
1534	1532	1526	1534-1532-1526	Shongweni Road/M13 Eastbound	M13 eastbound off-slip	Left	1	9	0	445	A	229	33.62	28.40	804	C			
1540	1530	1525	1540-1530-1525	Shongweni Road/M13 Eastbound	M13 eastbound off-slip	Right	228	34	63	359	C								
1532	1530	1525	1532-1530-1525	Shongweni Road/M13 Eastbound	Shongweni Road (south)	Thru	544	6	43	1260	A	681	8.39	43.13	1579	A			
1532	1530	1543	1532-1530-1543	Shongweni Road/M13 Eastbound	Shongweni Road (south)	Right	137	19	43	319	B								
1521	1520	2034	1521-1520-2034	New Access Road/Shongweni Ro	Shongweni Road (north)	Thru	439	3	34	1300	A	440	2.50	18.51	2374	A	12.18	19.36	B
1521	1520	1529	1521-1520-1529	New Access Road/Shongweni Ro	Shongweni Road (north)	Right	1	2	0	1070	A								
1529	1520	2034	1529-1520-2034	New Access Road/Shongweni Ro	Shongweni Road (south)	Left	0	39	0	109	D	1	39.23	0.52	236	D			
1529	1520	1521	1529-1520-1521	New Access Road/Shongweni Ro	Shongweni Road (south)	Thru	1	39	1	127	D								
2034	1520	1521	2034-1520-1521	New Access Road/Shongweni Ro	Access Road	Left	294	27	33	880	C	294	26.57	24.68	1191	C			
2034	1520	1529	2034-1520-1529	New Access Road/Shongweni Ro	Access Road	Right	0	27	0	311	C								
1279	2001	2002	1279-2001-2002	Kassier Road/Northern Access	Kassier Road (north)	Left	669	7.82	61.29	1090.92	A	2018	7.82	68.96	2927	A	9.64	41.75	A
1279	2001	1288	1279-2001-1288	Kassier Road/Northern Access	Kassier Road (north)	Thru	1350	7.82	73.51	1835.76	A								
2002	2001	1279	2002-2001-1279	Kassier Road/Northern Access	Access Road	Left	196	45.76	65.43	300.00	D	197	45.75	40.27	490	D			
2002	2001	1288	2002-2001-1288	Kassier Road/Northern Access	Access Road	Right	1	43.83	0.68	190.32	D								
1288	2001	1279	1288-2001-1279	Kassier Road/Northern Access	Kassier Road (south)	Thru	584	1.02	18.69	3121.98	A	693	4.60	19.53	3551	A			
1288	2001	2002	1288-2001-2002	Kassier Road/Northern Access	Kassier Road (south)	Right	110	23.94	25.60	428.99	C								
2043	2044	2010	2043-2044-2010	Kassier Road/Southern Access	Kassier Road (north)	Left	367	0.00	22.22	1650.00	A	1351	5.25	32.62	4141	A	8.36	32.57	A
2043	1308	1319	2043-1308-1319	Kassier Road/Southern Access	Kassier Road (north)	Thru	984	7.20	39.50	2491.11	A								
2044	1308	1319	2044-1308-1319	Kassier Road/Southern Access	Access Road	Left	119	35.96	26.96	440.00	D	281	35.91	33.31	844	D			
2044	1308	2043	2044-1308-2043	Kassier Road/Southern Access	Access Road	Right	162	36.53	40.23	403.77	D								
1319	1308	2043	1319-1308-2043	Kassier Road/Southern Access	Kassier Road (south)	Thru	531	2.23	34.40	1541.11	A	837	4.14	32.24	2595	A			
1319	1308	2044	1319-1308-2044	Kassier Road/Southern Access	Kassier Road (south)	Right	306	7.45	29.01	1054.00	A								

C2.2 PM Peak

A node	B node	C node	Ref	Intersection Name	Approach	Movement	Turn Volume	Turn Delay	Turn V/C	Turn Capacity	Turn LOS	Approach Volume	Approach Delay	Approach V/C	Approach Capacity	Approach LOS	Intersection Delay	Intersection V/C	Intersection LOS
1382	1359	1385	1382-1359-1385	Kassier Road/MR559	Kassier Road	Left	621	0.00	39.46	1573.02	A	747	0.02	21.49	3477	A	1.26	10.11	A
1382	1359	1310	1382-1359-1310	Kassier Road/MR559	Kassier Road	Thru	123	0.00	11.42	1075.09	A								
1382	1359	1337	1382-1359-1337	Kassier Road/MR559	Kassier Road	Right	4	3.45	0.44	828.92	A								
1386	1359	1310	1386-1359-1310	Kassier Road/MR559	MR559	Left	5	3.47	0.52	921.65	A	285	4.36	18.40	2743	A			
1386	1359	1337	1386-1359-1337	Kassier Road/MR559	MR559	Thru	0	4.35	0.00	773.50	A								
1386	1359	1382	1386-1359-1382	Kassier Road/MR559	MR559	Right	280	4.36	26.76	1047.93	A								
1310	1359	1337	1310-1359-1337	Kassier Road/MR559	J B McIntosh Drive	Left	0	0.00	0.01	1645.77	A	116	1.16	3.17	3650	A			
1310	1359	1382	1310-1359-1382	Kassier Road/MR559	J B McIntosh Drive	Thru	100	0.00	6.07	1645.62	A								
1310	1359	1386	1310-1359-1386	Kassier Road/MR559	J B McIntosh Drive	Right	16	8.59	3.39	458.57	A								
1337	1359	1382	1337-1359-1382	Kassier Road/MR559	Access	Left	10	4.46	1.46	711.04	A	12	5.66	0.72	1698	A			
1337	1359	1386	1337-1359-1386	Kassier Road/MR559	Access	Thru	1	17.78	0.53	196.56	B								
1337	1359	1310	1337-1359-1310	Kassier Road/MR559	Access	Right	0	4.54	0.02	690.62	A								
1339	1344	1349	1339-1344-1349	Kassier Road/N3 westbound	Kassier Road (north)	Thru	669	20.36	79.59	840.00	C	669	20.36	48.75	1371	C	21.63	48.32	C
1339	1344	1332	1339-1344-1332	Kassier Road/N3 westbound	Kassier Road (north)	Right	0	23.47	0.00	531.42	C								
1353	1344	1349	1353-1344-1349	Kassier Road/N3 westbound	N3 westbound off-slip	Left	79	12.75	7.83	1003.33	B	887	19.31	44.20	2007	B			
1353	1344	1339	1353-1344-1339	Kassier Road/N3 westbound	N3 westbound off-slip	Right	808	19.95	80.57	1003.33	B								
1349	1344	1339	1349-1344-1339	Kassier Road/N3 westbound	Kassier Road (south)	Thru	370	29.06	74.11	499.28	C	391	29.00	80.18	849	C			
1349	1344	1332	1349-1344-1332	Kassier Road/N3 westbound	Kassier Road (south)	Left	21	29.06	13.81	160.00	C								
1319	1328	1342	1319-1328-1342	Kassier Road/N3 eastbound	Kassier Road (north)	Left	574	21.21	73.55	780.00	C	1153	21.00	63.33	1821	C	18.16	62.17	B
1319	1328	1336	1319-1328-1336	Kassier Road/N3 eastbound	Kassier Road (north)	Thru	580	20.79	55.67	1041.07	C								
1336	1328	1319	1336-1328-1319	Kassier Road/N3 eastbound	Kassier Road (south)	Thru	1145	12.73	54.60	2097.84	B	1178	13.08	48.67	3421	B			
1336	1328	1342	1336-1328-1342	Kassier Road/N3 eastbound	Kassier Road (south)	Right	33	25.42	10.18	323.15	C								
1306	1328	1319	1306-1328-1319	Kassier Road/N3 eastbound	N3 eastbound off-slip	Left	503	23.58	73.88	680.56	C	592	22.75	43.48	1361	C			
1306	1328	1336	1306-1328-1336	Kassier Road/N3 eastbound	N3 eastbound off-slip	Right	89	17.71	13.08	680.56	B								
1251	1255	1262	1251-1255-1262	Kassier Road/Cliffdale Road	Kassier Road (north)	Left	9	8.77	2.34	387.49	A	2008	12.22	60.78	3303	B	12.67	54.51	B
1251	1255	1258	1251-1255-1258	Kassier Road/Cliffdale Road	Kassier Road (north)	Thru	1767	8.77	68.86	2566.01	A								
1251	1255	1249	1251-1255-1249	Kassier Road/Cliffdale Road	Kassier Road (north)	Right	232	38.61	66.30	349.85	D								
1262	1255	1258	1262-1255-1258	Kassier Road/Cliffdale Road	Access	Left	1	32.96	0.54	144.40	C	14	42.60	3.15	429	D			
1262	1255	1249	1262-1255-1249	Kassier Road/Cliffdale Road	Access	Thru	0	32.94	0.03	143.66	C								
1262	1255	1251	1262-1255-1251	Kassier Road/Cliffdale Road	Access	Right	13	47.22	9.02	140.79	D								
1258	1255	1249	1258-1255-1249	Kassier Road/Cliffdale Road	Kassier Road (south)	Left	32	4.83	7.89	400.11	A	2192	10.75	65.57	3343	B			
1258	1255	1251	1258-1255-1251	Kassier Road/Cliffdale Road	Kassier Road (south)	Thru	2159	10.84	84.30	2561.11	B								
1258	1255	1262	1258-1255-1262	Kassier Road/Cliffdale Road	Kassier Road (south)	Right	2	10.31	0.42	381.80	B								
1249	1255	1251	1249-1255-1251	Kassier Road/Cliffdale Road	Cliffdale Road	Left	182	37.40	83.93	216.49	D	192	37.23	19.09	1006	D			
1249	1255	1262	1249-1255-1262	Kassier Road/Cliffdale Road	Cliffdale Road	Thru	0	32.94	0.07	125.82	C								
1249	1255	1258	1249-1255-1258	Kassier Road/Cliffdale Road	Cliffdale Road	Right	11	33.04	1.66	665.57	C								
1246	1250	1251	1246-1250-1251	Kassier Road/M13 westbound	Kassier Road (north)	Thru	1040	3.06	36.25	2867.36	A	1173	6.78	36.74	3192	A	9.03	54.25	A
1246	1250	1240	1246-1250-1240	Kassier Road/M13 westbound	Kassier Road (north)	Right	133	35.89	41.02	324.18	D								
1257	1251	1255	1257-1251-1255	Kassier Road/M13 westbound	M13 westbound off-slip	Left	968	0.00	58.69	1650.00	A	1364	10.19	60.64	2250	B			
1257	1250	1246	1257-1250-1246	Kassier Road/M13 westbound	M13 westbound off-slip	Right	396	35.11	65.99	600.00	D								
1251	1250	1240	1251-1250-1240	Kassier Road/M13 westbound	Kassier Road (south)	Left	620	8.55	57.27	1081.67	A	2353	9.49	65.87	3573	A			
1251	1250	1246	1251-1250-1246	Kassier Road/M13 westbound	Kassier Road (south)	Thru	1734	9.82	69.60	2491.11	A								
1239	1243	1253	1239-1243-1253	Kassier Road/M13 eastbound	Kassier Road (north)	Left	179	10.31	26.81	668.31	B	1274	10.28	45.49	2802	B	10.77	55.72	B
1239	1243	1246	1239-1243-1246	Kassier Road/M13 eastbound	Kassier Road (north)	Thru	1095	10.27	51.34	2133.61	B								
1246	1243	1239	1246-1243-1239	Kassier Road/M13 eastbound	Kassier Road (south)	Thru	1861	4.81	67.56	2754.96	A	2130	7.74	66.93	3182	A			
1246	1243	1253	1246-1243-1253	Kassier Road/M13 eastbound	Kassier Road (south)	Right	269	28.07	62.86	427.28	C								
1237	1243	1239	1237-1243-1239	Kassier Road/M13 eastbound	M13 eastbound off-slip	Left	230	34.60	67.98	337.78	C	307	33.87	41.42	676	C			
1237	1243	1246	1237-1243-1246	Kassier Road/M13 eastbound	M13 eastbound off-slip	Right	77	31.71	22.86	337.78	C								
1230	1218	1222	1230-1218-1222	Kassier Road/Alverstone Road	Kassier Road (north)	Left	17	6.50	2.37	721.52	A	1089	7.58	30.23	3602	A	11.39	39.53	B
1230	1218	1212	1230-1218-1212	Kassier Road/Alverstone Road	Kassier Road (north)	Thru	1028	6.50	40.86	2515.30	A								
1230	1218	1204	1230-1218-1204	Kassier Road/Alverstone Road	Kassier Road (north)	Right	44	24.02	12.04	365.04	C								
1222	1218	1212	1222-1218-1212	Kassier Road/Alverstone Road	Hospital Access	Left	98	39.96	73.25	133.33	D	142	39.84	58.54	242	D			
1222	1218	1204	1222-1218-1204	Kassier Road/Alverstone Road	Hospital Access	Thru	0	39.96	0.00	0.00	D								
1222	1218	1230	1222-1218-1230	Kassier Road/Alverstone Road	Hospital Access	Right	44	39.58	40.50	108.75	D								
1212	1218	1204	1212-1218-1204	Kassier Road/Alverstone Road	Kassier Road (south)	Left	0	20.00	0.00	301.00	C	1856	9.50	57.72	3216	A			
1212	1218	1230	1212-1218-1230	Kassier Road/Alverstone Road	Kassier Road (south)	Thru	1817	9.59	72.27	2514.21	A								
1212	1218	1222	1212-1218-1222	Kassier Road/Alverstone Road	Kassier Road (south)	Right	39	5.48	9.71	399.69	A								
1204	1218	1230	1204-1218-1230	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Left	22	28.45	6.98	315.45	C	161	33.75	13.93	1157	C			
1204	1218	1222	1204-1218-1222	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Thru	1	28.64	0.41	294.64	C								
1204	1218	1212	1204-1218-1212	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Right	138	34.64	25.23	546.79	C								
1475	1479	2046	1475-1479-2046	Kassier Road/R103	R103 (west)	Thru	496	14.12	27.33	1815.01	B	726	20.51	29.75	2441	C	16.10	51.17	B
1475	1479	2045	1475-1479-2045	Kassier Road/R103	R103 (west)	Right	230	34.27	36.79	625.77	C								
2046	2045	1471	2046-2045-1471	Kassier Road/R103	R103 (east)	Left	946	3.69	39.90	2371.52	A	1981	15.40	54.17	3657	B			
2046	1479	1475	2046-1479-1475	Kassier Road/R103	R103 (east)	Thru	1035	26.10	80.43	1285.71	C								
2045	1479	1475	2045-1479-1475	Kassier Road/R103	Kassier Road	Left	494	13.60	51.60	957.14	B	1639	20.29	68.41	2397	C			
2045	1479	2046	2045-1479-2046	Kassier Road/R103	Kassier Road	Right	1145	23.18	79.54	1439.39	C								
1523	1521	1520	1523-1521-1520	Shongweni Road/M13 Westboun	Shongweni Road (north)	Thru	81	15	10	844	B	544	29.87	35.11	1550	C	23.84	47.72	C
1523	1521	1515	1523-1521-1515	Shongweni Road/M13 Westboun	Shongweni Road (north)	Right	464	33	66	706	C								
1567	1521	1520	1567-1521-1520	Shongweni Road/M13 Westboun	M13 westbound off-slip	Left	46	12	5	925	B	712	17.72	41.88	1700	B			
1567	1521	1523	1567-1521-1523	Shongweni Road/M13 Westboun	M13 westbound off-slip	Right	666	18	76	875	B								
1520	1521	1515	1520-1521-1515	Shongweni Road/M13 Westboun	Shongweni Road (south)	Left	1	25	1	125	C	938	24.98	69.58	1348	C			
1520	1521	1523	1520-1521-1523	Shongweni Road/M13 Westboun	Shongweni Road (south)	Thru	937	25	77	1223	C								
1533	1543	1548	1533-1543-1548	Shongweni Road/M13 Eastboun	Shongweni Road (north)	left	211	4	15	1434	A	751	4.56	27.46	2734	A	12.34	45.92	B
1526	1530	1532	1526-1530-1532	Shongweni Road/M13 Eastboun	Shongweni Road (north)	Thru	540	5	42	1300	A								
1534	1532	1528	1534-1532-1528	Shongweni Road/M13 Eastboun	M13 eastbound off-slip	Left	5	6	1	779	A	263	35.64	24.03	1096	D			
1540	1530	1525	1540-1530-1525	Shongweni Road/M13 Eastboun	M13 eastbound off-slip	Right	259	36	82	317	D								
1532	1530	1525	1532-1530-1525	Shongweni Road/M13 Eastboun	Shongweni Road (south)	Thru	1136	9	87	1300	A	1602	12.16	85.80	1868	B			
1532	1530	1543	1532-1530-1543	Shongweni Road/M13 Eastboun	Shongweni Road (south)	Right	466	19	82	568	B								
1521	1520	2034	1521-1520-2034	New Access Road/Shongweni R	Shongweni Road (north)	Thru	118	26	27	442	C	127	25.75	16.25	783	C	6.63	24.59	A
1521	1520	1529	1521-1520-1529	New Access Road/Shongweni R	Shongweni Road (north)	Right	10	24	3	340	C								
1529	1520	2034	1529-1520-2034	New Access Road/Shongweni R	Shongweni Road (south)	Left	0	39	0	103	D	8	39.36	3.43	230	D			
1529	1520	1521	1529-1520-1521	New Access Road/Shongweni R	Shongweni Road (south)	Thru	8	39	6	127	D								
2034	1520	1521	2034-1520-1521	New Access Road/Shongweni R	Access Road	Left	930	4	37	2493	A	931	3.74	28.01	3322	A			
2034	1520	1529	2034-1520-1529	New Access Road/Shongweni R	Access Road	Right	0	4	0	829	A								
1279	2001	2002	1279-2001-2002	Kassier Road/Northern Access	Kassier Road (north)	Left	264	9.98	37.22	713.30	A	1778	9.99	64.86	2742	A	7.88	57.78	A
1279	2001	1288	1279-2001-1288	Kassier Road/Northern Access	Kassier Road (north)	Thru	1513	9.99	74.58	2028.51	A								
2002	2001	1279	2002-2001-1279	Kassier Road/Northern Access	Access Road	Left	410	18.01	74.63	550.00	B	410	18.01	46.91	875	B			
2002	2001	1288	2002-2001-1288	Kassier Road/Northern Access	Access Road	Right	0	14.74	0.08	325.00	B								
1288	2001	1279	1288-2001-1279	Kassier Road/Northern Access	Kassier Road (south)	Thru	1782	3.44	60.78	2931.43	A	1782	3.44	54.73	3255	A			
1288	2001	2002	1288-2001-2002	Kassier Road/Northern Access	Kassier Road (south)	Right	0	11.43	0.08	323.78	B								
2043	2044	2010	2043-2044-2010	Kassier Road/Southern Access	Kassier Road (north)	Left	1031	0.00	62.48	1650.00	A	1513	12.01	68.80	2199	B	19.36	73.11	B
2043	1308	1319	2043-1308-1319	Kassier Road/Southern Access	Kassier Road (north)	Thru	482	37.72	87.78	548.89	D								
2044	1308	1319	2044-1308-1319	Kassier Road/Southern Access	Access Road	Left	671	16.36	55.51	1209.51	B	1874	19.38	72.73	2577	B			
2044	1308	2043	2044-1308-2043	Kassier Road/Southern Access	Access Road	Right	1203	21.07	87.97	1367.08	C								
1319	1308	2043	1319-1308-2043	Kassier Road/Southern Access	Kassier Road (south)	Thru	579	19.19	66.90	865.56	B	1648	26.06	78.04	2112	C			
1319	1308	2044	1319-1308-2044	Kassier Road/Southern Access	Kassier Road (south)	Right	1069	29.78	85.78	1246.42	C								

C3 Site 2 Key Intersection Results

C3.1 AM Peak – without Public Transport

							Turn					Approach					Intersection		
A node	B node	C node	Ref	Intersection Name	Approach	Movement	Volume	Delay	V/C	Capacity	LOS	Volume	Delay	V/C	Capacity	LOS	Delay	V/C	LOS
9904	1359	1385	9904-1359-1385	Kassier Road/MR559	Kassier Road	Left	234	26	51	444	C	1430	38.27	77.98	1834	D	28.51	35.41	C
9904	1359	1310	9904-1359-1310	Kassier Road/MR559	Kassier Road	Thru	105	26	29	352	C								
9904	1359	9903	9904-1359-9903	Kassier Road/MR559	Kassier Road	Right	1091	42	102	1038	D								
1385	1359	1310	1385-1359-1310	Kassier Road/MR559	MR559	Left	21	13	9	227	B	730	14.64	48.04	1520	B			
1385	1359	9903	1385-1359-9903	Kassier Road/MR559	MR559	Thru	263	13	50	530	B								
1385	1359	9904	1385-1359-9904	Kassier Road/MR559	MR559	Right	446	16	59	762	B								
1310	1359	9903	1310-1359-9903	Kassier Road/MR559	J B Mcintosh Drive	Left	0	38	0	0	D	109	38.23	32.78	331	D			
1310	1359	9904	1310-1359-9904	Kassier Road/MR559	J B Mcintosh Drive	Thru	98	38	47	211	D								
1310	1359	1385	1310-1359-1385	Kassier Road/MR559	J B Mcintosh Drive	Right	10	45	9	120	D								
9903	9904	1382	9903-9904-1382	Kassier Road/MR559	Middle Access	Left	123	0	7	1800	A	193	3.28	6.92	3266	A			
9903	1359	1385	9903-1359-1385	Kassier Road/MR559	Middle Access	Thru	61	9	6	972	A								
9903	1359	1310	9903-1359-1310	Kassier Road/MR559	Middle Access	Right	9	11	2	494	B								
1339	1344	9911	1339-1344-9911	Kassier Road/N3 westbound	Kassier Road (north)	Thru	3521	4	74	4560	A	3521	4	72.57	4852	A	4.96	41.85	A
1339	1344	1332	1339-1344-1332	Kassier Road/N3 westbound	Kassier Road (north)	Right	0	3	0	292	A								
9910	9911	1349	9910-9911-1349	Kassier Road/N3 westbound	N3 westbound off-slip	Left	319	9	18	1800	A	522	15	24.71	2111	B			
9910	1344	1339	9910-1344-1339	Kassier Road/N3 westbound	N3 westbound off-slip	Right	202	48	65	311	D								
9911	1344	1332	9911-1344-1332	Kassier Road/N3 westbound	Kassier Road (south)	Thru	202	2	15	1320	A	1338	2	22.75	5880	A			
9911	1344	1339	9911-1344-1339	Kassier Road/N3 westbound	Kassier Road (south)	Left	1136	2	25	4560	A								
1319	1328	1342	1319-1328-1342	Kassier Road/N3 eastbound	Kassier Road (north)	Left	726	28	103	696	C	3787	28	104.28	3631	C	24.99	84.16	C
1319	1328	1336	1319-1328-1336	Kassier Road/N3 eastbound	Kassier Road (north)	Thru	3061	28	103	2936	C								
1336	1328	1319	1336-1328-1319	Kassier Road/N3 eastbound	Kassier Road (south)	Thru	1065	3	25	4207	A	1337	11	29.00	4602	B			
1336	1328	1342	1336-1328-1342	Kassier Road/N3 eastbound	Kassier Road (south)	Right	272	43	92	295	D								
1306	1328	1319	1306-1328-1319	Kassier Road/N3 eastbound	N3 eastbound off-slip	Left	0	39	0	3	D	460	39	98.62	470	D			
1306	1328	1336	1306-1328-1336	Kassier Road/N3 eastbound	N3 eastbound off-slip	Right	460	39	99	467	D								
9905	1255	1262	9905-1255-1262	Kassier Road/Cliffdale Road	Kassier Road (north)	Left	65	8	31	220	A	3968	7.96	79.66	5020	A	10.01	56.88	B
9905	1255	1258	9905-1255-1258	Kassier Road/Cliffdale Road	Kassier Road (north)	Thru	3752	8	87	4228	A								
9905	1255	1249	9905-1255-1249	Kassier Road/Cliffdale Road	Kassier Road (north)	Right	147	8	26	571	A								
1262	1255	1258	1262-1255-1258	Kassier Road/Cliffdale Road	Access	Left	18	34	39	45	C	83	43.36	46.24	180	D			
1262	1255	1249	1262-1255-1249	Kassier Road/Cliffdale Road	Access	Thru	1	34	39	1	C								
1262	1255	9905	1262-1255-9905	Kassier Road/Cliffdale Road	Access	Right	65	46	49	133	D								
1258	1255	1249	1258-1255-1249	Kassier Road/Cliffdale Road	Kassier Road (south)	Left	8	9	1	690	A	1672	9.24	35.42	4217	A			
1258	1255	9905	1258-1255-9905	Kassier Road/Cliffdale Road	Kassier Road (south)	Thru	1651	9	31	3404	A								
1258	1255	1262	1258-1255-1262	Kassier Road/Cliffdale Road	Kassier Road (south)	Right	13	43	10	123	D								
1249	1255	9905	1249-1255-9905	Kassier Road/Cliffdale Road	Cliffdale Road	Left	182	38	93	197	D	212	38.72	78.91	269	D			
1249	1255	1262	1249-1255-1262	Kassier Road/Cliffdale Road	Cliffdale Road	Thru	0	38	2	12	D								
1249	1255	1258	1249-1255-1258	Kassier Road/Cliffdale Road	Cliffdale Road	Right	30	40	49	60	D								
1246	1250	9906	1246-1250-9906	Kassier Road/M13 westbound	Kassier Road (north)	Thru	2675	6	65	4064	A	2893	7	64.72	4470	A	8.08	54.77	A
1246	1250	1240	1246-1250-1240	Kassier Road/M13 westbound	Kassier Road (north)	Right	218	22	51	416	C								
1257	9906	1250	1257-9906-1250	Kassier Road/M13 westbound	M13 westbound off-slip	Left	1293	0	72	1800	A	1657	8	70.67	2344	A			
1257	1250	1246	1257-1250-1246	Kassier Road/M13 westbound	M13 westbound off-slip	Right	364	36	67	544	D								
9906	1250	1240	9906-1250-1240	Kassier Road/M13 westbound	Kassier Road (south)	Left	38	10	6	614	B	1298	10	33.61	3863	B			
9906	1250	1246	9906-1250-1246	Kassier Road/M13 westbound	Kassier Road (south)	Thru	1260	10	39	3249	B								
1239	1243	1253	1239-1243-1253	Kassier Road/M13 eastbound	Kassier Road (north)	Left	518	28	102	506	C	3353	28	102.23	3280	C	25.14	76.58	C
1239	1243	1246	1239-1243-1246	Kassier Road/M13 eastbound	Kassier Road (north)	Thru	2835	28	102	2774	C								
1246	1243	1239	1246-1243-1239	Kassier Road/M13 eastbound	Kassier Road (south)	Thru	1106	5	41	2702	A	1624	17	49.96	3250	B			
1246	1243	1253	1246-1243-1253	Kassier Road/M13 eastbound	Kassier Road (south)	Right	518	41	94	548	D								
1237	1243	1239	1237-1243-1239	Kassier Road/M13 eastbound	M13 eastbound off-slip	Left	214	36	89	239	D	271	36	83.96	323	D			
1237	1243	1246	1237-1243-1246	Kassier Road/M13 eastbound	M13 eastbound off-slip	Right	58	36	68	85	D								
1230	1218	1222	1230-1218-1222	Kassier Road/Alverstone Road	Kassier Road (north)	Left	66	16	52	127	B	3077	15.41	84.61	3629	B	15.41	53.75	B
1230	1218	1212	1230-1218-1212	Kassier Road/Alverstone Road	Kassier Road (north)	Thru	2957	15	89	3318	B								
1230	1218	1204	1230-1218-1204	Kassier Road/Alverstone Road	Kassier Road (north)	Right	55	15	30	183	B								
1222	1218	1212	1222-1218-1212	Kassier Road/Alverstone Road	Hospital Access	Left	92	29	29	319	C	111	29.48	16.81	660	C			
1222	1218	1204	1222-1218-1204	Kassier Road/Alverstone Road	Hospital Access	Thru	2	29	2	163	C								
1222	1218	1230	1222-1218-1230	Kassier Road/Alverstone Road	Hospital Access	Right	17	32	7	238	C								
1214	1204	1203	1214-1204-1203	Kassier Road/Alverstone Road	Kassier Road (south)	Left	271	0	14	1900	A	1458	8.85	31.71	4596	A			
1212	1218	1230	1212-1218-1230	Kassier Road/Alverstone Road	Kassier Road (south)	Thru	1053	7	43	2458	A								
1212	1218	1222	1212-1218-1222	Kassier Road/Alverstone Road	Kassier Road (south)	Right	133	42	56	238	D								
1204	1218	1230	1204-1218-1230	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Left	41	32	84	54	C	347	38.47	85.60	406	D			
1204	1218	1222	1204-1218-1222	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Thru	5	32	84	6	C								
1204	1218	1212	1204-1218-1212	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Right	297	40	86	346	D								
1475	1479	9907	1475-1479-9907	Kassier Road/R103	R103 (west)	Thru	885	9	38	2322	A	1558	11	49.83	3126	B	13.13	66.85	B
1475	1479	9906	1475-1479-9906	Kassier Road/R103	R103 (west)	Right	673	14	84	804	B								
9907	9906	1471	9907-9906-1471	Kassier Road/R103	R103 (east)	Left	1757	0	98	1800	A	2435	8	87.86	2771	A			
9907	1479	1475	9907-1479-1475	Kassier Road/R103	R103 (east)	Thru	678	30	70	971	C								
9906	1479	1475	9906-1479-1475	Kassier Road/R103	Kassier Road	Left	313	25	68	458	C	935	25	58.98	1585	C			
9906	1479	9907	9906-1479-9907	Kassier Road/R103	Kassier Road	Right	622	25	55	1127	C								
1523	1521	1520	1523-1521-1520	Shongweni Road/M13 Westbound	Shongweni Road (north)	Thru	1	30	1	133	C	10	30	2.49	396	C	2.94	13.19	A
1523	1521	1515	1523-1521-1515	Shongweni Road/M13 Westbound	Shongweni Road (north)	Right	9	30	3	264	C								
1567	1521	1520	1567-1521-1520	Shongweni Road/M13 Westbound	M13 westbound off-slip	Left	0	2	0	955	A	387	2	16.43	2356	A			
1567	1521	1523	1567-1521-1523	Shongweni Road/M13 Westbound	M13 westbound off-slip	Right	387	2	28	1400	A								
1520	1521	1515	1520-1521-1515	Shongweni Road/M13 Westbound	Shongweni Road (south)	Left	1	34	1	124	C	1	34	0.46	265	C			
1520	1521	1523	1520-1521-1523	Shongweni Road/M13 Westbound	Shongweni Road (south)	Thru	0	34	0	141	C								
1533	1543	1548	1533-1543-1548	Shongweni Road/M13 Eastbound	Shongweni Road (north)	Left	533	3	28	1900	A	1693	12	54.54	3103	B	14.37	47.82	B
1525	1530	1532	1525-1530-1532	Shongweni Road/M13 Eastbound	Shongweni Road (north)	Thru	1160	16	96	1203	B								
1534	1532	1525	1534-1532-1525	Shongweni Road/M13 Eastbound	M13 eastbound off-slip	Left	1	10	0	493	B	408	32	47.96	851	C			
1540	1530	1525	1540-1530-1525	Shongweni Road/M13 Eastbound	M13 eastbound off-slip	Right	407	32	90	447	C								
1532	1530	1525	1532-1530-1525	Shongweni Road/M13 Eastbound	Shongweni Road (south)	Thru	387	8	32	1203	A	387	8	28.97	1336	A			
1532	1530	1543	1532-1530-1543	Shongweni Road/M13 Eastbound	Shongweni Road (south)	Right	0	39	0	133	D								
1310	1265	1196	1310-1265-1196	J B Mcintosh Drive/Southern Access	J B Mcintosh Drive (South)	Thru	133	2	8	1561	A	135	2	4.80	2808	A	1.88	5.07	A
1310	1265	2068	1310-1265-2068	J B Mcintosh Drive/Southern Access	J B Mcintosh Drive (South)	Right	2	2	0	1247	A								
1196	1265	2068	1196-1265-2068	J B Mcintosh Drive/Southern Access	J B Mcintosh Drive (North)	Left	48	2	4	1263	A	157	2	5.66	2769	A			
1196	1265	1310	1196-1265-1310	J B Mcintosh Drive/Southern Access	J B Mcintosh Drive (North)	Thru	109	2	7	1507	A								
2068	1265	1310	2068-1265-1310	J B Mcintosh Drive/Southern Access	Southern Access	Left	0	39	0	108	D	2	39	1.10	224	D			
2068	1265	1196	2068-1265-1196	J B Mcintosh Drive/Southern Access	Southern Access	Right	2	39	2	117	D								
9902	1372	1377	9902-1372-1377	Kassier Road/Northern Access	Kassier Road (North)	Thru	1430	2	44	3124	A	3840	32	72.31	5311	C	27.41	49.55	C
9902	1372	9901	9902-1372-9901	Kassier Road/Northern Access	Kassier Road (North)	Right	2411	50	107	2186	D								
1377	1372	9901	1377-1372-9901	Kassier Road/Northern Access	Kassier Road (South)	Left	1	29	1	170	C	668	29	54.53	1224	C			
1377	1372	9902	1377-1372-9902	Kassier Road/Northern Access	Kassier Road (South)	Thru	667	28	63	1055	C								
9901	9902	1365	9901-9902-1365	Kassier Road/Northern Access	Northern Access	Left	671	0	18	3800	A	671	8	17.14	3917	A			
9901	1372	1377	9901-1372-1377	Kassier Road/Northern Access	Northern Access	Right	0	39	0	117	D								

C3.2 PM Peak – without Public Transport

A node	B node	C node	Ref	Intersection Name	Approach	Movement	Turn Volume	Turn Delay	Turn V/C	Turn Capacity	Turn LOS	Approach Volume	Approach Delay	Approach V/C	Approach Capacity	Approach LOS	Intersection Delay	Intersection V/C	Intersection LOS
9904	1359	1385	9904-1359-1385	Kassier Road/MR559	Kassier Road	Left	449	14	58	778	B	2206	19.67	71.33	3092	B	15.43	53.43	B
9904	1359	1310	9904-1359-1310	Kassier Road/MR559	Kassier Road	Thru	139	14	27	518	B								
9904	1359	9903	9904-1359-9903	Kassier Road/MR559	Kassier Road	Right	1619	22	90	1797	C								
1385	1359	1310	1385-1359-1310	Kassier Road/MR559	MR559	Left	7	22	48	14	C	302	30.08	55.98	541	C			
1385	1359	9903	1385-1359-9903	Kassier Road/MR559	MR559	Thru	115	22	48	240	C								
1385	1359	9904	1385-1359-9904	Kassier Road/MR559	MR559	Right	181	36	63	287	D								
1310	1359	9903	1310-1359-9903	Kassier Road/MR559	J B Mcintosh Drive	Left	1	18	0	154	B	93	20.93	8.33	1112	C			
1310	1359	9904	1310-1359-9904	Kassier Road/MR559	J B Mcintosh Drive	Thru	76	18	11	710	B								
1310	1359	1385	1310-1359-1385	Kassier Road/MR559	J B Mcintosh Drive	Right	16	34	7	217	C								
9903	9904	1382	9903-9904-1382	Kassier Road/MR559	Middle Access	Left	1100	0	61	1800	A	1429	6.34	51.08	2798	A			
9903	1359	1385	9903-1359-1385	Kassier Road/MR559	Middle Access	Thru	302	23	48	631	C								
9903	1359	1310	9903-1359-1310	Kassier Road/MR559	Middle Access	Right	22	28	6	367	C								
1339	1344	9911	1339-1344-9911	Kassier Road/N3 westbound	Kassier Road (north)	Thru	2560	4	59	4368	A	2564	5	57.11	4489	A	7.89	67.52	A
1339	1344	1332	1339-1344-1332	Kassier Road/N3 westbound	Kassier Road (north)	Right	4	41	3	121	D								
9910	9911	1349	9910-9911-1349	Kassier Road/N3 westbound	N3 westbound off-slip	Left	506	0	28	1800	A	901	17	40.42	2226	B			
9910	1344	1339	9910-1344-1339	Kassier Road/N3 westbound	N3 westbound off-slip	Right	395	39	92	428	D								
9911	1344	1332	9911-1344-1332	Kassier Road/N3 westbound	Kassier Road (south)	Thru	795	5	63	1265	A	4876	8	86.53	5635	A			
9911	1344	1339	9911-1344-1339	Kassier Road/N3 westbound	Kassier Road (south)	Left	4081	9	93	4370	A								
1319	1328	1342	1319-1328-1342	Kassier Road/N3 eastbound	Kassier Road (north)	Left	130	34	56	231	C	2025	23	81.34	2490	C	23.96	92.81	C
1319	1328	1335	1319-1328-1335	Kassier Road/N3 eastbound	Kassier Road (north)	Thru	1896	23	84	2259	C								
1335	1328	1319	1335-1328-1319	Kassier Road/N3 eastbound	Kassier Road (south)	Thru	3828	13	97	3927	B	4476	22	99.83	4519	C			
1335	1328	1342	1335-1328-1342	Kassier Road/N3 eastbound	Kassier Road (south)	Right	648	77	109	593	E								
1305	1328	1319	1305-1328-1319	Kassier Road/N3 eastbound	N3 eastbound off-slip	Left	0	36	1	15	D	668	36	93.46	715	D			
1305	1328	1335	1305-1328-1335	Kassier Road/N3 eastbound	N3 eastbound off-slip	Right	668	36	95	700	D								
9905	1255	1262	9905-1255-1262	Kassier Road/Cliffdale Road	Kassier Road (north)	Left	9	4	1	661	A	2267	7.84	43.32	5233	A	17.01	66.61	B
9905	1255	1258	9905-1255-1258	Kassier Road/Cliffdale Road	Kassier Road (north)	Thru	2042	4	48	4296	A								
9905	1255	1249	9905-1255-1249	Kassier Road/Cliffdale Road	Kassier Road (north)	Right	215	43	78	276	D								
1262	1255	1258	1262-1255-1258	Kassier Road/Cliffdale Road	Access	Left	1	34	4	19	C	14	43.27	8.00	169	D			
1262	1255	1249	1262-1255-1249	Kassier Road/Cliffdale Road	Access	Thru	0	34	3	10	C								
1262	1255	9905	1262-1255-9905	Kassier Road/Cliffdale Road	Access	Right	13	44	9	139	D								
1258	1255	1249	1258-1255-1249	Kassier Road/Cliffdale Road	Kassier Road (south)	Left	32	21	101	31	C	3855	21.22	101.60	3794	C			
1258	1255	9905	1258-1255-9905	Kassier Road/Cliffdale Road	Kassier Road (south)	Thru	3822	21	101	3782	C								
1258	1255	1262	1258-1255-1262	Kassier Road/Cliffdale Road	Kassier Road (south)	Right	2	49	101	2	D								
1249	1255	9905	1249-1255-9905	Kassier Road/Cliffdale Road	Cliffdale Road	Left	184	38	88	209	D	195	38.32	63.42	308	D			
1249	1255	1262	1249-1255-1262	Kassier Road/Cliffdale Road	Cliffdale Road	Thru	0	38	3	29	D								
1249	1255	1258	1249-1255-1258	Kassier Road/Cliffdale Road	Cliffdale Road	Right	11	38	17	69	D								
1246	1250	9905	1246-1250-9905	Kassier Road/M13 westbound	Kassier Road (north)	Thru	1109	3	26	4274	A	1242	7	27.53	4512	A	11.65	63.53	B
1246	1250	1240	1246-1250-1240	Kassier Road/M13 westbound	Kassier Road (north)	Right	133	42	56	238	D								
1257	9905	1255	1257-9905-1255	Kassier Road/M13 westbound	M13 westbound off-slip	Left	1158	0	64	1800	A	1554	10	69.75	2228	A			
1257	1250	1246	1257-1250-1246	Kassier Road/M13 westbound	M13 westbound off-slip	Right	396	39	93	428	D								
9905	1250	1240	9905-1250-1240	Kassier Road/M13 westbound	Kassier Road (south)	Left	64	13	91	69	B	4018	13	100.00	3987	B			
9905	1250	1246	9905-1250-1246	Kassier Road/M13 westbound	Kassier Road (south)	Thru	3954	13	99	3918	B								
1239	1243	1263	1239-1243-1263	Kassier Road/M13 eastbound	Kassier Road (north)	Left	179	33	96	186	C	1368	33	95.02	1440	C	32.61	97.26	C
1239	1243	1246	1239-1243-1246	Kassier Road/M13 eastbound	Kassier Road (north)	Thru	1189	33	95	1253	C								
1246	1243	1239	1246-1243-1239	Kassier Road/M13 eastbound	Kassier Road (south)	Thru	2474	11	90	2792	B	4350	32	98.43	4420	C			
1246	1243	1263	1246-1243-1263	Kassier Road/M13 eastbound	Kassier Road (south)	Right	1876	61	108	1718	E								
1237	1243	1239	1237-1243-1239	Kassier Road/M13 eastbound	M13 eastbound off-slip	Left	230	37	95	243	D	283	37	91.13	311	D			
1237	1243	1246	1237-1243-1246	Kassier Road/M13 eastbound	M13 eastbound off-slip	Right	53	37	79	68	D								
1230	1218	1222	1230-1218-1222	Kassier Road/Avenstone Road	Kassier Road (north)	Left	17	9	3	666	A	1173	10.26	26.13	4170	B	9.90	42.14	A
1230	1218	1212	1230-1218-1212	Kassier Road/Avenstone Road	Kassier Road (north)	Thru	1112	9	33	3378	A								
1230	1218	1204	1230-1218-1204	Kassier Road/Avenstone Road	Kassier Road (north)	Right	44	44	35	127	D								
1222	1218	1212	1222-1218-1212	Kassier Road/Avenstone Road	Hospital Access	Left	98	36	52	189	D	142	37.27	33.61	422	D			
1222	1218	1204	1222-1218-1204	Kassier Road/Avenstone Road	Hospital Access	Thru	0	41	3	58	D								
1222	1218	1230	1222-1218-1230	Kassier Road/Avenstone Road	Hospital Access	Right	44	40	25	176	D								
1214	1204	1263	1214-1204-1263	Kassier Road/Avenstone Road	Kassier Road (south)	Left	283	0	15	1900	A	2685	6.23	53.11	5055	A			
1212	1218	1230	1212-1218-1230	Kassier Road/Avenstone Road	Kassier Road (south)	Thru	2363	7	82	2851	A								
1212	1218	1222	1212-1218-1222	Kassier Road/Avenstone Road	Kassier Road (south)	Right	39	6	13	304	A								
1204	1218	1230	1204-1218-1230	Kassier Road/Avenstone Road	Kassier Road/Avenstone Road	Left	22	35	63	35	D	170	42.42	68.54	249	D			
1204	1218	1222	1204-1218-1222	Kassier Road/Avenstone Road	Kassier Road/Avenstone Road	Thru	1	35	63	2	D								
1204	1218	1212	1204-1218-1212	Kassier Road/Avenstone Road	Kassier Road/Avenstone Road	Right	147	44	69	212	D								
1475	1479	9907	1475-1479-9907	Kassier Road/R103	R103 (west)	Thru	496	15	28	1773	B	734	16	34.71	2114	B	18.26	63.82	B
1475	1479	9906	1475-1479-9906	Kassier Road/R103	R103 (west)	Right	238	20	70	341	B								
9907	9906	1471	9907-9906-1471	Kassier Road/R103	R103 (east)	Left	1002	0	56	1800	A	2037	13	63.80	3193	B			
9907	1479	1475	9907-1479-1475	Kassier Road/R103	R103 (east)	Thru	1035	25	74	1393	C								
9906	1479	1475	9906-1479-1475	Kassier Road/R103	Kassier Road	Left	523	25	93	554	C	2035	25	91.52	2224	C			
9906	1479	9907	9906-1479-9907	Kassier Road/R103	Kassier Road	Right	1513	24	90	1670	C								
1523	1521	1520	1523-1521-1520	Shongweni Road/M13 Westbound	Shongweni Road (north)	Thru	6	23	4	143	C	6	23	2.19	279	C	3.14	26.01	A
1523	1521	1515	1523-1521-1515	Shongweni Road/M13 Westbound	Shongweni Road (north)	Right	0	23	0	136	C								
1567	1521	1520	1567-1521-1520	Shongweni Road/M13 Westbound	M13 westbound off-slip	Left	4	3	1	692	A	669	3	32.04	2089	A			
1567	1521	1523	1567-1521-1523	Shongweni Road/M13 Westbound	M13 westbound off-slip	Right	666	3	48	1396	A								
1520	1521	1515	1520-1521-1515	Shongweni Road/M13 Westbound	Shongweni Road (south)	Left	1	34	1	118	C	8	34	3.05	259	C			
1520	1521	1523	1520-1521-1523	Shongweni Road/M13 Westbound	Shongweni Road (south)	Thru	7	34	5	141	C								
1533	1543	1548	1533-1543-1548	Shongweni Road/M13 Eastbound	Shongweni Road (north)	left	211	3	11	1894	A	797	18	30.05	2654	B	21.95	46.88	C
1525	1530	1532	1525-1530-1532	Shongweni Road/M13 Eastbound	Shongweni Road (north)	Thru	587	23	77	760	C								
1534	1532	1528	1534-1532-1528	Shongweni Road/M13 Eastbound	M13 eastbound off-slip	Left	5	5	0	1052	A	1078	23	56.53	1907	C			
1540	1530	1525	1540-1530-1525	Shongweni Road/M13 Eastbound	M13 eastbound off-slip	Right	1073	23	100	855	C								
1532	1530	1525	1532-1530-1525	Shongweni Road/M13 Eastbound	Shongweni Road (south)	Thru	666	25	88	760	C	672	25	69.41	968	C			
1532	1530	1543	1532-1530-1543	Shongweni Road/M13 Eastbound	Shongweni Road (south)	Right	6	34	3	208	C								
1310	1265	1196	1310-1265-1196	J B Mcintosh Drive/Southern Acces	J B Mcintosh Drive (South)	Thru	136	5	11	1289	A	168	5	8.89	2400	A	7.22	5.86	A
1310	1265	2068	1310-1265-2068	J B Mcintosh Drive/Southern Acces	J B Mcintosh Drive (South)	Right	32	5	3	1111	A								
1196	1265	2068	1196-1265-2068	J B Mcintosh Drive/Southern Acces	J B Mcintosh Drive (North)	Left	24	5	2	1057	A	116	5	4.96	2338	A			
1196	1265	1310	1196-1265-1310	J B Mcintosh Drive/Southern Acces	J B Mcintosh Drive (North)	Thru	92	6	7	1281	A								
2068	1265	1310	2068-1265-1310	J B Mcintosh Drive/Southern Acces	Southern Acces	Left	1	29	0	300	C	32	29	4.95	650	C			
2068	1265	1196	2068-1265-1196	J B Mcintosh Drive/Southern Acces	Southern Acces	Right	32	29	9	349	C								
9902	1372	1377	9902-1372-1377	Kassier Road/Northern Access	Kassier Road (North)	Thru	2183	3	70	3124	A	3065	10	70.35	4357	B	6.57	71.35	A
9902	1372	9901	9902-1372-9901	Kassier Road/Northern Access	Kassier Road (North)	Right	882	27	72	1233	C								
1377	1372	9901	1377-1372-9901	Kassier Road/Northern Access	Kassier Road (South)	Left	17	15	6	306	B	1361	16	58.87	2313	B			
1377	1372	9902	1377-1372-9902	Kassier Road/Northern Access	Kassier Road (South)	Thru	1344	15	67	2007	B								
9901	9902	1355	9901-9902-1355	Kassier Road/Northern Access	Northern Access	Left	3532	8	93	3800	A	3555	8	90.76	3917	A			
9901	1372	1377	9901-1372-1377	Kassier Road/Northern Access	Northern Access	Right	23	40	20	117	D								

C3.3 PM Peak – with Public Transport

A node	B node	C node	Ref	Intersection Name	Approach	Movement	Turn Volume	Turn Delay	Turn V/C	Turn Capacity	Turn LOS	Approach Volume	Approach Delay	Approach V/C	Approach Capacity	Approach LOS	Intersection Delay	Intersection V/C	Intersection LOS
9904	1359	1385	9904-1359-1385	Kasser Road/MR559	Kasser Road	Left	234	25	48	449	C	1488	42.54	80.26	1854	D	31.53	34.54	C
9904	1359	1310	9904-1359-1310	Kasser Road/MR559	Kasser Road	Thru	102	25	28	362	C								
9904	1359	9903	9904-1359-9903	Kasser Road/MR559	Kasser Road	Right	1152	48	103	1043	D								
1385	1359	1310	1385-1359-1310	Kasser Road/MR559	MR559	Left	21	12	8	272	B	691	13.53	42.64	1620	B			
1385	1359	9903	1385-1359-9903	Kasser Road/MR559	MR559	Thru	222	12	41	538	B								
1385	1359	9904	1385-1359-9904	Kasser Road/MR559	MR559	Right	447	15	55	810	B								
1310	1359	9903	1310-1359-9903	Kasser Road/MR559	J B Mcintosh Drive	Left	0	38	0	0	D	108	39.07	35.55	303	D			
1310	1359	9904	1310-1359-9904	Kasser Road/MR559	J B Mcintosh Drive	Thru	97	38	51	190	D								
1310	1359	1385	1310-1359-1385	Kasser Road/MR559	J B Mcintosh Drive	Right	10	45	9	113	D								
9903	9904	1382	9903-9904-1382	Kasser Road/MR559	Middle Access	Left	117	0	6	1800	A	176	3.04	5.26	3313	A			
9903	1359	1385	9903-1359-1385	Kasser Road/MR559	Middle Access	Thru	52	9	5	996	A								
9903	1359	1310	9903-1359-1310	Kasser Road/MR559	Middle Access	Right	8	11	1	556	B								
1339	1344	9911	1339-1344-9911	Kasser Road/N3 westbound	Kasser Road (north)	Thru	3039	4	87	4560	A	3039	4	62.20	4886	A	4.76	37.94	A
1339	1344	1332	1339-1344-1332	Kasser Road/N3 westbound	Kasser Road (north)	Right	0	3	0	326	A								
9910	9911	1349	9910-9911-1349	Kasser Road/N3 westbound	N3 westbound off-slip	Left	276	9	15	1800	A	478	17	22.64	2111	B			
9910	1344	1339	9910-1344-1339	Kasser Road/N3 westbound	N3 westbound off-slip	Right	202	48	65	311	D								
9911	1344	1332	9911-1344-1332	Kasser Road/N3 westbound	Kasser Road (south)	Thru	190	2	17	1143	A	1218	2	22.21	5485	A			
9911	1344	1339	9911-1344-1339	Kasser Road/N3 westbound	Kasser Road (south)	Left	1028	2	24	4363	A								
1319	1328	1342	1319-1328-1342	Kasser Road/N3 eastbound	Kasser Road (north)	Left	726	15	96	756	B	3364	14	91.97	3657	B	15.11	58.88	B
1319	1328	1335	1319-1328-1335	Kasser Road/N3 eastbound	Kasser Road (north)	Thru	2638	13	91	2902	B								
1335	1328	1319	1335-1328-1319	Kasser Road/N3 eastbound	Kasser Road (south)	Thru	968	3	22	4370	A	1230	11	26.26	4680	B			
1335	1328	1342	1335-1328-1342	Kasser Road/N3 eastbound	Kasser Road (south)	Right	262	42	83	315	D								
1305	1328	1319	1305-1328-1319	Kasser Road/N3 eastbound	N3 eastbound off-slip	Left	0	39	0	13	D	401	39	91.07	440	D			
1305	1328	1335	1305-1328-1335	Kasser Road/N3 eastbound	N3 eastbound off-slip	Right	401	39	94	428	D								
9905	1255	1262	9905-1255-1262	Kasser Road/Cliffdale Road	Kasser Road (north)	Left	69	8	24	291	A	3546	7.98	71.10	4987	A	10.26	49.61	B
9905	1255	1258	9905-1255-1258	Kasser Road/Cliffdale Road	Kasser Road (north)	Thru	3329	8	81	4101	A								
9905	1255	1249	9905-1255-1249	Kasser Road/Cliffdale Road	Kasser Road (north)	Right	148	8	25	596	A								
1262	1255	1258	1262-1255-1258	Kasser Road/Cliffdale Road	Access	Left	18	33	34	52	C	83	41.69	39.26	212	D			
1262	1255	1249	1262-1255-1249	Kasser Road/Cliffdale Road	Access	Thru	1	33	34	2	C								
1262	1255	9905	1262-1255-9905	Kasser Road/Cliffdale Road	Access	Right	65	44	41	159	D								
1258	1255	1249	1258-1255-1249	Kasser Road/Cliffdale Road	Kasser Road (south)	Left	8	10	1	682	A	975	10.05	23.89	4083	B			
1258	1255	9905	1258-1255-9905	Kasser Road/Cliffdale Road	Kasser Road (south)	Thru	954	10	29	3278	A								
1258	1255	1262	1258-1255-1262	Kasser Road/Cliffdale Road	Kasser Road (south)	Right	13	41	10	123	D								
1249	1255	9905	1249-1255-9905	Kasser Road/Cliffdale Road	Cliffdale Road	Left	180	37	79	233	D	213	36.79	49.78	428	D			
1249	1255	1262	1249-1255-1262	Kasser Road/Cliffdale Road	Cliffdale Road	Thru	0	37	1	58	D								
1249	1255	1258	1249-1255-1258	Kasser Road/Cliffdale Road	Cliffdale Road	Right	30	38	21	146	D								
1246	1250	9905	1246-1250-9905	Kasser Road/M13 westbound	Kasser Road (north)	Thru	2404	7	61	3927	A	2623	8	60.38	4343	A	8.43	50.02	A
1246	1250	1240	1246-1250-1240	Kasser Road/M13 westbound	Kasser Road (north)	Right	219	22	52	416	C								
1257	9905	1255	1257-9905-1255	Kasser Road/M13 westbound	M13 westbound off-slip	Left	1142	8	63	1800	A	1506	8	62.16	2422	A			
1257	1250	1246	1257-1250-1246	Kasser Road/M13 westbound	M13 westbound off-slip	Right	364	34	58	622	C								
9905	1250	1240	9905-1250-1240	Kasser Road/M13 westbound	Kasser Road (south)	Left	39	10	6	641	B	1202	10	30.91	3891	B			
9905	1250	1246	9905-1250-1246	Kasser Road/M13 westbound	Kasser Road (south)	Thru	1164	10	36	3249	B								
1239	1243	1253	1239-1243-1253	Kasser Road/M13 eastbound	Kasser Road (north)	Left	518	18	96	541	B	3081	17	93.24	3305	B	17.89	70.98	B
1239	1243	1246	1239-1243-1246	Kasser Road/M13 eastbound	Kasser Road (north)	Thru	2584	17	93	2764	B								
1246	1243	1239	1246-1243-1239	Kasser Road/M13 eastbound	Kasser Road (south)	Thru	1044	5	39	2792	A	1528	16	47.01	3250	B			
1246	1243	1253	1246-1243-1253	Kasser Road/M13 eastbound	Kasser Road (south)	Right	484	40	88	548	D								
1237	1243	1239	1237-1243-1239	Kasser Road/M13 eastbound	M13 eastbound off-slip	Left	214	36	90	238	D	272	36	84.48	322	D			
1237	1243	1246	1237-1243-1246	Kasser Road/M13 eastbound	M13 eastbound off-slip	Right	59	36	70	85	D								
1230	1218	1222	1230-1218-1222	Kasser Road/Alverstone Road	Kasser Road (north)	Left	66	14	31	211	B	2827	14.09	74.35	3802	B	14.53	49.11	B
1230	1218	1212	1230-1218-1212	Kasser Road/Alverstone Road	Kasser Road (north)	Thru	2706	14	82	3318	B								
1230	1218	1204	1230-1218-1204	Kasser Road/Alverstone Road	Kasser Road (north)	Right	55	14	20	273	B								
1222	1218	1212	1222-1218-1212	Kasser Road/Alverstone Road	Hospital Access	Left	92	29	29	325	C	111	29.49	15.92	697	C			
1222	1218	1204	1222-1218-1204	Kasser Road/Alverstone Road	Hospital Access	Thru	2	29	1	122	C								
1222	1218	1230	1222-1218-1230	Kasser Road/Alverstone Road	Hospital Access	Right	17	32	7	250	C								
1214	1204	1203	1214-1204-1203	Kasser Road/Alverstone Road	Kasser Road (south)	Left	272	0	14	1900	A	1402	8.81	39.51	4094	A			
1212	1218	1230	1212-1218-1230	Kasser Road/Alverstone Road	Kasser Road (south)	Thru	997	7	41	2455	A								
1212	1218	1222	1212-1218-1222	Kasser Road/Alverstone Road	Kasser Road (south)	Right	133	42	58	229	D								
1204	1218	1230	1204-1218-1230	Kasser Road/Alverstone Road	Kasser Road/Alverstone Road	Left	46	31	79	58	C	326	37.86	80.17	407	D			
1204	1218	1222	1204-1218-1222	Kasser Road/Alverstone Road	Kasser Road/Alverstone Road	Thru	5	31	79	7	C								
1204	1218	1212	1204-1218-1212	Kasser Road/Alverstone Road	Kasser Road/Alverstone Road	Right	275	39	80	342	D								
1475	1479	9907	1475-1479-9907	Kasser Road/R103	R103 (west)	Thru	885	9	38	2322	A	1540	11	49.45	3114	B	13.30	62.22	B
1475	1479	9906	1475-1479-9906	Kasser Road/R103	R103 (west)	Right	655	14	83	792	B								
9907	9906	1471	9907-9906-1471	Kasser Road/R103	R103 (east)	Left	1570	8	87	1800	A	2248	9	79.91	2813	A			
9907	1479	1475	9907-1479-1475	Kasser Road/R103	R103 (east)	Thru	678	29	67	1013	C								
9906	1479	1475	9906-1479-1475	Kasser Road/R103	Kasser Road	Left	309	25	67	458	C	889	28	55.92	1590	C			
9906	1479	9907	9906-1479-9907	Kasser Road/R103	Kasser Road	Right	580	28	51	1131	C								
1523	1521	1520	1523-1521-1520	Shongweni Road/M13 Westbound	Shongweni Road (north)	Thru	1	31	1	138	C	5	31	1.35	401	C	2.55	13.03	A
1523	1521	1515	1523-1521-1515	Shongweni Road/M13 Westbound	Shongweni Road (north)	Right	4	31	2	264	C								
1567	1521	1520	1567-1521-1520	Shongweni Road/M13 Westbound	M13 westbound off-slip	Left	0	2	0	955	A	387	2	16.43	2355	A			
1567	1521	1523	1567-1521-1523	Shongweni Road/M13 Westbound	M13 westbound off-slip	Right	387	2	28	1400	A								
1520	1521	1515	1520-1521-1515	Shongweni Road/M13 Westbound	Shongweni Road (south)	Left	1	34	1	124	C	1	34	0.46	265	C			
1520	1521	1523	1520-1521-1523	Shongweni Road/M13 Westbound	Shongweni Road (south)	Thru	0	34	0	141	C								
1533	1543	1548	1533-1543-1548	Shongweni Road/M13 Eastbound	Shongweni Road (north)	left	533	3	28	1900	A	1585	10	51.68	3103	B	13.17	43.47	B
1525	1530	1532	1525-1530-1532	Shongweni Road/M13 Eastbound	Shongweni Road (north)	Thru	1052	14	87	1203	B								
1534	1530	1528	1534-1530-1528	Shongweni Road/M13 Eastbound	M13 eastbound off-slip	Left	1	8	0	509	A	384	32	40.14	956	C			
1540	1530	1525	1540-1530-1525	Shongweni Road/M13 Eastbound	M13 eastbound off-slip	Right	383	32	85	447	C								
1532	1530	1525	1532-1530-1525	Shongweni Road/M13 Eastbound	Shongweni Road (south)	Thru	387	8	32	1203	A	387	8	28.44	1361	A			
1532	1530	1543	1532-1530-1543	Shongweni Road/M13 Eastbound	Shongweni Road (south)	Right	0	30	0	158	C								
1310	1265	1196	1310-1265-1196	J B Mcintosh Drive/Southern Acces	J B Mcintosh Drive (South)	Thru	130	2	8	1562	A	131	2	4.64	2824	A	1.84	4.84	A
1310	1265	2068	1310-1265-2068	J B Mcintosh Drive/Southern Acces	J B Mcintosh Drive (South)	Right	1	2	0	1262	A								
1196	1265	2068	1196-1265-2068	J B Mcintosh Drive/Southern Acces	J B Mcintosh Drive (North)	Left	41	2	3	1263	A	149	2	5.35	2779	A			
1196	1265	1310	1196-1265-1310	J B Mcintosh Drive/Southern Acces	J B Mcintosh Drive (North)	Thru	108	2	7	1515	A								
2068	1265	1310	2068-1265-1310	J B Mcintosh Drive/Southern Acces	Southern Acces	Left	0	39	0	108	D	2	39	1.91	225	D			
2068	1265	1196	2068-1265-1196	J B Mcintosh Drive/Southern Acces	Southern Acces	Right	2	39	2	117	D								
9902	1372	1377	9902-1372-1377	Kasser Road/Northern Access	Kasser Road (North)	Thru	1487	2	48	3124	A	3314	38	69.07	4799	D	31.36	47.23	C
9902	1372	9901	9902-1372-9901	Kasser Road/Northern Access	Kasser Road (North)	Right	1827	67	109	1674	E								
1377	1372	9901	1377-1372-9901	Kasser Road/Northern Access	Kasser Road (South)	Left	2	24	2	107	C	661	24	74.67	886	C			
1377	1372	9902	1377-1372-9902	Kasser Road/Northern Access	Kasser Road (South)	Thru	659	24	85	779	C								
9901	9902	1355	9901-9902-1355	Kasser Road/Northern Access	Northern Access	Left	559	8	15	3800	A	559	8	14.27	3917	A			
9901	1372	1377	9901-1372-1377	Kasser Road/Northern Access	Northern Access	Right	0	39	0	117	D								

C3.4 PM Peak – with Public Transport

							Turn					Approach					Intersection		
A node	B node	C node	Ref	Intersection Name	Approach	Movement	Volume	Delay	V/C	Capacity	LOS	Volume	Delay	V/C	Capacity	LOS	Delay	V/C	LOS
9904	1359	1385	9904-1359-1385	Kassier Road/MR559	Kassier Road	Left	433	14	55	783	B	1890	17.14	61.06	3096	B	14.59	43.62	B
9904	1359	1310	9904-1359-1310	Kassier Road/MR559	Kassier Road	Thru	133	14	25	536	B								
9904	1359	9903	9904-1359-9903	Kassier Road/MR559	Kassier Road	Right	1323	18	74	1777	B								
1385	1359	1310	1385-1359-1310	Kassier Road/MR559	MR559	Left	5	22	13	48	C	292	29.22	45.19	625	C			
1385	1359	9903	1385-1359-9903	Kassier Road/MR559	MR559	Thru	105	22	40	264	C								
1385	1359	9904	1385-1359-9904	Kassier Road/MR559	MR559	Right	171	34	55	313	C								
1310	1359	9903	1310-1359-9903	Kassier Road/MR559	J B Mcintosh Drive	Left	0	30	0	240	C	97	19.23	7.83	1241	B			
1310	1359	9904	1310-1359-9904	Kassier Road/MR559	J B Mcintosh Drive	Thru	82	17	11	755	B								
1310	1359	1385	1310-1359-1385	Kassier Road/MR559	J B Mcintosh Drive	Right	16	31	6	246	C								
9903	9904	1382	9903-9904-1382	Kassier Road/MR559	Middle Access	Left	823	0	46	1800	A	1124	6.22	39.89	2817	A			
9903	1359	1385	9903-1359-1385	Kassier Road/MR559	Middle Access	Thru	269	23	43	626	C								
9903	1359	1310	9903-1359-1310	Kassier Road/MR559	Middle Access	Right	31	27	8	389	C								
1339	1344	9911	1339-1344-9911	Kassier Road/N3 westbound	Kassier Road (north)	Thru	2268	4	51	4370	A	2268	4	50.04	4491	A	9.68	66.06	A
1339	1344	1332	1339-1344-1332	Kassier Road/N3 westbound	Kassier Road (north)	Right	0	40	0	121	D								
9910	9911	1349	9910-9911-1349	Kassier Road/N3 westbound	N3 westbound off-slip	Left	442	0	25	1800	A	836	18	37.53	2226	B			
9910	1344	1339	9910-1344-1339	Kassier Road/N3 westbound	N3 westbound off-slip	Right	395	39	92	428	D								
9911	1344	1332	9911-1344-1332	Kassier Road/N3 westbound	Kassier Road (south)	Thru	679	16	96	708	A	4188	10	97.62	4291	A			
9911	1344	1339	9911-1344-1339	Kassier Road/N3 westbound	Kassier Road (south)	Left	3509	10	98	3583	A								
1319	1328	1342	1319-1328-1342	Kassier Road/N3 eastbound	Kassier Road (north)	Left	129	22	44	296	C	1795	22	70.22	2556	C	10.57	80.36	B
1319	1328	1335	1319-1328-1335	Kassier Road/N3 eastbound	Kassier Road (north)	Thru	1666	22	74	2260	C								
1335	1328	1319	1335-1328-1319	Kassier Road/N3 eastbound	Kassier Road (south)	Thru	3348	11	87	3863	B	3904	15	87.80	4447	B			
1335	1328	1342	1335-1328-1342	Kassier Road/N3 eastbound	Kassier Road (south)	Right	556	35	96	583	D								
1305	1328	1319	1305-1328-1319	Kassier Road/N3 eastbound	N3 eastbound off-slip	Left	0	34	0	74	C	582	34	71.63	813	C			
1305	1328	1335	1305-1328-1335	Kassier Road/N3 eastbound	N3 eastbound off-slip	Right	582	34	79	739	C								
9905	1255	1262	9905-1255-1262	Kassier Road/Cliffdale Road	Kassier Road (north)	Left	9	4	1	708	A	2038	8.19	38.92	5237	A	12.73	57.61	B
9905	1255	1258	9905-1255-1258	Kassier Road/Cliffdale Road	Kassier Road (north)	Thru	1817	4	43	4233	A								
9905	1255	1249	9905-1255-1249	Kassier Road/Cliffdale Road	Kassier Road (north)	Right	213	41	72	296	D								
1262	1255	1258	1262-1255-1258	Kassier Road/Cliffdale Road	Access	Left	1	33	2	51	C	14	41.78	5.16	262	D			
1262	1255	1249	1262-1255-1249	Kassier Road/Cliffdale Road	Access	Thru	0	33	0	47	C								
1262	1255	9905	1262-1255-9905	Kassier Road/Cliffdale Road	Access	Right	13	42	8	165	D								
1258	1255	1249	1258-1255-1249	Kassier Road/Cliffdale Road	Kassier Road (south)	Left	32	14	29	109	B	3379	13.99	87.85	3846	B			
1258	1255	9905	1258-1255-9905	Kassier Road/Cliffdale Road	Kassier Road (south)	Thru	3346	14	92	3636	B								
1258	1255	1262	1258-1255-1262	Kassier Road/Cliffdale Road	Kassier Road (south)	Right	2	26	2	100	C								
1249	1255	9905	1249-1255-9905	Kassier Road/Cliffdale Road	Cliffdale Road	Left	178	37	78	228	D	189	37.19	46.08	410	D			
1249	1255	1262	1249-1255-1262	Kassier Road/Cliffdale Road	Cliffdale Road	Thru	0	37	0	58	D								
1249	1255	1258	1249-1255-1258	Kassier Road/Cliffdale Road	Cliffdale Road	Right	11	37	9	125	D								
1246	1250	9905	1246-1250-9905	Kassier Road/M13 westbound	Kassier Road (north)	Thru	999	3	24	4212	A	1132	8	25.45	4449	A	10.60	66.82	B
1246	1250	1240	1246-1250-1240	Kassier Road/M13 westbound	Kassier Road (north)	Right	133	43	56	237	D								
1257	9905	1255	1257-9905-1255	Kassier Road/M13 westbound	M13 westbound off-slip	Left	1039	0	58	1800	A	1435	11	63.31	2267	B			
1257	1250	1246	1257-1250-1246	Kassier Road/M13 westbound	M13 westbound off-slip	Right	396	38	85	467	D								
9905	1250	1240	9905-1250-1240	Kassier Road/M13 westbound	Kassier Road (south)	Left	67	12	38	177	B	3536	12	87.83	4026	B			
9905	1250	1246	9905-1250-1246	Kassier Road/M13 westbound	Kassier Road (south)	Thru	3469	12	90	3849	B								
1239	1243	1253	1239-1243-1253	Kassier Road/M13 eastbound	Kassier Road (north)	Left	179	33	82	218	C	1258	32	85.48	1472	C	21.69	86.20	C
1239	1243	1246	1239-1243-1246	Kassier Road/M13 eastbound	Kassier Road (north)	Thru	1079	32	86	1254	C								
1246	1243	1239	1246-1243-1239	Kassier Road/M13 eastbound	Kassier Road (south)	Thru	2234	11	85	2618	B	3865	17	90.50	4271	B			
1246	1243	1253	1246-1243-1253	Kassier Road/M13 eastbound	Kassier Road (south)	Right	1631	27	99	1653	C								
1237	1243	1239	1237-1243-1239	Kassier Road/M13 eastbound	M13 eastbound off-slip	Left	230	35	82	280	C	283	35	73.09	387	C			
1237	1243	1246	1237-1243-1246	Kassier Road/M13 eastbound	M13 eastbound off-slip	Right	53	35	58	106	C								
1230	1218	1222	1230-1218-1222	Kassier Road/Alverstone Road	Kassier Road (north)	Left	17	9	3	684	A	1074	10.11	25.62	4194	B	9.22	38.37	A
1230	1218	1212	1230-1218-1212	Kassier Road/Alverstone Road	Kassier Road (north)	Thru	1013	9	30	3376	A								
1230	1218	1204	1230-1218-1204	Kassier Road/Alverstone Road	Kassier Road (north)	Right	44	41	34	131	D								
1222	1218	1212	1222-1218-1212	Kassier Road/Alverstone Road	Hospital Access	Left	98	37	57	171	D	142	38.22	39.74	357	D			
1222	1218	1204	1222-1218-1204	Kassier Road/Alverstone Road	Hospital Access	Thru	0	42	0	36	D								
1222	1218	1230	1222-1218-1230	Kassier Road/Alverstone Road	Hospital Access	Right	44	41	29	150	D								
1214	1204	1203	1214-1204-1203	Kassier Road/Alverstone Road	Kassier Road (south)	Left	283	0	15	1900	A	2468	4.98	47.37	5209	A			
1212	1218	1230	1212-1218-1230	Kassier Road/Alverstone Road	Kassier Road (south)	Thru	2146	6	74	2891	A								
1212	1218	1222	1212-1218-1222	Kassier Road/Alverstone Road	Kassier Road (south)	Right	39	5	9	418	A								
1204	1218	1230	1204-1218-1230	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Left	22	36	39	57	D	160	43.03	62.44	256	D			
1204	1218	1222	1204-1218-1222	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Thru	1	36	39	3	D								
1204	1218	1212	1204-1218-1212	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Right	136	44	70	195	D								
1475	1479	9907	1475-1479-9907	Kassier Road/R103	R103 (west)	Thru	496	15	29	1731	B	725	17	36.08	2067	B	17.79	60.38	B
1475	1479	9906	1475-1479-9906	Kassier Road/R103	R103 (west)	Right	229	20	68	336	C								
9907	9906	1471	9907-9906-1471	Kassier Road/R103	R103 (east)	Left	936	0	52	1800	A	1971	13	62.56	3151	B			
9907	1479	1475	9907-1479-1475	Kassier Road/R103	R103 (east)	Thru	1035	26	77	1351	C								
9906	1479	1475	9906-1479-1475	Kassier Road/R103	Kassier Road	Left	503	23	83	604	C	1871	23	79.76	2346	C			
9906	1479	9907	9906-1479-9907	Kassier Road/R103	Kassier Road	Right	1368	23	78	1742	C								
1523	1521	1520	1523-1521-1520	Shongweni Road/M13 Westbound	Shongweni Road (north)	Thru	6	22	4	143	C	6	22	2.19	279	C	3.13	26.01	A
1523	1521	1515	1523-1521-1515	Shongweni Road/M13 Westbound	Shongweni Road (north)	Right	0	22	0	136	C								
1567	1521	1520	1567-1521-1520	Shongweni Road/M13 Westbound	M13 westbound off-slip	Left	4	3	1	832	A	669	3	32.04	2089	A			
1567	1521	1523	1567-1521-1523	Shongweni Road/M13 Westbound	M13 westbound off-slip	Right	666	3	48	1396	A								
1520	1521	1515	1520-1521-1515	Shongweni Road/M13 Westbound	Shongweni Road (south)	Left	1	34	1	118	C	8	34	3.05	259	C			
1520	1521	1523	1520-1521-1523	Shongweni Road/M13 Westbound	Shongweni Road (south)	Thru	7	34	5	141	C								
1533	1543	1548	1533-1543-1548	Shongweni Road/M13 Eastbound	Shongweni Road (north)	left	211	3	11	1894	A	743	18	28.21	2633	B	21.89	42.35	C
1525	1530	1532	1525-1530-1532	Shongweni Road/M13 Eastbound	Shongweni Road (north)	Thru	532	23	72	739	C								
1534	1532	1528	1534-1532-1528	Shongweni Road/M13 Eastbound	M13 eastbound off-slip	Left	5	4	0	1124	A	958	22	47.94	1999	C			
1548	1530	1525	1548-1530-1525	Shongweni Road/M13 Eastbound	M13 eastbound off-slip	Right	953	23	100	875	C								
1532	1530	1525	1532-1530-1525	Shongweni Road/M13 Eastbound	Shongweni Road (south)	Thru	666	26	90	739	C	672	26	69.10	973	C			
1532	1530	1543	1532-1530-1543	Shongweni Road/M13 Eastbound	Shongweni Road (south)	Right	6	32	3	234	C								
1310	1265	1196	1310-1265-1196	J B Mcintosh Drive/Southern Acces	J B Mcintosh Drive (South)	Thru	147	2	10	1461	A	170	2	6.29	2709	A	4.04	5.31	A
1310	1265	2068	1310-1265-2068	J B Mcintosh Drive/Southern Acces	J B Mcintosh Drive (South)	Right	23	3	2	1248	A								
1196	1265	2068	1196-1265-2068	J B Mcintosh Drive/Southern Acces	J B Mcintosh Drive (North)	Left	21	2	2	1199	A	118	2	4.47	2652	A			
1196	1265	1310	1196-1265-1310	J B Mcintosh Drive/Southern Acces	J B Mcintosh Drive (North)	Thru	97	2	7	1453	A								
2068	1265	1310	2068-1265-1310	J B Mcintosh Drive/Southern Acces	Southern Acces	Left	0	36	0	168	D	15	36	4.08	364	D			
2068	1265	1196	2068-1265-1196	J B Mcintosh Drive/Southern Acces	Southern Acces	Right	15	36	8	194	D								
9902	1372	1377	9902-1372-1377	Kassier Road/Northern Access	Kassier Road (North)	Thru	1882	3	60	3124	A	2689	13	67.72	3971	B	7.23	74.92	A
9902	1372	9901	9902-1372-9901	Kassier Road/Northern Access	Kassier Road (North)	Right	807	36	95	846	D								
1377	1372	9901	1377-1372-9901	Kassier Road/Northern Access	Kassier Road (South)	Left	7	14	5	117	B	1076	14	82.03	1312	B			
1377	1372	9902	1377-1372-9902	Kassier Road/Northern Access	Kassier Road (South)	Thru	1069	14	89	1195	B								
9901	9902	1355	9901-9902-1355	Kassier Road/Northern Access	Northern Access	Left	3120	0	82	3800	A	3127	0	79.85	3917	A			
9901	1372	1377	9901-1372-1377	Kassier Road/Northern Access	Northern Access	Right	8	39	6	117	D								

C4 Site 3 Key Intersection Results

C4.1 AM Peak

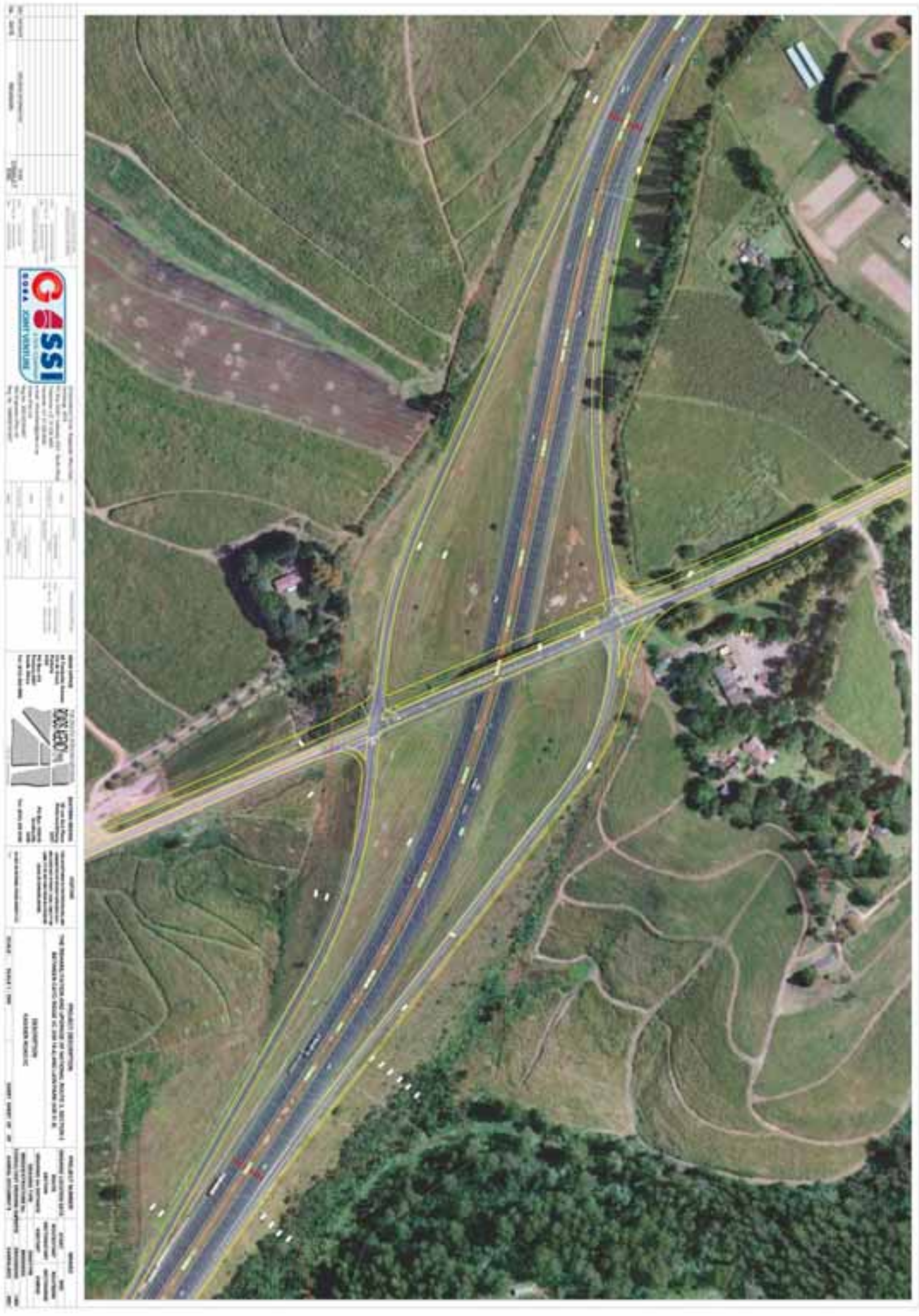
							Turn					Approach					Intersection		
A node	B node	C node	Ref	Intersection Name	Approach	Movement	Volume	Delay	V/C	Capacity	LOS	Volume	Delay	V/C	Capacity	LOS	Delay	V/C	LOS
1382	1359	1385	1382-1359-1385	Kassier Road/MR559	Kassier Road	Left	240	14.27	29.50	811.61	B	371	14.07	15.99	2318	B	16.37	12.03	B
1382	1359	1310	1382-1359-1310	Kassier Road/MR559	Kassier Road	Thru	128	13.79	17.18	742.90	B								
1382	1359	1337	1382-1359-1337	Kassier Road/MR559	Kassier Road	Right	3	13.43	0.41	763.87	B								
1385	1359	1310	1385-1359-1310	Kassier Road/MR559	MR559	Left	26	15.73	4.30	599.71	B	472	16.98	17.59	2683	B			
1385	1359	1337	1385-1359-1337	Kassier Road/MR559	MR559	Thru	0	15.55	0.05	574.20	B								
1385	1359	1382	1385-1359-1382	Kassier Road/MR559	MR559	Right	446	17.65	29.29	1509.11	B								
1310	1359	1337	1310-1359-1337	Kassier Road/MR559	J B Mcintosh Drive	Left	0	12.62	0.03	583.12	B	139	13.30	7.35	1806	B			
1310	1359	1382	1310-1359-1382	Kassier Road/MR559	J B Mcintosh Drive	Thru	116	12.42	14.15	823.49	B								
1310	1359	1385	1310-1359-1385	Kassier Road/MR559	J B Mcintosh Drive	Right	22	17.42	4.39	499.86	B								
1337	1359	1382	1337-1359-1382	Kassier Road/MR559	Access	Left	2	16.23	0.50	399.23	B	2	16.23	0.19	1288	B			
1337	1359	1385	1337-1359-1385	Kassier Road/MR559	Access	Thru	0	16.21	0.08	397.53	B								
1337	1359	1310	1337-1359-1310	Kassier Road/MR559	Access	Right	0	16.21	0.03	492.32	B								
1339	1344	1349	1339-1344-1349	Kassier Road/N3 westbound	Kassier Road (north)	Thru	1458	9.78	41.24	3527.85	A	1460	9.78	38.56	3786	A	11.48	26.49	B
1339	1344	1332	1339-1344-1332	Kassier Road/N3 westbound	Kassier Road (north)	Right	2	12.07	0.72	257.09	B								
1353	1344	1349	1353-1344-1349	Kassier Road/N3 westbound	N3 westbound off-slip	Left	130	26.98	14.84	873.00	C	332	28.40	24.36	1363	C			
1353	1344	1339	1353-1344-1339	Kassier Road/N3 westbound	N3 westbound off-slip	Right	202	29.31	41.32	490.00	C								
1349	1344	1339	1349-1344-1339	Kassier Road/N3 westbound	Kassier Road (south)	Thru	162	7.90	8.88	1828.73	A	982	8.43	18.45	5321	A			
1349	1344	1332	1349-1344-1332	Kassier Road/N3 westbound	Kassier Road (south)	Left	819	8.50	23.46	3492.65	A								
1319	1328	1342	1319-1328-1342	Kassier Road/N3 eastbound	Kassier Road (north)	Left	726	6.68	64.01	1135.92	A	1971	5.49	42.58	4632	A	9.16	30.94	A
1319	1328	1335	1319-1328-1335	Kassier Road/N3 eastbound	Kassier Road (north)	Thru	1245	4.79	35.49	3508.42	A								
1335	1328	1319	1335-1328-1319	Kassier Road/N3 eastbound	Kassier Road (south)	Thru	780	2.32	17.11	4560.00	A	1022	9.13	19.58	5219	A			
1335	1328	1342	1335-1328-1342	Kassier Road/N3 eastbound	Kassier Road (south)	Right	242	31.11	36.95	658.91	C								
1305	1328	1319	1305-1328-1319	Kassier Road/N3 eastbound	N3 eastbound off-slip	Left	0	40.99	0.00	165.00	D	214	43.14	41.83	515	D			
1305	1328	1335	1305-1328-1335	Kassier Road/N3 eastbound	N3 eastbound off-slip	Right	214	43.14	61.26	350.00	D								
1250	1255	1262	1250-1255-1262	Kassier Road/Cliffdale Road	Kassier Road (north)	Left	69	6.64	12.04	572.57	A	2127	6.63	43.79	4857	A	10.36	32.21	B
1250	1255	1258	1250-1255-1258	Kassier Road/Cliffdale Road	Kassier Road (north)	Thru	1935	6.52	52.17	3699.83	A								
1250	1255	1249	1250-1255-1249	Kassier Road/Cliffdale Road	Kassier Road (north)	Right	123	8.39	20.66	594.74	A								
1262	1255	1258	1262-1255-1258	Kassier Road/Cliffdale Road	Access	Left	18	26.07	10.61	171.84	C	83	31.96	15.30	544	C			
1262	1255	1249	1262-1255-1249	Kassier Road/Cliffdale Road	Access	Thru	3	28.07	3.18	101.39	C								
1262	1255	1250	1262-1255-1250	Kassier Road/Cliffdale Road	Access	Right	65	32.64	24.02	270.35	C								
1258	1255	1249	1258-1255-1249	Kassier Road/Cliffdale Road	Kassier Road (south)	Left	8	11.52	1.24	660.02	B	786	13.61	23.07	3405	B			
1258	1255	1250	1258-1255-1250	Kassier Road/Cliffdale Road	Kassier Road (south)	Thru	765	13.36	29.43	2598.58	B								
1258	1255	1262	1258-1255-1262	Kassier Road/Cliffdale Road	Kassier Road (south)	Right	13	30.15	8.61	148.48	C								
1249	1255	1250	1249-1255-1250	Kassier Road/Cliffdale Road	Cliffdale Road	Left	169	28.12	51.24	330.00	C	199	28.27	18.06	1103	C			
1249	1255	1262	1249-1255-1262	Kassier Road/Cliffdale Road	Cliffdale Road	Thru	0	26.82	0.09	320.67	C								
1249	1255	1258	1249-1255-1258	Kassier Road/Cliffdale Road	Cliffdale Road	Right	30	26.80	8.61	462.19	C								
1246	1250	1251	1246-1250-1251	Kassier Road/M13 westbound	Kassier Road (north)	Thru	1356	18.20	66.28	2046.64	B	1575	20.48	63.47	2481	C	25.96	50.89	C
1246	1250	1240	1246-1250-1240	Kassier Road/M13 westbound	Kassier Road (north)	Right	219	34.66	50.24	434.38	C								
1257	1251	1255	1257-1251-1255	Kassier Road/M13 westbound	M13 westbound off-slip	Left	770	32.17	64.74	1182.50	C	1134	30.69	46.55	2437	C			
1257	1250	1246	1257-1250-1246	Kassier Road/M13 westbound	M13 westbound off-slip	Right	364	27.16	28.83	1254.17	C								
1255	1250	1240	1255-1250-1240	Kassier Road/M13 westbound	Kassier Road (south)	Left	37	29.28	10.46	349.66	C	999	29.21	41.66	2396	C			
1255	1250	1246	1255-1250-1246	Kassier Road/M13 westbound	Kassier Road (south)	Thru	962	29.21	46.98	2048.21	C								
1239	1243	1213	1239-1243-1213	Kassier Road/M13 eastbound	Kassier Road (north)	Left	518	20.83	60.73	852.50	C	2042	19.46	53.76	3798	B	21.10	45.61	C
1239	1243	1246	1239-1243-1246	Kassier Road/M13 eastbound	Kassier Road (north)	Thru	1524	19.13	51.74	2946.00	B								
1246	1243	1239	1246-1243-1239	Kassier Road/M13 eastbound	Kassier Road (south)	Thru	869	7.00	32.60	2660.66	A	1326	19.56	38.67	3429	B			
1246	1243	1253	1246-1243-1253	Kassier Road/M13 eastbound	Kassier Road (south)	Right	458	43.40	59.38	769.24	D								
1237	1243	1239	1237-1243-1239	Kassier Road/M13 eastbound	M13 eastbound off-slip	Left	214	42.29	59.73	357.50	D	264	41.45	35.89	737	D			
1237	1243	1246	1237-1243-1246	Kassier Road/M13 eastbound	M13 eastbound off-slip	Right	51	37.92	13.42	379.17	D								
1230	1218	1222	1230-1218-1222	Kassier Road/Alverstone Road	Kassier Road (north)	Left	66	10.24	18.30	359.19	B	1857	10.10	56.58	3281	B	13.55	39.22	B
1230	1218	1212	1230-1218-1212	Kassier Road/Alverstone Road	Kassier Road (north)	Thru	1736	10.29	71.89	2415.61	B								
1230	1218	1204	1230-1218-1204	Kassier Road/Alverstone Road	Kassier Road (north)	Right	55	6.86	10.81	508.58	A								
1222	1218	1212	1222-1218-1212	Kassier Road/Alverstone Road	Hospital Access	Left	92	33.19	33.72	272.92	C	111	33.17	13.86	801	C			
1222	1218	1204	1222-1218-1204	Kassier Road/Alverstone Road	Hospital Access	Thru	2	31.59	0.85	197.54	C								
1222	1218	1230	1222-1218-1230	Kassier Road/Alverstone Road	Hospital Access	Right	17	33.72	5.21	330.18	C								
1212	1218	1204	1212-1218-1204	Kassier Road/Alverstone Road	Kassier Road (south)	Left	0	8.45	0.00	721.40	A	964	11.54	27.74	3474	B			
1212	1218	1230	1212-1218-1230	Kassier Road/Alverstone Road	Kassier Road (south)	Thru	831	6.83	33.31	2491.11	A								
1212	1218	1222	1212-1218-1222	Kassier Road/Alverstone Road	Kassier Road (south)	Right	133	39.07	50.81	261.38	D								
1204	1218	1230	1204-1218-1230	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Left	40	32.23	18.29	247.57	C	258	39.06	44.77	572	D			
1204	1218	1222	1204-1218-1222	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Thru	5	32.23	18.18	29.29	C								
1204	1218	1212	1204-1218-1212	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Right	205	40.74	69.69	294.77	D								
1475	1479	1481	1475-1479-1481	Kassier Road/R103	R103 (west)	Thru	885	7.22	36.69	2412.00	A	1482	15.31	40.97	3616	B	20.08	40.81	C
1475	1479	1471	1475-1479-1471	Kassier Road/R103	R103 (west)	Right	597	27.32	49.55	1204.22	C								
1481	1479	1471	1481-1479-1471	Kassier Road/R103	R103 (east)	Left	815	20.90	35.64	2286.00	C	1493	21.86	40.45	3690	C			
1481	1479	1475	1481-1479-1475	Kassier Road/R103	R103 (east)	Thru	678	22.92	48.27	1404.00	C								
1471	1479	1475	1471-1479-1475	Kassier Road/R103	Kassier Road	Left	301	14.61	32.71	919.00	B	745	25.99	40.21	1854	C			
1471	1479	1481	1471-1479-1481	Kassier Road/R103	Kassier Road	Right	441	33.82	47.46	936.00	C								
1523	1521	1520	1523-1521-1520	Shongweni Road/M13 Westboun	Shongweni Road (north)	Thru	1	0	0	1800	A	1	0.00	0.03	3596	A	2.98	3.83	A
1523	1521	1515	1523-1521-1515	Shongweni Road/M13 Westboun	Shongweni Road (north)	Right	0	3	0	1796	A								
1567	1521	1520	1567-1521-1520	Shongweni Road/M13 Westboun	M13 westbound off-slip	Left	0	3	0	1175	A	387	3.00	13.02	2972	A			
1567	1521	1523	1567-1521-1523	Shongweni Road/M13 Westboun	M13 westbound off-slip	Right	387	3	22	1797	A								
1526	1521	1515	1526-1521-1515	Shongweni Road/M13 Westboun	Shongweni Road (south)	Left	1	0	0	1800	A	1	0.00	0.03	3599	A			
1526	1521	1523	1526-1521-1523	Shongweni Road/M13 Westboun	Shongweni Road (south)	Thru	0	0	0	1799	A								
1533	1543	1548	1533-1543-1548	Shongweni Road/M13 Eastboun	Shongweni Road (north)	left	533	3	27	1906	A	1227	7.11	41.17	2986	A	10.44	33.25	B
1525	1530	1532	1525-1530-1532	Shongweni Road/M13 Eastboun	Shongweni Road (north)	Thru	694	11	61	1080	B								
1534	1532	1528	1534-1532-1528	Shongweni Road/M13 Eastboun	M13 eastbound off-slip	Left	1	5	0	934	A	332	25.39	22.82	1457	C			
1540	1530	1525	1540-1530-1525	Shongweni Road/M13 Eastboun	M13 eastbound off-slip	Right	331	25	63	523	C								
1532	1530	1525	1532-1530-1525	Shongweni Road/M13 Eastboun	Shongweni Road (south)	Thru	387	8	36	1080	A	387	8.16	27.33	1416	A			
1532	1530	1543	1532-1530-1543	Shongweni Road/M13 Eastboun	Shongweni Road (south)	Right	0	16	0	336	B								
1349	1700	2064	1349-1700-2064	Kassier Road/Northern Access	Kassier Road (north)	Left	1222	3.61	21.56	5669.86	A	1587	4.27	23.15	6857	A	9.19	22.00	A
1349	1355	1372	1349-1355-1372	Kassier Road/Northern Access	Kassier Road (north)	Thru	365	8.47	30.44	1197.00	A								
1700	1355	1372	1700-1355-1372	Kassier Road/Northern Access	Access Road	Left	6	25.74	1.41	410.00	C	428	28.95	23.44	1827	C			
1700	1355	1349	1700-1355-1349	Kassier Road/Northern Access	Access Road	Right	422	28.98	29.81	1417.19	C								
1372	1355	1349	1372-1355-1349	Kassier Road/Northern Access	Kassier Road (south)	Thru	559	8.63	23.29	2391.13	A	564	8.05	18.56	3041	A			
1372	1355	1700	1372-1355-1700	Kassier Road/Northern Access	Kassier Road (south)	Right	5	10.28	0.78	650.29	B								

C4.2 PM Peak

A node	B node	C node	Ref	Intersection Name	Approach	Movement	Turn Volume	Turn Delay	Turn V/C	Turn Capacity	Turn LOS	Approach Volume	Approach Delay	Approach V/C	Approach Capacity	Approach LOS	Intersection Delay	Intersection V/C	Intersection LOS
1382	1359	1385	1382-1359-1385	Kassier Road/MR559	Kassier Road	Left	436	3.36	32.76	1330.93	A	537	3.35	14.88	3609	A	11.48	11.05	B
1382	1359	1310	1382-1359-1310	Kassier Road/MR559	Kassier Road	Thru	97	3.31	9.65	1008.09	A								
1382	1359	1337	1382-1359-1337	Kassier Road/MR559	Kassier Road	Right	4	2.76	0.29	1269.58	A								
1385	1359	1310	1385-1359-1310	Kassier Road/MR559	MR559	Left	33	36.91	17.99	183.31	D	197	37.19	23.42	839	D			
1385	1359	1337	1385-1359-1337	Kassier Road/MR559	MR559	Thru	0	35.94	0.02	150.36	D								
1385	1359	1382	1385-1359-1382	Kassier Road/MR559	MR559	Right	164	37.43	32.35	506.68	D								
1310	1359	1337	1310-1359-1337	Kassier Road/MR559	J B McIntosh Drive	Left	5	2.57	0.31	1613.42	A	116	3.36	4.04	2915	A			
1310	1359	1382	1310-1359-1382	Kassier Road/MR559	J B McIntosh Drive	Thru	78	2.67	6.09	1277.32	A								
1310	1359	1385	1310-1359-1385	Kassier Road/MR559	J B McIntosh Drive	Right	40	4.89	6.38	624.44	A								
1337	1359	1382	1337-1359-1382	Kassier Road/MR559	Access	Left	10	35.07	8.57	121.04	D	12	35.88	2.59	446	D			
1337	1359	1385	1337-1359-1385	Kassier Road/MR559	Access	Thru	1	35.07	0.95	110.85	D								
1337	1359	1310	1337-1359-1310	Kassier Road/MR559	Access	Right	0	35.57	0.06	214.48	D								
1339	1344	1349	1339-1344-1349	Kassier Road/N3 westbound	Kassier Road (north)	Thru	2238	13.93	67.98	3291.64	B	2254	14.19	66.27	3402	B	16.72	65.65	B
1339	1344	1332	1339-1344-1332	Kassier Road/N3 westbound	Kassier Road (north)	Right	17	48.16	15.26	110.46	D								
1353	1344	1349	1353-1344-1349	Kassier Road/N3 westbound	N3 westbound off-slip	Left	579	26.87	61.09	947.26	C	974	29.63	65.36	1490	C			
1353	1344	1339	1353-1344-1339	Kassier Road/N3 westbound	N3 westbound off-slip	Right	395	30.74	72.80	542.50	C								
1349	1344	1339	1349-1344-1339	Kassier Road/N3 westbound	Kassier Road (south)	Thru	637	12.46	47.06	1352.90	B	2977	14.42	65.28	4561	B			
1349	1344	1332	1349-1344-1332	Kassier Road/N3 westbound	Kassier Road (south)	Left	2341	14.95	72.97	3207.63	B								
1319	1328	1342	1319-1328-1342	Kassier Road/N3 eastbound	Kassier Road (north)	Left	129	19.84	25.48	505.54	B	1661	22.32	57.61	2883	C	21.79	57.91	C
1319	1328	1335	1319-1328-1335	Kassier Road/N3 eastbound	Kassier Road (north)	Thru	1532	22.61	64.44	2377.87	C								
1335	1328	1319	1335-1328-1319	Kassier Road/N3 eastbound	Kassier Road (south)	Thru	2199	15.76	68.87	3192.00	B	2736	19.99	63.29	4322	B			
1335	1328	1342	1335-1328-1342	Kassier Road/N3 eastbound	Kassier Road (south)	Right	537	37.28	47.52	1130.22	D								
1305	1328	1319	1305-1328-1319	Kassier Road/N3 eastbound	N3 eastbound off-slip	Left	0	21.78	0.00	161.00	C	722	27.44	44.20	1634	C			
1305	1328	1335	1305-1328-1335	Kassier Road/N3 eastbound	N3 eastbound off-slip	Right	722	27.44	67.32	1072.50	C								
1250	1255	1262	1250-1255-1262	Kassier Road/Cliffdale Road	Kassier Road (north)	Left	9	6.43	2.07	436.87	A	1907	8.65	41.30	4618	A	10.89	42.49	B
1250	1255	1258	1250-1255-1258	Kassier Road/Cliffdale Road	Kassier Road (north)	Thru	1666	6.19	43.49	3831.68	A								
1250	1255	1249	1250-1255-1249	Kassier Road/Cliffdale Road	Kassier Road (north)	Right	232	34.25	66.39	349.21	C								
1262	1255	1258	1262-1255-1258	Kassier Road/Cliffdale Road	Access	Left	1	27.27	0.67	117.09	C	14	34.19	2.96	472	C			
1262	1255	1249	1262-1255-1249	Kassier Road/Cliffdale Road	Access	Thru	0	27.27	0.04	122.29	C								
1262	1255	1250	1262-1255-1250	Kassier Road/Cliffdale Road	Access	Right	13	34.63	5.47	232.16	C								
1258	1255	1249	1258-1255-1249	Kassier Road/Cliffdale Road	Kassier Road (south)	Left	32	7.01	5.61	562.91	A	2213	10.98	54.89	4046	B			
1258	1255	1250	1258-1255-1250	Kassier Road/Cliffdale Road	Kassier Road (south)	Thru	2179	11.03	65.55	3326.07	B								
1258	1255	1262	1258-1255-1262	Kassier Road/Cliffdale Road	Kassier Road (south)	Right	2	18.43	1.03	157.64	B								
1249	1255	1250	1249-1255-1250	Kassier Road/Cliffdale Road	Cliffdale Road	Left	182	30.61	63.20	288.75	C	193	30.43	18.44	1048	C			
1249	1255	1262	1249-1255-1262	Kassier Road/Cliffdale Road	Cliffdale Road	Thru	0	27.23	0.03	320.15	C								
1249	1255	1258	1249-1255-1258	Kassier Road/Cliffdale Road	Cliffdale Road	Right	11	27.41	2.42	439.20	C								
1246	1250	1251	1246-1250-1251	Kassier Road/M13 westbound	Kassier Road (north)	Thru	887	16.44	44.26	2006.47	B	1020	21.84	46.68	2187	C	27.14	62.54	C
1246	1250	1240	1246-1250-1240	Kassier Road/M13 westbound	Kassier Road (north)	Right	133	57.89	72.98	182.20	E								
1257	1251	1255	1257-1251-1255	Kassier Road/M13 westbound	M13 westbound off-slip	Left	1020	33.92	83.04	1228.13	C	1416	31.83	55.73	2541	C			
1257	1250	1246	1257-1250-1246	Kassier Road/M13 westbound	M13 westbound off-slip	Right	396	26.43	30.17	1312.50	C								
1255	1250	1240	1255-1250-1240	Kassier Road/M13 westbound	Kassier Road (south)	Left	50	26.74	29.20	170.55	C	2375	26.63	81.44	2916	C			
1255	1250	1246	1255-1250-1246	Kassier Road/M13 westbound	Kassier Road (south)	Thru	2325	26.63	84.68	2745.41	C								
1239	1243	1213	1239-1243-1213	Kassier Road/M13 eastbound	Kassier Road (north)	Left	179	34.57	38.33	467.00	C	1146	36.71	56.06	2083	D	23.61	58.58	C
1239	1243	1246	1239-1243-1246	Kassier Road/M13 eastbound	Kassier Road (north)	Thru	967	37.11	59.89	1615.00	D								
1246	1243	1239	1246-1243-1239	Kassier Road/M13 eastbound	Kassier Road (south)	Thru	1677	10.21	63.80	2628.34	B	2721	16.59	64.23	4236	B			
1246	1243	1253	1246-1243-1253	Kassier Road/M13 eastbound	Kassier Road (south)	Right	1044	26.82	64.93	1607.83	C								
1237	1243	1239	1237-1243-1239	Kassier Road/M13 eastbound	M13 eastbound off-slip	Left	230	41.86	61.85	371.25	D	283	40.98	36.94	766	D			
1237	1243	1246	1237-1243-1246	Kassier Road/M13 eastbound	M13 eastbound off-slip	Right	53	37.16	13.46	393.75	D								
1230	1218	1222	1230-1218-1222	Kassier Road/Alverstone Road	Kassier Road (north)	Left	17	6.19	2.34	730.27	A	973	6.78	27.31	3564	A	10.56	37.98	B
1230	1218	1212	1230-1218-1212	Kassier Road/Alverstone Road	Kassier Road (north)	Thru	912	6.19	35.69	2555.90	A								
1230	1218	1204	1230-1218-1204	Kassier Road/Alverstone Road	Kassier Road (north)	Right	44	19.33	15.82	277.71	B								
1222	1218	1212	1222-1218-1212	Kassier Road/Alverstone Road	Hospital Access	Left	147	36.17	62.48	235.02	D	191	35.87	37.34	513	D			
1222	1218	1204	1222-1218-1204	Kassier Road/Alverstone Road	Hospital Access	Thru	0	41.09	0.00	54.63	D								
1222	1218	1230	1222-1218-1230	Kassier Road/Alverstone Road	Hospital Access	Right	44	34.85	19.83	222.17	C								
1212	1218	1204	1212-1218-1204	Kassier Road/Alverstone Road	Kassier Road (south)	Left	0	8.27	0.02	400.36	A	1761	8.23	51.09	3446	A			
1212	1218	1230	1212-1218-1230	Kassier Road/Alverstone Road	Kassier Road (south)	Thru	1654	8.27	64.20	2575.49	A								
1212	1218	1222	1212-1218-1222	Kassier Road/Alverstone Road	Kassier Road (south)	Right	107	7.61	22.77	469.99	A								
1204	1218	1230	1204-1218-1230	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Left	22	33.41	9.69	227.40	C	99	40.17	22.45	441	D			
1204	1218	1222	1204-1218-1222	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Thru	1	33.41	9.69	12.59	C								
1204	1218	1212	1204-1218-1212	Kassier Road/Alverstone Road	Kassier Road/Alverstone Road	Right	76	42.24	37.68	200.96	D								
1475	1479	1481	1475-1479-1481	Kassier Road/R103	R103 (west)	Thru	496	13.36	26.50	1872.00	B	716	21.61	29.76	2406	C	22.83	47.98	C
1475	1479	1471	1475-1479-1471	Kassier Road/R103	R103 (west)	Right	220	40.25	41.17	533.73	D								
1481	1479	1471	1481-1479-1471	Kassier Road/R103	R103 (east)	Left	969	19.79	36.30	2394.00	B	1904	22.31	49.19	3870	C			
1481	1479	1475	1481-1479-1475	Kassier Road/R103	R103 (east)	Thru	1935	24.43	70.12	1476.00	C								
1471	1479	1475	1471-1479-1475	Kassier Road/R103	Kassier Road	Left	488	17.84	55.34	882.00	B	1523	24.04	64.57	2358	C			
1471	1479	1481	1471-1479-1481	Kassier Road/R103	Kassier Road	Right	1034	26.97	70.09	1476.00	C								
1523	1521	1520	1523-1521-1520	Shongweni Road/M13 Westbound	Shongweni Road (north)	Thru	6	0	0	1303	A	497	2.99	16.16	3078	A	8.19	16.23	A
1523	1521	1515	1523-1521-1515	Shongweni Road/M13 Westbound	Shongweni Road (north)	Right	491	3	28	1774	A								
1567	1521	1520	1567-1521-1520	Shongweni Road/M13 Westbound	M13 westbound off-slip	Left	4	3	1	285	A	669	12.16	64.33	1040	B			
1567	1521	1523	1567-1521-1523	Shongweni Road/M13 Westbound	M13 westbound off-slip	Right	666	12	84	795	B								
1520	1521	1515	1520-1521-1515	Shongweni Road/M13 Westbound	Shongweni Road (south)	Left	1	0	0	1793	A	8	0.00	0.22	3592	A			
1520	1521	1523	1520-1521-1523	Shongweni Road/M13 Westbound	Shongweni Road (south)	Thru	7	0	0	1799	A								
1533	1543	1548	1533-1543-1548	Shongweni Road/M13 Eastbound	Shongweni Road (north)	left	211	3	11	1894	A	704	12.57	26.02	2704	B	17.87	31.77	B
1525	1530	1532	1525-1530-1532	Shongweni Road/M13 Eastbound	Shongweni Road (north)	Thru	493	17	61	810	B								
1534	1532	1528	1534-1532-1528	Shongweni Road/M13 Eastbound	M13 eastbound off-slip	Left	5	4	0	1176	A	650	19.91	32.77	1983	B			
1540	1530	1525	1540-1530-1525	Shongweni Road/M13 Eastbound	M13 eastbound off-slip	Right	645	20	80	808	B								
1532	1530	1525	1532-1530-1525	Shongweni Road/M13 Eastbound	Shongweni Road (south)	Thru	6	19	82	919	B	499	22.70	43.59	1144	C			
1532	1530	1543	1532-1530-1543	Shongweni Road/M13 Eastbound	Shongweni Road (south)	Right	493	23	2	334	C								
1349	1700	2064	1349-1700-2064	Kassier Road/Northern Access	Kassier Road (north)	Left	2295	3.00	40.26	5699.96	A	2816	8.62	44.78	6289	A	13.46	52.02	B
1349	1355	1372	1349-1355-1372	Kassier Road/Northern Access	Kassier Road (north)	Thru	522	32.81	88.55	589.00	C								
1700	1355	1372	1700-1355-1372	Kassier Road/Northern Access	Access Road	Left	15	8.61	3.35	458.94	A	2741	17.63	77.13	3554	B			
1700	1355	1349	1700-1355-1349	Kassier Road/Northern Access	Access Road	Right	2726	17.48	88.07	3094.89	B								
1372	1355	1349	1372-1355-1349	Kassier Road/Northern Access	Kassier Road (south)	Thru	252	25.49	21.37	1179.00	C	252	25.49	19.82	1324	C			
1372	1355	1700	1372-1355-1700	Kassier Road/Northern Access	Kassier Road (south)	Right	0	85.13	0.00	140.67	D								

Appendix D

SANRAL Interim Kassier Road/N3 Interchange Design



Appendix E

SATURN Model Calibration and Validation Report

Tongaat Hulett

Shongweni SATURN Model Update

Calibration and Validation Report

Rep/01

Issue | 18 March 2013

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Contents

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1 Introduction

In 2007 Arup Pty (Ltd) were appointed Tongaat Hulett Developments to develop a SATURN Traffic Simulation Model to assess the future impact on the road network of the Shongweni development.

The outcome from the modelling was that a number of road upgrades were required in order for the road network to cope with the expected traffic volumes from the development. These road improvements were as follows:

- An additional two bridges within the development over the N3;
- The R103/Kassier Road intersection is upgraded;
- The N3 interchange is upgraded to allow two lanes per direction across the bridge, as well as right turning lanes at each ramp terminal; and
- The N3 ramp terminals are signalised.

Since the modelling was first undertaken in 2007/2008 there have been a number of changes to the scheme and the Shongweni Local Area Plan has been issued. As a result of this, Tongaat Hulett have appointed Arup Pty (Ltd) to update the model using the latest land uses from Tongaat Hulett and to test the impact on the road network of not constructing the two additional bridges over the N3. The model would also then be used in assessing individual sites for the Traffic Impact Assessment.

2 Traffic Model

As stated above a SATURN model was developed in 2007 in order to assess the impact that the proposed development at Shongweni would have on the surrounding road network and the upgrades required to accommodate the development.

As part of this study the 2007 was calibrated and validated to ensure accuracy between the modelled outcomes and real life outcomes. The results of this can be seen in "Model Development and Forecasting Report" (2009).

2.1 Network Model Updates

As part of the work the first stage was to ensure that the model was upto date with regards to intersection layouts. It became obvious that there had been changes to some of the intersections and these would need to be updated in the model. The intersections changed were as follows:

- Intersection of Kassier Road/Alverstone Road;
- Kassier Road/M13 interchange; and
- Shongweni Road/M13 interchange.

For the intersections of Kassier Road/Alverstone Road and Kassier Road/M13 interchange these have been upgraded to signal control as in the 2007 model these were under priority control. For the Shongweni Road/M13 interchange a westbound off-ramp has been constructed since the original model was developed.

These have been the only changes to the network since the original model was developed in 2007.

2.2 Zonal System Updates

No updates to the zonal system have been made for the updated model.

2.3 Matrix Updates

The 2007 model originally modelled the AM peak only as the original purpose of the model was as a planning tool to indicate the infrastructure required.

As part of the process of updating the model counts were carried out at various intersections in the 2012 for the AM peak. The purpose of these counts was to allow the matrix to be updated to 2012. Originally the updated model was to undertaken to determine if the upgrades indicated in 2007, in particular the two additional bridges, were required with the revised land uses.

After this initial assessment the decision was taken to use the model to undertake the Traffic Impact Assessment for sites 1, 2 and 3. In light of this a PM matrix had to be developed so additional PM peak counts were undertaken to help with this process.

The outcome of this was a 2012 AM and PM base matrix for use in the model.

2.3.1 AM Peak Matrix Development

Development of the AM peak matrix involved four steps and these are outlined below:

- Use the traffic counts to develop the trip ends;
- Distribute these around the zones using the distribution from the eThekwini Emme2 model;
- Furness the matrix to get the distribution;
- Carry out a logic test using the traffic counts to determine that the distribution within the matrix is logical; and
- Furness the revised matrix.

The traffic counts were carried out at specific locations that would allow the trip ends for various zones to be determined. The logic tests were carried out to ensure that the distribution the furnessing process came up with is logical.

2.3.2 PM Peak Matrix Development

For the PM peak matrix the following process was followed:

- Use the traffic counts to develop the trip ends;
- Use the trip distribution from the AM peak matrix inverted;
- Furness the matrix;
- Use the PM peak counts to carry out logic tests; and
- Furness the revised matrix.

2.4 Speed Flow-Relationships

These relationships govern the relationship between the traffic demand, road speed limits and speed at capacity, road capacity and the resulting speeds and delays experienced by vehicles on the network. The relationships are typically developed through empirical observation. The curves used in the model are shown in **Table 1**.

Table 1: Speed Flow Curves used in the SATURN Model

Speed (kph)		Capacity (PCUs/hr)	Power	Index
Free Flow	At Capacity			
120	80	2100	6.2	111
120	80	4200	6.2	112
120	80	6300	6.2	113
120	80	8400	6.2	114
100	70	1900	5.5	121
100	70	3800	5.5	122
100	70	5700	5.5	123
80	60	1800	4.5	131
80	60	3600	4.5	132
80	60	5400	4.5	133
80	20	1800	3.0	141
80	20	3600	3.0	142
80	20	5400	3.0	143
60	30	1500	3.5	211
60	30	3000	3.5	212
60	30	4500	3.5	213
60	20	1500	2.0	221
60	20	3000	2.0	222
60	20	4500	2.0	223
40	20	600	2.1	321
40	20	1200	2.1	322
40	20	1800	2.2	323

The column marked ‘index’ in **Table 1** refers to the code SATURN uses to associate each link with a given curve.

Journey time validation on key routes indicated that these curves are still suitable for the model and reflected current conditions in the study area.

3 Model Calibration and Validation

The model calibration and validation consists of two components and these are as follows:

- Validation of the traffic count data i.e. by means of a comparison of the observed and modelled traffic counts; and
- Comparison of observed and modelled journey times over three set routes.

3.1 Model Calibration and Validation Critera

When carrying out the calibration and validation of the model a number of criteria have to be meet in order to accept the model. The criteria used in this project are from Great Britain's Design Manual for Roads and Bridges (DMRB)[1] and these can be seen in **Table 2** below.

Table 2: Calibration and Validation Criteria from the DMRB

Criteria and Measures	Acceptability Guidelines
Assigned hourly flows compared with observed flows	>85% of all cases
Individual flows within 15% for flows 700 – 2700 vph	
Individual flows within 100 vph for flows <700 vph	
Individual flows within 400vph for flows >2700 vph	
Total screenline flows (normally >5 links) to be within 5%	All (or nearly all screenlines)
GEH statistic	>85% of all cases
Individual flows GEH <5 Screenlink totals GEH <4	
Modelled journey times compared with observed times	
Times within 15% (or 1 minute if higher)	>85% of all cases

3.1.1 Model Count Validation

As stated above one of the ways to calibrate and validate a model is to compare the observed and modelled traffic counts to ensure that the results are within a certain range. The range can be seen in **Table 2** above.

The results of the traffic count validation for the AM and PM peak models can be seen in **Table 3** and **Table 4** respectively.

[1] Design Manual for Roads and Bridges, Volume 12 Traffic Appraisal of Road Schemes, Section 2 Part 1; Traffic Appraisal in Urban Areas.

Table 3: Validation Results for the AM Peak Model

Intersection	Arm	Movement	Observed	Modelled	Difference	GEH	Validated
M13/Kassier Road north interchange	Kassier Road (north)	Left	336	369	33	1.78	Yes
		Straight	704	731	27	0.99	Yes
	Kassier Road (south)	Straight	551	571	20	0.84	Yes
		Right	271	238	-32	2.07	Yes
	M13 eastbound off-ramp	Left	140	175	35	2.80	Yes
		Right	12	37	25	5.00	Yes
M13/Kassier Road south interchange	Kassier Road (north)	Straight	520	611	91	3.81	Yes
		Right	172	157	-17	1.20	Yes
	M13 westbound off-ramp	Left	200	234	34	2.33	Yes
		Right	295	299	4	0.20	Yes
	Kassier Road (south)	Left	28	30	2	0.37	Yes
		Straight	558	510	-47	2.06	Yes
Kassier Road/Cliffdale Road	Kassier Road (north)	Straight	703	702	0	0.04	Yes
		Right	88	92	4	0.37	Yes
	Kassier Road (south)	Left	21	7	-13	3.79	Yes
		Straight	417	348	-68	3.51	Yes
	Cliffdale Road	Left	131	139	8	0.67	Yes
		Right	34	25	-8	1.66	Yes
N3/Kassier Road north interchange	Kassier Road (north)	Left	580	543	-36	1.56	Yes
		Straight	253	195	-57	3.86	Yes
	Kassier Road (south)	Straight	411	361	-49	2.54	Yes

	N3 eastbound off-ramp	Right	177	169	-7	0.59	Yes
		Left	11	5	-5	2.08	Yes
		Right	38	68	26	3.70	Yes
N3/Kassier Road south interchange	Kassier Road (north)	Straight	253	258	5	0.33	Yes
		Right	18	1	-16	5.33	No
	N3 westbound off-ramp	Left	43	23	-19	3.54	Yes
		Right	114	166	52	4.40	Yes
	Kassier Road (south)	Left	89	95	6	0.60	Yes
		Straight	428	364	-63	3.20	Yes
Kassier Road/Mr559	Kassier Road (north)	Left	198	181	-16	1.27	Yes
		Straight	112	98	-13	1.36	Yes
	Mr559	Left	10	17	7	1.93	Yes
		Right	374	366	-7	0.42	Yes
	Kassier Road (south)	Straight	92	92	0	0.05	Yes
		Right	6	8	2	0.88	Yes
Kassier Road/R102	R102 (east)	Left	391	421	30	1.49	Yes
		Straight	556	556	0	0	Yes
	Kassier Road (south)	Left	209	230	21	1.43	Yes
		Right	270	273	3	0.21	Yes
	R102 (west)	Straight	726	726	0	0	Yes
		Right	431	456	25	1.19	Yes
M13/Shongweni Road north interchange	Shongweni Road (north)	Left	448	437	-10	0.51	Yes
		Straight	343	364	21	1.13	Yes

	M13 eastbound off-ramp	Left	3	1	-1	1.49	Yes
		Right	191	192	1	0.07	Yes
	Shongweni Road (south)	Straight	349	317	-31	1.73	Yes
		Right	7	0	-6	3.74	Yes
M13/Shongweni Road south interchange	Shonweni Road (north)	Straight	5	1	-3	2.33	Yes
		Right	357	364	7	0.38	Yes
	M13 westbound off-ramp	Left	0	0	0	0	
		Right	358	317	-40	2.21	Yes
	Shongweni Road (south)	Left					
		Straight	358	317	-40	2.21	Yes

Table 4: Validation Results for the PM Peak Model

Intersection	Arm	Movement	Observed	Modelled	Difference	GEH	Validated
Kassier Road/Mr559	Kassier Road (north)	Left	320	349	29	1.60	Yes
		Straight	94	94	0	0.02	Yes
	Mr559	Left	6	4	-1	0.91	Yes
		Right	134	134	0	0.02	Yes
	Kassier Road (south)	Straight	71	76	5	0.6	Yes
		Right	11	13	2	0.51	Yes
Kassier Road/Alverstone Road	Kassier Road (north)	Left	14	14	0	0	Yes
		Straight	372	373	1	0.03	Yes
		Right	14	14	0	0.0	Yes
	Hospital Access	Left	80	80	0	0.01	Yes

		Straight					
		Right	36	36	0	0.02	Yes
	Kassier Road (south)	Left	108	77	-30	3.19	
		Straight	732	754	22	0.81	Yes
		Right	31	32	1	0.15	Yes
	West arm	Left	18	18	0	0.02	Yes
		Straight	1	1	0	0.0	Yes
		Right	62	62	0	0.02	Yes
Kassier Road/Cliffdale Road	Kassier Road (north)	Straight	441	426	-14	0.71	Yes
		Right	164	172	8	0.64	Yes
	Kassier Road (south)	Left	27	27	0	0.02	Yes
		Straight	474	477	3	0.16	Yes
	Cliffdale Road	Left	138	139	1	0.5	Yes
		Right	9	9	0	0.02	Yes
Kassier Road/J B Mcintosh Drive	Kassier Road (north)	Straight	59	59	0	0	Yes
		Right	32	32	0	0.01	Yes
	Kassier Road (south)	Left					
		Straight	45	45	1	0.08	Yes
	J B Mcintosh Drive	Left	39	39	0	0.04	Yes
		Right	5	5	0	0	Yes
Kassier Road/M13 North Interchange	Kassier Road (north)	Left	206	147	-58	4.44	Yes
		Straight	379	377	-1	0.10	Yes
	Kassier Road (south)	Straight	748	717	-30	1.14	Yes

		Right	192	198	6	0.42	Yes
	M13 eastbound off-ramp	Left	188	188	0	0.03	Yes
		Right	38	38	0	0.03	Yes
Kassier Road/M13 South Interchange	Kassier Road (north)	Straight	304	306	2	0.10	Yes
		Right	109	109	0	0.01	Yes
	M13 westbound off-ramp	Left	300	300	0	0.02	Yes
		Right	324	325	1	0.04	Yes
	Kassier Road (south)	Left	36	36	0	0.04	Yes
		Straight	572	590	18	0.75	Yes
Shongweni Road/M13 north interchange	Shongweni Road (north)	Left	173	173	0	0	Yes
		Straight	185	182	-2	0.23	Yes
	M13 eastbound off-ramp	Left	4	4	0	0.2	Yes
		Right	223	224	1	0.08	Yes
	Shongweni Road (south)	Straight	566	546	-19	0.83	Yes
		Right	5	5	0	0	Yes
Shongweni Road/M13 south interchange	Shongweni Road (north)	Straight	5	5	0	0	Yes
		Right	181	181	0	0.01	Yes
	M13 westbound off-ramp	Left	3	3	0	0	Yes
		Right	546	546	0	0	Yes
	Shongweni Road (south)	Left	1	1	0	0	Yes
		Straight	7	5	-1	0.61	Yes
Kassier Road/N3 north interchange	Kassier Road (north)	Left	100	106	6	0.56	Yes
		Straight	309	327	18	1.01	Yes

	Kassier Road (south)	Straight	497	499	2	0.08	Yes
		Right	27	27	0	0	Yes
	N3 eastbound off-ramp	Left	14	6	-7	2.66	Yes
		Right	73	73	0	0	Yes
Kassier Road/N3 south interchange	Kassier Road (north)	Straight	359	382	23	1.18	Yes
		Right	18	18	0	0.10	Yes
	N3 westbound off-ramp	Left	63	64	1	0.18	Yes
		Right	323	324	1	0.05	Yes
	Kassier Road (south)	Left	17	17	0	0	Yes
		Straight	213	202	-10	0.77	Yes
Kassier Road/R102	R102 (east)	Left	460	462	2	0.07	Yes
		Straight	849	849	0	0	Yes
	Kassier Road	Left	315	322	7	0.37	Yes
		Right	440	437	-2	0.14	Yes
	R102 (west)	Straight	407	407	0	0	Yes
		Right	146	146	0	0.03	Yes
Mr559/Mr461	Mr559 (east)	Left	7	7	0	0	Yes
		Straight	61	71	10	1.20	Yes
	Mr461	Left	58	67	9	1.20	Yes
		Right	6	6	0	0	Yes
	Mr559 (west)	Straight	276	284	8	0.46	Yes
		Right	77	79	2	0.24	Yes

The results from **Table 3** show that for the AM peak the majority of the links have a GEH of less than five. If the GEH is less than five then it indicates that there is a good match between the observed and modelled traffic flows. In order to show a model is calibrated and validated it is required that 85% of more of the links have a GEH of five or less. For the AM peak it can be seen that only one of the counts has a GEH of five or more and so this model is calibrated satisfactorily.

For the PM peak, **Table 4**, there was an issue with some of the counts having GEH figures greater than five. The issue was that these counts were all in the range of 700-2700 vehicles per hour and because of this the 85% threshold was not being reached. A number of matrix revisions were undertaken in order to rectify this situation, but it was never possible to completely remove these issues. Due to this, the decision was made to use matrix estimation to finalise the matrix and remove these issues. The results of this can be seen in **Table 4** and from this it can be seen that all the counts have a GEH of less than five. The result of this is that the PM peak is calibrated.

3.2 Journey Time Validation

As part of the calibration and validation process three journey time surveys were undertaken in the model area to help with the process of ensuring a realistic model. The three routes chosen were as follows:

- Route 1 - North-south on Kassier Road;
- Route 2 - South from Kassier Road to M13 towards Cato Ridge;
- Route 3 - South from Kassier Road to N3 towards Cato Ridge.

Each of these routes can be seen in **Figure 1**.

For each route a number of runs were undertaken in the AM and PM peak with the time at which they reached key intersections being recorded. From this it would be possible to determine the average time taken to travel between certain points in the network.

As stated in **Table 2**, in order for the model to be calibrated for journey times the modelled time should be within one minute or 15% of the observed time.

Table 5: Journey Time Validation Results for the AM Peak Model

Route	Direction	Observed Time	Modelled Time	Difference		Validated
				Time	Percentage	
Route 1	North-South	9:52	9:43	-9	1.5	Yes
	South-North	9:31	8:33	-58.2	10.2	Yes
Route 2	South-West	6:46	7:07	21.4	5.3	Yes
	West-South	7:29	6:10	1.8	0.5	Yes
Route 3	South-West	6:22	6:03	-19.8	5.2	Yes
	West-South	6:08	06:14	6.5	1.8	Yes

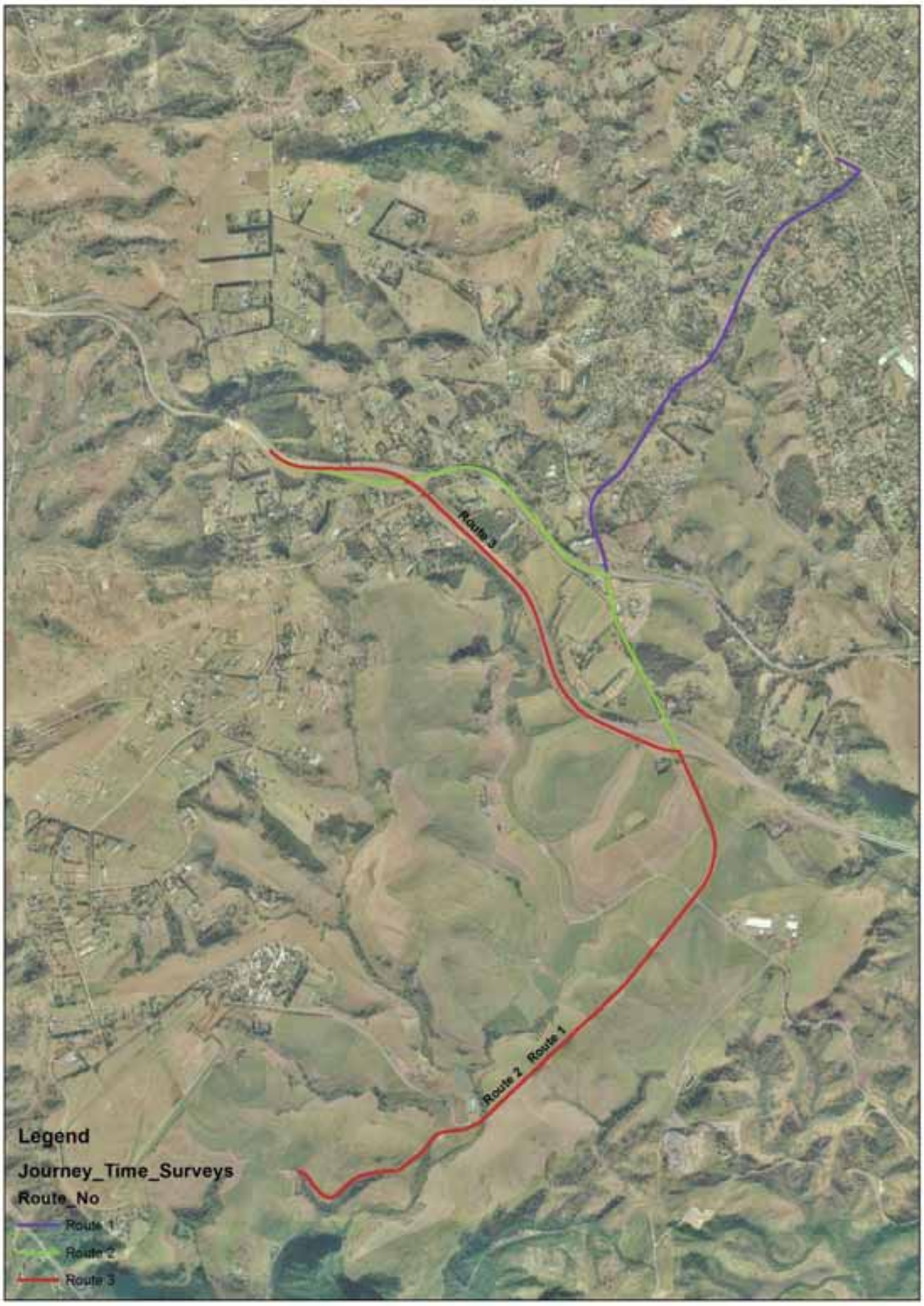
The results from **Table 5** show that for the AM peak all of the journey time surveys they are all within the one minute or 15% of the observed times and as such the AM peak model is calibrated with regards to journey times.

Table 6: Journey Time Validation Results for the PM Peak Model

Route	Direction	Observed Time	Modelled Time	Difference		Validated
				Time	Percentage	
Route 1	North-South	8:50	8:46	-4.4	0.8	Yes
	South-North	9:17	8:39	-39	7.0	Yes
Route 2	South-West	7:10	7:10	0.3	0.1	Yes
	West-South	7:03	6:09	28	8.2	Yes
Route 3	South-West	6:13	6:03	-10.6	2.8	Yes
	West-South	6:22	6:16	-6.7	1.7	Yes

For the PM peak the results of the journey time calibration can be seen in **Table 6** above. The results show that for the PM the difference between the observed and modelled journey times was less than the one minute and the 15% difference as per the criteria laid down in the DMRB. The result is that for the PM peak the journey time surveys are calibrated.

Figure 1: Journey Time Routes



4 Conclusion

The purpose of this report was to outline the updates to the Shongweni model since it was originally developed in 2007 and to show that the model has undergone calibration and validation in regards to these upgrades.

The main upgrades to the model have been as follows:

- Upgrade of the Kassier Road/M13 interchange to signals;
- Upgrade of the Kassier Road/Alverstone Road intersection to signals;
- Construction of a westbound off-ramp at the Shongweni Road/M13 interchange;
- Update of the AM peak matrix to 2012 using traffic counts from 2012 to determine the trip ends; and
- Development of a PM peak matrix using 2012 traffic counts to determine the trip ends.

Following on from these updates, the model was calibrated and validated against traffic counts and journey time surveys.

The results from the calibration and validation of the traffic counts show that for both the AM and PM peak more than 85% of the traffic counts have a GEH of five or less. As the number of traffic counts with a GEH of less than five then it can be said that both the AM and PM peak models are calibrated in relation to the traffic counts.

For the journey time surveys three separate routes were timed during the AM and PM peak periods and from this the average journey times for these was calculated. These were then compared to the modelled journey times from the SATURN model. The results from the journey times surveys showed that for both the AM and PM peak the modelled journey times were within the one minute, or 15% criteria, as set out in the DMRB.

As the AM and PM models have satisfied the criteria for model calibration and validation, as laid down in the DMRB, it can be said that the AM and PM 2012 Shongweni models are calibrated and validated.

APPENDIX 5:

DELINEATION OF 1:100 YEAR FLOODLINE (GOBA)

GOBA
8 Sinembe Crescent
La Lucia Ridge
Durban
4321
Tel: +27 31 583 3400
Fax: +27 31 583 3401

UMHLATUZANA CATCHMENT SEWER REPORT

SIZE: A0	DATE: 26/11/2010	DRAWN BY: MA THERON	TRUNK SEWER ROUTES	LAYOUT NO: 020044/100/005	SCALE: 1 : 5 000

J:\020044 Umhlatuzana Trunk Sewer\Drawings\100

APPENDIX 6:

SERVICES CONFIRMATION

Proof of capacity is to be attached to the Final EIR.

APPENDIX 7:

AGRICULTURAL POTENTIAL OF REM OF ERF 79 ASSAGAY; REM OF PTN 2 OF FARM BOTHA'S HALFWAY HOUSE NO 921, REM OF PTN 24 OF FARM SUMMERVELD NO 14226, REM OF FARM KIRKFALLS NO 14227; FARM SHONGWENI NO 15346 (REPORT 2 OF 2012; REF: CK 94/23110/10/23) (ROY MOTTRAM AND ASSOCIATES CC)

AGRICULTURAL POTENTIAL

of

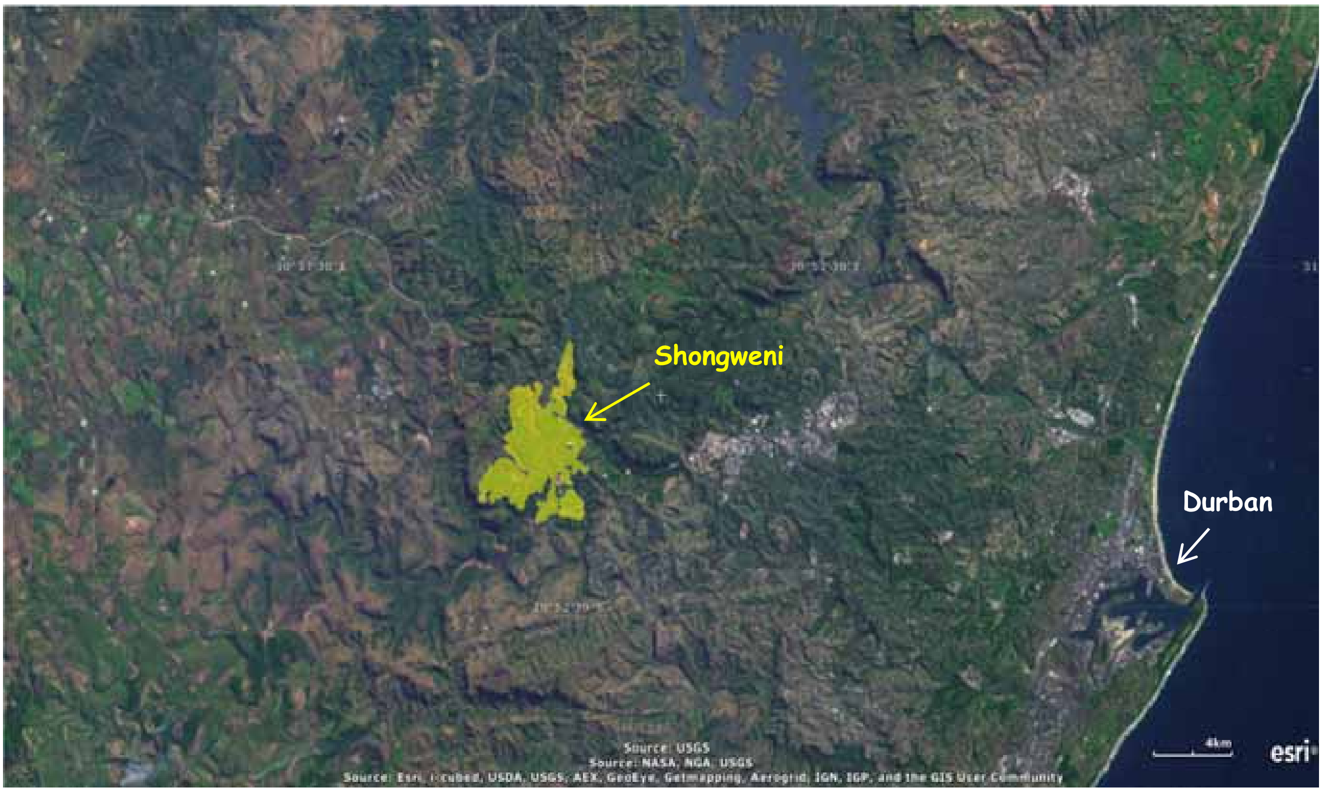
Rem of Erf 79 Assagay; Rem of Ptn 2 of Farm Botha's Halfway House No 921

Rem of Ptn 24 of Farm Summerveld No 14226

Rem of Farm Kirkfalls No 14227; Farm Shongweni No 15346

SHONGWENI

Report 2 of 2012



Mottram and Associates cc

Specialists in Irrigation, Water and Project Management *ck 94/23110/10/23*

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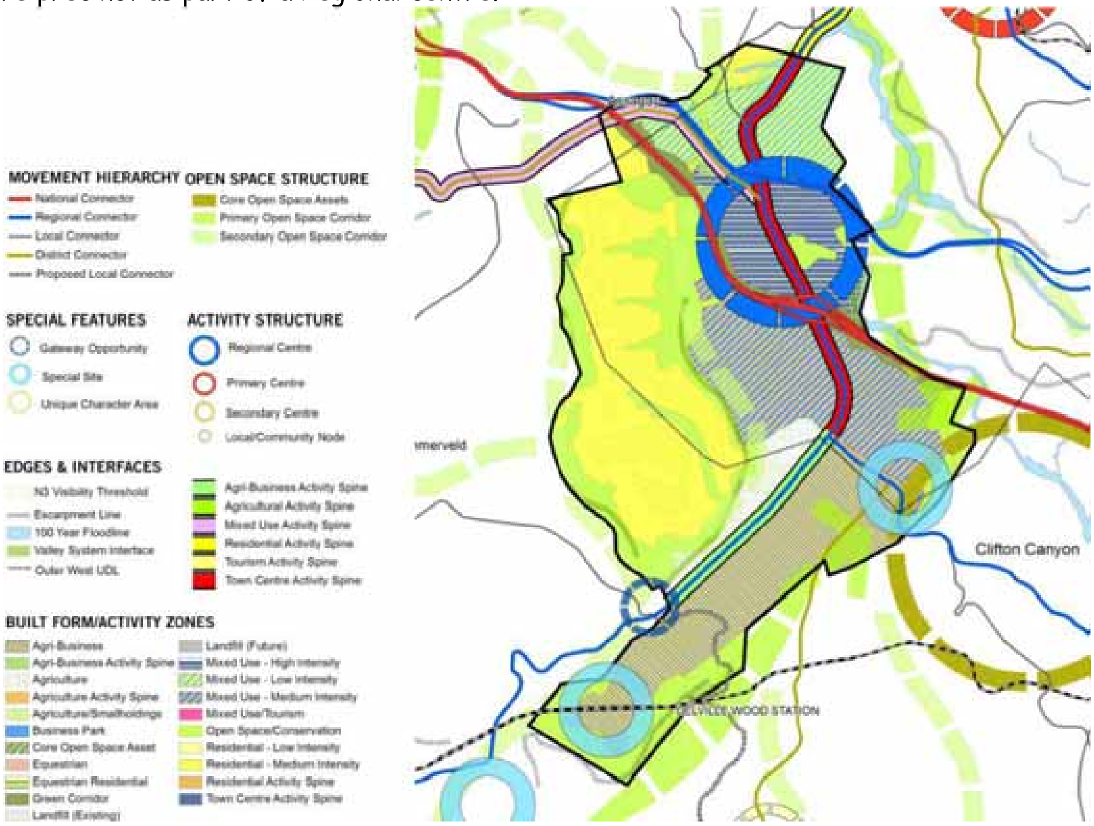
CONTENTS

1 EXECUTIVE SUMMARY

1.1 Planned Expansion of Outer West of eThekwini Municipality

The eThekwini Municipality is South Africa's second most important economic region. The metropolitan city contributes over 60% of KZN's GDP and over 10% of the country's GDP. The National Development Plan published in by the National Planning Commission recognises and have identified the Western (N3) and Northern (N2) corridors for future growth in alignment with both the Provincial and National Government objectives. These corridors provide good access, suitable topography and greenfield opportunities. They are close to existing and new employment and economic opportunities.

The SDF includes that this Western node seeks to exploit opportunities offered by those of eThekwini. The Shongweni properties lie in the eThekwini Municipality. The expansion programme in this node is for agri-business, office and business parks, equestrian centres, mixed use (high, medium and low density), residential (low and medium density, and a town centre precinct as part of a Regional centre.



1.2 Location

The properties, situated along the PC2 eThekwini – Msunduzi - Umgeni Corridor, straddle the N3 south of the M13. They are immediately south of Assagay/Hillcrest and west of Pinetown.

1.3 Infill Development

This outer western node is an important link between eThekwini and Msunduzi. eThekwini's expansion is moving northwards and westwards, and this leads into these properties. There is little doubt that over the next 10 years this corridor will be transformed into a well-connected, compact and intense urban conglomeration serving the greater region.

1.4 Agricultural Assessment

The agricultural potential of these properties has been assessed and the Estate is deemed to have a limited agricultural potential. The sugarcane yields over last nine years have varied between 31 and 45 t ha^{-1} $annum^{-1}$. With current costs and price of sugarcane the economic break-even yield for this Estate is 45 t ha^{-1} $annum^{-1}$.

Yields predicted by Canesim show significantly higher yields, viz. 62 to 92t ha^{-1} $annum^{-1}$ thus verifying the fact that production on this Estate over the past nine years is well below these simulated yields.

The soils on the Estate vary significantly and with no irrigation water available to maximise the benefits of the good soils, good management must be sustained to keep yields at or above this break-even yield. Currently *Eldana* is a problem together with low soil fertility in specific areas.

The inclusion of high value crops with the minimal water available may improve viability on these areas. Elsewhere it would entail the use of municipal water and significant Capex. The Umgeni catchment is stressed with respect to water supply and this will not change in the foreseeable future nor until all the proposed dams are built. This together with municipal rates and rising electricity costs would render such alternatives unviable.

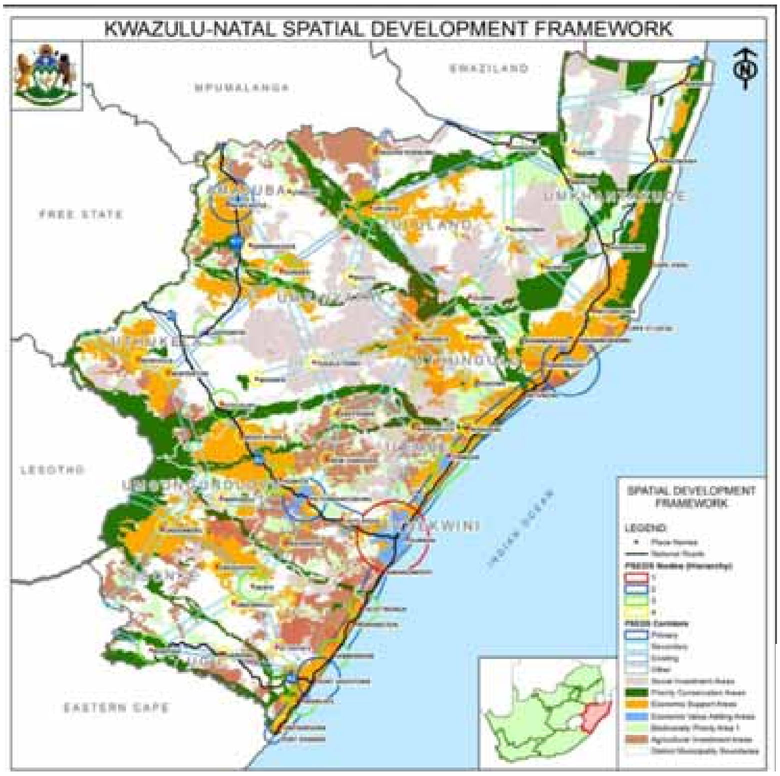
Land capability on these properties vary between Class III and IV due to the limitations that exist, and with respect to agricultural land categories these properties fall within Category C (Ref KZN Agric Report N/A/2012/11).

1.5 Compliance with Provincial Strategic Planning

In terms of the KZN Provincial Spatial Economic Development Strategy (PSEDS) these properties are located in the eThekwini – Msunduzi - Umgeni Corridor (Provincial Corridor PC2). This PSEDS has been adopted by the KwaZulu Natal Cabinet.

Furthermore, the Provincial Planning Commission has recently launched its Provincial Growth and Development Strategy (PGDS) and Plan (PGDP) that provide a clear roadmap towards what is required in order to achieve the Province's key objectives. The PGDS is the primary strategy driving growth and development in the Province and the PGDP the implementation plan. Within this plan there is an explicit recognition of the importance of and the need to promote agriculture and rural development.

The map below illustrates the Provincial SDF and the hierarchy therein. The red outline, Hierarchy 1 includes the property.



The potential for industrial development in the Province is anchored in the nodes of eThekwini and Msunduzi. This will be northwest and west along the N3. This development will require corresponding support for intensive agriculture, intensive mixed use, residential, office and business parks.

Tongaat Hulett being directly involved in both rural and agricultural development as well as urban development, has an approach that is aligned with the PGDS, the PGDP and PSEDS in that it revolves around a strategic focus on agricultural and rural development. This focus is the extensive planting of new areas to sugarcane as an anchoring market guaranteed product.

1.6 Compliance with Municipal Strategic Planning

As part of the IDP-SDF package of plans, the eThekwini Municipality has adopted the Shongweni Local Area Plan (LAP) that deals with a portion of the western corridor. This LAP indicates the intention and desire to create a new mixed use, sub-regional centre on the N3 with some adjacent commercial development. Surrounding this commercial development there is residential and equestrian.

Given the new national Priority Infrastructure Co-ordinating Committee (PICC)'s Strategic Integrated Project 2 (SIP2) that focuses on the corridor between Durban and Gauteng there is no doubt that this corridor will come under increasing pressure, and this will be from the east moving west as the city expands.

It is therefore important that proactive provision be made to enable appropriate and timeous decision making on new land use and development. The Shongweni landholdings are situated at the centre of this identified new growth region and therefore will require conversion from agriculture when the time comes.

All municipal services such as roads, sewerage, electricity and waste disposal have been planned to accommodate the development of these properties.

1.7 Compliance with Local Planning

The Municipal SDF includes these properties as does the Municipal Land Use Management System (LUMS) for high and medium density mixed use, agri-business, low and medium density residential and open space/conservation development from 2015 to 2020. This is in alignment with the above LAP.

1.8 Efficient and Effective Use of Infrastructure and Resources

The properties are extremely well located with respect to existing available and future planned infrastructures as follows:

- eThekwini accommodates an efficient transportation network consisting of the N3, the R103, the M13, D705, P551 and P554 and a series of local access roads
- The main Durban - Johannesburg Rail extends through the length of the municipality
- There exist numerous other public and private transportation services, viz. buses and taxis
- The supply of water to the Municipality has and is being upgraded (Umgeni Water)
- ESKOM has identified various initiatives to upgrade its facilities as the demand unfolds

1.9 Impact on Adjacent Agricultural Uses

Some of the land surrounding these properties is under urban development. In terms of the Provincial and Municipal SDF and IDP future development will be focused in the identified areas within the corridor and should not be allowed to encroach onto surrounding agricultural land, providing that land has good potential. With TH's approach to identifying more suitable land for sugarcane production, the development should not impact negatively on adjacent land. Land up the North Coast of KZN, further inland (westwards and northwards) is being considered.

1.10 Employment and Socio-Economic Benefits

Since the beginning of the twentieth century the contribution of agriculture to the national GDP has decreased significantly, from 20% to below 4%. Development that includes construction and real estate has over this period increased significantly.

The development of these properties will create a large number of employment opportunities and rates' income for the Municipality.

It is reported that on existing holdings (McCarthy & Pringle, 2007), the benefit in conversion from agriculture to development is estimated:

- 50:1 job creation
- 588:1 rates
- 250:1 turnover – contribution to GDP

TH having existing holdings is able to generate economic returns without incurring holding costs. TH are in a position to either acquire other land for new agricultural development and/or structure ownership and conform meaningfully to land reform in the medium term and empowerment in the longer term.

1.11 Impact on Food Security

DAEARD acknowledges TH's commitment to the agricultural sector in South Africa and KwaZulu Natal in particular together with its associated strategies to increase agricultural production whilst creating new and enhanced agricultural opportunities and a potential revenue base for emerging farmers. DAEARD is working with TH and other role players in agricultural, rural and urban development, toward obtaining an understanding of the agricultural potential and future agricultural scenario in the Northern and Western corridors.

The importance of agriculture and food security, a key objective identified by Province in its PGDS and PGDP, has already been incorporated in Tongaat Hulett's strategies and action plans. Currently from a sugar perspective, Tongaat Hulett own 4 sugar mills along the North Coast of KZN and is committed to these operations and the employment they facilitate.

In KZN the land used for sugarcane production has increased over the last 3 years by 17 835ha, an increase of 15% and this includes land taken out for urban development. Thus the impact of urban development on sugarcane production is insignificant.

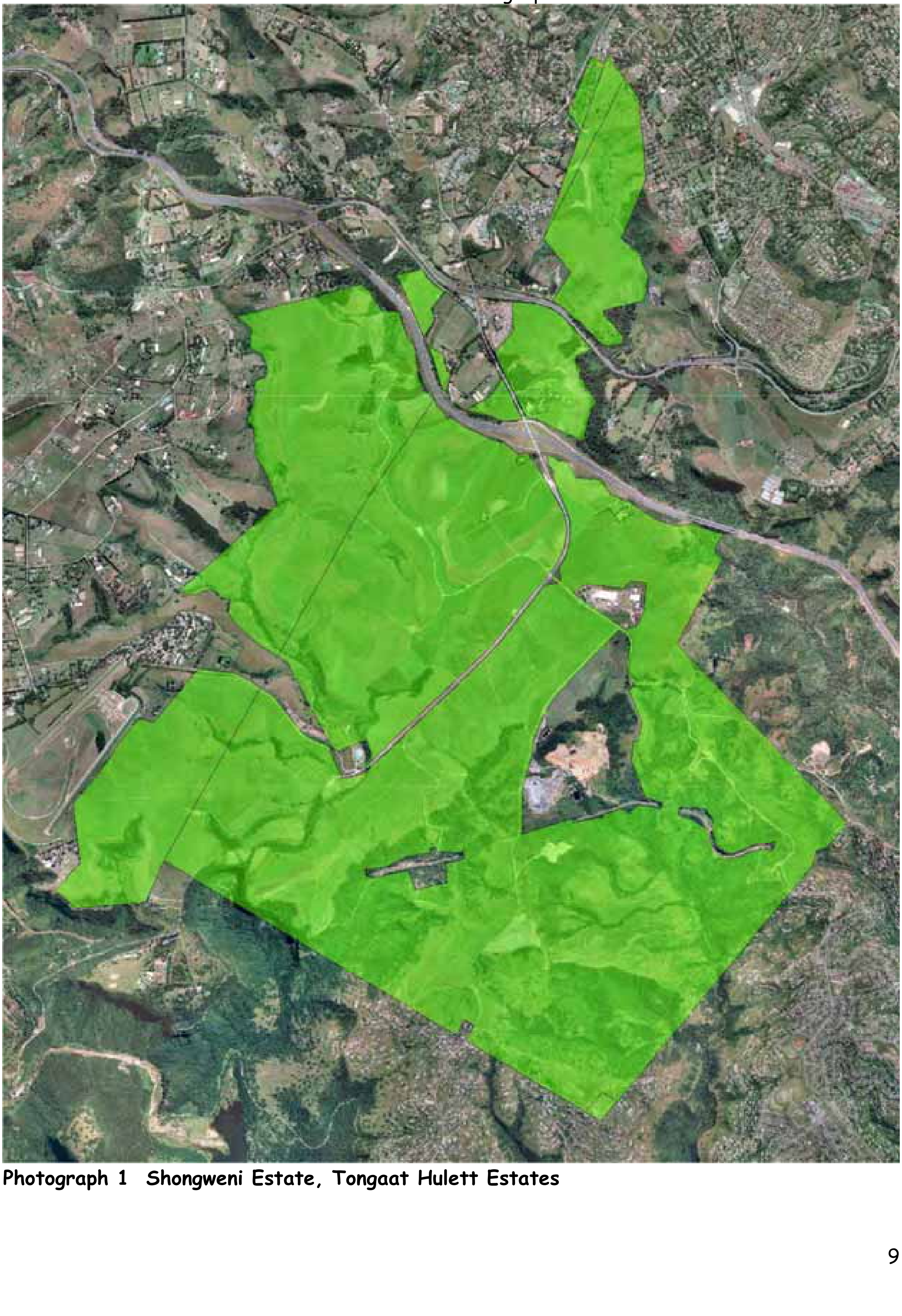
Tongaat Hulett only owns 8% of the total quantum of land that supplies cane to its mills so even a total loss of this 8% is insignificant.

What is very significant is the fact that Tongaat Hulett commenced with new sugarcane areas in 2009 and by the end of the 2012/13 season this will be 9 506ha. In 2013/14 a further 10 000ha is to be identified and developed and 7 000ha in 2014/15. Therefore at the end of 3 years Tongaat Hulett will have developed an additional 26 506ha of new sugarcane land. This together with the existing 17 835ha increment will produce a 44 341ha increase from 2009, and increase of 37%.

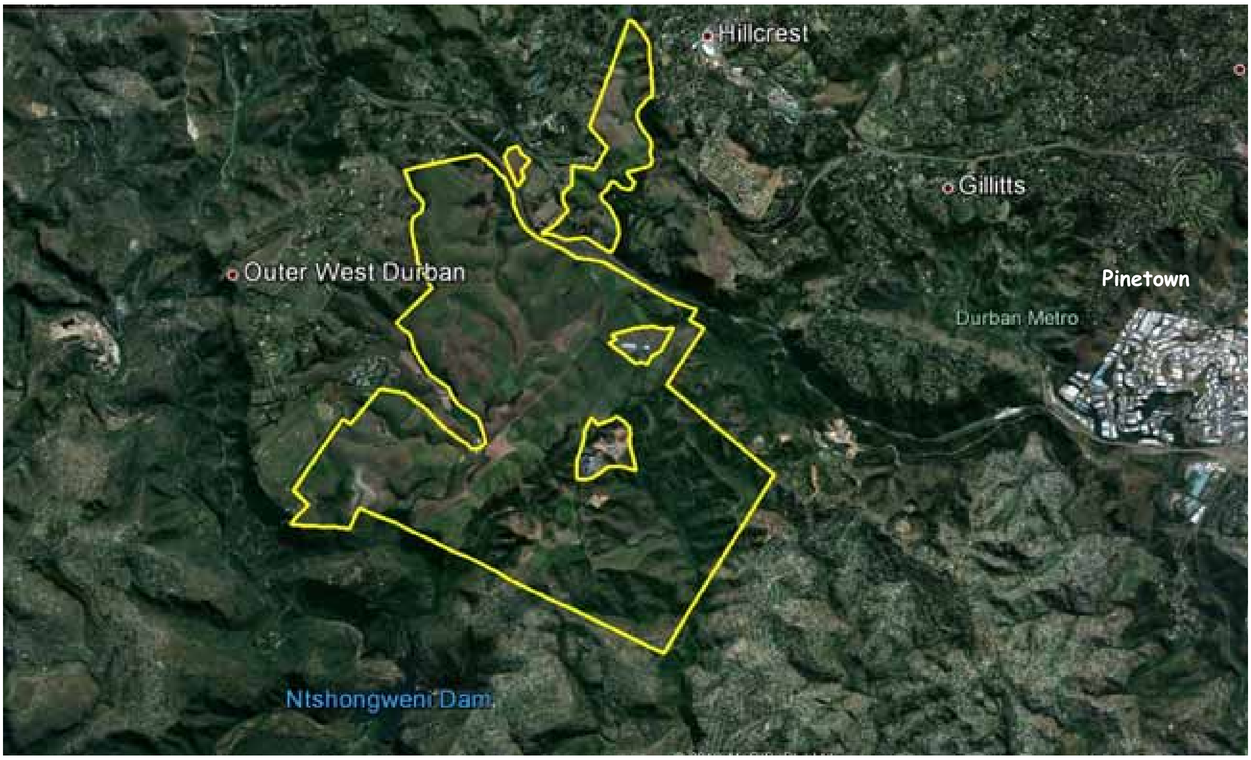
Apart from this fact it is noteworthy that the new areas being developed are in the rural hinterland. This combined with a rural development and food security strategy of new sugarcane development providing an anchor for services, investment, training, etc., allows for other more intensive food related crops to be grown for local consumption.

2 INTRODUCTION

Shongweni Estate is situated astride the N3 west of the Cities of Pinetown and Durban in KwaZulu Natal. Its boundaries are illustrated in Photographs 1 and 2 below.



Photograph 1 Shongweni Estate, Tongaat Hulett Estates



Photograph 2 Satellite Image of Shongweni Estate and Location

Shongweni Estate, hereinafter referred to as the Estate is situated between 700 and 451m above sea level within the following coordinates:

$29^0$46'42.91" S	$30^0$45'11.66" E	$29^0$47'58.20" S	$30^0$44'37.37" E
$29^0$47'42.88" S	$30^0$43'32.39" E	$29^0$48'37.35" S	$30^0$43'31.90" E
$29^0$49'59.94" S	$30^0$42'28.82" E	29^0 50'58.20" S	$30^0$43'45.44" E
$29^0$48'51.55" S	$30^0$45'39.91" E	$29^0$48'11.96" S	$30^0$45'01.86" E
$29^0$47'33.03" S	$30^0$45'20.66" E		

Photograph 3 Production Lands on Shongweni Estate

The Department of Agriculture, Environment Affairs and Rural Development (DAEARD) has acknowledged Tongaat Hulett's (TH) commitment to the agricultural sector in South Africa and KwaZulu Natal in particular together with its associated strategies to increase agricultural production whilst creating new and enhanced agricultural opportunities and a potential revenue base for emerging farmers.

DAEARD also recognises the need from a socio-economic perspective, for new investment and development in growth corridors and would like to ensure that this is appropriately managed. DAEARD is working with TH and other role players in agricultural, rural and urban development, toward obtaining an understanding of the agricultural potential and future agricultural scenario in the Northern and Western corridors.

With respect to the approach on land assessment, namely:

- Assessment of agricultural potential of prime development land in the corridors
- Understanding of where new TH planting is and has been undertaken – from 2009
- Assessment of agricultural potential of land where TH's new areas of planting will occur
- Identification of other land with potential for agriculture – not limited to sugar cane.
- Specific areas in the Ndwedwe area

Tongaat Hulett Developments (TDH) having identified this land for development requested an evaluation of the agricultural potential of Shongweni Estate. In compiling this report previous reports on this Estate have been studied and relevant and pertinent information extracted therefrom for inclusion.

3 SOIL-PLANT-ATMOSPHERE CONTINUUM (SPAC)

A basic soil survey based upon the requirements of DAEARD was carried out and a survey of all the relevant crops that could be cultivated on this land and a selection of the most viable and sustainable crops, was conducted.
A study was made of the Bio Resource Units that exist in this area with respect to climate, terrain, aspect, natural resources and water resources available.

3.1 Soils

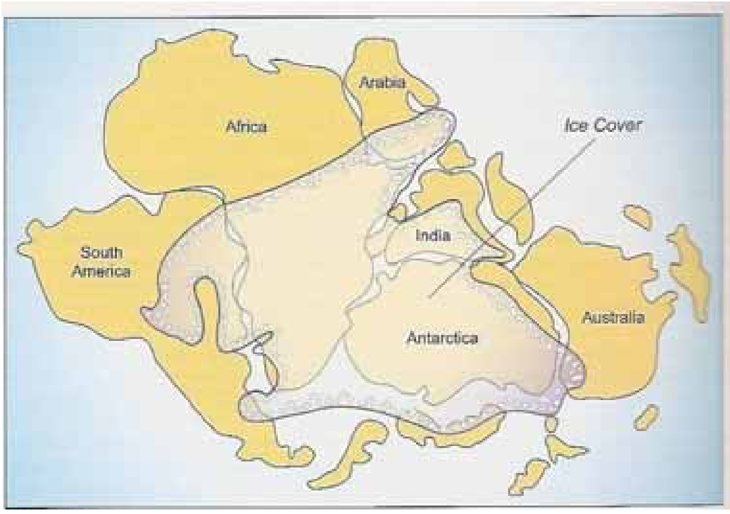


Figure 1 The extent of the ice cover over Godwana during the Great Ice Age

Around 400 million years ago, a glacial event in the Great Ice Age that lasted 50 million years, got underway. Across Godwana, which then sprawled over the southern polar region, vast ice sheets ground over India, nearly all Africa south of the Equator, south eastern South America, Antarctica and Southern Australia, leaving as evidence a thick layer of glacial sediments, known in South Africa as Dwyka Tillite, as they melted?
Dwyka Tillite is defined as accumulated glacial debris that has turned into rock, comprising a jumbled mix of boulders, pebbles, gravel and sand set in a matrix of glacial flour.

The Estate lies toward the southern section of the 'Valley of a Thousand Hills'. Figure 2 (Fig 18) below provides an illustration of geological time and what happened between the Drakensberg in the West and the Sea in the East (Norman and Whitfield, 2006). This starts with the Drakensberg lava into the full sequence of underlying Karoo sandstones, shales and mudstones, invaded by ubiquitous sills of Karoo dolerite. Past Pietermaritzburg there are thick beds of flat-lying Natal sandstone of much older age, while the Valley of a Thousand Hills reveals intrusive granites and metamorphic gneisses around 1 100 million years old, but which are easily eroded.

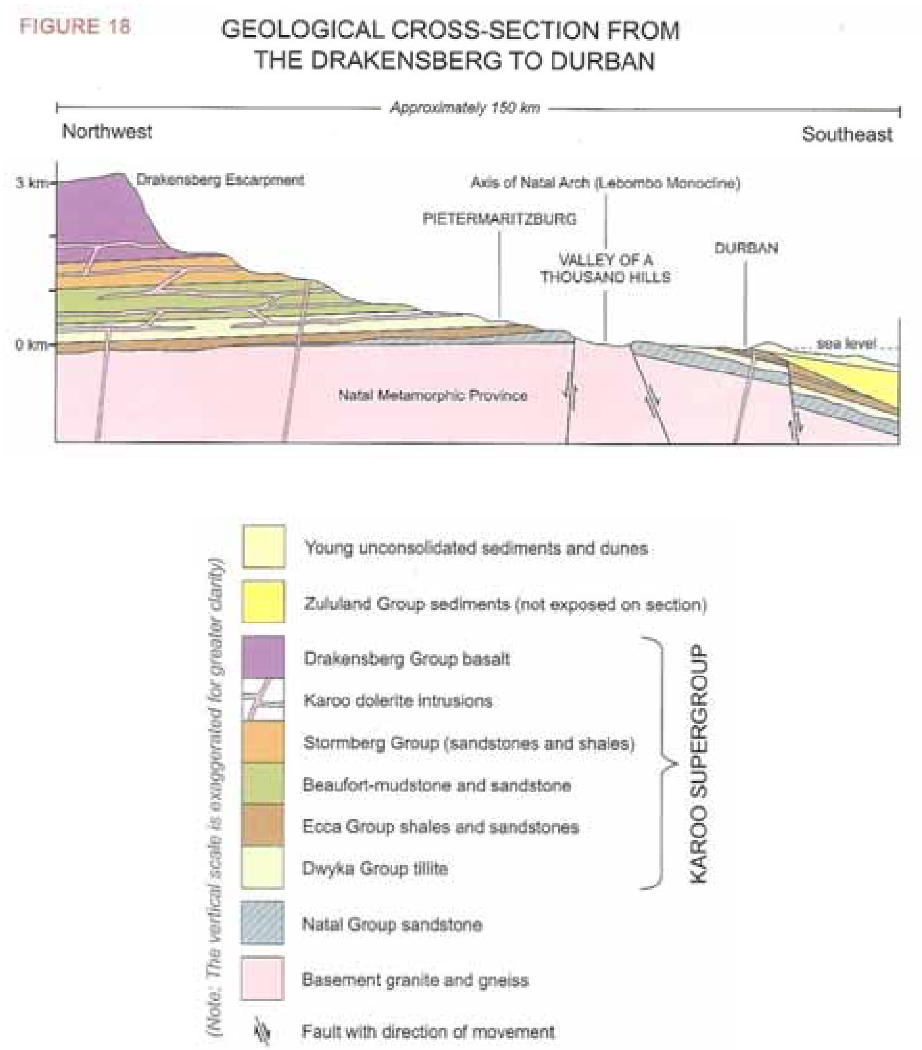


Figure 2 Geology of the areas surrounding the Estate (Norman and Whitfield, 2006)

On the Estate where the N3 goes through there is a prominent hill made of upfaulted, weathered biotite gneiss, part of the granite exposed in the Valley of a Thousand Hills.

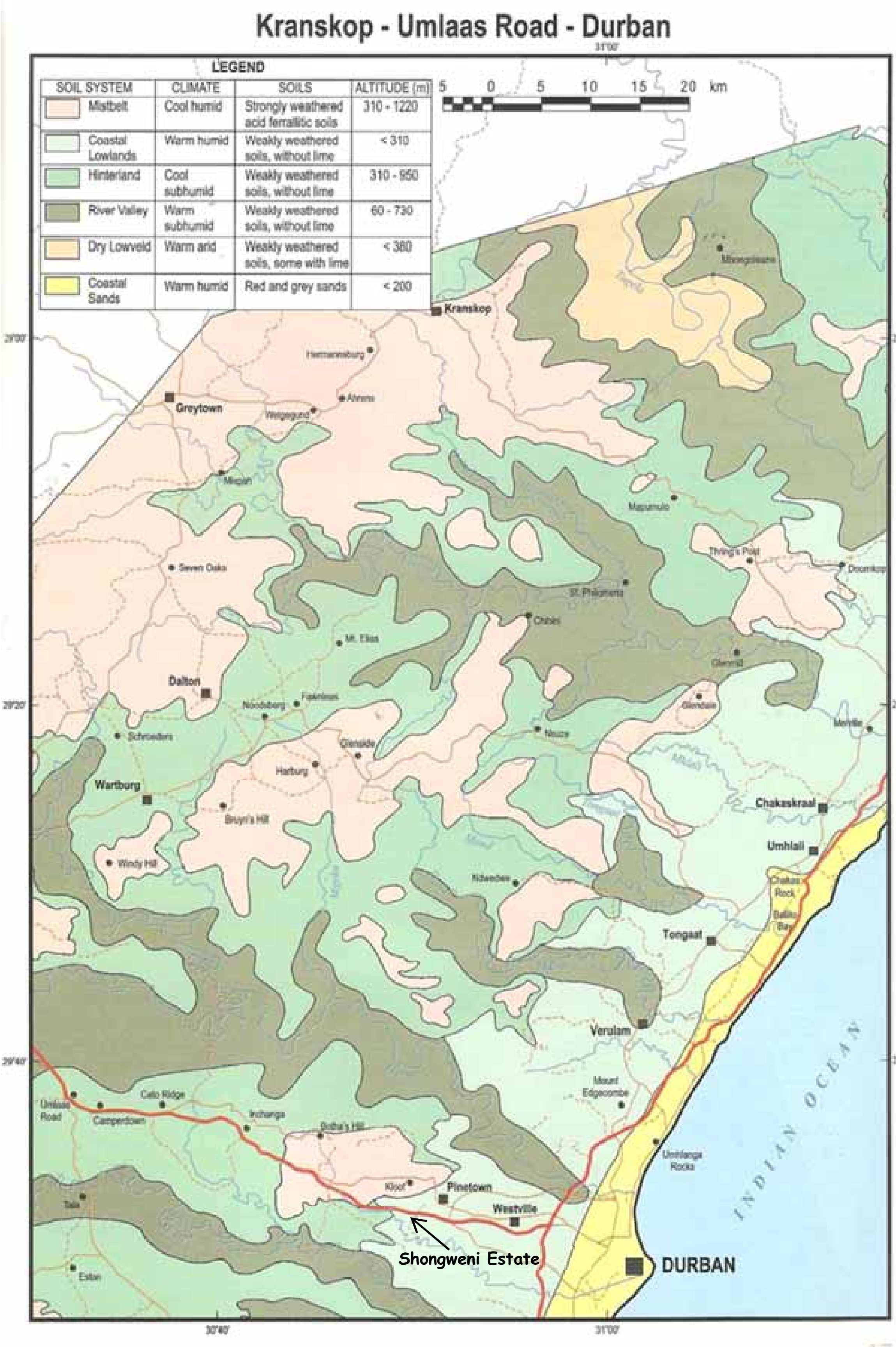


Figure 3 Soils of the South African Sugar Industry in and around the Estate

These hinterland soils on the Estate are predominantly weakly weathered. Table 1 presents the soils found on the Estate.

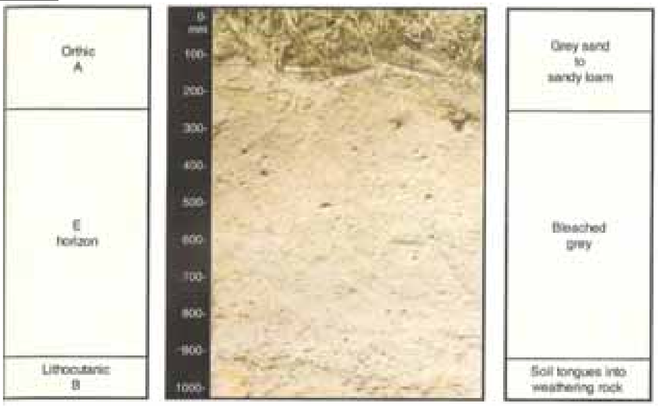
Table 1 Soils and Areas thereof on Shongweni Estate

Block Name	Block No	Soil Form	Area(ha)	Block Name	Block No	Soil Form	Area(ha)
ALBINIA	1	CARTREF	8.00	NTABANKULU	54	CARTREF	12.00
ALBINIA	2	GLENROSA	7.6	MLUNGIS	57	GLENROSA	8.80
ALBINIA	3	CARTREF	6.60	DAM ROAD	58	GLENROSA	10.50
ALBINIA	4	GLENROSA	9.1	DAM ROAD	59	GLENROSA	7.20
ALBINIA	5	CLOVELLY	14.10	TIMOTHYS	60	CARTREF	4.20
ALBINIA	6	GLENROSA	9.60	TIMOTHYS	61	GLENROSA	6.40
ALBINIA	7	GLENROSA	7.10	CATTLE KRAAL	63	CLOVELLY	15.70
ALBINIA	8	GLENROSA	6.90	BARRACKS	64	CLOVELLY	11.70
RESERVOIR	9	CLOVELLY	9.70	PLANGWENI	65	MAGWA	6.30
RESERVOIR	10	GLENROSA	6.80	PLANGWENI	66	CLOVELLY	10.50
VEG GARDEN	11	GLENROSA	7.10	PLANGWENI	67	CLOVELLY	17.60
OFFICE	12	GLENROSA	5.30	NTINGUS	68	CLOVELLY	7.00
HEADQUARTERS	13	MAGWA	3.10	DELVILLEWOOD	69	CLOVELLY	8.50
HILO ROAD	14	MAGWA	13.30	DELVILLEWOOD	70	CLOVELLY	12.40
HILO ROAD	15	NOMANCI	11.70	DELVILLEWOOD	71	CARTREF	6.00
JACKSONS DRIFT	16	MISPAH	11.50	DELVILLEWOOD	72	GLENROSA	13.40
DAM	17	GLENROSA	17.80	DELVILLEWOOD	73	CARTREF	10.10
DAM	18	GLENROSA	9.20	DELVILLEWOOD	74	CARTREF	18.70
MICHAELS	19	GLENROSA	6.20	DELVILLEWOOD	75	CARTREF	15.90
GLENDENING	20	KRANSKOP	14.50	DELVILLEWOOD	76	CARTREF	12.00
MICHAELS	21	KRANSKOP	12.50	BRAESIDE	77	CARTREF	12.30
ELLIOTS	22	FERNWOOD	21.10	BALOWAKHE	78	CLOVELLY	6.40
GLENDING	23	KRANSKOP	9.70	BALOWAKHE	79	CLOVELLY	15.80
GLENDENING	24	GLENROSA	17.50	BALOWAKHE	80	CLOVELLY	21.70
GUM TREE	25	GLENROSA	17.30	SUMMERVELD	81	CLOVELLY	14.70
GUM TREE	26	NOMANCI	15.40	SUMMERVELD	82	GLENROSA	10.20
GUM TREE	28	MAGWA	20.30	SUMMERVELD	83	GLENROSA	4.10
MICHAELS	29	MAGWA	10.30	ACADEMY	84	CARTREF	5.70
MICHAELS	30	KRANSKOP	13.40	ACADEMY	85	FERNWOOD	10.10
MICHAELS	31	KRANSKOP	12.60	ACADEMY	86	GLENROSA	10.10
MDONIS	32	MAGWA	9.40	SUMMERVELD	87	GLENROSA	12.60
MICHAELS	33	KRANSKOP	12.00	SUMMERVELD	88	NOMANCI	8.10
DIP TANK	34	GLENROSA	22.80	SUMMERVELD	89	GLENROSA	4.30
DIPPING TANK	35	GLENROSA	20.40	TURF CLUB	90	NOMANCI	14.90
JACKSONS DRIFT	36	GLENROSA	21.00	PADDOCK	91	GLENROSA	10.90
PUMOWAKHE	37	HUTTON	16.10	PADDOCK	92	CLOVELLY	8.90
BRAESIDE	40	CARTREF	15.10	FARM SCHOOL	93	GLENROSA	7.30
MICHAELS	41	MAGWA	11.40	FARM SCHOOL	94	GLENROSA	6.60
DEPOT	42	MAGWA	14.50	FARM SCHOOL	95	GLENROSA	9.30
DEPOT	43	MAGWA	12.50	FARM SCHOOL	96	GLENROSA	6.30
COMPOUND	44	MAGWA	16.70	FARM SCHOOL	101	CARTREF	8.10
COMPOUND	45	MAGWA	11.50	NDENGEZI	102	HUTTON	8.50
COMPOUND	46	MAGWA	12.90	NDENGEZI	103	HUTTON	8.10
HILO ROAD	47	MAGWA	6.90	NDENGEZI	104	HUTTON	6.80
HILO ROAD	48	MAGWA	6.00	NDENGEZI	105	HUTTON	10.60
BARRACKS	49	MAGWA	13.40	NDENGEZI	106	HUTTON	11.50
BARRACKS	50	CLOVELLY	5.90	NDENGEZI	107	HUTTON	4.10
BARRACKS	51	CLOVELLY	10.30	NDENGEZI	108	HUTTON	8.90
BARRACKS	52	CLOVELLY	12.50	NDENGEZI	109	HUTTON	4.80
BARRACKS	53	CLOVELLY	12.40				

Table 2 Areas (ha) of Different Soil Forms on Shongweni Estate

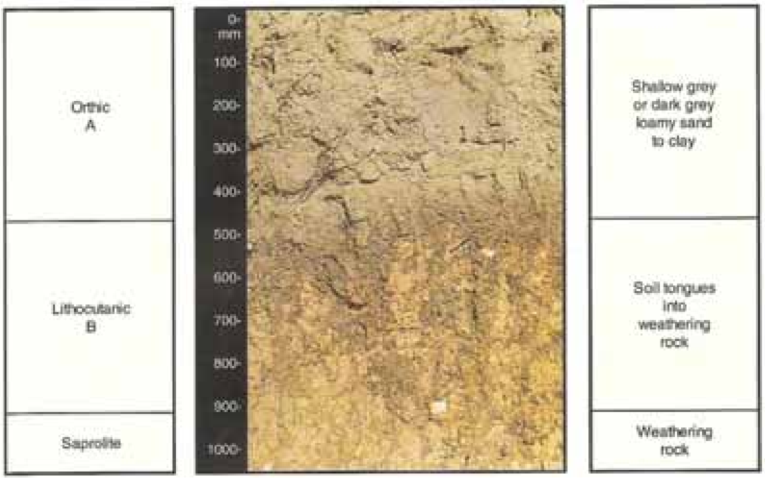
Cartref	134.7
Glenrosa	319.7
Clovelly	215.8
Magwa	168.5
Hutton	32.7
Nomanci	50.1
Fernwood	31.2
Kranskop	74.7
Mispah	11.5
	1038.9

3.1.1 Cartref Soil Form



This soil is derived from Natal Group Sandstone and/or Dwyka Tillite. Both types occur on the Estate. These soils have a high erosion hazard, moderate to poor drainage, medium infiltration rate and, an available soil water content of 80 to 140mm m^{-1}. Their make-up is as presented in the diagram above.
When cultivating these soils it is advisable to use minimum tillage and to ensure that good soil conservation structures are in place to control surface water and runoff. They normally have a low nutrient status especially with respect to calcium, magnesium and potassium. They have a high nitrogen requirement and applications should be split as far as possible.

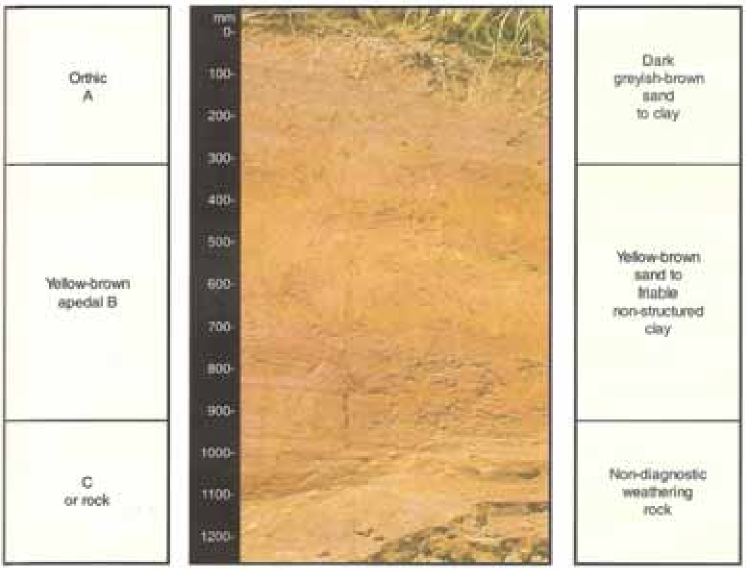
3.1.2 Glenrosa Soil Form



These soils are derived from numerous parent materials all occurring in this region, namely Natal Group Sandstone, Granite and Dwyka Tillite. They have a high to moderate erosion hazard, good to moderate drainage, good to medium infiltration rate and an available soil water content of 80 to 140mm m^{-1}. Their make-up is as presented in the diagram above.

When cultivating these soils it is advisable to use minimum tillage and to ensure that good soil conservation structures are in place to control surface water and runoff. They normally have a low nutrient status especially with respect to calcium, magnesium and potassium.

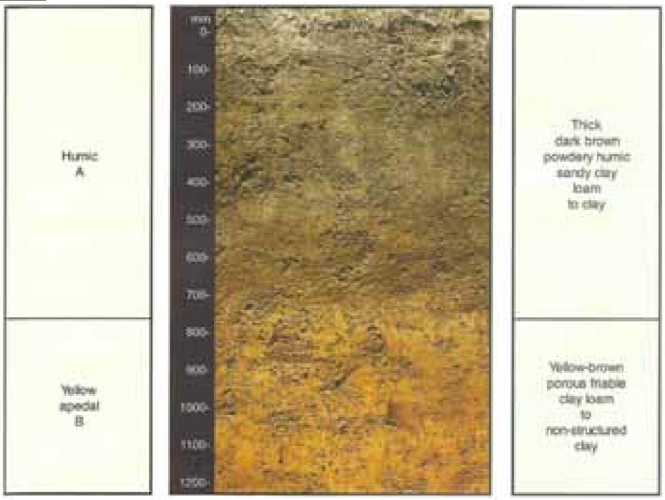
3.1.3 Clovelly Soil Form



These soils are derived from Natal Group Sandstone and Dwyka Tillite. They have a moderate to low erosion hazard, excessive drainage, good infiltration rate and an available soil water content of 80 to 140mm m^{-1}. Their make-up is as presented in the diagram above.

When cultivating these soils it is advisable to use minimum tillage although mechanical cultivation can be used with success, and to ensure that good soil conservation structures are in place to control surface water and runoff. They normally have a low nutrient status especially with respect to calcium, magnesium, phosphorus, zinc and potassium. Iron deficiency induced by manganese toxicity may occur under misty/cloudy conditions in Spring.

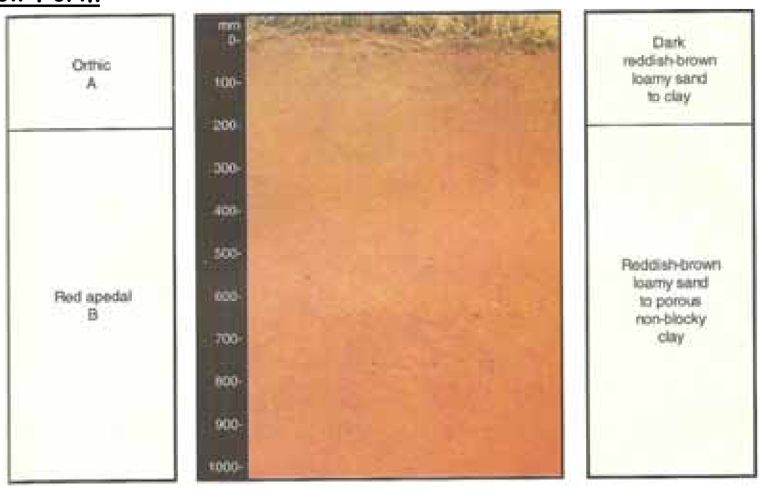
3.1.4 Magwa Soil Form



These soils are derived from Natal Group Sandstone. They have a low erosion hazard, good drainage, good infiltration rate and an available water content of 140 to 180 mm m^{-1}. Their make-up is as presented in the diagram above.

As with any good farming practice it is advisable to ensure good soil conservation structures are in place albeit that these soils have good physical properties and do not erode easily. They do exhibit aluminium toxicity and need lime and/or gypsum to correct this toxicity and deficiencies of calcium and magnesium. They are normally low in potassium and zinc and moderate in phosphorus.

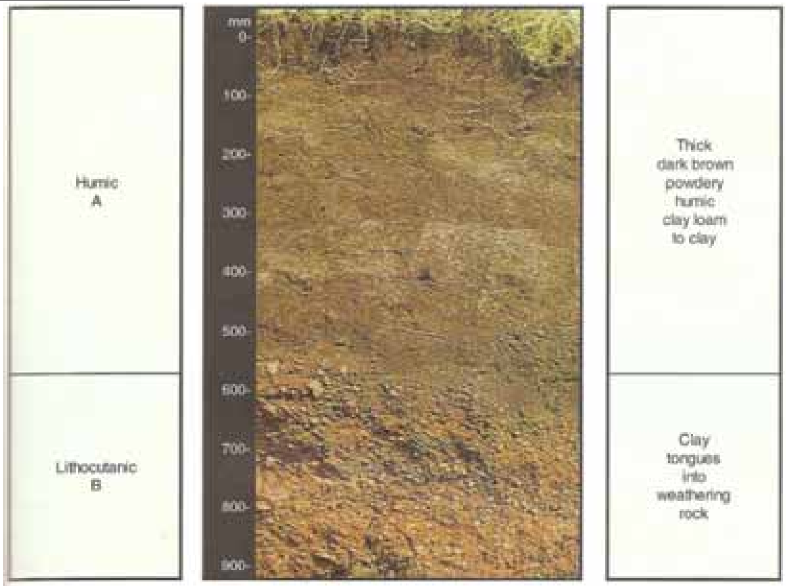
3.1.5 Hutton Soil Form



These soils are derived from Natal Group Sandstone and Dolerite. They have a low to very low erosion hazard, good drainage, good infiltration rate and an available soil water content of more than 180 mm m^{-1}. Their make-up is as presented in the diagram above.

As with any good farming practice it is advisable to ensure that good soil conservation structures are in place albeit that these soils have good physical properties and do not erode easily. They do exhibit high phosphorus fixation and need lime and/or gypsum to correct this fixation.

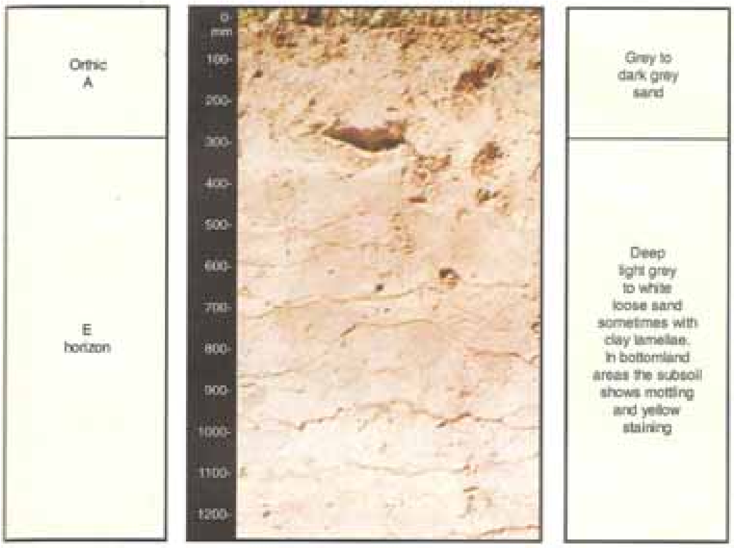
3.1.6 Nomanci Soil Form



These soils are derived from Natal Group Sandstone and Dwyka Tillite. They have a moderate to low erosion hazard, good drainage, good infiltration rate and an available soil water content of 120 to 180mm m^{-1}. Their make-up is as presented in the diagram above.

As with any good farming practice it is advisable to ensure that good soil conservation structures are in place albeit that these soils have good physical properties and do not erode easily. Their nutrient status is normally low and they require lime, phosphorus, potassium and zinc.

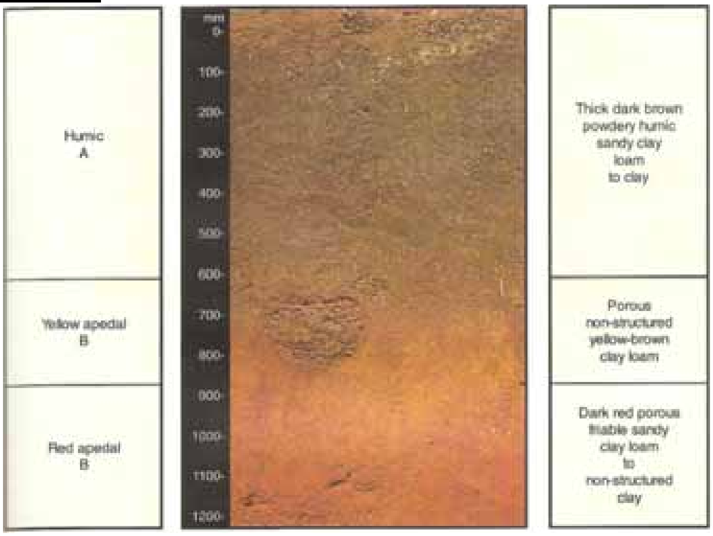
3.1.7 Fernwood Soil Form



These soils are derived from Coastal Recent Sands. They have a very high erosion hazard, excessive drainage, good infiltration rate and an available soil water content of < 80mm m^{-1}. Their make-up is as presented in the diagram above.

It is essential to ensure that good soil conservation structures are in place and these include trash blankets and the practice of minimum tillage. Their nutrient status is normally low and they require lime, phosphorus, potassium and zinc.

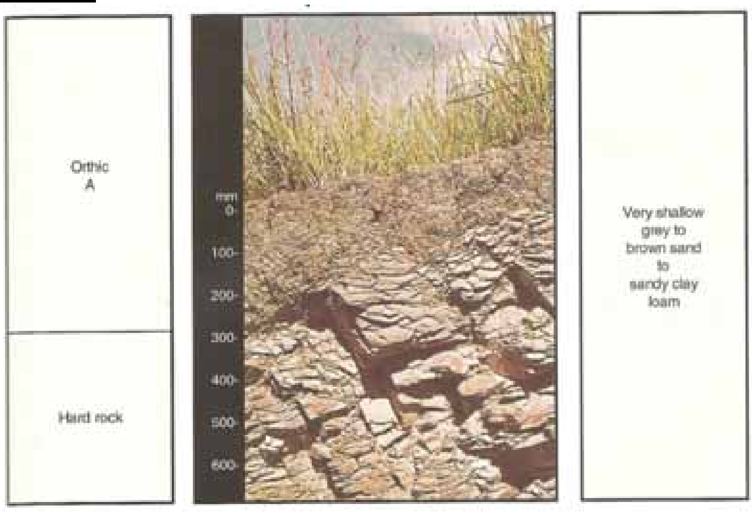
3.1.8 Kranskop Soil Form



These soils are derived from Natal Group Sandstone, Dwyka Tillite and Dolerite. They have low erosion hazard, good drainage, good infiltration rate and an available water content of 140 to 180 mm m^{-1}. Their make-up is as presented in the diagram above.

As with any good farming practice it is advisable to ensure that good soil conservation structures are in place albeit that these soils have good physical properties and do not erode easily. Their nutrient status is normally low and they require lime, phosphorus, potassium and zinc.

3.1.9 Mispah Soil Form



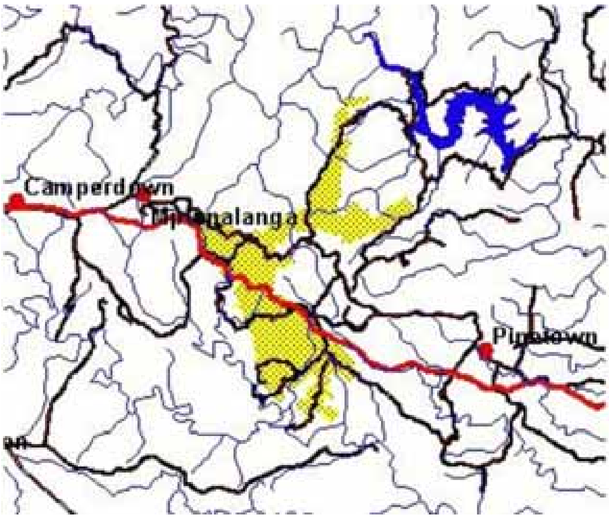
These soils are derived from Cave Sandstone and Vryheid Sediments. They have a moderate to high erosion hazard, moderate drainage, medium infiltration rate and an available soil water content of < 80mm m^{-1}. Their make-up is as presented in the diagram above.

It is essential to ensure that good soil conservation structures are in place and these include trash blankets and the practice of minimum tillage. Their nutrient status is normally low and they require lime, phosphorus, potassium and zinc. Soil depth is the major limiting factor on these soils.

3.2 Plants

The Estate falls within BioResource Unit (BRU) Wb16. This Wb16 is found in BioResource Group 3(BRG 3.6) that is defined as Moist Coast Hinterland Ngongoni Veld. The natural vegetation consists entirely of bushed grassland.

Indicator species are *Aristida junciformis (Ngongoni Three-awn), Lantana camara (Lantana), Syzygium cordatum (Water Berry), Solanum mauritianum (Bugweed).* Map 1 below indicates the locality of BRU Wb16 in KwaZulu Natal.



Map 1 Locality of BRU Wb16 in KwaZulu Natal

Farming in this BRU that has a good potential is semi-intensive. There are moderate limitations due to soil, slope and temperature, and good soil conservation measures must be put in place. Numerous crops can be grown in this area and are discussed later in this report.

The average grazing capacity within this BRU is 2.8AU ha^{-1} for a 250 day grazing cycle and thus supplementary grazing will be required in the 90 day dormant season.

Game animals include Oribi on good veld, common Reedbuck, Grey Duiker, Blue Duiker, Bushbuck and Wild Pig in forest areas. The grazing capacity of these animals is about 70% of that for agricultural production – 4.1AU ha^{-1}.

Several predictive yield models have been developed for certain of the more well-known crops that might be suitable in this BRU Wb16 and Table 3 presents some of these crops that **could** be cultivated in the area and the expected yields thereof. These yields should be considered as a 10 year average expected over the long term by a good commercial farmer. These yields will not be used in any business plan for inexperienced or resource limited farmers.

It must also be noted that these yields are not what one would currently expect but are those that may occur in a two-degree global warming scenario.

Table 3 Modelled Crop Yields for BRU Wb16 - Drummond

Crop	Average Yield	Maximum Yield	Minimum Yield
	t ha^{-1}	t ha^{-1}	t ha^{-1}
Cabbage - transplant	67.4	71.2	60.5
Carrot - hybrid	53	59.7	41.8
Cowpeas - For Hay	5.6	6.1	4.8
Dry Bean	1.1	1.2	0.9
Lucerne - Irrigated	7.5	7.5	7.5
Maize - Dryland	4.2	4.8	3.5
Maize - Irrigated	7.7	7.7	7.7
Sorghum - Dryland	4.2	4.6	3.4
Sorghum - Irrigated	7.4	8.2	5.9
Soyabean - Irrigated	3.5	3.7	3.1
Sugarcane - Irrigated	66.6	70.6	60
Sunflower	1.5	1.7	1.2
Tomato - transplant	77.6	84.6	67.7

There are of course other horticultural crops that do well in this BRU and these are dealt with later in the report.

3.3 Climate

Table 4 presents the climate that is experienced in BRU Wb16 and subsequently the Estate.

Table 4 Climate of BioResource Unit Wb16 - Drummond

	Annual	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Rainfall (mm)	823	104	102	110	54	39	22	21	30	57	81	102	101
Effective Rain (mm)	658	83	82	88	43	31	18	17	24	46	65	82	81
Mean Temp (deg C)	18.1	21.2	21.5	20.9	19	16.6	14.2	14.1	15.3	17	18	19	20.7
Max Temp (deg C)	23.4	25.9	26.1	25.5	24.1	22.5	20.6	20.7	21.7	22.3	22.9	23.6	25.4
Min Temp (deg C)	12.7	16.8	17	16	13.5	10.6	7.9	7.7	9.2	11.4	12.8	14.1	15.9
Mean Daily Relative Humidity (%)	71	75	75	74	71	67	65	65	66	70	72	74	74
Mean Daily Solar Radiation (MJ/sq m/d)		24.8	23.8	21.5	18.6	15.7	14.0	14.8	17.6	20.6	23.2	24.5	25.9
Heat Units Base 10		347.0	322.0	338.0	270.0	205.0	126.0	127.0	164.0	210.0	248.0	270.0	332.0
Heat Units Base 12		285.0	266.0	276.0	210.0	143.0	66.0	65.0	102.0	150.0	186.0	210.0	270.0
Pan Evap (mm)	1607	169	147	145	117	104	92	99	122	135	150	153	174

The mean annual sunshine is 6.6h d^{-1} and there is no frost severity. Between October and March, the main growing season, mean daily sunshine is 6.1h.

For sugarcane production the base temperature for heat units is 12 degrees the total must not be less than 1750 HU annum^{-1}. This BRU experiences an average of 2229 HU annum^{-1}.

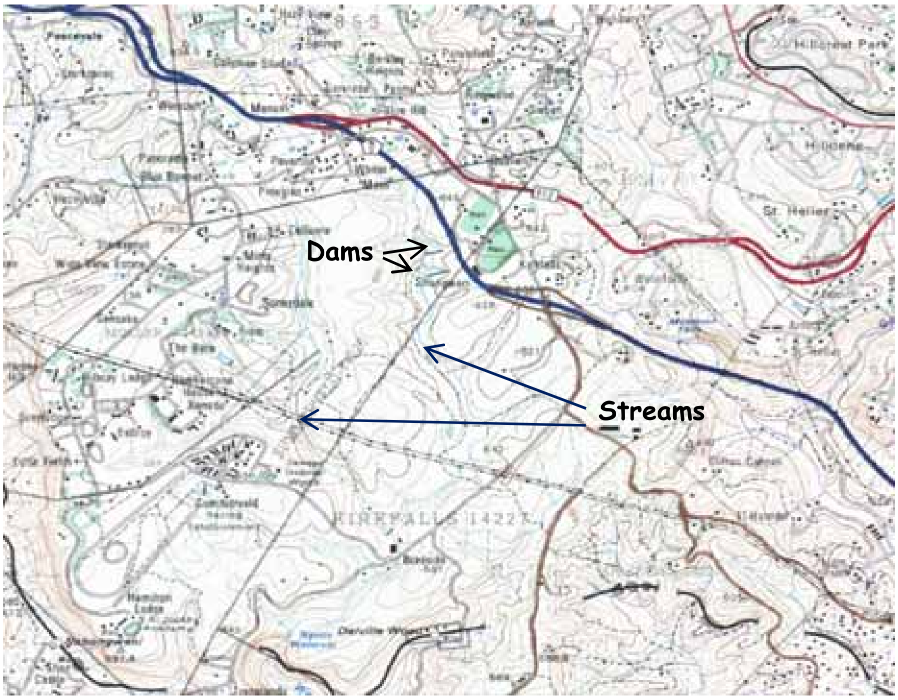
Although predominantly a summer rainfall area, the climate experienced can sustain crops throughout the year especially if supplemented with irrigation. Effective rainfall is estimated at

80% of total rainfall. Humidity is relatively high and thus crop evaporation will be correspondingly low.

The Estate has a climate capability classification of C2 and this indicates that the climate will support a wide range of adapted crops and a year round growing season. Moisture stress and lower temperatures increase risk and decrease yields relative to C1.

3.4 Water Resources

There are two small dams on the Estate and numerous small streams as can be seen in Map 2 below.



Map 2 Location of Shongweni Estate

The Estate although forming part of the catchment area for the Shongweni Dam does not fall in a Controlled Area with respect to irrigation and water storage. These water resources however are not sufficient for irrigation of sugarcane currently being produced on the Estate.

3.5 Terrain

The Estate comprises of flat, gentle and steep slopes as can be seen in Map 2 above and Photograph 4 below.

Photograph 4 Varying Terrain on the Shongweni Estate

Drainage lines on the Estate run in a various directions, being predominantly south and south-east. There is a need for contours on these fields and minimum tillage practices are carried out when possible.

4 CURRENT SITUATION

Shongweni Estate cultivates some 1085ha of dryland sugarcane. Currently the aim is to harvest on a 14 to 16 month cycle. The varieties being cultivated are N12, N16, N29 and N35. The *modus operandii* for operations is:

Plant Cane

- Spray with chemical weed killer – Glyphosate (Roundup)
- Plough out and then Disc with a heavy offset disc harrow
- Spot spray with glyphosate
- Disc with offset disc harrow
- Ridge and plant with 'double stick' seed cane (double stick improves germination percentage and minimises gapping)
- Apply Bandit(1l ha^{-1}) and Zinatex(2l ha^{-1}) in the row

Ratoon Cane (October to February)

- Hand harvest – in field loading onto trailers
- Hand hoeing for weeds
- Depending upon time of year, chemical spray applied (type according to weed spectrum)
- Fertiliser and Lime applied on the row by hand
- Post emergent herbicide application – winter spray followed by long term spray
- Hand hoe after long term spray
- If canopy not closed carry out short term spray (1l Gramoxone and 1l Amatrine)

Despite records having been kept by TH prior to the changes in management there are minimal historical records on the Estate. Yield data was extrapolated through Field Operations Office on Tongaat Estate using their data and data obtained from the mill.

The field layout is illustrated in Photograph 3 above. Not all of the lands have been under production over the last ten years, hence the gaps in yield data presented in Table 5 below.

Table 5 Sugarcane Yield Data for Shongweni Estate 2003 to 2011

		2003			2004			2005			2006			2007			2008			2009			2010			2011		
Block No	Dryland Area	Var	Yield	Rat	Var	Yield	Rat	Var	Yield	Rat	Var	Yield	Rat	Var	Yield	Rat	Var	Yield	Rat	Var	Yield	Rat	Var	Yield	Rat	Var	Yield	Rat
	ha		t ha^{-1}			t ha^{-1}			t ha^{-1}			t ha^{-1}			t ha^{-1}			t ha^{-1}			t ha^{-1}			t ha^{-1}			t ha^{-1}	
1	8.00	N12	49.2	3	N12	60.2	4	N12	40.8	4	N12	0.0	5	N12	18.5	5	N12		6	N12	20.57	6	N12	0	7	N12	14.3	7
2	7.6	N12		5	N12	29.7	5	N12		6	N12	0.0	6	N12		7	N12	13.13	7	N12		8	N12	22.5	8	N12		9
3	6.60	N12		0	N12	38.7	0	N12		1	N12		1	N12		2	N12	0	2	N12		3	N12	24.4	3	N12		4
4	9.1	N12	49.4	1	N12		2	N12	0.0	2	N12		3	N12	23.7	3	N12		4	N12		5	N12	45.6	5	N12		6
5	14.10	MIX	39.9	0	MIX		1	MIX	43.5	1	MIX		2	MIX	26.9	2	MIX	26.95	3	MIX	20.23	4	MIX	25.1	4	MIX	12.8	5
6	9.60	N12	51.3	1	N12		2	N12	43.5	2	N12		3	N12	37.6	3	N12	31.75	4	N12	34	5	MIX		5	MIX		P
7	7.10	N12		6	N12	42.5	6	N12	42.6	7	N12		8	N12	46.9	8	N12	24.78	9	N12	31.84	10	N12	28.4	5	N12	21.2	6
8	6.90	N12	51.0	1	N12		2	N12	43.7	2	N12		3	N12	33.7	3	N12	25.36	4	N12	93	5	N12		6	N12		6
9	9.70	N12	51.8	0	N12		1	N12	42.2	1	N12		2	N12	41.4	2	N12		3	N12	30.66	3	N12	48.5	11	N12	36.4	11
10	6.80	N12	45.8	1	N12		2	N12	42.5	2	N12	0.0	3	N12	41.1	3	N12		4	N12	43.73	4	N12	0	6	N12	30.8	7
11	7.10	N12	44.0	1	N12		1	N12	43.7	1	N12	0.0	2	N12	38.0	2	N12		3	N12	20.28	3	N12	0	4	N12	17.9	4
12	5.30	N12	43.8	0	N12		1	N12	46.9	1	N12		2	N12		3	N12	43.84	3	N12		4	N12	0	5	N12	35.5	5
13	3.10	N12	70.5	0	N12	33.2	1	N12		0	N12		0	N12	97.4	1	N12		1	N12	102.8	1	N12		P	N12	25.4	P
14	13.30	N12	44.2	2	N12		3	N12	36.9	3	N12		4	N12	43.1	4	N12		5	N12	25	5	N12	40.3	4	N12		P
15	11.70	N12	43.1	1	N12		2	N12	39.6	2	N12		3	N12	23.5	3	N12		4	N12	34.06	4	N12	59.4	2	MIX		3
16	11.50	N12	38.8	7	MIX		0	N12	32.7	0	N12	0.0	1	N12	31.1	1	N12		2	N12	31.48	2	N12		P	MIX	48.6	P
17	17.80	N12	45.2	7	MIX		0	N29	31.1	0	N29		1	N29		2	N29	21.38	2	N29	22.2	3	N12		5	N12	24.3	5
18	9.20	N12		1	N12		1	N12	48.5	1	N12		2	N12	18.4	2	N12		3	N12	7.88	3	N12		3	N12	19.6	3
19	6.20	N12		0	N12	33.5	0	N12		1	N12		2	N12	37.1	3	N12		4	N12	44.52	4	N29	7.72	3	N29	12.7	4
20	14.50	N12		4	N12	44.8	4	N12	28.2	5	N12		6	N12	87.4	P	N12	48.5	0	N12		1	N29		4	N12		P
21	12.50	N12	55.3	6	MIX		0	N12	0.0	0	N12	29.7	1	N12	26.0	1	N12		2	N12	21.25	2	N12		4	N37		P
22	21.10	N12		7	N12	39.1	7	N12		0	N12	46.9	0	N12		1	N12	43.48	1	N12	18.6	2	N12		5	N12	25.4	5
23	9.70	N12	62.0	5	N12	49.2	6	N12		7	N12	27.8	7			P	MIX	42.27	0	MIX	39.5	1	N12	21.2	1	N12	31.1	2
24	17.50	N12		4	N12	62.5	4	N12		5	N12	28.4	5			P	N12	36.52	0	N12		1	N12		3	N12	15.7	3
25	17.30	N12		4	N12	39.7	4	N12		5	N12	9.9	5	N12		6	N12	30.87	6	MIX		P	N12	0	3	N12	18.6	3
26	15.40	N12		6	N12	40.6	6	N12		0	N12		0	N12		1	N12	46.91	1	N12	0	2	MIX	38.3	2	MIX		3
28	20.30	N12	47.6	7	N12		0	N12	33.5	0	N12	28.3	1	N12	29.9	1	N12		1	N12	29	1	N12	23.4	1	N12	24.8	2
29	10.30	N12		2	N12	40.6	2	N12		3	N12	29.7	3	N12	26.5	4	N12	59.73	4	N12	57.88	5	MIX		P	MIX	44.2	1
30	13.40	N12		2	N12	39.5	2	N12		3	N12	25.4	3	N12		4	N12	38.98	4	N12	21.38	5	N12	50.4	2	N12		3
31	12.60	N12	52.0	2	N12	54.0	3	N12		4	N12	40.3	4	N12		5	N12	34.76	5	N12		6	N12	0	2	N12	26.3	2
32	9.40	N12	47.4	3	N12		4	N12		5	N12	0.0	5	N12		6	N12	31.61	6	N12		P	N12	46.4	6	N12	28.2	6
33	12.00	N12	49.9	2	N12		3	N12	85.3	4	N12	28.7	5	N12		6	N12	37.27	6	N12		7	N12	0	6	N12	21.2	6
34	22.80	N12		1	N12	44.3	1	N12		2	N12	40.3	2	N12		3	N12	27.89	3	N12	38.15	4	N12	17.6	6	N37		P
35	20.40	N12		0	N12	44.3	0	N12		1	N12	0.0	1	N12		2	N12	51.23	2	N12	33.05	3	N12	29.4	P	N12		1
36	21.00	N16	65.0	4	N16	42.5	5	N16	56.6	5	N16	0.0	6	N16		LUP	N16		7	N16	58.53	P	N12	26.9	7	N12		8
37	16.10	N12	39.9	1	N12	28.1	2	N12	124.7	3	N12	0.0	4	N12		5	N12	25.99	5	N12		P	N12	33.2	4	N12	49.5	5
40	15.10	N12	59.2	6	N29		0	N29	45.6	0	N29		1	N29	40.6	1	N29	29.92	3	N29		4	N12		5	N12	36.7	5
41	11.40	N12	49.1	5	N12		6	N12	53.2	6	MIX		0	MIX	40.3	P	MIX		0	MIX	30.79	P	N12		4	N12	31.5	4
42	14.50	N12	65.7	7	N12		8	N12	43.7	8	MIX	0.0	0	MIX	43.4	P	MIX		1	MIX	47.53	1	N16	55.3	1	MIX	48.2	2
43	12.50	N12	56.2	2	N12		3	N12	58.0	3	N12	46.3	4	N12		5	N12	44.55	5	N12		6	N12	19	P	N12	32.9	1
44	16.70	N12	63.9	2	N12	44.5	3	N12		4	N12	46.7	4	N12		5	N12	46.15	5	N12	20.97	6	N29	21.9	4	MIX		P
45	11.50	N12		0	N12	49.9	0	N12		1	N12		1	N12		2	N12	45.77	2	N12	32.93	3	MIX		1	MIX	29.4	1
46	12.90	N12	63.8	0	N12	50.4	1	N12		2	N12	38.9	2	N12	36.3	2	N12	116.5	3	N12	43.32	3	MIX	21.1	2	N12	33.4	3
47	6.90	N12	63.8	4	N12	54.0	5	N12		6	N12	51.1	6	N12		7	N12	33.5	7	N12		P	N12	34.7	6	MIX		P
48	6.00	N12	63.9	2	N12	50.0	3	N12		4	N12		4	N12		5	N12	34.82	5	N12	10.12	6	N12		P	N12	34.8	7
49	13.40	N12	51.8	1	N12	64.6	2	N12	40.5	2	N12		3	N12	30.4	3	N12		4	N12	32.61	4	N12		4	N12	46.8	P
50	5.90	N12	43.1	7	N12		7	N12	24.5	7	N12	52.0	0	N12	32.0	P	N12		1	N12		1	N12	26.9	4	N12	41.7	4
51	10.30	N12		6	N12	46.9	6	MIX		0	MIX	44.1	0	MIX		1	MIX	24.33	1	MIX	44.06	2	N12	27.6	P	N12		5
52	12.50	N12	60.8	0	N12		1	N12		2	N12	0.0	2	N12	54.1	3	N12		4	N12	43.45	4	N12		P	N12		1
53	12.40	N12		0	N12	56.7	0	N12	43.5	1	N12		2	N12	53.8	3	N12	48.26	3	N12		4	N12	0	P	N12		P
54	12.00	N12		5	N12	42.5	5	N12	29.5	6	N12		7	N12	30.7	7	N12		0	N12	33.48	P	N12	27	2	MIX	35.9	P
57	8.80	N12	0.0	5	N12		6	N12	23.6	6	N12	0.0	0	N12	26.7	P	N12		1	N12	11.28	1	MIX	33.8	3	N12		3
58	10.50	N12		5	N12	51.8	5	N12	28.5	6	N12		7			P	N35	40	0	N35	98.36	1	N12	32.7	5	MIX		4
59	7.20	N12		5	N12	39.1	5	N12	24.8	6	N12		7			P	N12		0	N12	60	1	N12	36.6	4	N12		6
60	4.20	N12	26.8	3	N12		4	N12	19.9	4	N12		5	N12	22.2	5	N12		0	N12	37.61	P	N12	43.1	1	N12		5

		2003			2004			2005			2006			2007			2008			2009			2010			2011		
Block No	Dryland Area	Var	Yield	Rat	Var	Yield	Rat	Var	Yield	Rat	Var	Yield	Rat	Var	Yield	Rat	Var	Yield	Rat	Var	Yield	Rat	Var	Yield	Rat	Var	Yield	Rat
	ha		t ha^{-1}			t ha^{-1}			t ha^{-1}			t ha^{-1}			t ha^{-1}			t ha^{-1}			t ha^{-1}			t ha^{-1}			t ha^{-1}	
61	6.40	N12		5	N12	15.5	5	N12		6	N12		6	N12	18.3	6	N12		8	N12	**43.43**	**8**	N12		2	**N12**	46.1	2
63	15.70	N12		4	N12	49.1	4	N12	34.1	5	N12		6	N12	37.1	6	N12		0	N12	**21.33**	**P**	N35	18.1	2	**N12**	13.7	2
64	11.70	N12	65.2	6	N12	62.5	7	N12	34.3	0	N12		1	N12	41.5	1	N12	39.53	2	N12	**24.54**	**3**	N12	30.1	2	**N35**		3
65	6.30	N12	54.9	4	N12	66.9	5	N12	34.3	6	N12	36.8	7	N12	32.6	7	N12	39.16	5	N12	**37.19**	**6**	N12	28.2	1	**N12**		3
66	10.50	N12		0	N12	46.6	0	N12		1	N12	34.9	1	N12		2	N12		0	N12	**40.29**	**P**	N12	55.7	P	**N12**	53.9	2
67	17.60	N12		4	N12		4	N12		5	N12		5	N12		P	N12	38.12	4	N12	**24.98**	**5**	N12		1	**N37**	63.1	P
68	7.00	N12	42.4	3	N12		4	N12	42.0	4	N12	28.3	5	N12	23.3	5	N12	35.81	4	N12	**10.42**	**5**	N12		4	**N37**	86	1
69	8.50	N12	54.3	1	N12	45.2	2	N12		3	N12	0.0	3	N12		4	N12	47.41	4	N12	**29.76**	**5**	N12		7	**N12**	24.4	1
70	12.40	N12	57.4	1	N12		2	N12	51.6	2	N12	0.0	3	N12		4	N12	39.03	6	N12		**P**	N12	37.3	1	**N12**	35.9	4
71	6.00	N12	55.7	1	N12		2	N12	50.9	2	N12	0.0	3	N12		4	N12		0	N12	**40.03**	**P**	N12		6	**N12**	49.9	7
72	13.40	N12	44.8	3	N12		4	N12	56.8	4	N12	0.0	5	N12		6	N12	27.24	5	N12	**15.99**	**6**	N12	0	6	**N12**		2
73	10.10	N12	36.0	4	N12		5	N12	49.2	5	N12	0.0	6	N12	30.7	6	N12	33.45	3	N12	**26.86**	**4**	N12		6	**N12**	14.6	6
74	18.70	N12	49.0	2	N12		3	N12	40.4	3	N12	0.0	4	N12		5	N12	29.14	1	N12	**1.24**	**1**	N12	33.4	P	**N12**	32.5	6
75	15.90	N12	46.9	0	N12		1	N12	47.3	1	N12		2	N12		3	N12	23.35	5	N12		**P**	N12	73.9	1	**N12**	23.4	6
76	12.00	N12		5	N12		5	N12	33.7	5	N12		0	N12	30.8	P	N12	42.32	1	N12	**23.38**	**2**	N12		7	**N12**	37.8	1
77	12.30	N12	44.7	2	N12		3	N12	25.3	3	N12	0.0	4	N12		5	N12	27.21	6	N12		**P**	N12		5	**N12**	33.3	2
78	6.40	N12		7	N12	48.2	7	N12		0	N12		0	N12		1	N29	21.66	7	N29		**8**	N12	0	2	**N12**	78.9	8
79	15.80	N12	44.2	3	N12		4	N12	26.4	4	N12		5	N12		6	N12		2	N12		**3**	N12		P	**N12**		5
80	21.70	N12	47.6	5	N12		0	N29	26.7	0	N29	0.0	1	N29	30.3	1	N12	43.96	3	N12		**4**	N12		3	**N12**		LUP
81	14.70	N12		5	N12	44.9	5	N12		0	N12	27.5	0	N12	51.8	1	N12		4	N12	**25.78**	**4**	N12	18	P	**MIX**	26	P
82	10.20	N12		0	N12	39.1	0	N12		1	N12	33.5	1	N12	36.9	2	N12		2	N12	**25.55**	**2**	N29	36.9	8	**N12**	26.8	3
83	4.10	N12	53.3	0	N12	33.6	1	N12		2	N12	14.1	2	N12	35.3	3	N12	49.96	1	N12	**28.07**	**2**	N12	21.3	3	**N12**		P
84	5.70	N12	39.1	6	N12	21.1	7	N12		0	N12	41.3	0	N12	44.9	1	N12	35.48	3	N12	**18.94**	**4**	N12	31.4	4	**N12**		9
85	10.10	N12		7	N12	42.0	7	N12		0	N12	35.8	0	N12		1	MIX	43.81	1	MIX		**2**	N12		P	**N12**	26.1	4
86	10.10	N12	56.3	0	N12	35.8	1	N12		2	N12		2	N12		3	N12	43.49	3	N12		**4**	N12		3	**N12**		5
87	12.60	N12	56.0	4	N12		5	N12	50.0	5	MIX		0	MIX	41.2	P	N12	30.21	1	N12		**2**	n37		P	**N12**	15.5	P
88	8.10	N12	37.4	0	N12		1	N12	45.0	1	N12	0.0	2	N12	33.5	2	N12		3	N12	**27.85**	**3**	N12		3	**N12**	14.1	3
89	4.30	N12		7	N12	30.6	7	N12		0	N12		0	N12		1	N12	33.94	0	N12	**114.5**	**1**	N12		5	**N37**		P
90	14.90	N12		6	N12	26.4	0	N12	35.6	1	N12		2	N12	30.7	2	N12		1	N12	**37.32**	**1**	MIX	39.6	2	**N12**	36.2	3
91	10.90	N12	43.8	3	N12		4	N12	34.4	4	N12		5	N12		P	N12	29.48	2	N12	**23.01**	**3**	N12	39.4	4	**N12**	30.5	5
92	8.90	N12		4	N12	32.4	4	N12		5	N12	0.0	0	N12	27.5	P	N12	33.75	1	N12		**2**	N12	18.6	2	**MIX**	36.3	3
93	7.30	N12	35.2	5	N12		6	N12		0	N12		0	N12	39.5	1	N12	49.92	2	N12	**41.94**	**3**	N12	0	4	**N12**		5
94	6.60	N12	34.8	4	N12	24.3	5	N12	25.6	6	N12	21.2	0	N12	46.4	P	N12	27.26	0	N12		**1**	N12	24	2	**N12**		3
95	9.30	N12		7	N12	31.5	7	N12		0	N12		0	N12	35.4	1	N12	52.31	9	N12	**18.55**	**P**	N12	20.9	2	**N12**	23.4	4
96	6.30	N12		6	N12	28.6	6	N12	1.8	7	N12		0	N12	54.3	P	N21	48	0	N21	**156.6**	**1**	N12	22.8	4	**N12**	29	3
101	8.10	N12		6	N12	28.5	6	N12		7	N12		8	N12	31.0	9	N12		7	N12		**P**	N12	22	2	**N12**		2
102	8.50	376		6	376		6			0	N21		0	N21		P	N21		0	N21	**56**	**P**	N12	0	4	**N12**		5
103	8.10	N12		5	N12	33.1	5	N12		7	N12		7	N12		LUP	N21		0	N21	**14.57**	**P**	N12	29.6	1	**N12**	25.8	3
104	6.80	N12	37.9	5	N12	36.0	6	N12		7	N21		0	N21		LUP	N12		0	N12	**5.568**	**P**	N12		1	**N12**	21.7	4
105	10.60	N12	14.4	6	N12	33.2	6	N12		7	N21		0	N21		LUP							N21	12.9	2	**N12**		2
106	11.50	N12	14.5	6	N12	33.2	6	N12		7	N12		7	N12		LUP	N12		7	N12	**140.4**	**P**	N12		P	**N12**	80.7	1
107	4.10	N12	14.4	6	N12		6	N12			N12												N21	6.48	1	**N21**		3
108	8.90	N12	14.5	6	N12	33.2	6	N12		7	N12		7	N12		LUP							N21		1	**N12**		P
109	4.80	N12	15.2	6	N12		6	N12			N12												N12		1	**N21**		2
			45.42			41.44			40.92			34.15			37.09			38.1			37.88			31.16			32.9	

The mean yield per hectare per annum is expressed in the last row of Table 5. This mean annual yield ranged from 31.16 to 45.42 t ha^{-1} $annum^{-1}$.

This is deemed a reasonable yield for dryland sugarcane in this area. Apart from the relatively low seasonal rainfall over this period there is evidence of lack of nutrition and presence of *Eldana*. These issues need to be rectified to improve yields.

5 AGRONOMIC AND HORTICULTURAL CROP SUITABILITY

The following crops could be grown in the area and each are discussed with respect to the conditions on the Estate and their advantages and disadvantages:

- Sugarcane
- Bananas
- Grasses for instant lawn
- Vegetable crops
- Cut flowers, potted plants and medicinal plants

5.1 Sugarcane

Sugarcane is being produced on the Estate with some success. The main soils on the Estate are Cartref(135ha), Glenrosa(319ha), Clovelly(216ha) and Magwa(169ha). These soils as recorded above have various soil water characteristic and nutrient status. Yields to-date have varied and are on average over the last 8 years, deemed poor yields.

Canesim, a sugarcane crop growth simulation model adopted by SASRI for crop yield estimation, was used to predict potential yields that might be obtained on Shongweni. The yields predicted for Shongweni varies from 62 to 92 t ha^{-1} $annum^{-1}$. Due to the restrictions that exist on the Estate it is doubtful that such yields could be obtained let alone sustained.

With improved management, especially control of *Eldana,* yields of 50 t ha^{-1} $annum^{-1}$ can be sustained.

The current RV price per tonne (August) for sugarcane is R 3 157.

Assuming a potential yield of 50 t ha^{-1} $annum^{-1}$ and a potential RV of 12% the Estate comprising of 1 085ha could produce 6 510 tonnes RV sugarcane with a value of R 20 552 070.

With the current costs of production being R 25 541 ha^{-1} for plant cane and R 15 959 ha^{-1} for ratoon cane and assuming 12.5% plant cane each year (8 year rotation) the annual production costs for the Estate are R 18 609 085 (COMBUD and Cane Growers, 2012).

Thus in normal rain seasons with an average annual yield per hectare of 50 tonnes, an expected profit before Capex, tax, interest, etc. could be R 1 942985 or R 1 791 ha^{-1}. The break-even yield potential is 45 t ha^{-1} $annum^{-1}$.

5.2 Bananas

Bananas required a well-drained soil with good soil water retention characteristics. They have a high water requirement throughout the year and on this Estate supplementary irrigation is essential. As there is no water for irrigation of this crop this option is not an option.

5.3 Grasses

Most grass species will do well in this climate and on these aspects. Instant lawn is considered as with all the development in the area there is a market in the short and medium term.

Instant lawn could be cultivated on some of the flatter lands that are deeper and with no drainage problems. Sufficient water might be able to be obtained from either or both of the dams to cultivate say 10ha.

Current production cost of 'instant lawn' grass is R 150 000 ha^{-1}, and the selling price is between R 240 000 and R 270 000 ha^{-1} laid. Thus excluding capital costs to purchase equipment, and two crops per year, one could expect R 900 000 from 10ha of land.

Without irrigation this is not a possibility and it is a short to medium term enterprise.

5.4 Vegetable Crops

Certain vegetable crops, especially in winter months, could be grown on the Estate providing there was irrigation, secure fencing, and wind breaks.

These crops are reasonably labour intensive and would provide employment to the local populace. It is estimated that 2 labourers would be required for each hectare planted.

Again selection of suitable lands, rotation practices and growing season would significantly affect this enterprise.

With high value crops and use of Municipal and/or borehole water vegetables could be grown especially under controlled environment conditions. There is a good market for perishable crops but water is the limiting factor.

5.5 Medicinal Plants and Trees

The Durban Metropolitan Area is the main regional trading area in addition to a possible small local market. The current demand for the numerous species used in indigenous medicines exceeds supply and as a result several species, e.g. wild ginger and pepper-bark tree have become extinct outside KZN. Little cultivation is carried out due mainly to lack of knowledge of indigenous plant cultivation and the economics of associated markets.

From current experience, it will be necessary to have irrigation to establish a small nursery of the selected medicinal plants and to ensure that transplants survive in the ground. Many medicinal plants grow in afforested areas, thus the choice on this Estate is minimal. The growing areas and handling facilities would also have to be secure.

Experience has shown to-date that a grower needs to involve at least a herbalist in the operation, to ensure a market. The presentation and marketing of traditional medicine has its own culture and *modus operandi.*

This industry of cultivated medicinal plants is still in relative infancy and one would need to build up a stock in a nursery. This facet will be dealt with in the following paragraph.

5.6 Cut flowers and potted plants, including indigenous trees

If one has access to land and finance, then the option of growth houses can be utilised on land that is not necessarily suited for open-air cultivation.

As this Estate is not situated in lower lying areas, sturdy structures would have to be erected to contend with wind conditions. This area also experiences misty conditions and high humidity, conditions that favour disease.

A high level of management will be required for production, sanitation, harvesting, packing and marketing. There is potential competition in this market locally, however if selected niche products were chosen and produced, and finance was not limiting, this could be an option. If a licence for irrigation is not possible then use of Municipal, dam or borehole water would have to be made to guarantee availability year round.

6 SUMMARY

The Estate falls within BioResource Unit (BRU) Wb16. This Wb16 is found in BioResource Group 3(BRG 3.6) that is defined as Moist Coast Hinterland Ngongoni Veld. The natural vegetation consists entirely of bushed grassland.

Indicator species are *Aristida junciformis (Ngongoni Three-awn), Lantana camara (Lantana), Syzygium cordatum (Water Berry), Solanum mauritianum (Bugweed).* Map 1 below indicates the locality of BRU Wb16 in KwaZulu Natal.

The Estate lies toward the southern section of the 'Valley of a Thousand Hills'. The Valley of a Thousand Hills reveals intrusive granites and metamorphic gneisses around 1 100 million years old, but which are easily eroded. The soils are part of the Hinterland Soil Systems comprising of weakly weathered soils without lime. Of the 1 085ha cultivated on the Estate the main soils are Cartref(135ha), Glenrosa(319ha), Clovelly(216ha) and Magwa(169ha).

Although predominantly a summer rainfall area, the climate experienced can sustain crops throughout the year especially if supplemented with irrigation.

The Estate has a climate capability classification of C2 and this indicates that the climate will support a wide range of adapted crops and a year round growing season. Moisture stress and lower temperatures increase risk and decrease yields relative to C1.

There are no water resources apart from two small dams on the Estate. These water resources however are not sufficient for irrigation of sugarcane currently being produced on the Estate. The Estate although forming part of the catchment area for the Shongweni Dam does not fall in a Controlled Area with respect to irrigation and water storage.

Over the past 8 years poor average sugarcane yields have been obtained, ranging from 31.16 to 45.42 t ha^{-1} $annum^{-1}$ under dryland production. With the current costs of re-establishment (8 year rotation) and production costs the break even yield assuming a 12% RV, is 45 t ha^{-1} $annum^{-1}$. Unless disease is eradicated and yields improved this Estate could incur loss.

Canesim predicts yields of 62 to 92 t ha^{-1} $annum^{-1}$ provided all growth conditions are met but due to the lack of water resources and poor soils for crop production such yields will not be attained.

There is electricity on the Estate and the road infrastructure to and from the Estate is excellent. The in-field road network is very good.

There is existing agricultural infrastructure (sheds, workshops, offices, dwellings for staff, etc.) on the Estate but need to be maintained and in some cases refurbished.

The Estate is close to good markets and having the N3 highway running through and the rail close by is beneficial. However transport to the sugar mill is a significant cost and can be considered a limitation.

7 CONCLUSIONS

Having considered the cropping and land use options on this Estate together with the inherent costs and restrictions, and the need for development in the growth corridor that has been identified by Province and the eThekwini Municipality, the development of this Estate for high and medium density mixed use, agri-business, low and medium density residential and open space/conservation will:

- Fulfil the planned expansion of the Outer West node of eThekwini Municipality
- Provide infill development in this node
- Comply with Provincial and Municipal strategic planning
- Comply with local planning
- Make effective and efficient use of existing infrastructure and resources
- Create positive employment and socio-economic benefits

DAEARD recognise the need for development in growth corridors and would like to ensure that it is appropriately managed. Together with TH they are working toward understanding the agricultural potential in the Western and Northern corridors.

In KZN the land used for sugarcane production has increased over the last 3 years by 17 835ha, an increase of 15% and this includes land taken out for urban development. Thus the impact of urban development on sugarcane production is insignificant.

Tongaat Hulett only owns 8% of the total quantum of land that supplies cane to its mills so even a total loss of this 8% is insignificant.

What is very significant is the fact that Tongaat Hulett commenced with new sugarcane areas in 2009 and by the end of the 2012/13 season this will be 9 506ha. In 2013/14 a further 10 000ha is to be identified and developed and 7 000ha in 2014/15. Therefore at the end of 3 years Tongaat Hulett will have developed an additional 26 506ha of new sugarcane land. This together with the existing 17 835ha increment will produce a 44 341ha increase from 2009, and increase of 37%.

Apart from this fact it is noteworthy that the new areas being developed are in the rural hinterland. This combined with a rural development and food security strategy of new sugarcane development providing an anchor for services, investment, training, etc., allows for other more intensive food related crops to be grown for local consumption.

Thus removing the property from agricultural production will have little or no impact on Food Security in the region.

Dr Roy Mottram
28 August 2012

8 APPENDICES

8.1 Appendix I - Sugar Cane Establishment Gross Margins – Mechanical Land Preparation

SUGAR CANE ESTABLISHMENT COSTS					Mechanical Land Preparation			2012 - 2013	
References: COMBUD, CaneGrowers									
					Unit	**Price Per Unit**	**Qty**	**Per Ha**	**Value Per Yield Unit**
GROSS INCOME								**18942.00**	**378.84**
Product Income (Crops)									
Sugar Cane RV =		12%			ton RV	3157.00	50.00	18942.00	378.84
MARKETING COSTS								**0.00**	**0.00**
GROSS INCOME minus MARKETING COSTS								**18942.00**	**378.84**
ALLOCATABLE VARIABLE COSTS								**25541.21**	**510.82**
Directly Allocatable Variable Costs								**14752.71**	**472.42**
PRE HARVEST COST								**14752.71**	**295.05**
Seedbed Preparation									
		Ploughing			hours	246.88	3.27	807.30	16.15
		Harrowing (2X)			hours	240.57	2.56	615.86	12.32
		Ridging			hours	224.11	2.06	461.67	9.23
		Contour structures			hours	246.88	2.00	493.76	9.88
Plant Material		Seed cane			ton	513.87	10.00	5138.70	102.77
Fertilizer		DAP (38)+	0.5%Zn		ton	6020.00	0.20	1204.00	24.08
		1.0.1 (48)			ton	5230.00	0.40	2092.00	41.84
	Labour (Split in furrow and topdress)				days	84.06	2.00	168.12	3.36
Herbicides	Pre-emergent								
		Acetachlor			litres	40.89	2.00	81.78	1.64
		Diuron			litres	66.74	2.50	166.85	3.34
		Paraquat			litres	60.16	1.00	60.16	1.20
	Post-emergent								
		Ametryn			litres	38.31	4.00	153.24	3.06
		MCPA			litres	40.42	3.50	141.47	2.83
		Wetting agent			litres	65.80	0.50	32.90	0.66
	Spot Spray								
		Ametryn		5%	litres	38.31	0.20	7.66	0.15
		MCPA		5%	litres	40.42	0.18	7.07	0.14
		Wetting agent		5%	litres	65.80	0.03	1.65	0.03
	Tractor and Boom Spray				hours	147.02	1.20	176.42	3.53
Casual Labour	Planting				days	84.06	25.00	2101.50	42.03
	Hoeing/Spraying				days	84.06	10.00	840.60	16.81
Irrigation					hectares	0.00	3.00	0.00	0.00
MARGIN ABOVE DIRECTLY ALLOCATABLE VARIABLE COSTS								**4189.29**	**-93.58**
Indirectly Allocatable Variable Costs								**1920.00**	**38.40**
PRE HARVEST COST								**1920.00**	**38.40**
	Energy				litres	10.00	120.00	1200.00	24.00
	Repairs and Maintenance							720.00	14.40
TOTAL PRE HARVEST COSTS								**16672.71**	**333.45**
TOTAL HARVEST COSTS								**8868.50**	**177.37**
	Labour (cut and stack on ground)				tons	35.16	50.00	1758.00	35.16
	Bell Loader				tons	10.36	50.00	518.00	10.36
	Transport (40kms)				tons	131.85	50.00	6592.50	131.85
GROSS MARGIN ABOVE TOTAL ALLOCATABLE VARIABLE COSTS								**-6599.21**	**-131.98**

8.2 Appendix II – Sugarcane Establishment Gross Margins – Minimum Tillage

SUGAR CANE ESTABLISHMENT COSTS				Minimum Tillage		2012 - 2013		
References: COMBUD, CaneGrowers								
				Unit	**Price Per Unit**	**Qty**	**Per Ha**	**Value Per Yield Unit**
GROSS INCOME							**18942.00**	**378.84**
Product Income (Crops)								
Sugar Cane RV =	12%			ton RV	3157.00	50.00	18942.00	378.84
MARKETING COSTS							**0.00**	**0.00**
GROSS INCOME minus MARKETING COSTS							**18942.00**	**378.84**
ALLOCATABLE VARIABLE COSTS							**24719.40**	**494.39**
Directly Allocatable Variable Costs							**22799.40**	**455.99**
PRE HARVEST COST							**13930.90**	**278.62**
Seedbed Preparation		Full cover spray with Glyphosate						
		Min Till with disc ridger in interrow						
		Glyphosate		litres	30.08	8.00	240.64	4.81
		Minimum Till		hours	415.34	2.00	830.68	16.61
		Contour structures		hours	246.88	2.00	493.76	9.88
Plant Material		Seed cane		ton	513.87	10.00	5138.70	102.77
Fertilizer		DAP (38)+ 0.5%Zn		ton	6020.00	0.20	1204.00	24.08
		1.0.1 (48)		ton	5230.00	0.40	2092.00	41.84
	Labour (Split in furrow and topdress)			days	84.06	2.00	168.12	3.36
Herbicides	Pre-emergent							
		Acetachlor		litres	40.89	2.00	81.78	1.64
		Diuron		litres	66.74	2.50	166.85	3.34
		Paraquat		litres	60.16	1.00	60.16	1.20
	Post-emergent							
		Ametryn		litres	38.31	4.00	153.24	3.06
		MCPA		litres	40.42	3.50	141.47	2.83
		Wetting agent		litres	65.80	0.50	32.90	0.66
	Spot Spray							
		Ametryn	5%	litres	38.31	0.20	7.66	0.15
		MCPA	5%	litres	40.42	0.18	7.07	0.14
		Wetting agent	5%	litres	65.80	0.03	1.65	0.03
Casual Labour	Planting			days	84.06	25.00	2101.50	42.03
	Hoeing/Spraying			days	84.06	12.00	1008.72	20.17
Irrigation				hectares		3.00	0.00	0.00
MARGIN ABOVE DIRECTLY ALLOCATABLE VARIABLE COSTS							**-3857.40**	**-77.15**
Indirectly Allocatable Variable Costs							**1920.00**	**38.40**
PRE HARVEST COST							**1920.00**	**38.40**
	Energy			litres	10.00	120.00	1200.00	24.00
	Repairs and Maintenance						720.00	14.40
TOTAL PRE HARVEST COSTS							**15850.90**	**317.02**
TOTAL HARVEST COSTS							**8868.50**	**177.37**
	Labour			tons	35.16	50.00	1758.00	35.16
	Bell Loader			tons	10.36	50.00	518.00	10.36
	Transport (40kms)			tons	131.85	50.00	6592.50	131.85
GROSS MARGIN ABOVE TOTAL ALLOCATABLE VARIABLE COSTS							**-5777.40**	**-115.55**

8.3 Appendix III – Sugarcane Ratoon Gross Margins – Dryland – Burnt Early Harvest

SUGAR CANE RATOON COSTS			Dryland - Burnt Early Harvest			2012 - 2013	
References: COMBUD, CaneGrowers							
			Unit	**Price Per Unit**	**Qty**	**Per Ha**	**Value Per Yield Unit**
GROSS INCOME						**18942.00**	**378.84**
Product Income (Crops)							
Sugar Cane RV =		12%	ton RV	3157.00	50.00	18942.00	378.84
MARKETING COSTS						**0.00**	**0.00**
GROSS INCOME minus MARKETING COSTS						**18942.00**	**378.84**
ALLOCATABLE VARIABLE COSTS						**15959.23**	**319.18**
Directly Allocatable Variable Costs						**14039.23**	**280.78**
PRE HARVEST COST						**5170.73**	**103.41**
Trash							
		Spread Tops and clean up	days	84.06	2.00	168.12	3.36
Verge							
		Tractor and Slasher (4X)	hours	194.87	1.00	194.87	3.90
Fertilizer							
		1.0.1 (48)	ton	5230.00	0.57	2954.95	59.10
		Topdress	hours	231.25	0.60	138.75	2.78
	Labour (Conductor)		days	84.06	1.00	84.06	1.68
Herbicides							
	Pre-Emergent						
		Acetochlor 960g/l	litres	38.44	2.80	107.63	2.15
		Ametryn 500g/l	litres	36.01	3.00	108.03	2.16
	Tractor and Boom Sprayer		hours	191.48	0.62	118.72	2.37
	Labour (Conductor)		days	84.06	1.00	84.06	1.68
	Post-emergent						
		Ametryn 500g/l	litres	38.31	4.50	172.40	3.45
		MCPA	litres	37.99	3.50	132.97	2.66
		Volcano Blend (Adjuvant)	litres	61.85	0.50	30.93	0.62
	Tractor and Boom Sprayer		hours	191.48	0.62	118.72	2.37
	Labour (Conductor)		days	84.06	1.00	84.06	1.68
Casual Labour							
	Hoeing		days	84.06	8.00	672.48	13.45
Irrigation			hectares	0.00	3.00	0.00	0.00
MARGIN ABOVE DIRECTLY ALLOCATABLE VARIABLE COSTS						**4902.77**	**98.06**
Indirectly Allocatable Variable Costs						**1920.00**	**38.40**
PRE HARVEST COST						**1920.00**	**38.40**
	Energy		litres	10.00	120.00	1200.00	24.00
	Repairs and Maintenance					720.00	14.40
TOTAL PRE HARVEST COSTS						**7090.73**	**141.81**
TOTAL HARVEST COSTS						**8868.50**	**177.37**
	Labour		tons	35.16	50.00	1758.00	35.16
	Bell Loader		tons	10.36	50.00	518.00	10.36
	Transport (40kms)		tons	131.85	50.00	6592.50	131.85
GROSS MARGIN ABOVE TOTAL ALLOCATABLE VARIABLE COSTS						**2982.77**	**59.66**

8.4 Appendix IV – Sugarcane Ratoon Gross Margins – Dryland Burnt Late Harvest

SUGAR CANE RATOON COSTS			Dryland - Burnt Late Harvest		2012 - 2013		
References: COMBUD, CaneGrowers							
			Unit	**Price Per Unit**	**Qty**	**Per Ha**	**Value Per Yield Unit**
GROSS INCOME						**19012.98**	**380.26**
Product Income (Crops)							
Sugar Cane RV =		12%	ton RV	3168.83	50.00	19012.98	380.26
MARKETING COSTS						**0.00**	**0.00**
GROSS INCOME minus MARKETING COSTS						**19012.98**	**380.26**
ALLOCATABLE VARIABLE COSTS						**15083.93**	**301.68**
Directly Allocatable Variable Costs						**13163.93**	**263.28**
PRE HARVEST COST						**4295.43**	**85.91**
Trash							
		Spread Tops and clean up	days	84.06	2.00	168.12	3.36
Verge							
		Tractor and Slasher (4X)	hours	194.87	1.00	194.87	3.90
Fertilizer							
		1.0.1 (48)	ton	5230.00	0.57	2954.95	59.10
		Topdress	hours	231.25	0.60	138.75	2.78
	Labour (Conductor)		days	84.06	1.00	84.06	1.68
Herbicides							
	Pre-Emergent						
		Acetochlor 960g/l	litres	38.44	2.80	107.63	2.15
		Ametryn 500g/l	litres	36.01	3.00	108.03	2.16
	Tractor and Boom Sprayer		hours	191.48	0.62	118.72	2.37
	Labour (Conductor)		days	84.06	1.00	84.06	1.68
Casual Labour							
	Hoeing		days	84.06	4.00	336.24	6.72
Irrigation			hectares	0.00	3.00	0.00	0.00
MARGIN ABOVE DIRECTLY ALLOCATABLE VARIABLE COSTS						**5849.05**	**116.98**
Indirectly Allocatable Variable Costs						**1920.00**	**38.40**
PRE HARVEST COST						**1920.00**	**38.40**
	Energy		litres	10.00	120.00	1200.00	24.00
	Repairs and Maintenance					720.00	14.40
TOTAL PRE HARVEST COSTS						**6215.43**	**124.31**
TOTAL HARVEST COSTS						**8868.50**	**177.37**
	Labour		tons	35.16	50.00	1758.00	35.16
	Bell Loader		tons	10.36	50.00	518.00	10.36
	Transport (40kms)		tons	131.85	50.00	6592.50	131.85
GROSS MARGIN ABOVE TOTAL ALLOCATABLE VARIABLE COSTS						**3929.05**	**78.58**

8.5 Appendix V Sugarcane Ratoon Gross Margin – Dryland – Trashed

SUGAR CANE RATOON COSTS			Dryland - Trashed			2012 - 2013	
References: COMBUD, CaneGrowers							
			Unit	Price Per Unit	Qty	Per Ha	Value Per Yield Unit
GROSS INCOME						18942.00	378.84
Product Income (Crops)							
Sugar Cane RV =		12%	ton RV	3157.00	50.00	18942.00	378.84
MARKETING COSTS						0.00	0.00
GROSS INCOME minus MARKETING COSTS						18942.00	378.84
ALLOCATABLE VARIABLE COSTS						14922.36	298.45
Directly Allocatable Variable Costs						13002.36	260.05
PRE HARVEST COST						4133.86	82.68
Trash							
		Spread Tops and clean up	days	84.06	4.00	336.24	6.72
Verge							
		Tractor and Slasher (4X)	hours	194.87	1.00	194.87	3.90
Fertilizer							
		1.0.1 (48)	ton	5230.00	0.57	2954.95	59.10
		Topdress	hours	231.25	0.60	138.75	2.78
	Labour (Conductor)		days	84.06	1.00	84.06	1.68
Herbicides							
	Post-emergent - Spot Spray						
		Ametryn 500g/l (2X)	litres	38.31	1.00	38.31	0.77
Casual Labour							
	Hoeing/Spraying		days	84.06	4.60	386.68	7.73
Irrigation			hectares		3.00	0.00	0.00
MARGIN ABOVE DIRECTLY ALLOCATABLE VARIABLE COSTS						5939.64	118.79
Indirectly Allocatable Variable Costs						1920.00	38.40
PRE HARVEST COST						1920.00	38.40
	Energy		litres	10.00	120.00	1200.00	24.00
	Repairs and Maintenance					720.00	14.40
TOTAL PRE HARVEST COSTS						6053.86	121.08
TOTAL HARVEST COSTS						8868.50	177.37
	Labour		tons	35.16	50.00	1758.00	35.16
	Bell Loader		tons	10.36	50.00	518.00	10.36
	Transport (40kms)		tons	131.85	50.00	6592.50	131.85
GROSS MARGIN ABOVE TOTAL ALLOCATABLE VARIABLE COSTS						4019.64	80.39

APPENDIX 8:

REPORT OF THE GEOTECHNICAL INVESTIGATION FOR THE PROPOSED SHONGWENI RETAIL AREA – PRECINCT I, II AND III (DRENNAN MAUD ENGINEERS)

APPENDIX 9:

WETLAND STUDY FOR TONGAAT HULETT DEVELOPMENTS, SHONGWENI DEVELOPMENT SITES & SHONGWENI BULK WATER SUPPLY LINE (GROUNDTRUTH)

Wetland Study

Tongaat Hulett Developments: Shongweni Development Sites

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Reference: GTW252-160813-01

Date: August 2013

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Indemnity

The project deliverables, including the reported results, comments, recommendations and conclusions, are based on the author's professional knowledge as well as available information. The study is based on assessment techniques and investigations that are limited by time and budgetary constraints applicable to the type and level of survey undertaken. GroundTruth therefore reserves the right to modify aspects of the project deliverables if and when new/additional information may become available from research or further work in the applicable field of practice, or pertaining to this study.

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[1] Project deliverables (including electronic copies) comprise *inter alia:* reports, maps, assessment and monitoring data, ESRI ArcGIS shapefiles, and photographs.

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List of acronyms

Acronym	Explanation
CARA	Conservation of Agricultural Resources Act (No. 43 of 1983)
DAEA	Department of Agriculture and Environmental Affairs
DWA	Department of Water Affairs
Ha equiv.	Hectare Equivalents
HGM	Hydrogeomorphic unit
KZN	KwaZulu-Natal
LRI	Land Resources International
MAP	Mean Annual Precipitation
NFEPA	National Freshwater Ecosystem Priority Areas
PES	Present Ecological State
PET	Potential Evapotranspiration
PGS	Present Geomorphic State
PHS	Present Hydrological State
PVS	Present Vegetation State
THD	Tongaat Hulett Development

1. INTRODUCTION

Tongaat Hulett Developments (THD) appointed GroundTruth Water, Wetlands and Environmental Engineering (GroundTruth) to provide input into three proposed Shongweni development sites (**Figure 1-1**), with regards to the potential impacts of the proposed developments. The development of the proposed facilities will comprise a retail and/or commercial developments (**Figure 1-1**), near Shongweni, KwaZulu-Natal (**Figure 1-2**). In accordance with national legislation, proposed developments should identify the extent of freshwater ecosystems onsite and avoid these systems as far as possible. However, should the destruction of freshwater ecosystems be unavoidable, appropriate impact mitigation measures must be implemented. This report includes details regarding the previous study undertaken by Land Resources International (LRI) in 2007 (LRI, 2007) that delineated the extent of the wetland habitat onsite. In addition, the riparian assessment report undertaken by GroundTruth (2013) detailing the Wekeweke Stream system has been used to inform this study. This study includes an assessment of the wetland systems for the current scenario.

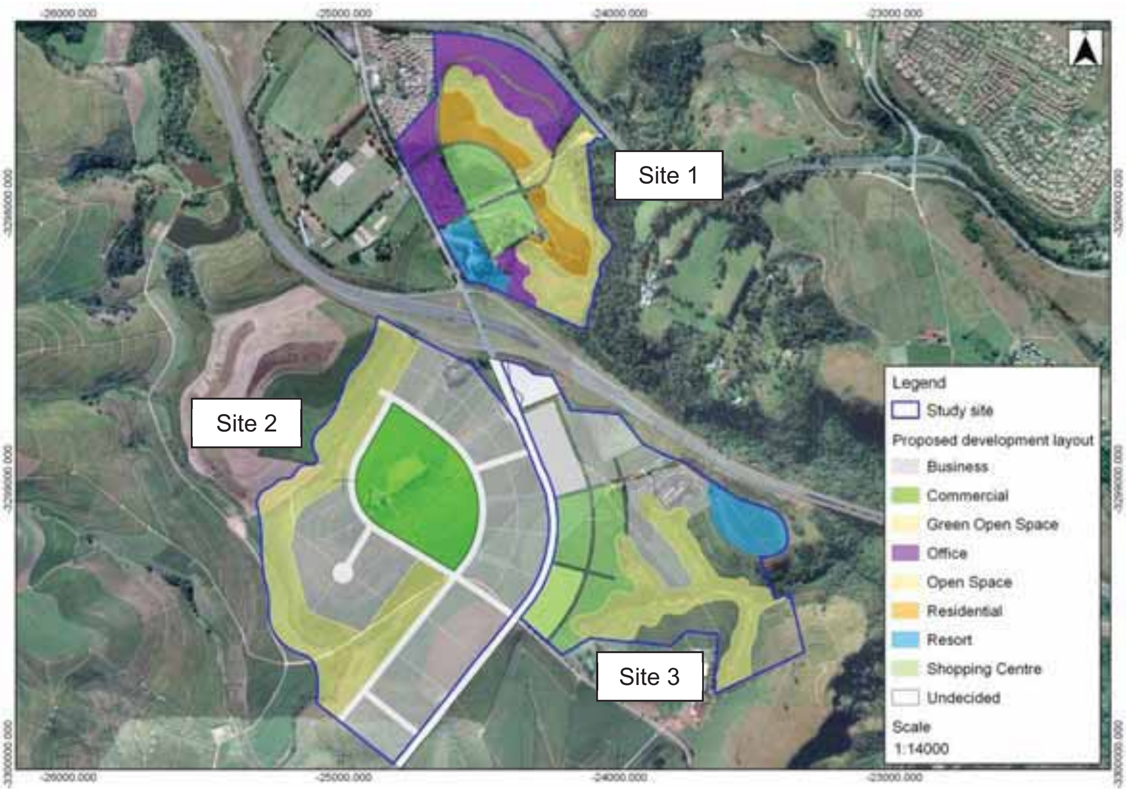


Figure 1-1 Proposed layouts for the three sites of the Shongweni development
(Supplied by Tongaat Hulett Developments)

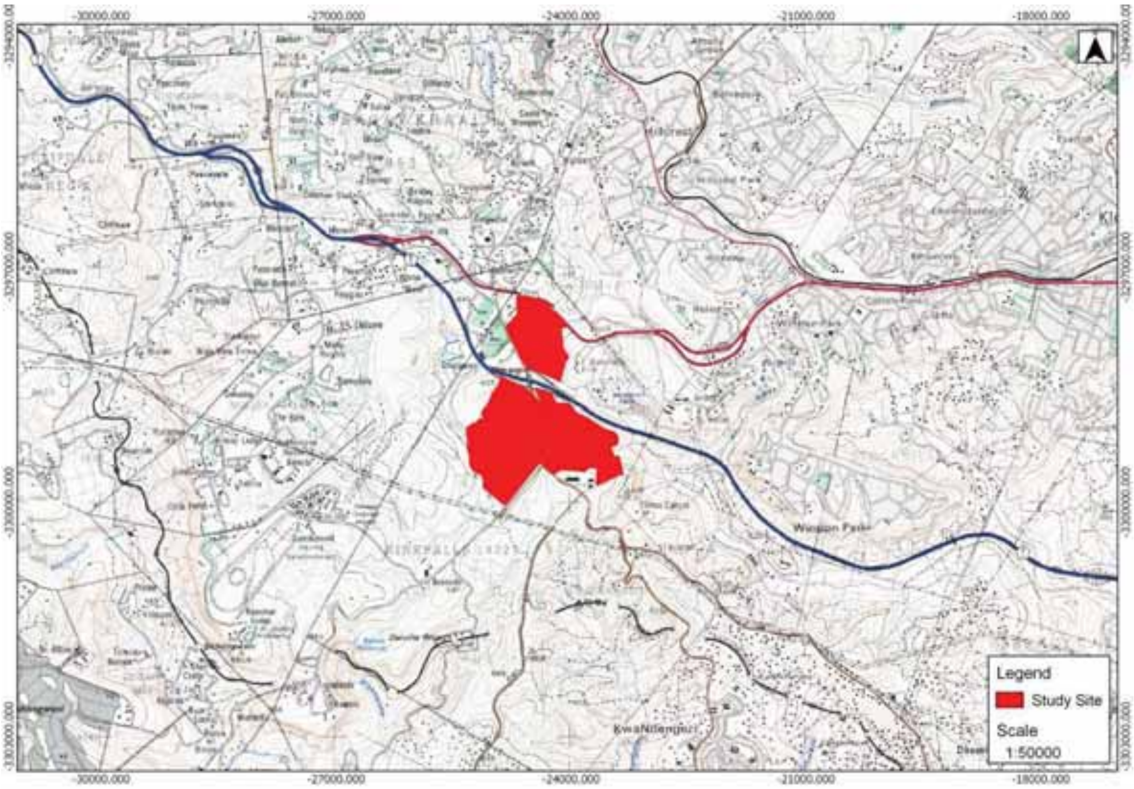


Figure 1-2 Locality of the study site

Considering the loss of wetland habitat at a national level, accepted best practice has been to adopt a 'no-net-loss' policy, with no further loss in wetland functioning and integrity. In many instances, if wetland habitat is impacted upon, the 'no-net-loss' approach may be achieved through onsite mitigation measures. However, should a residual impact be incurred, the loss may be addressed by the protection and rehabilitation of onsite and offsite candidate wetlands, based on either the KZN Norms and Standards for Biodiversity Offsetting (Ezemvelo KZN Wildlife, 2009) or the Draft SANBI Wetland Offset Framework (Macfarlane *et al.,* 2012b).

2. STUDY SITE

The following section provides an overview of the greater study site, focusing on the regional context, climate, geology and wetland types.

2.1. Regional/landscape context

South Africa is a semi-arid country, and thus wetlands are important features within the landscape as they provide ecosystem services directly related to water quantity and quality. Approximately 300,000 ha of wetlands or 2.4% of South Africa's surface area remain. It is estimated that over 50% of South Africa's wetlands have been lost (Kotze *et al*., 1995), and of the remaining systems, 48% are classified as critically endangered (Nel & Driver, 2012).

Within the KwaZulu-Natal region, wetlands have been subjected to high levels of modification and destruction (Kotze *et al*, 1995; Macfarlane *et al*., 2012). The factors contributing towards the degradation of the systems vary greatly, but the predominant impacts include urbanisation, abstraction, dams, cultivation, drainage and over-grazing (Macfarlane *et al*., 2012). The loss of wetland habitat within KwaZulu-Natal is considered to be of concern due to the value of wetlands in terms of contributions to water quantity and quality, supporting unique biological diversity and other ecosystem services (Kotze *et al*, 2007). Taking into consideration the above-mentioned degradation of freshwater ecosystems, it is important that the proposed development attempt to maintain the current levels of ecosystem service delivery, and where possible, enhance the systems' ability to supply these benefits and services. Enhancement through rehabilitation, specifically by the Working for Wetlands programme, has proven to be successful with regards to improving wetland systems' integrity and functionality (Macfarlane *et al*., 2012), highlighting the potential value of wetland rehabilitation within a regional context.

The study area falls within two quaternary catchments, as defined by Midgley *et al.* (1994). Sites 1 and 3 fall within the U60F quaternary catchment, whilst Site 2 falls within the U60C quaternary catchment. These quaternary catchments both form part of the greater Mgeni catchment, which is a regionally important water resource.

2.2. Climate

The mean annual precipitation (MAP) for the U60F catchment is 967.8mm and Potential Evapo-transpiration (PET) is 224.2mm (Schulze, 2007), which suggests that the wetlands within the catchment would have **Low** sensitivity to hydrological impacts within the catchment (Macfarlane *et al.*, 2007). The MAP for U60C is 772.1mm and PET is 1622.5mm (Schulze, 2007), which suggests that the wetland within the catchment would have a **Moderate** sensitivity to hydrological impacts within the catchment (Macfarlane *et al.*, 2007).

2.3. Geology

Mucina and Rutherford (2006) describe the geology for the greater region to be underlain by Ordovician Natal Group sandstone, which is dominated by shallow, nutrient-poor sandy soils (Mucina & Rutherford, 2006). The geology of the study site as classified by eThekwini Municipality's geological spatial coverage is shown in **Figure 2-1**. It is evident that the Natal Group sandstone dominates the study site.

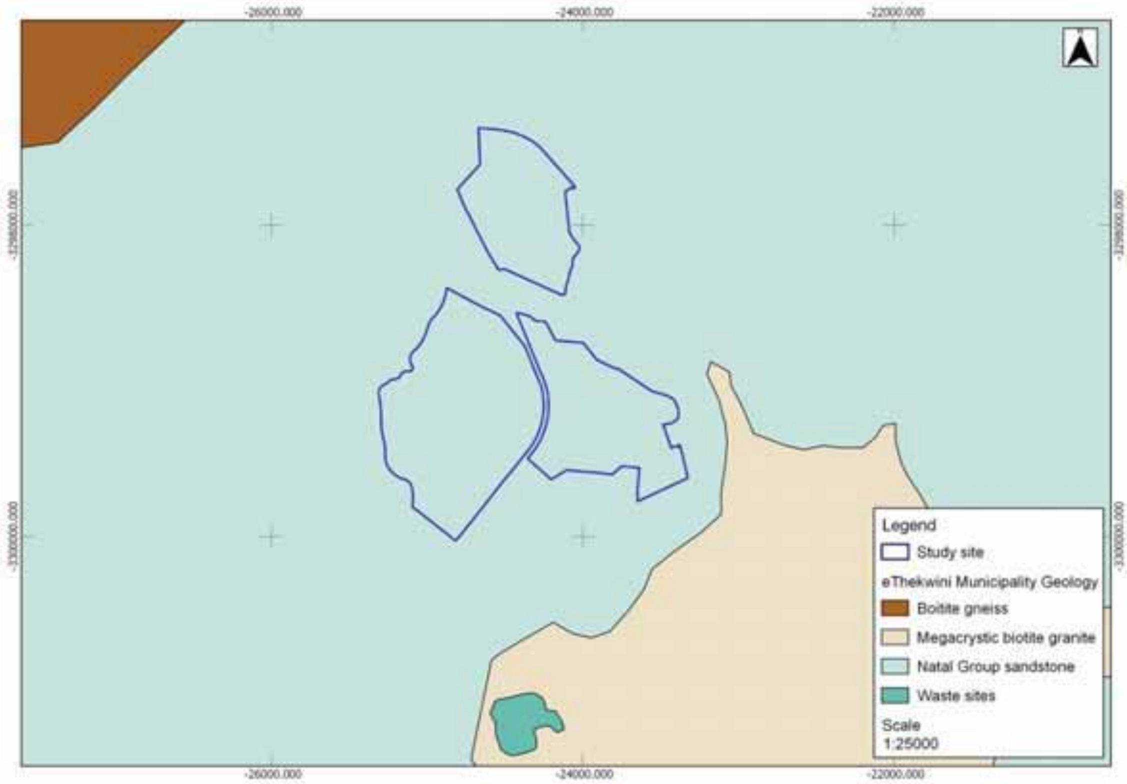


Figure 2-1 The geology of the study site
(eThekwini Municipality, n.d.)

2.4. Vegetation types

Under natural conditions the surrounding landscape and study site would have been characterised by particular vegetation types. The historical dominant vegetation type present would have been the KwaZulu-Natal Sandstone Sourveld (SVs5) followed by the Ngongoni Veld (SVs4), which fall under the Sub-Escarpment Savanna (SVs) bioregion (Nel *et al.,* 2011; Mucina and Rutherford, 2006).

The KwaZulu-Natal Sandstone Sourveld (SVs5) has been classified as having an 'endangered' conservation status, due to the lack of protection it receives. Of the remaining 32% only a small percentage (0.2%) is statutorily protected in reserves including Krantzkloof and Vernon Crookes Nature Reserves. This vegetation type extends from Mapumula to Port Shepstone, and commonly occurs at altitudes of 500-1 100m above sea level. The greatest threat to this vegetation type has been agriculture, forestry, and urbanization (Mucina and Rutherford, 2006).

The Ngongoni Veld (SVs4) has been classified as 'vulnerable', with less than 1% receiving formal protection. Approximately 61% remains, whilst the other 39% has been transformed by similar impacts as KwaZulu-Natal Sandstone Sourveld. Unlike the afore-mentioned vegetation type, this type stretches across KwaZulu-Natal and the Eastern Cape and generally occurs at altitudes of 400-900m above sea level.

2.5.Wetland classification

The South African National Biodiversity Institute (SANBI, 2009) has developed a wetland classification system for all wetlands in South Africa, allowing for the differentiation between the systems and the prioritisation of these systems either for conservation or management purposes. Various classification systems existed, however; South Africa lacked a broad classification system. The SANBI (2009) classification system categorises the wetland systems according to their abiotic features (main biophysical drivers) of these systems, which influences the functionality of the wetlands.

The definition of a wetland, particularly relating to this classification system has to be understood. The definitions informing the classification system included:

- "*Areas of marsh, fen, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed six metres*"[2]
- *"Land which is transitional between terrestrial and aquatic systems, where the water table is usually at, or near the surface, or the land is periodically covered with shallow water and which land in normal circumstances supports, or would support, vegetation adapted to life in saturated soil*."[3]

The result was SANBI's adapted version for the definition of a wetland (SANBI, 2009):

- *"An area of marsh, peatland or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water the depth of which at low tide does not exceed ten metres."*

The SANBI classification system uses a hierarchical system based on six levels to differentiate between the various wetland types, with the first level dividing wetlands according to their system (*e.g.* marine, estuarine or inland systems) and the sixth level grouping the wetlands according to their wetland characteristics, namely geology, natural vs. artificial, vegetation cover type, substratum, salinity and acidity/alkalinity.

[2] Ramsar Convention (Davis, 1994)
[3] National Water Act (Act No. 36 of 1998)

In terms of the assessment of ecosystem functioning and health, the fourth level classifies wetland systems based on the principles of the hydrogeomorphic (HGM) approach (Ewart-Smith *et al.*, 2006) with eight primary HGM unit types:

- Channel (river, including the banks);
- Channelled valley-bottom wetland;
- Unchannelled valley-bottom wetland;
- Floodplain wetland;
- Depression;
- Flat;
- Hillslope seep; and
- Valleyhead seep (SANBI, 2009).

For the purpose of this study the HGM unit classification in Kotze *et al*. (2007) was used to classify the wetland systems into six different HGM units (**Appendix 1**) and assess the systems. The HGM unit types defined by Kotze *et al*. (2007) differ from the SANBI (2009) types, with the river classification being excluded and flat wetlands being grouped with the depression wetlands. According to LRI (2007), unchannelled valley-bottom wetlands are present within the study sites (**Table 2-1**). .

Table 2-1 A description of the wetlands based on the SANBI classification to Level 4

System (Level 1)	Bioregion (Level 2)	Landscape Unit (Level 3)	HGM Unit (Level 4)	Description of HGM Units (Kotze *et al*, 2007)
Inland systems	Sub-Escarpment Savanna Bioregion	Valley Floor landscape units	**Valley-bottom**	
			Unchannelled	Valley-bottom areas with no clearly defined stream channel usually gently sloped and characterised by alluvial sediment deposition, generally leading to a net accumulation of sediment. Water inputs mainly from channel entering the wetland and also from adjacent slopes.

2.6. Threat status of the wetlands

The wetland type, as described in **Section 2.5**, falls within the Sub-Escarpment Savanna bioregion. Based on the wetland and vegetation types, and the level of protection these systems receive, the ecosystem threat status can be assessed (Nel *et al*., 2011). **Table 2-2** depicts the HGM units found within the study site and the corresponding threat status.

Table 2-2 HGM units classified according to their threat status and level of protection (adapted from Net *et al.,* 2011 and Macfarlane *et al.,* 2012)

Wetland Type (WT) / HGM Unit	Ecosystem Threat Status (ETS) per WT	Level of Protection (WT)	ETS per Wetland Vegetation Group
Unchannelled valley-bottom wetland	Critically Endangered (CR)	Not Protected (NP)	CR

For the wetland type the ecosystem threat status is considered to be 'critically endangered'. This is mostly related to minimal protection this vegetation unit receives and the level of transformation that has occurred historically, as is evident within the study site. It should be noted that Ezemvelo KZN Wildlife (2009) makes reference to the fact that transformed systems, such as the systems within the study site, would need to be assessed taking into consideration the level of degradation. The rehabilitation of transformed wetland systems allows for the provisioning of wetland habitat that previously was non-existent.

2.7. National Freshwater Ecosystem Priority Areas

The National Freshwater Ecosystem Priority Areas (NFEPA) is a tool that has recently been developed to assist in the conservation and sustainable use of South Africa's freshwater ecosystems, including rivers, wetlands and estuaries. The maps and supporting documentation offer a comprehensive suite of information promoting suitable water resource planning. In addition, they provide a spatial overview of these systems, assisting in the implementation of the National Water Act, the Biodiversity Act and the Protected Areas Act (Nel *et al.,* 2011).

The freshwater ecosystems have been classified according to their Present Ecological State (A-F & Z categories). Wetlands are classified as 'AB', 'C', and 'DEF' or 'Z' (**Table 2-3**); dependent on whether the systems are considered to be in good, moderately modified or heavily modified condition, respectively (Nel *et al.,* 2011). These categories have not been based on field data, as there is a lack of such data at a national scale. Thus, the process modelled the ecological categories to serve as a guideline to inform the selection of NFEPA wetlands.

Table 2-3 Description of NFEPA wetland condition categories
(Nel *et al.,* 2011)

PES equivalent	NFEPA condition	Description	% of total wetland area*
Natural or Good	AB	Percentage natural land cover ≥ 75%	47
Moderately modified	C	Percentage natural land cover 25-75%	18
Heavily to critically modified	DEF	Riverine wetland associated with a D, E, F or Z ecological category river	2
	Z1	Wetland overlaps with a 1:50 000 'artificial' inland water body from the Department of Land Affairs: Chief Directorate of Surveys and Mapping (2005-2007)	7
	Z2	Majority of the wetland unit is classified as 'artificial' in the wetland locality GIS layer	4
	Z3	Percentage natural land cover ≤ 25%	20

*this percentage excludes unmapped wetlands, including those that have been irreversibly lost at a national level

According to the available NFEPA wetlands coverage, none of the wetland HGM units onsite were classified as NFEPA wetlands, most likely due to their altered nature. However; the HGM unit within Site 2 drains into a NFEPA river, the Wekeweke Stream (**Figure 2-2**). The condition of this system is considered to be 'AB', and therefore should be maintained at this level. The natural vegetation recorded within portions of the river system is most likely the reason for this classification. To provide more detailed information on the Wekeweke Stream, a riparian assessment has been undertaken on the system (GroundTruth, 2013) assessing the present ecological state of the system and the ecological importance and sensitivity. The results of the assessment informed the recommendations relating to the potential development of Site 2 and its associated buffers, stormwater management and site specific rehabilitation.

Figure 2-2 View of NFEPA systems and their classification

3. STUDY TEAM

The project team consisted of two team members, with experience in the assessment of wetland habitats within KwaZulu-Natal (**Table 3-1**).

Table 3-1 Team members, roles, experience levels and qualifications

Wetland Practitioner	Role in the Study	Experience Levels	Qualifications
Craig Cowden	• Conducting the infield wetland assessments • Review of the wetland assessments • Compilation of the project report	14 years' experience, with input into various wetland studies, including: • Delineation, • Assessments, • Rehabilitation planning and • Mitigation & offset requirements	B.Sc. (Agric) Pr.Sci.Nat - Ecology
Fiona Eggers	• Conducting the infield wetland assessments • GIS mapping • Conducting the wetland assessments • Compilation of the project report	3 years' experience with input into various wetland studies: • Delineation, • Assessments, and • Mitigation & offset requirements	M.Sc (Botany)

4. STUDY METHODOLOGY

The following methodology was adopted to inform the assessment of the wetland habitat potentially impacted upon by the proposed development.

4.1. Site visit

A site visit was conducted on the 11th October 2012, informed by the LRI (2007) wetland mapping. The site visit served to verify the current level of ecological integrity and ecosystem services provided by the wetland habitat potentially impacted upon by the proposed development.

4.2. Assessment of wetland functioning and condition

The assessment of the potential impacts of the proposed development was derived by evaluating the level of ecosystem functioning and ecological integrity/condition of the identified wetlands within each of the proposed development site boundaries, as outlined in the following sections.

4.2.1. Assessment of wetland functioning

At the outset of the assessment, the wetland systems identified during the original delineation study were classified as specific hydrogeomorphic (HGM) units. To quantify the level of functioning of the wetland systems, and to highlight their relative importance in providing ecosystem benefits and services at a landscape level, a WET-EcoServices (Kotze *et al.,* 2007) assessment was performed for each HGM unit. The WET-EcoServices assessment technique focuses on assessing the extent to which a benefit is being supplied by the wetland habitat, based on both:

- The opportunity for the wetland to provide the benefits; and
- The effectiveness of the particular wetland in providing the benefit.

Ecosystem services, which include direct and indirect benefits to society and the surrounding landscape, were assessed by rating various characteristics of the wetland and its surrounding catchment, based on the following scale:

- Low (0);
- Moderately Low (1);
- Intermediate (2);
- Moderately High (3); and
- High (4)

The scores obtained from these ratings for the wetland HGM units were then incorporated into WET-EcoServices scores for each of the fifteen ecosystem services (**Table 4-1**):

Table 4-1. Ecosystem services supplied by wetlands
(Kotze *et al.,* 2007, p14)

Ecosystem services supplied by wetlands	**Indirect benefits**	**Regulating and supporting benefits**	Flood attenuation		The spreading out and slowing down of floodwaters in the wetland, thereby reducing the severity of floods downstream
			Stream flow regulation		Sustaining stream flow during low flow periods
			Water quality enhancement benefits	Sediment trapping	The trapping and retention in the wetland of sediment carried by runoff waters
				Phosphate assimilation	Removal by the wetland of phosphates carried by runoff waters
				Nitrate assimilation	Removal by the wetland of nitrates carried by runoff waters
				Toxicant assimilation	Removal by the wetland of toxicants (e.g. metals, biocides and salts) carried by runoff waters
				Erosion control	Controlling of erosion at the wetland site, principally through the protection provided by vegetation
			Carbon storage		The trapping of carbon by the wetland, principally as soil organic matter
	Direct benefits	**Biodiversity maintenance**			Through the provision of habitat and maintenance of natural process by the wetland, a contribution is made to maintaining biodiversity
		Provisioning benefits	Provision of water for human use		The provision of water extracted directly from the wetland for domestic, agricultural or other purposes
			Provision of harvestable resources		The provision of natural resources from the wetland, including livestock grazing, craft plants, fish, etc.
			Provision of cultivated foods		The provision of areas in the wetland favourable for the cultivation of foods
		Cultural benefits	Cultural heritage		Places of special cultural significance in the wetland, e.g. for baptism or gathering of culturally significant plants
			Tourism and recreation		Sites of value for tourism and recreation in the wetland, often associated with scenic beauty and abundant birdlife
			Education and research		Sites of value in the wetland for education or research

While Wet-EcoServices assists in identifying the importance and sensitivity of specific wetlands, it is recognised as having limitations in terms of:

- Quantifying specific impacts linked to development or changes within the landscape; and
- Accounting for the size of the wetland and ecosystem services strongly associated with the size of the systems.

4.2.2. Assessment of wetland condition/integrity

To determine the level of ecological integrity, a WET-Health (MacFarlane *et al.*, 2007) assessment was performed for each HGM unit within each of the sites. The WET-Health assessment technique gives an indication of the deviation of the systems from the wetlands' natural reference condition for the following biophysical drivers:

- Hydrology - defined as the distribution and movement of water through a wetland and its soils;
- Geomorphology - defined as the distribution and retention patterns of sediment within the wetland; and
- Vegetation - defined as the vegetation structural and compositional state.

The impacts on the wetlands, determined by features of the wetlands and their catchment, were scored based on the impact scores and then represented as Present State Categories as outlined in WET-Health (**Table 4-2**).

Table 4-2 Impact scores and present state categories for describing the integrity of wetlands (MacFarlane *et al.*, 2009)

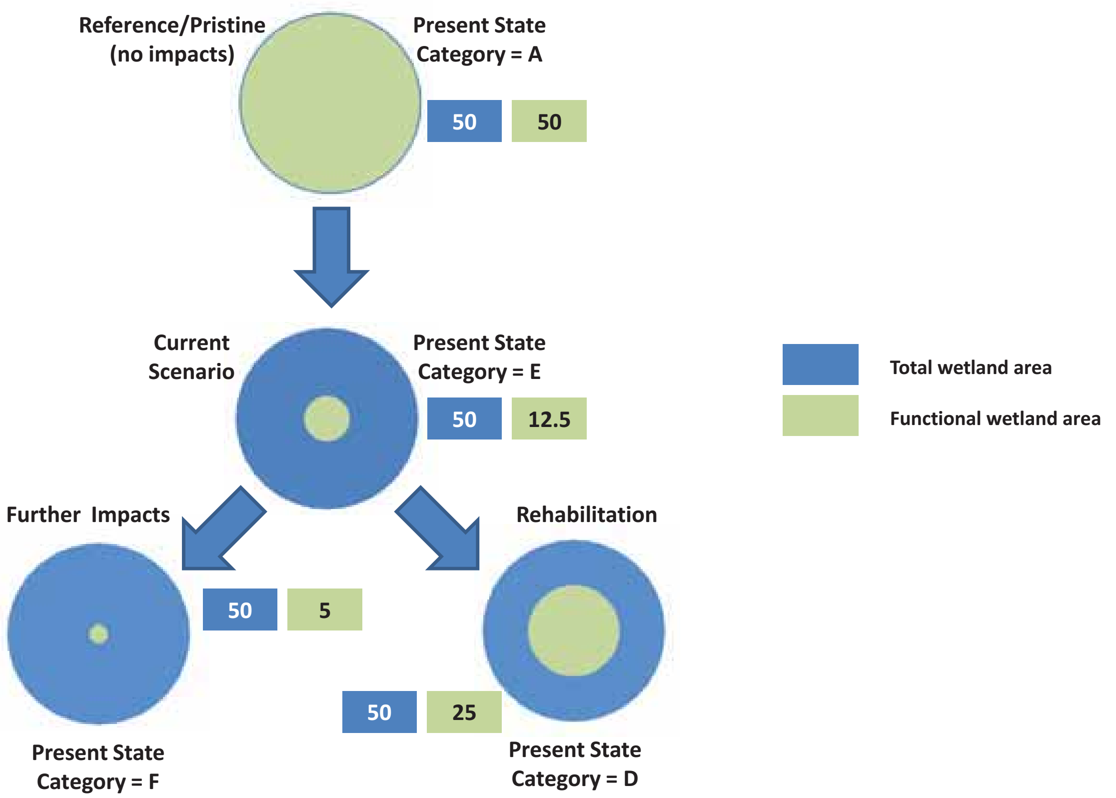
Impact Category	Description	Impact Score Range (0-10)	Present State Category
None	Unmodified, natural.	0-0.9	**A**
Small	Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1-1.9	**B**
Moderate	Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact.	2-3.9	**C**
Large	Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4-5.9	**D**
Serious	The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6-7.9	**E**
Critical	Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8-10	**F**

The scores for hydrology, geomorphology and vegetation were simplified into a composite impact score, using the predetermined ratio of 3:2:2 (MacFarlane *et al,* 2007), respectively for the three components. The composite impact score was used to derive a health score that then provided the basis for the calculation of hectare equivalents (also referred to as functional area), which can be described as the health of a wetland expressed as an area. Cowden & Kotze (2007) make use of a simple example to explain the concept of hectare equivalents conceptually illustrated in **Box 4-1**.

Box 4-1. Example of the use of hectare equivalents to represent changes in wetland health.

The assessment of wetland health is based on comparisons to a reference state *i.e.* where the wetland's health is unmodified and the functional area of wetland is equivalent to the full extent of the system. For example, if the health of a 50ha wetland is 100% (*Present State Category=A*) this equates to 50 hectare equivalents. In many instances the current scenario for a particular system reflects some form of historical degradation. If the abovementioned wetland was *seriously* degraded, the health would be reduced from the reference state to 25% (*reflecting a wetland health score of 2.5*); a drop in hectare equivalents from 50 to 12.5 (50ha x 0.25) hectare equivalents would be recorded. The following would therefore be expected if the wetland in the above scenario was subject to the following two future options:

a) Further degradation of the wetland linked to development, with the system's health being further reduced to 10% would result in a drop in hectare equivalents to 5 hectare equivalents; and
b) Rehabilitation of the wetland habitat, with the system's health being increased to 50% would result in a gain in hectare equivalents to 25 hectare equivalents.



NOTE:
The sizes of the circles are directly related to the extent of wetland habitat and functional wetland area in the landscape

5. ASSUMPTIONS AND LIMITATIONS

Studies that focus on the potential impacts of a proposed development rely on various assumptions, with the following assumptions being made during the assessment of these particular wetland systems:

- The reference benchmark vegetation of the wetlands on site is considered to be predominantly Sandstone Sourveld (SVs5) followed by the Ngongoni Veld (SVs 4) (Mucina and Rutherford, 2006), and sedge meadow.
- The bioregion is considered to be Sub-Escarpment Savanna (SVs) (Nel *et al.,* 2011), which has been classified as being critically endangered.
- For the purpose of this study, it is considered that the proposed development layouts as supplied by THD (**Figure 1-1**) were the final development plans. However; should the development layouts be altered, the assessment of the potential impacts on the wetland habitat will have to be revisited to incorporate these changes.
- The extent of wetlands as determined in the delineation undertaken by LRI in 2007 was used for the assessment of wetlands within the potential development sites.
- The hectare equivalent calculations relating to functional wetland area in the development sites accounts for the entire extent of the HGM units in the landscape (*i.e.* including wetland areas that extend beyond the study site).
- It is assumed that the wetland/riparian habitat within the development sites will be appropriately rehabilitated.
- The retained wetland habitat would be appropriately re-vegetated to include a suitable mix of wetland plant species to promote functioning and biodiversity.
- An alien plant control programme would be implemented and maintained within the development site.
- Monitoring of the wetland rehabilitation and management will be undertaken.

The following limitations apply to the studies undertaken for this report:

- It should be noted that this report describes the mitigation of impacts associated with the development using hectare equivalents. Whilst mitigation may be best practice within an international context, the implementation of such activities in South Africa is limited and various approaches and techniques may be considered appropriate to validate that “no-net-loss” is evident within the region.
- The wetland assessment techniques used in this study were developed relatively recently and in some instances, such as highly modified/transformed systems, they may have shortfalls. These techniques, however, have been compiled based on international best practice to apply to South African conditions, undergoing a peer-review process during their development. These assessment techniques should therefore, be seen as the most appropriate tools for wetland assessments at this time.
- For the purpose of this study only the HGM units within the study site boundaries were assessed.
- The assessment of the wetland systems’ ecological integrity includes catchment conditions and it should be noted that changes in the HGM units catchments, beyond those linked to the development, would have an adverse effect on the systems’ integrity.

6. STUDY RESULTS

The results of the assessment of the wetland ecosystems within the study area are outlined in the following sections.

6.1. Characteristics of the freshwater ecosystems

The freshwater ecosystems associated with the study area, comprise unchannelled valley-bottom wetlands. The wetlands within Sites 1 and 3 drain into the uMhlatuzana River, whilst Site 2 drains into the Wekeweke Stream (**Figure 6-1**).

Figure 6-1 View of the study sites and the wetland habitat identified by LRI

Site 1 is positioned between the M13 regional road to the north and N3 National Highway in the south. This site is characterised by a steep catchment and four unchannelled valley-bottom wetland systems. The four HGM units cover an area of approximately 12ha within the study site that is approximately 53 ha in extent. All of the HGM units drain into the uMhlatuzana River, which is generally in a poor condition. The river and the adjacent wetland habitat are heavily infested with alien vegetation, including *Eucalyptus sp*, *Acacia mearnsii* (black wattle), *Melia azedarach* (syringa), *Populus sp etc*. These wetlands are fed by surface and sub-surface water inputs. Other than the alien invasive plant species, the wetlands are impacted by the infrastructure within the catchment, the sugarcane in the catchment and the wetlands, and its associated waterways and road network.

Site 2 is on the southern side of the N3 national highway, and to the west of Kassier Road. The unchannelled-valley bottom wetlands are approximately 6.7 ha in extent, whilst the study site is approximately 160 ha, including the development layout and portions of the buffer zone. The catchment has been extensively modified through the cultivation of sugarcane, which extends into portions of the HGM units. The extensive road network associated with the agricultural practices, which transect the wetlands, contributes towards additional water inputs into the systems and the impoundment of flows upstream of the roads. Although these systems have not been classified as being nationally important, they nevertheless, drain into a National Freshwater Ecosystem Priority Area (NFEPA) river, namely the Wekeweke stream (see **Section 2.5**). Development within Site 2 would therefore require appropriate mitigation measures to reduce the impacts on this adjacent wetland system.

Site 3 is also located on the southern side of the N3 national highway, to the east of Kassier Road, and is characterised by five unchannelled valley-bottom wetlands of approximately 9.5 ha in size and draining into the uMhlatuzana River. The study site is approximately 81 ha in extent. As with the other sites, sugarcane cultivation has taken place within portions of the wetland habitat and the catchment area. These wetlands are also fed by surface and sub-surface water inputs, with additional water entering the site from the adjacent Denny Mushrooms infrastructure. These additional water inputs have resulted in the artificial expansion of the wetland habitat onsite. Since the delineation of the site in 2007, it appears as though the wetland habitat in this area has expanded, although this was not verified infield.

6.2. Wetland ecological functioning

The general features of the HGM units were assessed in terms of the ecosystem functioning at a landscape level for the current scenario. Due to the similar characteristics of the catchments and systems, the HGM units within each site were assessed as a single wetland complex. This was repeated for each of the sites. The score for each ecosystem service represents the likely extent to which that benefit is being supplied by the specific wetland and was interpreted based on the following rating outlined by Kotze *et al.* (2007):

- <0.5 Low
- 0.5-1.2 Moderately low
- 1.3-2.0 Intermediate
- 2.1-2.8 Moderately high
- >2.8 High

Generally the HGM Units within Site 1 are supplying ecosystem services at an ***Intermediate*** level (**Figure 6-2** and **Table 6-1**). The HGM units are considered to be important in terms of enhancing water quality within the landscape and contributing towards flood attenuation. The importance of these wetlands in terms of enhancing water quality is linked to the high opportunity that exists as a result of the potential for elevated levels of pollutants to be introduced to the systems, rather than as a result of the effectiveness of the wetlands at providing these services. The effectiveness of the wetlands, in terms of enhancing water quality, has been greatly reduced by the transformation of the systems for agriculture and the encroachment of alien invasive plant species. The modified nature of the wetlands limits their integrity in terms of biodiversity and therefore limits the systems’ ability to provide undisturbed wetland habitat within the landscape. The systems’ provision of direct benefits and services, such as harvestable natural resources and use for education, is limited due to the wetlands' location on privately-owned property.

Generally, the wetlands within Site 2 are supplying ecosystem services at ***Moderately High*** levels (**Figure 6-2** and **Table 6-1**). The HGM units are considered to be important in terms of enhancing water quality within the landscape, and contributing towards flood attenuation. The importance of these systems in terms of enhancing water quality is linked to the high opportunity that exists as a result of the potentially elevated level of pollutants that could be introduced to the system, rather than as a result of the effectiveness of the wetlands providing this service. The effectiveness of the wetlands, in terms of enhancing water quality, has been greatly reduced by the transformed nature of the systems particularly relating to the agricultural activities within the systems and their catchments and the encroachment of alien invasive plant species. Biodiversity maintenance was recorded as ***High***, primarily due to the presence of proportionally more natural vegetation and the NFEPA classification of the downstream system. The modified nature of these systems would usually limit their ability to provide undisturbed wetland habitat within the landscape, but this is offset by the noteworthiness linked to the NFEPA classification of the Wekeweke stream. For phosphate trapping, nitrate and toxicant removal, ***Intermediate*** levels of service delivery were recorded. As for Site 1, the systems provision of direct benefits and services is limited due to the wetlands location on privately-owned property.

Generally, the HGM units within Site 3 are supplying ecosystem services at an ***Intermediate*** level (**Figure 6-2** and **Table 6-1**). The HGM units are considered to be important in terms of enhancing water quality within the landscape. The importance of these wetlands in terms of enhancing water quality is linked to the high opportunity that exists as a result of elevated levels of pollutants being introduced to the systems through the agricultural practices, the septic tank soak-away from the staff quarters, and the neighbouring Denny Mushroom facilities, rather than as a result of the effectiveness of the wetlands at providing these services. The effectiveness of the wetlands, in terms of enhancing water quality, has been greatly reduced by the transformation of the systems. The modified nature of the wetland systems limits their integrity in terms of biodiversity and therefore limits the systems' ability to provide undisturbed wetland habitat within the landscape. As for the other sites, the systems' provision of direct benefits and services is limited.

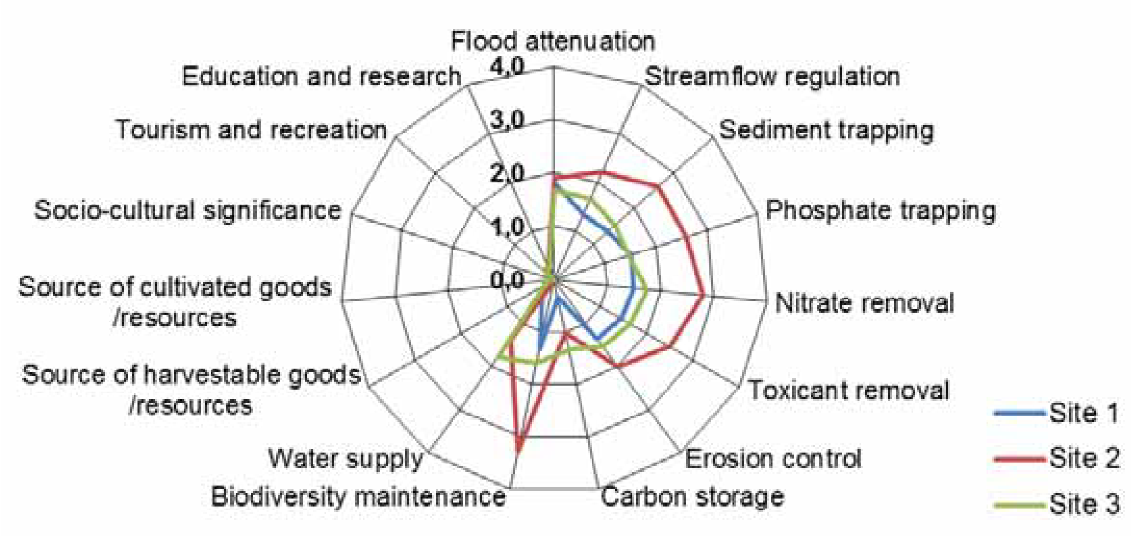


Figure 6-2 Graphic representation of the wetland ecosystem services for each of the sites

Table 6-1 Summary of Ecosystem Services Scores[4] for each of the sites

Ecosystem Services	Site 1	Site 2	Site 3
Flood attenuation	1.8	1,9	1.7
Score for effectiveness:	*1.4*	*1,7*	1.7
Score for opportunity:	*2.2*	*2,0*	1.5
Stream flow regulation	1.3	2,2	1.5
Sediment trapping	1.4	2,6	1.8
Score for effectiveness:	*0.7*	*1,9*	1.6
Score for opportunity:	*2.0*	*3,3*	1.5
Phosphate trapping	1.5	2,6	1.3
Score for effectiveness:	*1.7*	*2,5*	1.6
Score for opportunity:	*1.3*	*2,7*	1.8
Nitrate removal	1.5	2,8	0.2
Score for effectiveness:	*2.0*	*2,6*	0.2
Score for opportunity:	*1.0*	*3,0*	0.0
Toxicant removal	1.4	2,5	0.3
Score for effectiveness:	*1.5*	*2,4*	0.3
Score for opportunity:	*1.3*	*2,7*	1.7
Erosion control	1.4	2,0	1.7
Score for effectiveness:	*1.3*	*2,0*	1.5
Score for opportunity:	*1.5*	*2,1*	1.5
Carbon storage	0.3	1,0	1.8
Biodiversity maintenance	1.3	3,3	1.6
Score for noteworthiness:	*2.0*	*3,3*	1.5
Score for integrity:	*0.6*	*2,0*	1.3
Water supply	0.4	1,4	1.6
Source of harvestable goods /resources	0.0	0,0	1.8
Source of cultivated goods /resources	0.2	0,0	0.2
Socio-cultural significance	0.0	0,0	0.2
Tourism and recreation	0.0	0,1	0.0
Education and research	0.3	0,3	0.3

[4] Where applicable the scores for opportunity and effectiveness have been presented to ensure understanding of effectiveness of the system due to its modified state.

6.3. Wetland ecological condition/integrity assessment results

The ecological integrity or Present Ecological State (PES) of the HGM units associated with the development sites was assessed for the hydrology, geomorphology and vegetation components. The integrity of the biophysical components of the wetlands was assessed for the current scenario to guide the selection of the preferred site for the proposed development. The results for the three components for each of the sites and a summary are outlined in the following sections. The results for all sites are summarized in **Table 6-2** (detailed scores are included in **Appendix 1**).

Table 6-2 Summary of the overall area weighted ecological integrity scores of the wetlands per site for the current scenario

		Hydrology	Geomorphology	Vegetation
Site 1	**Impact Score**	7.5	3.4	9.6
	PES Category	**E**	**C**	**F**
Site 2	**Impact Score**	7.0	2.5	8.0
	PES Category	**E**	**C**	**F**
Site 3	**Impact Score**	6.4	2.2	9.0
	PES Category	**E**	**C**	**F**

Description	Impact score	Present state category
Unmodified, natural.	0 – 0.9	**A**
Largely natural with few modifications. A slight change in ecosystem processes is discernible and a small loss of natural habitats and biota may have taken place.	1 – 1.9	**B**
Moderately modified. A moderate change in ecosystem processes and loss of natural habitats has taken place but the natural habitat remains predominantly intact	2 – 3.9	**C**
Largely modified. A large change in ecosystem processes and loss of natural habitat and biota has occurred.	4 – 5.9	**D**
The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable.	6 – 7.9	**E**
Modifications have reached a critical level and the ecosystem processes have been modified completely with an almost complete loss of natural habitat and biota.	8 – 10	**F**

6.3.1. Assessment of impacts on hydrology

The impact scores recorded for the hydrological component for all of the sites was generally greater than **6**, translating into a Present Hydrological State (PHS) category of **E** – “The change in ecosystem processes and the loss of natural habitat and biota is great but some remaining natural habitat features are still recognisable”. The modifications to the wetlands’ PHS are linked primarily to the following factors:

- Site 1:
    - Canalized flows through portions of the wetland, linked to the waterways which are currently eroding with two headcut erosional features recorded within the systems;
    - Extensive sugarcane cultivation within the wetland habitat;
    - Alien invasive vegetation within the wetland habitat, increasing the direct uptake of water; and
    - Altered water flows into the wetlands linked to catchment changes.
- Site 2:
    - Canalised flows through the wetlands, linked to the channels that extend through the majority of the HGM Units;
    - The infilling of a portion of the wetlands due to roads that cross or are directly adjacent to the HGM units; and
    - Altered water flows into the wetlands linked to catchment changes.
- Site 3:
    - Canalised flows through the wetland, linked to the channel that extends through the length of the main HGM Unit.
    - The infilling of a portion of the wetland linked to access roads through the HGM Unit;
    - Alien invasive vegetation within the wetland habitat, increasing the direct uptake of water;
    - Additional water inputs into the wetlands, from the septic tank soak-away at the staff accommodation, and water discharged into the HGM units from Denny Mushrooms facilities; and
    - Altered water flows into the wetlands linked to catchment changes.

6.3.2. Assessment of impacts on geomorphology

The impact score recorded for the geomorphic component for all of the sites was generally greater than **2**, translating into a Present Geomorphic State (PGS) category of **C** – “Moderately modified. A moderate change in geomorphic processes has taken place but the system remains predominantly intact.” In this instance the modifications to the wetlands’ PGS were evident due to impacts linked primarily to the following factors within all three sites:

- The extent of the identified erosional features or channel incision within specific HGM units;
- Infilling of portions of the wetland habitat resulting in the deactivation of downstream areas; and
- Altered water flows into the wetlands linked to catchment changes.

6.3.3. Assessment of impacts on vegetation

The impact score recorded for the vegetation component for all of the sites was greater than **8**, translating into a Present Vegetation State (PVS) category of **F** – "Vegetation composition has been totally or almost altered, and if any characteristic species still remain, their extent is very low." The modifications to the wetlands' PVS are linked primarily to the following factors:

- Site 1:
    - Complete removal of wetland vegetation through the cultivation of sugarcane;
    - Encroachment of alien invasive vegetation into portions of the wetland habitat; and
    - Erosion through a portion of the wetland habitat.
- Site 2:
    - Removal of areas of wetland vegetation through the cultivation of sugarcane; and
    - Infilling of a portions of the wetland habitats, thus removing the wetland vegetation entirely;
- Site 3:
    - Almost complete removal of wetland vegetation through the cultivation of sugarcane;
    - Encroachment of alien invasive vegetation into portions of the wetland habitat and catchment; and
    - Infilling of a portion of the wetland habitat, thus removing the wetland vegetation entirely.

6.3.4. Overall ecosystem integrity

The historical activities at each of the sites have resulted in modifications to the systems' ecological integrity. For ease of interpretation the scores for hydrology, geomorphology and vegetation are able to be simplified into a composite score for the entire wetland complex by area-weighting the scores obtained for the individual HGM units, as outlined in Macfarlane *et al.* (2007). These scores were then used to derive hectare equivalents, which were used as the 'currency' for assessing the loss and gains in wetland integrity (Cowden & Kotze, 2009; Kotze & Ellery, 2009).

Based on the current PES score for Site 1, the approximately 12 ha of wetland habitat, is considered to be the equivalent to 3.64 ha of intact wetland habitat (**Table 6-3** and **Figure 6-3**). The graphical representation of the functional wetland area versus the total extent of the wetland habitat onsite, clearly illustrates that the wetland habitat within Site 1 is only functioning at approximately 31% (**Figure 6-3**).

Table 6-3. Site 1: Ecological integrity and hectare equivalents

Site 1			
	Hydrology	Geomorphology	Vegetation
Area weighted impact scores	7.5	3.4	9.6
PES Categories	E	C	F
Overall Impact Score	6.93		
Overall PES Category	E		
Hectares of Wetland	11.86		
Hectare Equivalents	3.64		

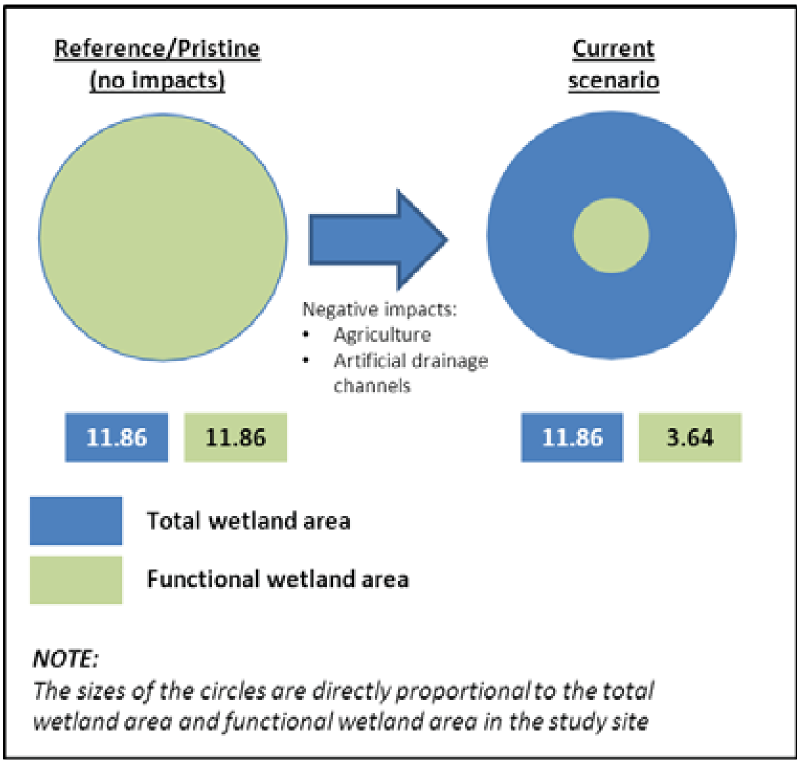


Figure 6-3 A graphic representation of the wetland habitat within Site 1, in terms of both spatial extent and functional area, comparing the reference conditions to the current scenario.

Based on the current PES scores for Site 2, the approximately 6.7 ha of wetland habitat, is considered to be the equivalent to 2.7 ha of intact wetland habitat (**Table 6-4** and **Figure 6-4**). The graphical representation of the functional wetland area versus the total extent of the wetland habitat onsite, clearly illustrates that the wetland habitat within Site 2 is only functioning at approximately 40% (**Figure 6-4**).

Table 6-4. Site 2: Ecological Integrity and Hectare Equivalents

Site 2			
	Hydrology	**Geomorphology**	**Vegetation**
Area weighted impact scores	7.0	2.5	8.0
PES Categories	E	C	F
Overall Impact Score	**6.0**		
Overall PES Category	E		
Hectares of Wetland	**4.0**		
Hectare Equivalents	**2.7**		

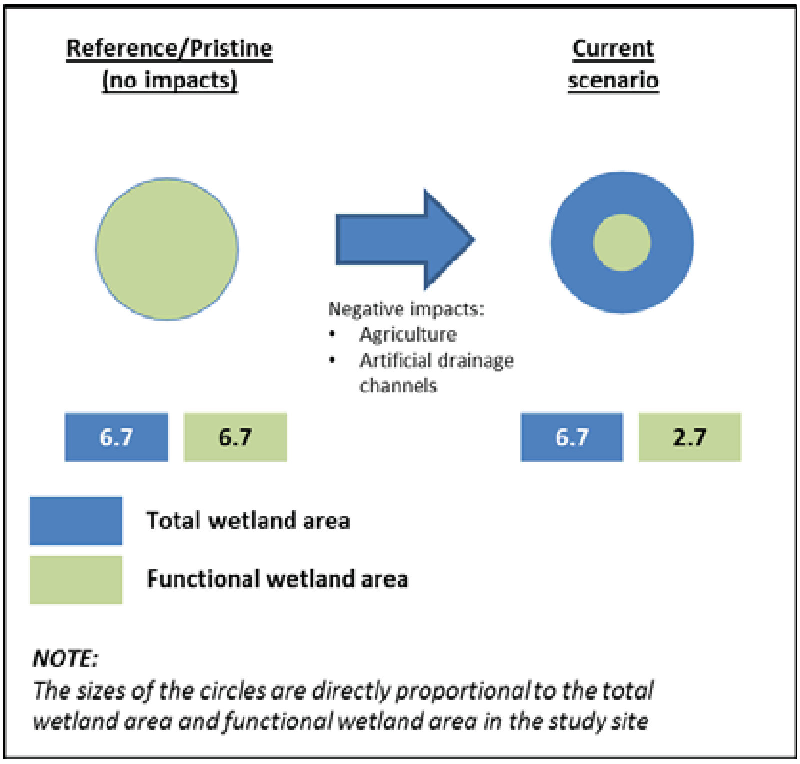


Figure 6-4 A graphic representation of the wetland habitat within Site 2, in terms of both spatial extent and functional area, comparing the reference conditions to current scenario.

Based on the current PES score for Site 3, the approximately 9.5 ha of wetland habitat, is considered to be the equivalent to 3.92 ha of intact wetland habitat (**Table 6-5** and **Figure 6-5**). The graphical representation of the functional wetland area versus the total extent of the wetland habitat onsite, clearly illustrates that the wetland habitat within Site 3 is only functioning at approximately 41% (**Figure 6-5**).

Table 6-5. Site 3: Ecological integrity and hectare equivalents

Site 3			
	Hydrology	Geomorphology	Vegetation
Area weighted impact scores	6.4	2.2	9.0
PES Categories	E	C	F
Overall Impact Score	5.94		
Overall PES Category	D		
Hectares of Wetland	9.67		
Hectare Equivalents	3.92		

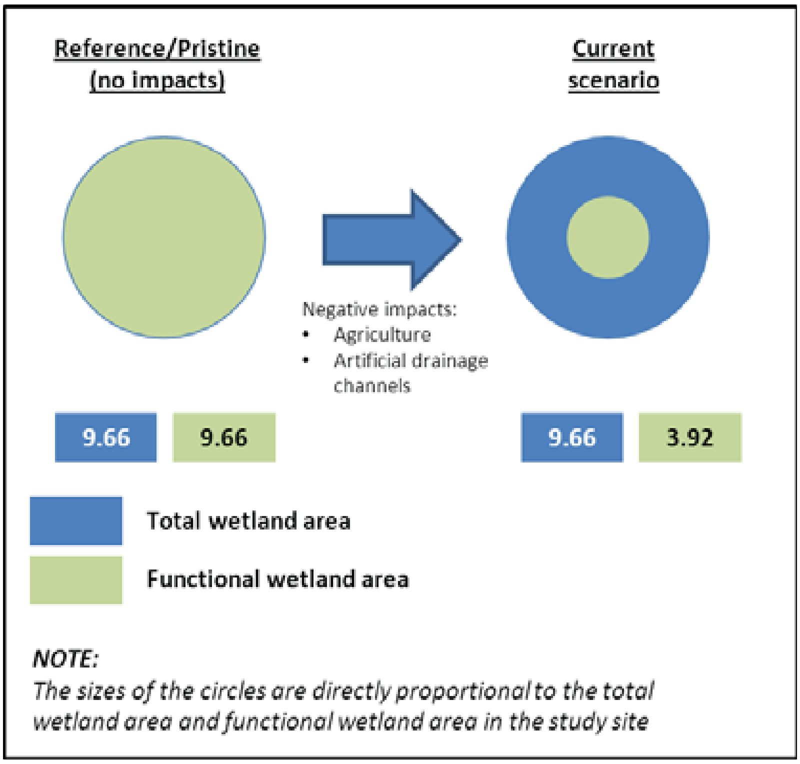


Figure 6-5 A graphic representation of the wetland habitat within Site 3, in terms of both spatial extent and functional area, comparing the reference conditions to current scenario.

7. DEVELOPMENT SITES & RECOMMENDATIONS

It is evident from each of the development layouts that each of the layouts aims at retaining portions of the identified wetland habitat as open space (**Figure 7-1**). However, each layout includes encroachment into the wetland habitat in order to accommodate the proposed developments. Site 1 currently has 11.85 ha of wetland onsite, whilst the proposed open space of the development layout is 16.14 ha, including a buffer zone around the wetlands, and the direct loss of an entire HGM unit. Site 2 has approximately 6.7 ha of wetland within the study site boundaries, whilst the open space is approximately 28.66 ha in extent, incorporating the Wekeweke Stream and the buffer around portions of the wetland and riparian habitat. However, approximately 1.4ha of wetland habitat will be lost as a result of the proposed development, which is generally undesirable, if unmitigated, considering the wetlands onsite drain into a NFEPA stream. Site 3 has approximately 9.5 ha of wetland onsite, with the proposed development layout accommodating an area of 15.1 ha of open space. This area again includes a buffer around the wetlands, and the destruction of the small wetland in the northern portion of the site. For each of these sites, especially Site 2, the impacts on the wetland systems and downstream riparian habitat would have to be appropriately managed to ensure the integrity of the wetland and riparian habitats are not impaired.

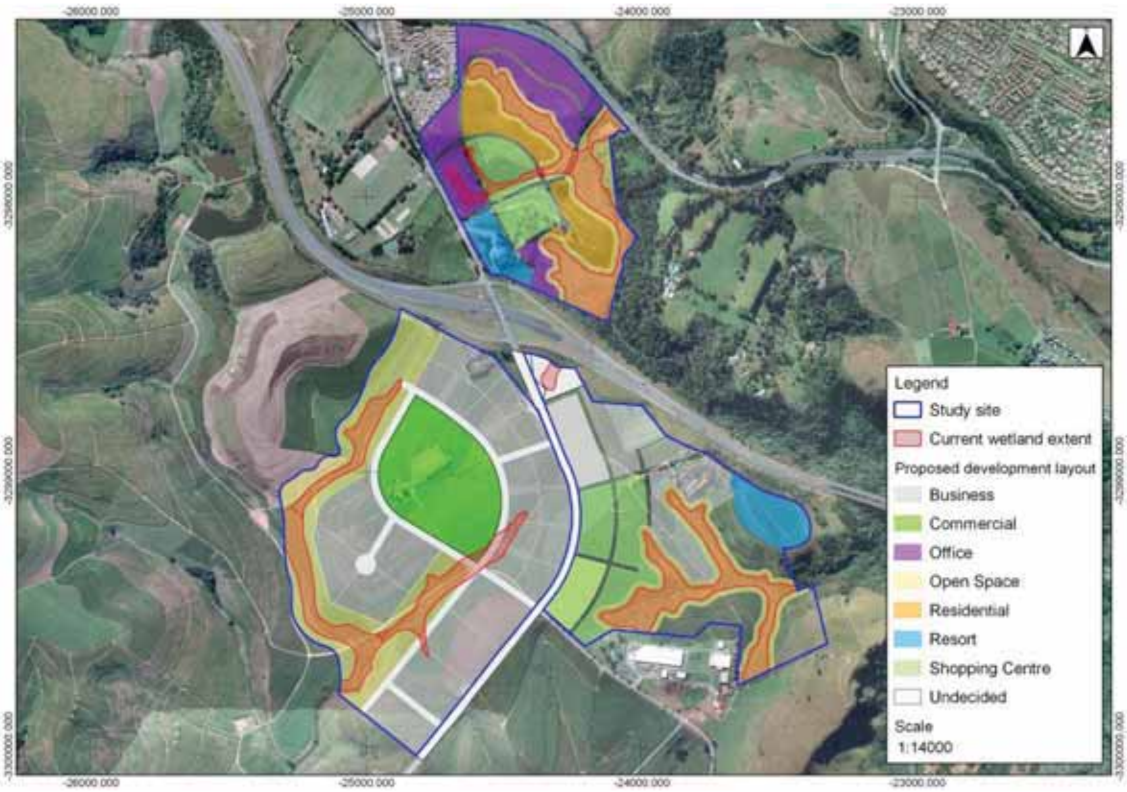


Figure 7-1 View of the current wetland habitat onsite and the proposed development layouts for each of the sites

7.1. Development sites overview

The landscape context and the actual functional area of the wetlands versus the extent of the wetland habitat are important to consider when finalising the layout of the proposed developments. **Table 7-1** and **Figure 7-2** provide an overview of each of the sites.

Table 7-1 Comparison of the wetland habitat extents versus functional area for each site

	Site 1	Site 2	Site 3
Actual wetland area (ha)	11.85	6.74	9.66
Functional area (ha)	3.64	2.70	3.92
Functional area (%)	31%	40%	41%

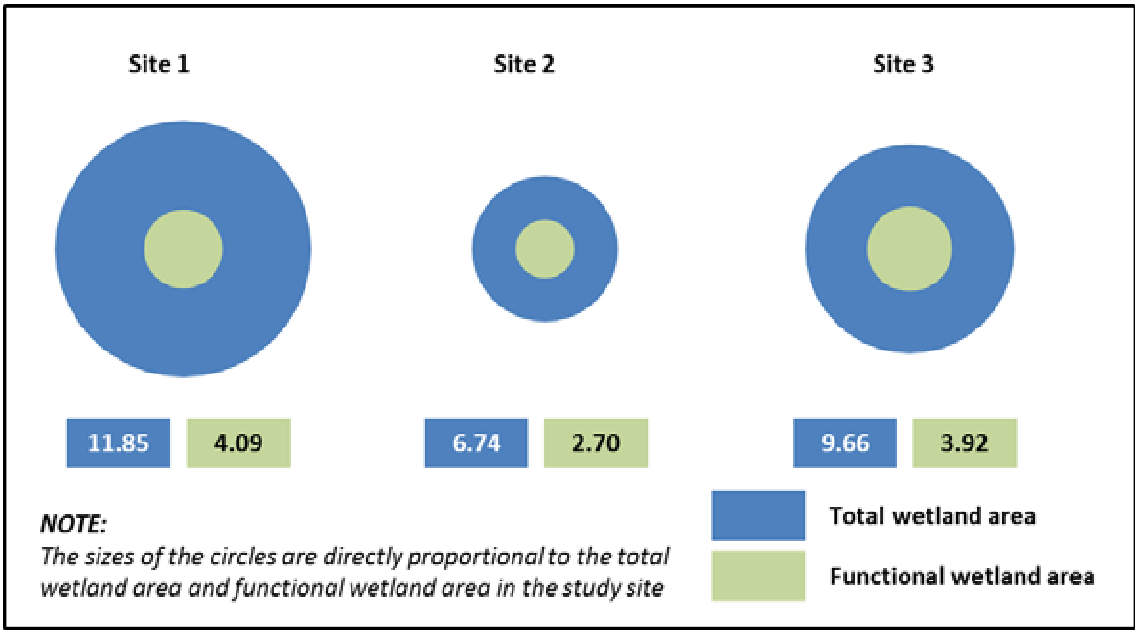


Figure 7-2 A graphic representation of the wetland habitats per site, in terms of both spatial extent and functional area for the current scenario

It is noted that in the future all three sites will be developed with similar land uses but that the current focus is the proposed retail development, with Site 2 being the preferred site. This wetland assessment is therefore assesses the wetland impacts of development layouts proposed for each site, but focuses more on Site 2 in terms of mitigation of impacts

Despite the limited area of functional wetland habitat within the site, the unmitigated development of Site 2 is unfavourable due the NFEPA classification of the Wekeweke stream. However, development within this system's catchment could be appropriately managed to ensure the impacts on the Wekeweke stream are negligible and there are no adverse effects downstream of the development site. The detailed assessment of the riparian habitat and the fauna and flora within the Wekeweke Stream (GroundTruth, 2013a), highlights the importance of both an appropriate buffer, in this instance a minimum of 32m [5],

[5] It should be noted that this is subject to confirmation that specific buffer requirements are not required for the protection of Red Data frog species, which requires additional frog surveys, as highlighted in GroundTruth (2013a).

from the riparian habitat, and retaining functional wetland habitat between the development and the stream, to mitigate potential impacts from the development within Site 2.

Therefore, in order for the development (as currently proposed in accordance with the layout) to be considered within Site 2, the following is a prerequisite:

1) Adoption and rehabilitation of a minimum 32m buffer from the boundary of the riparian habitat of the Wekeweke Stream adjacent to the site;
2) Rehabilitation of the riparian habitat adjacent and downstream of Site 2 as discussed by GroundTruth (2013a);
3) Implementation, rehabilitation and management of the variable buffer zones adjacent to the wetland habitat reflected in the supplied layout; and
4) Rehabilitation of the remaining areas of wetland habitat within and directly adjacent to the site (GroundTruth, 2013b).

It is anticipated that impacts on the wetland habitat within Site 1 and 3 could be balanced with the appropriate rehabilitation and enhancement of the remaining wetland areas *i.e.* onsite mitigation. Of concern for Site 1 and 3 is the loss of effective wetland area within the landscape, eliminating the possibility of future rehabilitation and the reversal of historical degradation. The development within either of these sites must be carefully managed to ensure the impacts on the remaining wetland habitat are minimised. However; the adoption of the above-mentioned mitigation measures for Site 2 should be taken into consideration for the other two sites, even though the wetland habitats do not drain into a NFEPA stream.

7.2. Recommendations

Considering the loss of wetland habitat within KwaZulu-Natal, it is recommended that the planning and implementation of the proposed development should adopt a 'no-net-loss' approach, without any further loss in functioning and integrity of the natural freshwater ecosystems. This would require the appropriate rehabilitation of the wetland and/or riparian habitat on the selected site, the adoption of appropriate buffer zones and management practices to protect the systems and enhance their functioning where possible.

7.2.1. Wetland rehabilitation[6]

In order to mitigate the impacts of the proposed development layout on the identified wetland ecosystems, rehabilitation of the remaining areas of wetland habitat within and directly adjacent to the development site would be required. The rehabilitation of the wetland habitat would include the following activities:

- Rehabilitating the remaining areas of the valley-bottom wetlands adjacent and within the development site, promoting the effectiveness and opportunity for the system to provide benefits and services, including:
    - Deactivation of any drainage channels and the incised channel, promoting more frequent overtopping of the channel across the wetland habitat and where appropriate diffuse flow;

[6] Refer to GroundTruth (2013b), a detailed wetland rehabilitation plan for Site 2.

  - Maximising the extent of the seasonal and permanent wetness zones within the wetland habitat; and
  - Eradication of alien invasive plant species within the wetland.
- Active re-vegetation of the wetland habitat with appropriate wetland species, promoting biodiversity, emergent vegetation and nutrient uptake.

7.2.2. Buffer zones

To reduce impacts on the receiving ecosystems, the developments should incorporate an appropriate buffer zone from the edge of the freshwater ecosystems to protect the systems from further degradation. For Site 2, a recommended buffer distance of at least 32m surrounding the riparian habitat is required, but is subject to confirmation that specific buffers are not required for Red Data frog species (GroundTruth, 2013a). In addition, the remaining areas of wetland habitat within and adjacent to Site 2 should also be buffered in accordance with the variable buffer reflected in the development layout. A minimum buffer distance of 20m is recommended for the other two development sites (Sites 1 and 3). The assessment of the wetland habitats and their associated buffer zones must be reviewed prior to the development of these sites.

The above-mentioned buffers would generally only be considered appropriate if the following best management practices for buffer zones were adopted to further promote the protection of the wetland systems:

- Rehabilitation of the buffer zone, with the removal of alien invasive vegetation species; and the active replanting of indigenous plants, to ensure a **DENSE**, undisturbed vegetative community;
- Ideally, the establishment of indigenous vegetative cover within the buffer should take place prior to the implementation of construction activities to filter runoff before it enters the wetland habitat (Valparaiso City, 2004). However, if practical limitations exist to achieve this, the existing vegetation should be maintained to fulfil the buffer role during the construction phases. This would require a commitment from the developer to undertake the rehabilitation of the buffer zone upon completion of the construction activities;
- Enforcement and management of the buffer zone to ensure that there is no encroachment that would reduce the efficacy of the buffer zone; and
- On-going maintenance of the buffer zone including the wetland and riparian habitats.

7.2.3. Storm water runoff

To limit the impacts of storm water runoff on the freshwater ecosystems the discharge of storm water runoff into the identified systems should be managed by means of:

- Multiple discharge points that are reasonably spread out across the development adjoining the wetland habitat;
- The erosional features within the wetland habitat would need to be appropriately stabilised to ensure that no further erosion of the systems occurs, especially from water entering the erosion features from the adjacent slopes;

- Flow through the buffer zone should be via diffuse flow and concentrated flow should be avoided (Cornelius-Carolina, 2004; Valparaiso City, 2004). This would assist in reducing the concentration of flows and hence the risks of erosion and further degradation of the receiving environments;
- Accompanying each discharge point should be suitable baffle structures (*e.g.* gabion mattresses) that will dissipate the energy of storm flow and encourage infiltration thus reducing the likelihood of erosion;
- The runoff entering the buffer zone should not exceed 1.5m/sec as this is considered to reduce the pollutant removal performance of the buffer area (Valparaiso City, 2004);
- Stormwater may not be discharged directly into the Wekeweke Stream, but should be directed into the rehabilitated tributary wetlands; and
- It is also recommended that these outflow points incorporate a best management practice approach to trap excess suspended solids and other pollutants originating from the proposed development before entering the buffer zones. These will need to be regularly serviced and maintained to ensure adequate functioning and efficacy.

In this instance, the identified wetland systems are considered to be largely dominated by groundwater inputs, and thus the infiltration of storm water is essential in maintaining these systems. This may be achieved through appropriate stormwater management including but not limited to porous pavements, grassed swales, and infiltration trenches and basins within the wetlands catchments.

8. WETLAND MAINTENANCE

The management of the surrounding landscape would need to be modified to promote the functioning and integrity of the remaining wetland habitat. The management would also need to incorporate the maintenance of the rehabilitation interventions within the wetland area. A significant component of the maintenance would be to monitor the effectiveness of the interventions, potentially including weir, chute, and/or earthen berms. The management recommendations within the following section have been derived from Ezemvelo KZN Wildlife's Biodiversity Stewardship programme guideline documents (Kotze & Cowden, 2009; Camp & McCulloch, 2009).

8.1.Management

The above-mentioned guidelines include recommendations for burning and grazing, within wetland habitat. Wetlands rely on the removal of excess plant material at regular intervals to promote plant productivity and maintain habitat value for wetland dependent species (Kotze & Cowden, 2009). Generally, the removal of plant material is achieved using fire. Kotze & Cowden (2009) recommend the following approach to the regular defoliation of the wetland area, either by burning or brush-cutting in this instance:

- The defoliation of the wetland areas would need to be integrated into the overall plan, including the adjacent buffer zones;
- The interval for defoliation of the wetland areas should be every 2 to 3 years;
- The wetland area should be divided into two blocks, with each half being cleared alternately, leaving remnant habitat in the area for wetland dependant species;
- The implementation of burns should:
    - Promote cool, patchy burns by burning when relative humidity is high and air temperatures are low;
    - Promote head fires (with the wind) rather than back burns (against the wind); and
    - Be delayed to the following year if the conditions are not favourable in terms of achieving the abovementioned criteria.

8.2.Control of emerging alien invasive plant species

Emerging alien invasive plant species clearing will have to take place with the initial rehabilitation of the systems, after which follow-up activities are required to eradicate emerging seedlings or coppicing stumps. The implementation of follow-up operations is essential in order to reach ***maintenance levels*** in terms of controlling alien invasive plants within the development site.

It is recommended that the follow-up alien plant clearing activities adopt the following approach:

- Manual activities, including hand-pulling of seedlings, to reduce the risk of the translocation of herbicide;
- Frequent follow-up operations, with four operations being undertaken per year,
- The control of alien vegetation should take place indefinitely; and
- Where necessary foliar application of herbicide to emerging coppice.

9. CONCLUSION

Freshwater ecosystems, dominated by wetland characteristics, were identified within the development sites. The wetlands have been largely modified, with the alteration of the systems' integrity associated with historical disturbance linked to extensive agriculture, the construction of roads, and the encroachment of alien invasive vegetation. As discussed, all three sites will ultimately be developed with similar land uses in the future, but the current focus is the proposed retail development, with Site 2 being the preferred site. The site characteristics and the integrity of the wetlands onsite were taken into consideration during the assessment of the wetland habitats within each site.

Within Site 2, the wetland habitat drains directly into the Wekeweke Stream, a NFEPA system. However, development within this system's catchment could be appropriately mitigated by:

- Avoiding the riparian habitat associated with the Wekeweke stream;
- Retaining functional wetland habitat within the tributaries to provide natural buffering between the development and the stream, to mitigate potential impacts from the development;
- Incorporating appropriate buffer zones; and
- Rehabilitating the wetland and riparian habitat in accordance with a formalised plan.

Impacts on the wetland habitat within Site 1 and 3 could potentially be balanced with the appropriate rehabilitation and enhancement of the remaining wetland areas *i.e.* onsite mitigation. Of the two sites, Site 1 results in a greater loss of wetland habitat in the post-development landscape in comparison to Site 3. However, the adoption of the above-mentioned Site 2 mitigation measures for Sites 1 and 3, would not only serve to mitigate the potential impacts on uMhlatuzana River, but also contribute towards improved wetland habitat within the greater landscape. This is particularly desirable for Site 1, which will result in the greatest loss of wetland habitat.

To prevent further impacts on the wetland systems, linked to additional flows and to promote the assimilation of nutrients, specific planning and mitigation activities should be adopted to reduce the impacts associated with the proposed developments to ensure a "no-net-loss" in functioning and integrity of the freshwater ecosystems, including:

- Wetland rehabilitation and stabilisation of erosional features within the wetland habitat;
- Rehabilitation of the riparian habitat associated with all three sites;
- Implementation of the recommendations for Site 2, as described in the riparian assessment report (GroundTruth, 2013a);
- Adoption, rehabilitation and management of appropriate buffer zones;
- Appropriate storm water management; and
- Wetland and riparian habitat management, including alien invasive plant removal.

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11. APPENDICES

Appendix 1 - WET-Health Scores

Table A2-1 Ecological integrity of the wetland systems reflected as impact scores for Site 1

Site 1				
HGM Unit	Ha	Hydrology	Geomorphology	Vegetation
1	2.39	6.5	3.0	9.2
2	1.48	8.0	2.4	10
3	5.57	8.0	4.8	10
4	2.42	7.0	1.4	9.1
Area Weighted Impact Scores		7.5	3.4	9.6
PES Category		E	C	F

Table A2-2 Ecological integrity of the wetland systems reflected as impact scores for Site 2

Site 2				
HGM Unit	Ha	Hydrology	Geomorphology	Vegetation
1	4.09	7.0	3.3	7.4
2	2.65	7.0	1.3	9.0
Impact Scores		7.0	2.5	8.0
PES Category		E	C	F

Table A2-3 Ecological integrity of the wetland systems reflected as impact scores for Site 3

Site 3				
HGM Unit	**Ha**	**Hydrology**	**Geomorphology**	**Vegetation**
1	0.42	7.0	1.2	9.0
2	0.89	7.0	1.1	9.5
3	1.59	7.0	3.2	10
4	4.87	6.0	2.5	8.5
5	1.9	6.5	1.2	9.2
Area Weighted Impact Scores		**6.4**	**2.2**	**9.0**
PES Category		**E**	**C**	**F**

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Project Ref: GTW252/241013/01 24 October 2013

Mr. Rory Wilkinson
Tongaat Hulett Developments (Pty) Ltd
P.O. Box 22319
Glenashley
4022

Dear Rory

Re: Shongweni Bulk Water Supply Line

Further to your request to provide comments and recommendations regarding the proposed bulk water supply pipeline to serve Shongweni, the following comments and recommendations were based on a desktop review of available information. Available information included the extent of wetland habitat[1], the alignment of the proposed bulk water supply line[2], a previous study undertaken by GroundTruth (2013)[3], and experience in the area.

The following limitations apply to the review of the supplied information:

- This study was subject to the use of existing information to inform the discussions and recommendations. No site visit was undertaken as a component of the review;
- The extent of the identified wetland/riparian habitat was not verified and it assumed that the extent as supplied is representative of the current conditions onsite; and
- Recommended mitigation activities would be adopted in accordance with best practice to manage impacts on the identified freshwater ecosystems.

The wetland/riparian habitat along the proposed pipeline route (**Appendix 1**) has been altered through historical anthropogenic disturbances including *inter alia*, housing, sugarcane, infrastructure development, dams, *etc*. and have also been invaded by alien invasive vegetation. However, considering the loss of freshwater ecosystems within KwaZulu-Natal, it is recommended that the planning and implementation of the proposed pipeline adopt a 'no-net-loss' approach as far as possible, ensuring no further loss in functioning and integrity of the systems. This may be achieved through appropriate mitigation activities (described below), removal of alien vegetation and rehabilitation of the freshwater ecosystems.

[1] Undertaken by Land Resources International and supplied by Tongaat Hulett Developments.
[2] Supplied by Tongaat Hulett Developments.
[3] GroundTruth, 2013. Tongaat Hulett Developments: Shongweni Development Sites. Wetland study. Report No. GTW252-160813-01. GroundTruth, Pietermaritzburg.

State of the freshwater ecosystems

A desktop review of the freshwater ecosystems, potentially impacted upon by the proposed bulk water supply pipeline, was undertaken to establish the condition of the systems taking the following into consideration:

- The level of catchment modifications; and
- The level of change within the system based on:
    - Visible erosion;
    - Agricultural activities;
    - Damming of the systems;
    - Infrastructure development; and
    - Alien vegetation infestation.

The desktop review of the freshwater ecosystems highlighted that all of the systems have been highly transformed through agricultural practices and infrastructure development. Generally, the wetlands systems would be considered as '**Seriously**' modified and classed as '**E**' category systems in terms of the WET-Health (Macfarlane *et al*., 2007) integrity classes *i.e*. "The change in ecosystem processes and loss of natural habitat and biota is great but some remaining natural habitat features are still recognizable". The identified riparian habitat, specifically the uMhlatuzana River, is also considered to be modified in the vicinity of the pipeline alignment, which coincides with an existing road crossing.

Potential impacts

The impacts of the proposed bulk water supply pipeline are predominantly related to the construction phase of the pipeline. Therefore, the adoption of appropriate mitigation measures to limit the impacts on the freshwater ecosystems during the construction phase is essential. The likely impacts include the following:

- Direct impacts causing riparian and wetland habitat destruction,
    - Riparian bank and bed modification; and
    - Wetland hydrological impacts and alterations to flow patterns
- Impacts on water quality linked to construction activities and soil disturbance; and
- Impacts on water quality linked to the operational phase due to leaks and/or damage to the infrastructure.

Given that the majority of the systems are currently highly modified, these impacts can be largely controlled, mitigated and rehabilitated through appropriate and comprehensive mitigation measures and an environmental management plan (EMP), followed by prompt and appropriate rehabilitation of the crossings.

Construction phase impacts

Issues related specifically to construction within the wetland and riparian areas are as follows:

- The introduction of foreign materials to the system, such as fuel, cement and other building materials;
- Compaction of the wetland soils from heavy vehicles;
- Modifications to the wetlands, river banks and beds from the trenching process;
- Trench erosion and the diversion of subsurface flow as a result of preferential flow paths having been created;
- Risk of erosion forming upstream of the trench if infilling is not adequately compacted or the longitudinal slope of the wetland system is not maintained;
- Disturbance of vegetation and the encroachment on alien invasive or ruderal wetland plant species;

- The impoundment of flows upstream of the trenches and desiccation of the systems downstream of the trenching. These conditions could continue post-development depending on how effectively the area has been rehabilitated; and
- Direct loss of portions of the wetland and riparian habitat.

The crossing of the uMhlatuzana River may be problematic for machinery working in the systems as the flow of the river will need to be diverted while trenching across the river, and seepage from the upstream damming may enter the trench during construction. The EMP should therefore focus on defining a rapid approach to be adopted when trenching across this system to avoid potential impacts. Many of the riparian and wetland habitats are dominated by alien plants, with construction activities unlikely to impact on indigenous species and providing opportunity for localised removal of alien invasive vegetation and rehabilitation with indigenous plant species. Riparian plant species of conservation significance which may be located within the pipeline route would need to be taken into account by the Environmental Control Officer during implementation.

Operational phase impacts

Previous experience in these settings has highlighted the need to consider potential impacts on the freshwater ecosystems and the water resource associated with possible damage to the infrastructure during the operational phase. Based on the integrity of the identified freshwater ecosystems and the risks associated with the potential substantial water inputs associated with a burst pipe, additional or specific mitigation activities are recommended. These mitigation activities would aim to reduce the residual impacts on the wetland/riparian ecosystems.

Recommendations

The freshwater ecosystems identified along the length of the proposed bulk water pipeline have already been modified and the proposed construction activities are considered to pose a relatively low risk to the freshwater ecosystems' current integrity and functioning. However, damage and lack of maintenance of the infrastructure is of concern in terms of freshwater ecosystems and the water resource during the operational phase. Therefore, in some instances additional mitigatory measures may need to be implemented to further reduce the likelihood of residual and future impacts. These additional mitigation activities include the re-design and/or re-alignment of the infrastructure and in some instances adopting additional measures during the construction process. The details regarding these additional mitigation activities are described in the following sections from a best-case to worst-case scenario depending on the local circumstances and practical limitations onsite.

Buffer zones

To protect the freshwater ecosystems from impacts linked to the construction phase and potential leaks during the operational phase appropriate buffer zones should be adopted. Buffer zones are often determined as 'blanket' recommendations for all watercourses surrounded by a particular land use. Generally, buffers are adopted to protect ecosystems from physical disturbance and to protect the water resource from pollution within an altered landscape.

For example, the following buffer zones have been advocated for the following land uses:

- In an urban setting : 15m to 30m (KZN Department of Agriculture and Environmental Affairs, KZN Department of Water Affairs and Forestry, & Ezemvelo KZN Wildlife);
- In an agricultural setting : 10m from edge of the river (CARA, Act 84 of 1983)
- In an urban landscape : 30m (Gauteng Department of Agriculture, Conservation and Environment)
- In a rural landscape : 50m (Gauteng Department of Agriculture, Conservation and Environment)

For this project, the adoption of buffer zones may be difficult, considering the existing infrastructure restricting the alignment of the pipeline. It is however recommended that the infrastructure be planned beyond a 20m buffer where possible (**Appendix 1**). Where challenges are foreseen in this regard, it is recommended that the infrastructure be aligned adjacent to existing services, such as roads, within the freshwater ecosystems. This would be preferable to installing infrastructure in open or undeveloped portions of the systems.

Re-alignment of infrastructure

The alignment of the infrastructure within the freshwater ecosystems needs to be implemented taking into account the following recommendations:

- Where the proposed alignment of the infrastructure would be parallel to flow direction, the infrastructure should be realigned outside of the identified wetland or riparian habitat
- Where the proposed infrastructure crosses the wetland or riparian habitat, the following needs to be considered
    - Crossings should be aligned with existing infrastructure, such as roads or bridges,
    - Infrastructure should be positioned on the downstream side of a road crossing/dams to negate potential impacts linked to headward erosion and sub-surface impoundment of flow;
    - Where the infrastructure is unable to be aligned with existing services, the crossing should be planned at a narrow section and be perpendicular to the flow direction, minimising the amount of disturbance to the freshwater ecosystem and the risks of headward erosion

Prevention of sub-surface flow channel and erosion

In those instances where the alignment of the infrastructure would be unable to avoid the freshwater ecosystems, there would be a risk of erosion or the trench serving as a sub-surface flow channel, especially where a valley-bottom has a lateral slope draining towards the main channel. It is recommended that following additional mitigation measures be adopted:

- "Trench-breakers", which are in-trench barriers, should be installed along the length of the trench within the wetland to deactivate the flow of water along the trench;
- These barriers would be placed at head-to-toe intervals, where the top of downstream barrier "floods" to the base of next barrier upstream. The intervals of barriers are therefore determined by the slope of the wetland down the length of the trench;
- Traditionally, these barriers are constructed using a mix of cement, sand and in situ soil, but in this instance, where work will be within the wetland, it is recommended that the barriers be constructed using 20%bentonite and in situ soil mix or impermeable geotextile liners; and
- Small-scale diversion berms should be constructed on the surface of the trench, directly downstream of the "trench-breaker" to reduce the risk of the trench becoming a preferred surface flow path.

Specific mitigation during construction activities

The following mitigation measures specific to freshwater ecosystems should be added to any general recommendations made within the EMP:

- Excavate the crossings in the winter months as this is the driest period for this region;
- The crossings of the freshwater ecosystems should be perpendicular to the direction of flow;
- The crossings should be designed to ensure that flow patterns along the freshwater ecosystems are not altered or diverted potentially resulting in erosion;
- The crossings should be rehabilitated to ensure that no barriers exist within the stream and that in-stream habitat is similar to the natural situation;
- On steep slopes draining towards the identified freshwater ecosystems, small-scale diversion berms should be constructed on the surface of the pipeline alignment to reduce the risk of the pipeline becoming a preferred surface flow path leading to erosion;
- "Trench-breakers", which are in-trench barriers, should be installed along the length of the pipeline to minimise the interception and accumulation of water from the adjacent hillslope within the infilled trench;
- Remove the top 50cm of the wetland/riparian topsoil and stockpile this material during the construction period, to be replaced once activities have been completed. This is to maintain the existing seed bed and soil profiles as best as possible;
- During installation, the excavated soil from the trench should be placed on the upslope side of the trench, minimizing the risk of excess sediment entering the downstream areas of the freshwater ecosystems;
- The pipeline alignment should be rehabilitated, with the wetland and riparian habitat at the crossing points being restored to near-natural conditions. In addition, areas where disturbance adjacent to these ecosystems has occurred should also be rehabilitated. This should be done as soon as possible after the pipeline construction activities have ceased.
- The working servitude across the systems must be as narrow as practically possible. *i.e*. machinery must utilise the same route through the systems at all times so as to avoid unnecessary disturbance;
- In riparian areas, backfilling should occur as soon as possible, compact if possible and reshape river to original levels; and
- For the wetland crossings, it would be preferable if the alignment was within road reserves or downstream of the road crossings where possible, to
    - Minimise the risks of headward erosion and
    - Align the impacts of the pipeline with portions of the wetland habitat deactivated by road crossings.

Wetland rehabilitation and management

A number of opportunities exist for the rehabilitation of the wetland habitat due to the degree of modifications that have taken place. In order to further mitigate the potential impacts of the proposed line on the identified wetland ecosystems, rehabilitation of those areas of wetland habitat within the servitude would be required. The rehabilitation of the wetland habitat would include the following activities:

- Rehabilitating/enhance the wetland, promoting the effectiveness and opportunity for the system to provide benefits and services, including:
    - Eradication of alien invasive plant species within the wetland and study site.
    - Active re-vegetation of the wetland habitat with appropriate wetland species, promoting biodiversity, emergent vegetation and nutrient uptake.
    - The removal of excess vegetative material within the wetland at regular intervals (every 2-3 years depending on growth) to promote new growth and prevent the further encroachment of ruderal or weedy species.

Riparian rehabilitation and management

In order to mitigate the potential impacts of the proposed line on the identified riparian ecosystems, rehabilitation of those areas of riparian habitat associated with the uMhlatuzana River would be required. The rehabilitation of the riparian habitat would include the following activities:

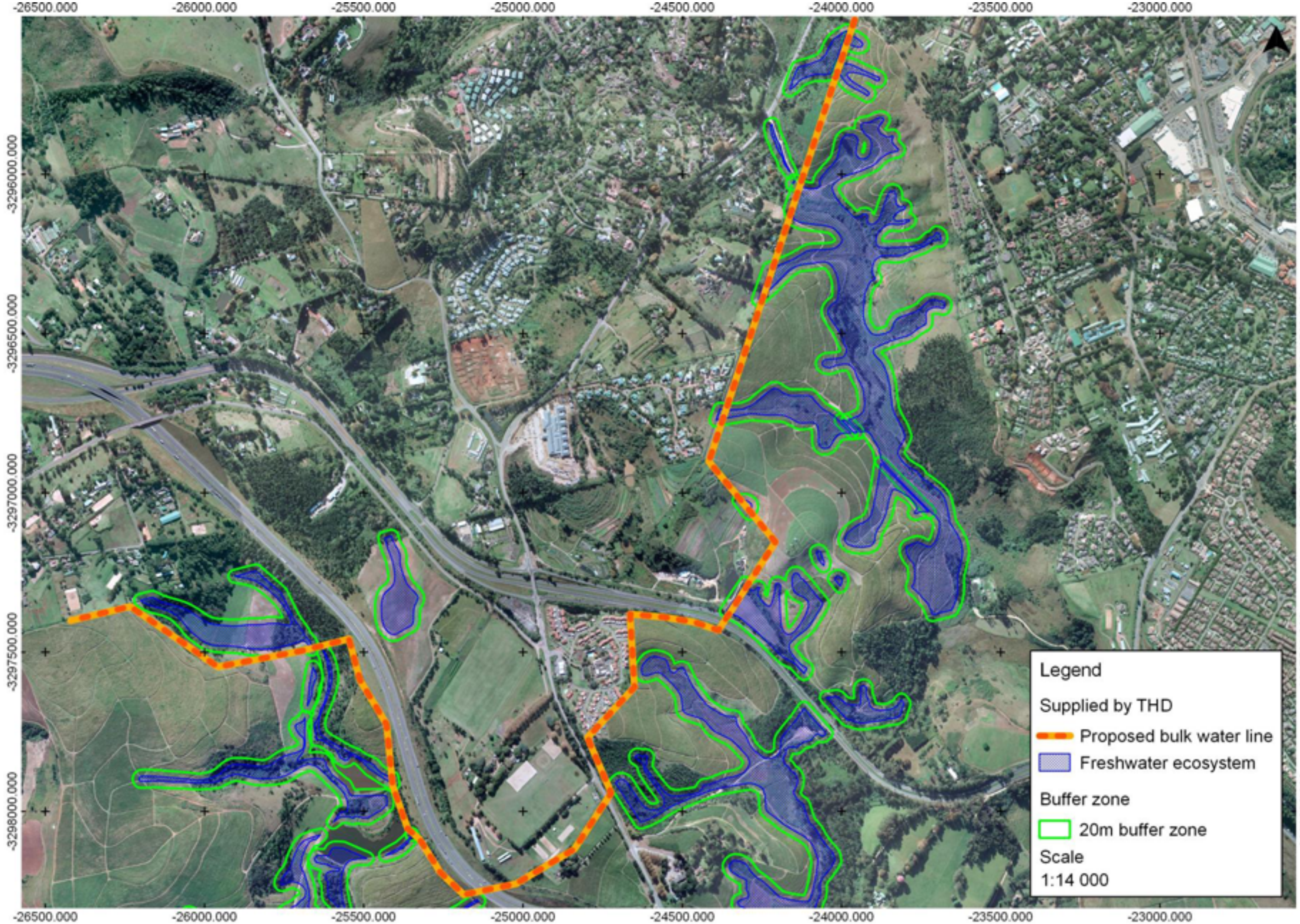
- The eradication and control of alien invasive plant species;
- Active re-vegetation of the riparian habitat with appropriate riparian species, promoting biodiversity:
- The re-vegetation of the of the channel banks with appropriate indigenous woody vegetation is required.

Please contact us should you have any further queries.

Yours faithfully

Craig Cowden
Ecologist
Pr.Sci.Nat

Appendix 1: Overview of proposed bulk water line and proposed buffer zones



APPENDIX 10:

RIPARIAN ASSESSMENT REPORT FOR TONGAAT HULETT DEVELOPMENTS: ASSESSMENT OF RIPARIAN ECOSYSTEMS AND SENSITIVE FAUNA AND FLORA ASSOCIATED WITH THE WEKEWEKE RIVER SYSTEM FOR THE PROPOSED SHONGWENI REGIONAL RETAIL/COMMERCIAL DEVELOPMENT (GROUNDTRUTH)

Riparian Assessment Report

Tongaat Hulett Developments:

Assessment of Riparian Ecosystems and Sensitive Fauna and Flora Associated with the Wekeweke River System for the Proposed Shongweni Regional Retail/Commercial Development

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Date: **August 2013**

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[1] Project deliverables (including electronic copies) comprise *inter alia:* reports, maps, assessment and monitoring data, ESRI ArcView shapefiles, and photographs.

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1. INTRODUCTION

1.1 Project description and background

GroundTruth Water, Wetlands and Environmental Engineering (GroundTruth) was appointed by Tongaat Hulett Developments (THD) to carry out a specialist riparian ecosystem assessment along the Wekeweke River system, adjacent to the proposed Shongweni Regional Retail/Commercial Development Site in Shongweni, KwaZulu-Natal (Figure 1-1). The development site is predominately under sugarcane, but may affect the Wekeweke River to the south and west of the proposed development.

1.2 Objectives

The primary aim of this study is to assess the present status of the riparian ecosystems and habitats in the Wekeweke River system as well as to establish whether the system supports Red Data species flagged by the NFEPA and DWA PES/EIS databases. The following objectives were considered for achieving the overall aim:

- Determine the present ecological state (PES) of the Wekeweke River system.
- Determine the ecological importance and sensitivity (EIS) of the Wekeweke River system, including field surveys of Red Data plants and frogs that potentially occur in the system.
- Provide recommendations in terms of development constraints and opportunities; particularly to ensure impacts on ecological assets are limited and avoided where possible.
- Define appropriate buffer zones[2] around sensitive and important features so as to adequately protect natural assets within the study area.

1.3 Methodology

The abovementioned objectives were achieved by collecting desktop and on-site biotic data. This data was used to determine the presence of ecological assets (e.g. aquatic ecosystems, other important habitats, ecological corridors, etc.) within the study area, establish the presence of conservation important plant and frog species (e.g. rare, Red Data, protected, and other notable species), and highlight which areas are particularly important in terms of supporting such biota.

[2] Buffer zones are vegetated areas positioned between natural habitats, such as wetlands, and adjacent areas of various land use and serve to filter impacts, e.g. excessive runoff, sedimentation, contamination, nutrient loading, etc., arising from upslope land use activities (Graham and de Winnaar, *In Press*).

1.3.1 Desktop assessments

Data and literature relating to the freshwater aquatic ecosystems within the study area was sourced and used to identify and describe the study area. This was achieved using data from, *inter alia*, the Department of Water Affairs' most recent assessment of the Present Ecological State, Ecological Importance and Ecological Sensitivity (PES EI ES) of South African rivers, the vegetation types of South Africa classification system and map (Mucina and Rutherford, 2006) and National Freshwater Ecosystem Priority Area (NFEPA) information (Nel *et al.*, 2011).

1.3.2 Field-based assessments

Site visits were conducted in March 2013 to provide site-specific details in order to establish the actual status of the study area in terms of supporting Red Data species identified during the desktop assessment process, as well as to establish the present condition of the Wekeweke River system. Information obtained included the presence of ecological indicators (including alien invasive species) and conservation important plant and frog species, as well as any additional detail that may facilitate the overall study. Various study components assessed during the field-based investigations are outlined as follows:

- ***Vegetation survey:*** Vegetation was assessed on the 6 March 2013 by examining the various habitat types, identifying dominant plant species within these areas, and establishing the presence of *Gladiolus cruentus* (Critically Endangered) and *Hydrostachys polymorpha* (Vulnerable), which according to NFEPA and DWA PES/EIS, potentially occur along the Wekeweke River. Any additional flora features were also identified whilst investigating the aforementioned species.
- ***Frog surveys:*** Frog surveys were done over two days (20 and 21 March 2013) in key riparian and wetland sites within the system, primarily to determine the presence of *Afrixalus spinifrons* (Vulnerable) and *Hemisus guttatus* (Vulnerable), but also any other frogs that may be of importance. These surveys included active searching, net sampling and call identification techniques.
- ***Aquatic biomonitoring:*** Aquatic biomonitoring techniques were employed at a single site (-29.820249°S; 30.738160°E), downstream of the proposed development, to assess the present health and condition of the Wekeweke River system. Riparian Vegetation Assessment Response Index (VEGRAI), benthic diatoms and macro-invertebrates were sampled using the protocols prescribed by Kleynhans *et al.* (2007), Taylor *et al.* (2005) and Dickens and Graham (2002) respectively. These methods are used to determine the ecological condition of the Wekeweke River downstream of the proposed development and can be used to set post-development targets. Results from the benthic diatom and macro-invertebrate assessments were interpreted using Table 1-1 below.

Table 1-1: River Condition Classes for SASS version 5 for the Upper North Eastern Coastal Belt (Dallas, 2007) and SPI (Prygiel and Coste, 2000; Harding and Taylor, 2011)

Health Category	SASS Score [1]	SASS ASPT [2]	SPI [3]
Pristine	>180	>7.3	>17.0
Near Natural	>158	>6.8	>13.0
Moderately Modified	>118	>6.3	> 9.0
Significantly Modified	> 95	>5.6	> 5.0
Severely Modified	< 95	<5.6	< 5.0

[1] SASS Score – South African Scoring System (SASS) Score for macro-invertebrates
[2] SASS ASPT – South African Scoring System (SASS) Average Score Per Taxon for macro-invertebrates
[3] SPI – Species Pollution sensitivity Index for benthic diatoms

1.4 Study area

The study area is defined roughly by the Wekeweke River system between the N3 near Hillcrest and the waterfall where the Wekeweke River drops into the Shongweni Valley (-29.834235°S, 30.723304°E; Figure 1-1). The catchment is dominated by sugarcane and has distinct riparian and wetland zones present along the Wekeweke River.

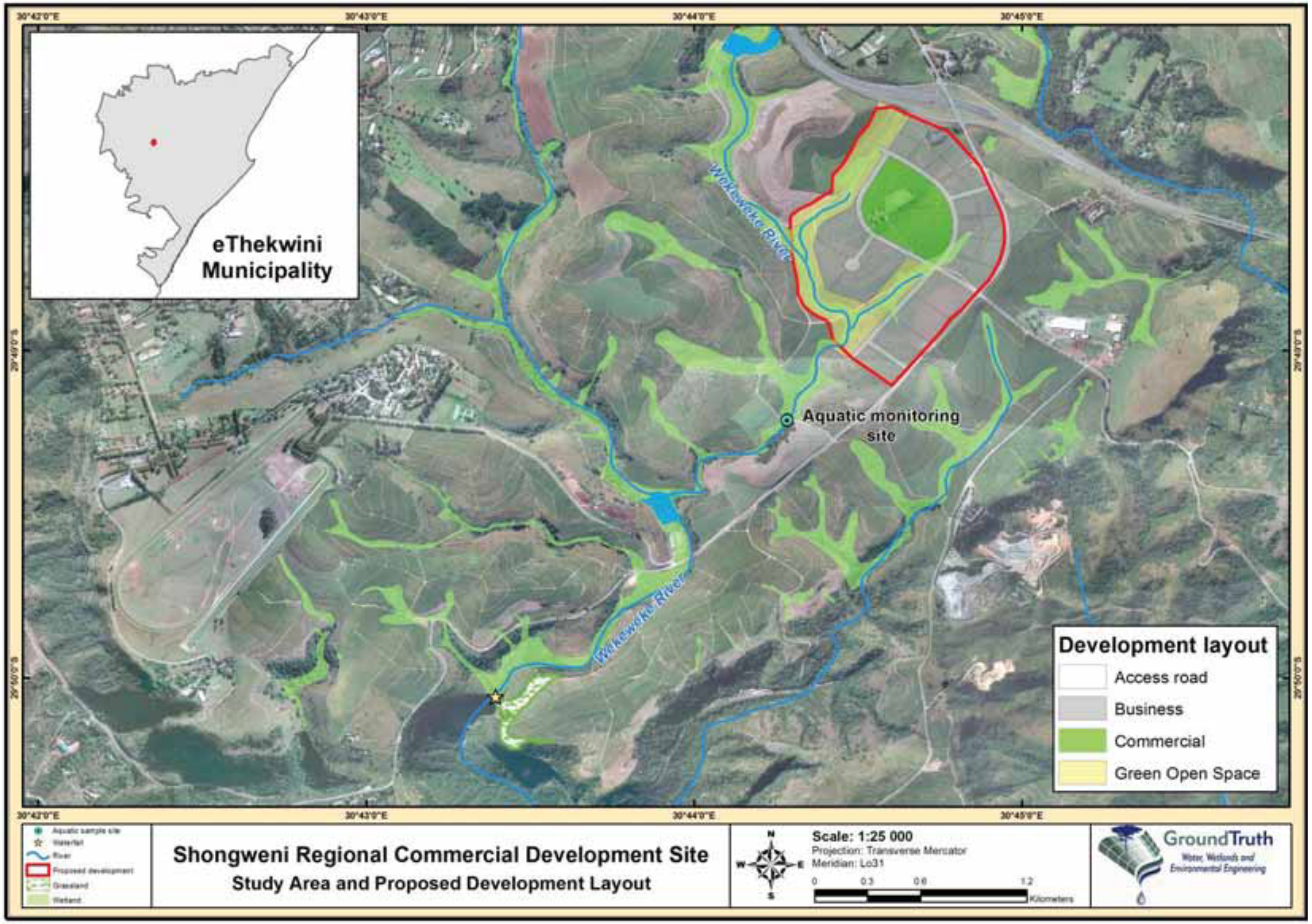

Figure 1-1: Overview of the study area and proposed development site

2. BACKGROUND REVIEW AND CONTEXT

2.1 Riparian system

The study area is located within the Wekeweke River catchment in water management area (WMA) 11, secondary catchment U6. This system has been classified in the latest Department of Water Affairs commissioned Present Ecological State, Ecological Importance and Ecological Sensitivity assessment as being in a “B category”, that is, “Largely natural with few modifications. A small change in natural habitats and biota may have taken place but the ecosystem functions are essentially unchanged.” (Kleynhans and Louw, 2008). This said, it was noted that sections of the system had instream dams and sections of the riparian zone that had been modified by the surrounding landuse and alien vegetation infestation. The Wekeweke system is also a National Freshwater Priority Area (NFEPA) river and is classified as a Freshwater Ecosystem Priority Area (Nel *et al*., 2011).

2.2 Riparian vegetation

Gladiolus cruentus (Critically Endangered) and *Hydrostachys polymorpha* (Vulnerable) could potentially occur in the Wekeweke River system (Nel *et al*., 2011). *Gladiolus cruentus* is a specialist plant that occurs on steep slopes and cliffs on seasonally wet sandstone associated with the Table Mountain series, similar to the habitat found at the tip of the escarpment where the river drops into the Shongweni valley. Similarly, *Hydrostachys polymorpha* is also likely to occur in the system where clean, turbulent water with high oxygen content.

2.3 Terrestrial vegetation

The study is located within the KwaZulu-Natal Sandstone Sourveld vegetation type within the Sub-Escarpment savannah Bioregion (Mucina and Rutherford, 2006). This vegetation is defined by short, species-rich grassland with scattered low shrubs and suffrutices and is classified as Endangered (Mucina and Rutherford, 2006). Although the area in and around the study area has been highly transformed through sugarcane cultivation, a remnant patch of KwaZulu-Natal Sandstone Sourveld exists downstream of the study area, close to the escarpment to the Shongweni Valley.

2.4 Fish

A desktop assessment of the area indicated that the following fish species could be present within the Wekeweke system: *Awaous aeneofuscus, Anguilla mossambica, Amphilius natalensis, Barbus gurneyi, Barbus viviparous, Clarias gariepinus, Oreochromis mossambicus, Pseudocrenilabrus philander, Tilapia rendalli* and *Tilapia sparrmanii*. A number of these species, may however, not be in streams adjacent to the study as a result of the downstream waterfall forming a natural barrier as well as the farm dams upstream of the waterfall.

2.5 Frogs

The frogs *Afrixalus spinifrons* (Near Threatened) and *Hemisus guttatus* (Vulnerable), could potentially be present in the Wekeweke River system (Nel *et al*., 2011). These species both occur in riparian/wetland habitats similar to those found in the valley bottoms around the site. It is likely that the study area supports a number of other, less sensitive frog species.

Table 2-1, provides a full list of frog species that potentially occur within the study area based on known distribution ranges and habitat preferences.

Table 2-1: List of frogs that potentially occur within the study area

Scientific Name	Common Name	Habitat (after du Preeze and Carruthers, 2009)
Afrana angolensis	Common River Frog	Banks of slow-flowing streams, other permanent water bodies.
Afrixalus fornasinii	Greater Leaf-folding Frog	Wide variety of densely vegetated habitats in coastal swamps, streams and dams.
Afrixalus spinifrons	Natal Leaf-folding Frog	Wide variety of habitats in coastal bushveld grassland and moist upland grassland.
Arthroleptis wahlbergi	Bush Squeaker	Leaf litter in forests and adjacent thickets, and occasionally grassland
Breviceps mossambicus	Mozambique Rain Frog	Savanna and grassland with shallow, well-drained, humus-rich, rocky soils.
Amietophrynus gutturalis	Guttural Toad	Around open pools, dams, vleis and other permanent/semi- permanent water bodies.
Cacosternum nanum nanum	Bronze Caco	Wide variety of vegetation types from grassland to forest.
Hemisus guttatus	Spotted Shovel-nosed Frog	Pans and marshy ground in coastal bush and grassland, foraging over large distances in wide range of habitats.
Hyperolius acuticeps	Sharp-nosed Reed Frog	Coastal bushveld and grassland.
Hyperolius argus	Argus Reed Frog	Coastal bushveld grassland.
Hyperolius marmoratus	Painted Reed Frog	Reeds and other vegetation around a wide variety of water bodies.
Hyperolius pusillus	Water Lily Frog	Open, grassy pans, ponds, vleis and dams in savanna and grassland.
Hyperolius tuberilinguis	Tinker Reed Frog	Dense vegetation along rivers or in pans, pools and dams.
Kassina senegalensis	Bubbling Kassina	Grassland around vleis and pans.
Leptopelis natalensis	Natal Tree Frog	Coastal forest and bushveld, and occasionally grassland.
Phrynobatrachus natalensis	Snoring Puddle Frog	Edges of permanent and temporary water bodies, including marshes, lakes, rivers, streams and pools.
Ptychadena oxyrhynchus	Sharp-nosed Grass Frog	Moist, open savanna and woodland, close to water, but can forage some

Scientific Name	Common Name	Habitat (after du Preeze and Carruthers, 2009)
		distance from water.
Schismaderma carens	Red Toad	Widespread in savanna and grassland, and adapts to human habitation.
Strongylopus fasciatus	Striped Stream Frog	Open grassy areas near dams, ponds or streams in forest, thicket, savannah and grassland.
Strongylopus grayii	Clicking Stream Frog	Wide variety of vegetation from grassland to forest.
Tomopterna natalensis	Natal Sand Frog	Variety of habitats in grassland and savannah.
Xenopus laevis	Common Platanna	Aquatic habitats in any form of freshwater aquatic ecosystems (natural and artificial).

3. RESULTS

3.1 Flora

The vegetation along the Wekeweke River system comprises scarp forest, riverine forest, cliff face communities, grasslands and wetlands. These vegetation communities are described in more detail as follows:

3.1.1 Scarp forest

Scarp forest occurs along the edges of the sandstone plateau, at the beginning of steep cliffs approximately 3.5km downstream of the proposed development site. The Scarp Forest was moist in areas close to the waterfall and where there was seepage. However, most of the Scarp Forest is dry, grading into mesic Eastern Valley Bushveld as it extends further into the valley.

Figure 3-1: Scarp forest around the waterfall downstream of the prosposed development site

A comprehensive species inventory of Scarp Forest species in the area was not possible because of topography on which it occurred. Some more common species are *Ficus burkei* (Common Wild Fig), *Protorhus longifolia* (Red Beech) and *Rapanea melanophloeos* (Cape Beech). Unusual species found in these communities included the rare *Eugenia sp.* nov. B. (Krantz Myrtle) and the more common *Tarchonanthus trilobus subsp. trilobus* (Trident Camphor Tree). Both species are confined almost exclusively to sandstone rock faces. Herbaceous species in moist areas included *Impatiens hochstetteri* and *Plectranthus ciliatus*.

3.1.2 Riverine forest

Upstream of the waterfall the forest appears to comprise mainly more common and pioneer species. This forest is either younger or has been subjected to repeated disturbance, compared to the old-growth forest in stable, protected habitat along the krantz edges. Typical species of this more seral, upstream forest include*: Albizia adianthifolia* (Flatcrown), *Bridelia micrantha* (Mitzeerie), *Celtis africana* (White Stinkwood), *Dalbergia obovata* (Climbing Flat-bean), *D. armata* (Hluhluwe Creeper), *Cryptocarya woodii* (Cape Wild-quince), *Ficus burkei* (Common Wild Fig), *Ficus sur* (Broom Cluster Fig), *Halleria lucida* (Tree Fuschia), *Macaranga capensis* (Wild Poplar), *Maesa lanceolata* (False Assegai),

Figure 3-2: Seral forest downstream of the prosposed development site

Protorhus longifolia (Red Beech), *Psychotria capensis* (Black Bird-berry), *Syzygium cordatum* (Umdoni), *Rapanea melanophloeos* (Cape Beech) *and Searsia chirindensis* (Red Currant). Some of these more common trees are typical of forests along watercourses. *Cassipourea gummiflua* is also likely to be present, as it was seen in moist forest beneath the krantzes and is found on many forested watercourses. *Isoglossa woodii* is a dominant herb. There was extensive alien plant invasion around and into the forest. Particular problem species were *Acacia mearnsii* (Black Wattle), *Chromolaena odorata* (Chromolaena), *Lantana camara* (Lantana), *Melia azedarach* (Syringa), the hybrid origin *Populus x canescens* (Grey Poplar), *Rubus sp.* (Bramble) *and Solanum mauritianum* (Bugweed), but there are many others.

3.1.3 Cliff faces

A significant population of the Critically Endangered *Gladiolus cruentus* occurs on south-facing rock faces alongside the Wekeweke waterfall. These species are confined to damp areas within spray drift range. Abundance estimates were difficult to calculate as populations were inaccessible and hard to see. However, it is likely that more than 100 plants occur on these cliffs.

Figure 3-3: *Gladiolus cruentus* on the cliff face downstream of the proposed development site

The cliffs also host one of the largest populations of *Gasteria croucheri* (Red Data Vulnerable) in KwaZulu-Natal. There are currently three recognized subspecies – *Gasteria croucheri* subsp. *croucheri*, subsp. *pendulifolia* (confined to the Umgeni River system to the north) and the recently described subsp. *pondoensis* (so far known from the Msikaba and Mtentu Rivers in Pondoland). Plants on these cliffs can be referred to subsp. *croucheri*, but are a distinct form, differing from typical subsp. *croucheri* in less squat appearance and are possibly worthy of recognition as a distinct subspecies. *Delosperma velutinum* is another rare, range-restricted species that occurs on these cliffs.

Typical cremnophytes[3] on these rock faces are *Agapanthus* sp., *Aloe arborescens*, *Bulbine natalensis*, *Cinerara* cf. *albicans* (flowering material needed to confirm), *Crassula perfoliata*, *Crassula perforata* var. *heterotricha*, *Cyrtanthus sanguineus* and *Talbotia elegans*. *Euphorbia evansii*, usually not seen this far south in KwaZulu-Natal is a small succulent tree that was seen on these rock faces.

[3] Plants adapted to growing on vertical habitats such as cliffs.

3.1.4 Grassland

Figure 3-4: Remnant of KwaZulu-Natal Sandstone Sourveld to the south of the proposed development site

Because of rocky topography in certain areas, some grassland on slopes above the forest along the Wekeweke River has survived sugar cane cultivation. This grassland (see Figure 1-1) is the Endangered KwaZulu-Natal Sandstone Sourveld vegetation type (Mucina & Rutherford 2006; *c.f.* Section 2.3). Although, not the focus of this study, it appeared to retain good plant species diversity. Some rare or range-restricted species were present including *Aloe parviflora* and *Phymaspermum pinnatifidum*. It is possible that if surveyed under more favourable conditions (the grassland was in a moribund state at the time of the survey), other rare or range-restricted species could be found. The establishment of certain weedy and ruderal indigenous species, indicative of lack of burning, suggest this area has not been actively managed.

3.1.5 Wetland

Figure 3-5: Example of wetland vegetation within the study area.

Wetlands were present in the open areas along the Wekeweke River. Agriculture and alien invasive species have disturbed the wetland vegetation. *Pteridium aquilinum* (Bracken Fern), an indigenous displacer, has become dominant in certain areas. Nonetheless, large areas of wetland still contain a typical suite of wetland species including the following:

- *Cyperus dives*
- *Dissotis canescens*
- *Ischaemum fasiculatum*
- *Kniphofia* cf. *linearifolia* (flowering material needed to confirm)
- *Lobelia erinus*
- *Miscanthus capensis*
- *Persicaria* sp.
- *Pavonia columella*
- *Phyllanthus meyerianus*
- *Tephrosia shiluwanensis*
- *Typha capensis*
- A number of smaller Cyperaceae species are present.

Woody plants within the wetland areas include scattered occurrences of *Cyathea dregei* (Grassland Tree Fern), *Phoenix reclinata* (Wild Date Palm) and the common pioneer *Maesa lanceolata* (False Assegai). Notable alien plants include Bramble (*Rubus* sp.) and *Schinus terebinthifolius* (Brazilian Pepper).

The wetland zone could be divided into vegetation types. The wetland delineation report by the LRI (2007) noted the presence of swamp forest, reed beds, bulrush meadows, mixed meadows, sedge meadows and *Hygrophilous* grassland in the study area.

3.2 Aquatic ecosystems

3.2.1 Riparian Vegetation Assessment Response Index (VEGRAI)

The following table provides a summary of the present ecological state of the riparian vegetation along the Wekeweke River.

Table 3-1: Description of the riparian vegetation along the Wekeweke River, downstream of the proposed Shongweni Regional Retail/Commercial Development Site

River:	**Wekeweke**		
Latitude:	29.820249°S	**Date:**	6 March 2013
Longitude:	30.738160°E	**Time:**	12:00
Upstream		**Downstream**	
			
VEGRAI Ecological Condition		**Moderately modified**	
Reference:	The marginal zone would have been a grass-dominated system with a high proportion of sedges and reeds with the occasional presence of Tree Ferns. The non-marginal zone would have been characterised by a variety of herbaceous plant species. There would have been a significant contribution of lateral flow from a natural catchment maintaining the high proportion of herbaceous species and exclusion of woody components.		
Drivers:	• Alien plant infestation • Removal of vegetation • Road crossing • Sugarcane cultivation • Dumping		
Present:	The marginal zone is characterised by a dominance of herbaceous plant species with dense cover of *Ischaemum fasiculatum*. A relatively deep channel incision defines the upstream edge of the marginal zone resulting in reduced cover in parts. Localised removal of vegetation along the marginal		

zone and river channel incision due to construction of a road crossing.

The non-marginal zone is also characterised by a dominance of herbaceous plant species comprising a mix of grasses, sedges and herbs. A few woody plants scattered across the non-marginal zone. Upper bank is bounded by sugarcane with cleared gum trees on the downstream bank and there is localised removal of vegetation due to construction of a road crossing. A few alien plant species, such as *Lantana camara* and *Rubus* sp., are noted for the non-marginal zone, especially downstream of the road crossing.

3.2.2 Benthic diatoms

The benthic diatom community in the Wekeweke River was sampled at the aquatic biomonitoring site (29°49'12.84"S; 30°44'17.08"E) on the 6th of March 2013. Results from the benthic diatom analyses, including the number of species, the Specific Pollution sensitivity Index (SPI[4]), the percentage of Pollution Tolerant Valves (% PTV[5]), and the percentage of deformed cells for this site are presented in Table 3-2. Appendix 2 provides a full list of all species recorded from the site.

Table 3-2: Benthic diatom from the sample taken on 6 March 2013 in the Wekeweke system

Number of Species	Specific Pollution sensitivity Index (SPI)	% Pollution Tolerant Valves (% PTV)	% Deformed Cells	River Health Category
14	3.7	96.3	0.0	**Severely Modified**

The Specific Pollution Index assessed the benthic diatom community health to be “severely modified” (Table 3-2). Almost all (96.3%) of the 400 cells analysed comprised Pollution Tolerant Valves (PTV), highlighting that the benthic community has become significantly altered in response to water quality impacts from the upstream catchment.

3.2.3 Aquatic macroinvertebrates

The macroinvertebrate community in the Wekeweke system was assessed on the 6th of March 2013 using SASS version 5 (Dickens and Graham, 2002). Results for the macroinvertebrate analyses, based on the SASS5[6] protocol, are presented in Table 3-3. Appendix 3 provides the data sampling sheet from the SASS5 sampling, showing the diversity and abundance of macroinvertebrate taxa collected.

With reference to the SASS5 ASPT, the Wekeweke River, downstream of the development site was to found to be “significantly modified” (Table 3-3).

4 SPI is a measure of river health/condition where a higher index value indicates a better river health
5 PTV is a measure of the proportion of sampled diatoms that are tolerant to reasonable amounts of pollution
6 SASS5 is a biotic index designed for assessing the condition of South African rivers using aquatic macroinvertebrate assemblages, but has useful potential for application in DRC rivers due to its practicality of adopting family-level identifications to define SASS indices.

Table 3-3: SASS5 results from the assessment on the 6th of March 2013 in the Wekeweke system

Number of Taxa	SASS5 Score	SASS5 ASPT	River Health Category
20	113	5.7	**Significantly Modified**

Families present in the sample included Oligochaeta, Amphipoda, Potamonautidae, Atyidae, Baetidae, Coenagrionidae, Aeshnidae, Gomphidae, Libelluidae, Belostomatidae, Hydrophyschidae, Leptoceridae, Pisuliidae, Elmidae, Gyrinidae, Hydrophilidae, Chironomidae, Culicidae, Simuliidae and Tipulidae. The majority of these taxa were relatively pollution tolerant and together are indicative of moderate to high levels of water pollution.

3.2.4 Fish

Fish sampling was not undertaken at sites on the Wekeweke River due to a malfunctioning electro-shocker apparatus. Nevertheless, shoals of small fish (probably *Oreochromis mossambicus*) were observed in the farm dam, upstream of the development site, as well as in the Wekeweke River, just upstream of the waterfall.

The Wekeweke River is not likely to be an important system in terms of supporting fish. This is the consequence of various natural and artificial factors, notably the waterfall barrier downstream and the presence of farm dams. The latter is also likely to result in the introduction of alien fish species, such as *Micropterus* species (Bass species).

3.3 Frogs

The frog survey conducted on 19 and 21 March 2013 determined the presence of two, common and widespread species of frog, namely *Amietia angolensis* (Common River Frog) and *Phrynobatrachus natalensis* (Snoring Puddle Frog). However, it should be noted that the site was visited late into the season and breeding activity had ceased. As a result, this study was unable to establish the true diversity of frogs for the site. A high richness of 35 frog species has been recorded for the quarter degree grid for the site (i.e. 2930CD) and 2930DD, immediately adjacent. Thus, it is anticipated that up 20 species (*see Table 2-1, Section 2.5*) may utilise portions of the study area. The other 15 species of frog are unlikely to occur in the study area given the lack of optimal habitat or expected absence from that portion of the quarter degree grid.

4. DISCUSSION

4.1 Assumptions and limitations

The following assumptions and limitations need to be taken into consideration:

- This report was produced based on a single site visit and not all plant species present would have been flowering at the time of the visit. It is therefore possible that some rare and significant plant species were overlooked.
- It was not possible to sample fish diversity within the Wekeweke River due to a malfunctioning electro-shocker apparatus. In-field observations confirmed that the system is not significant in terms of supporting fish.
- Frog assessments were limited due to the time of year in which they were undertaken. The appropriate time for frog assessments in the Wekeweke system is between October and February.

4.2 Important habitats and ecosystems

The following three important habitat types occur within the study area:

- ***Riverine vegetation* –** The riparian areas along the Wekeweke River are currently affected by dams, sugarcane cultivation and infestations by alien plant species, which contribute to the generally "modified" ecological status (*c.f.* Section 3.2). Nevertheless, these areas are characterised as freshwater aquatic ecosystems and therefore protected under the auspices of the National Water Act (Act 36 of 1998). It is thus important that these areas remain unaffected to maintain their aquatic habitat functionality and continued supply of valuable ecological and hydrological services in the landscape, such as improving water quality (reductions in suspended sediments, excess plant nutrients and other pollutants), streamflow regulation (flood attenuation, water storage and sustaining streamflow), groundwater recharge, erosion control, and the maintenance of biodiversity for wetland-dependant fauna and flora (Kotze and Breen, 1994). Small reach of the Wekeweke, immediately upstream of the waterfall, comprises riparian vegetation that is in good condition.
- ***Wetlands*** – The wetland habitats are relatively intact. Similar to the riparian zone, wetland areas are impacted by agriculture, dams, abstraction points and surface drainage (LRI, 2007) and alien invasive vegetation. These areas are important ecological assets that purify water, act as refugia for biodiversity and assist in floodwater attenuation. As such, it is important that these areas are managed correctly and that appropriate buffer zones are properly demarcated and maintained.
- ***KwaZulu-Natal Sandstone Sourveld*** – The patch of KwaZulu-Natal Sandstone Sourveld vegetation above and adjacent to the waterfall (see Figure 1-1) is significant on the basis that it is an endangered vegetation type (Mucina and Rutherford, 2006). This area is a remnant of the natural vegetation of the site and should be used as a reference when designing and revegetating the proposed development area.

4.3 Conservation important species

A population of *Gladiolus cruentus* (Critically Endangered) occurs downstream of the proposed development site at the waterfall (*see Figure 1-1, Section 1.1*). *G. cruentus* is dependent on spray mist from the waterfall, thus it is important that normal flow volumes from the upstream catchment be maintained. Although, it is unlikely that the proposed development will reduce flows, instead flow volumes are more likely to increase as a result of change in land use from sugarcane to mixed development. This could potentially improve habitat availability for *G. cruentus*.

Hydrostachys polymorpha (Vulnerable) was not observed during the field surveys and is unlikely to occur along the Wekeweke River on the basis that it requires, clean, turbulent water. The Wekeweke River appears to be impacted on by relatively high levels of sedimentation resulting from disturbances and increased surface erosion from a predominantly, unnatural catchment land cover. The result is a well-defined sandy substrate, with only a few riffle sections, which is characteristic of the Wekeweke River.

Potential Red Data frogs, i.e. *Afrixalus spinifrons* (Near Threatened) and *Hemisus guttatus* (Vulnerable) were not recorded within the study area. *A. spinifrons* has been recorded from the Marianhill region, approximately 5km away, as well as further inland from the study area. *H. guttatus* has been recorded from Winston Park, about 2.5km from the study area. Thus, there is a very good chance that both species occur within the study area. Another frog, *Hyperolius acuticeps*, may also occur in the area. At present, *H. acuticeps* is not listed as Red Data, but is rare and its conservation status is currently being re-evaluated.

4.4 Current impacts affecting the study area

The study area is affected by a number of impacts, these include:

- ***Alien invasive plants –*** Areas along the Wekeweke River are invaded by alien plants to some degree, particularly forest ecotones and to a lesser extent wetland areas. This has no doubt resulted in decreased ecological functionality and integrity of vegetation within these areas, which in turn reduces the capability of the area to support biodiversity, particularly conservation important species.
- ***Altered hydrology –*** The hydrology of the Wekeweke River system, adjacent to the proposed development site, has been altered by instream dams, water abstraction and drainage of wetland areas. These hydrological issues have no doubt impacted the riparian and wetland habitats within the study area and is of particular importance when considering the downstream population of the threatened *Gladiolus cruentus.*
- ***Catchment transformation –*** Majority of the terrestrial catchment areas have been transformed by sugarcane cultivation. This transformation not only alters the natural hydrological regime of the Wekeweke River, but is also likely to contribute significantly in terms of water pollution (e.g. sedimentation, herbicide/pesticide application, etc.).

- ***Solid waste dumping –*** Certain areas are affected by localised dumping of solid waste. These areas of disturbance encourage growth of ruderal and alien invasive plant species.
- ***Lack of formal veld management –*** Areas of grassland, such as adjacent to the Wekeweke River waterfall (see Figure 1-1), show signs of transition to scrub and all parts contain ruderal species indicative of lack of burning. Intervention is therefore needed in the form of an active fire management plan.

4.5 Impacts from the proposed Shongweni Regional Retail/Commercial Development

The following impacts, typical of mixed land use developments, may potentially occur as a consequence of the proposed Shongweni Regional Retail/Commercial Development:

- ***Habitat loss and transformation –*** poorly planned and constructed developments may result in unnecessary degradation and loss of habitat supporting biodiversity, potentially including frog species of conservation important
- ***Increased stormwater runoff –*** Introduction of hardened, impervious surfaces (e.g. roofs, driveways, parking areas, roads, etc.) to the catchment areas with construction of a shopping centre and office, business, and residential areas will increase stormwater runoff.
- ***Pollution from runoff –*** Stormwater runoff may incorporate a wide variety of pollutants such as the plant nutrients (nitrogen and phosphorus), oxygen demanding organic compounds, toxic heavy metals, hydrocarbons and pesticides. These pollutants can adversely affect aquatic biota and ecosystems downstream.

4.6 Recommendations

The untransformed areas along the Wekeweke River system contain a diversity of habitats and vegetation types. These are important harbours of fauna and flora biodiversity, in which unusual, rare and Red Listed species are present. It is important that all these habitats and vegetation types remain connected and are protected as far as possible within the context of the proposed development. The following recommendations referring to the study area therefore require consideration to avoid and/or mitigate impacts that may arise from the proposed Shongweni regional retail/commercial development:

- Ensure, where possible, that the development footprint avoids riparian and wetland habitat areas, including the aquatic habitats associated with all watercourses draining into the Wekeweke River. The aquatic habitat provided by the watercourses are also considered important in terms of filtering impacts before entering the Wekeweke River system. With reference to the development's layout plan, approximately **1.7ha of wetland habitat will be removed**. Detailed wetland assessment and rehabilitation studies have been undertaken to provide specific wetland management recommendations for the Shongweni Regional Retail/Commercial Development.

- A **buffer zone of at least 32m should be adopted** to preserve and protect the riparian areas of the Wekeweke River and any associated wetland habitat from the proposed development (Figure 4-1). Generally, buffers are adopted to protect ecosystems from physical disturbance and to protect the water resource from diffuse pollution sources within an altered landscape. In the case of the Shongweni Regional Retail/Commercial Development, the 32m buffer would only be required on the eastern bank of the Wekeweke River system, including the two watercourses draining the development site. Approximately 1.7ha of wetland habitat will need to be removed for the proposed development footprint with some of the developed area also intruding into the 32m buffer zone. Majority of the remaining 32m buffer can be accounted for by the allocated Green Open Space. This area has the ability to buffer the Wekeweke River, and functional frog habitat, from physical disturbances such as surface runoff, sedimentation, pollution/contamination, alien weed control, etc. However, these areas would need to be rehabilitated, with the removal sugarcane and any other alien vegetation. Rehabilitation should also include active replanting of KwaZulu-Natal Sandstone Sourveld plant species, ensuring a multi-layered, undisturbed vegetative community develops. The buffer zone would need to be maintained and managed indefinitely with integration into other local/regional ecological corridors.
- An area, referred to as the **extended management area** in Figure 4-1, is proposed downstream of the Green Open Space to account for the losses of wetland habitat (1.7ha) and potential wetland buffer (3.6ha) as noted above. This loss of functioning habitat will reduce the integrity and functioning of aquatic habitat downstream. The purpose of the extended management area is to enhance the functional area of wetland habitat downstream of the development to safeguard the downstream aquatic environment. A 10m buffer is recommended to limit disturbances to the extended management area due to rehabilitation activities.
- A small sewer pumpstation (26m by 26m) will need to be constructed, just south of the study site within the extended management area. Althought the footprint area, and associated loss of potential terrestrial buffer, is negligible (about 0.1ha), it will be important that appropriate mitigation measures are in place in case of power failures and/or operational failures to the pumpstation. The following recommendations should therefore be implemented to protect the freshwater ecosystems:
    - the location of the sewer pumpstation must be constructed on contour;
    - a designated bund area must be constructed below or directly adjacent to the sewer pumpstation to capture accidental spills/leaks;
    - the pumpstation should include a backup generator; and
    - emergency procedures should to in place to manage pumpstation failures and spills/leaks with immediate effect.
- In addition to the 32m buffer, and in the absence of frog surveys during the period of peak activity (i.e. October to February), a conservative approach should be adopted. Generally, a more substantial buffer should be considered to conserve

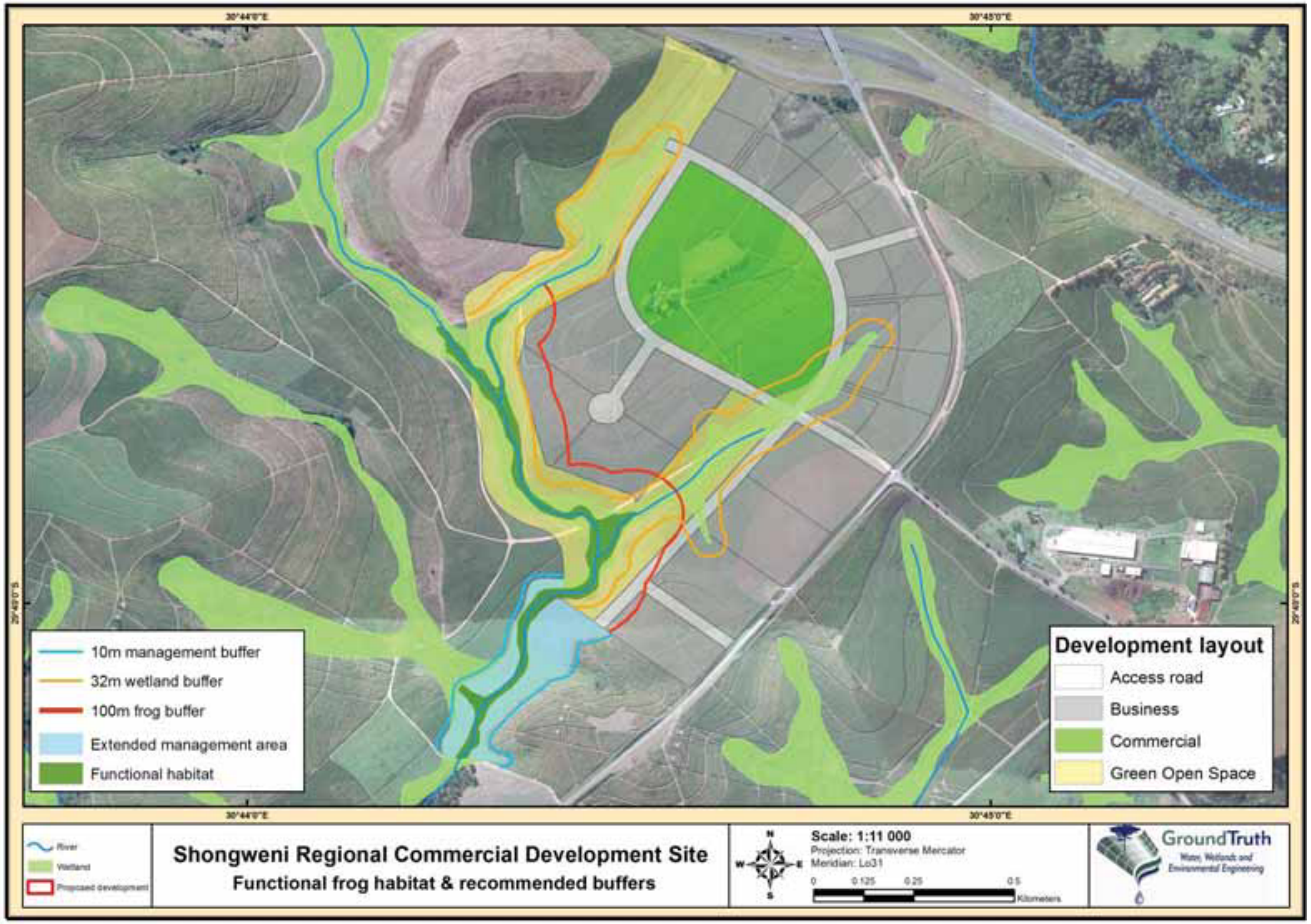

Figure 4-1: **Map showing the present frog habitat availability with reference to various options for creating additional habitat and buffers for conservation important frog species**

Red Data frogs that potentially occur in the area (*c.f.* Section 4.3). In the case of sensitive aquatic biota, such as frogs, buffers are important for providing sufficient terrestrial habitat for frogs to forage away from breeding sites, rather than solely being adopted to protect the aquatic habitats from physical disturbance or pollution within an altered landscape. Buffers of 60 to 185m are recommended for *Afrixalus spinifrons* and *Hemisus guttatus* (Graham and de Winnaar, *In Press*), although a **100m buffer**, with natural vegetation cover, would be considered sufficient. A portion of the development footprint, however, occurs within the recommended frog habitat buffer of 100m (Figure 4-1). Thus, in the context of the proposed development, a variable buffer (or habitat corridor) is recommended that provides for protection of conservation important biota, through enhanced terrestrial and aquatic habitat availability, functionality, and connectivity.

Figure 4-1 below provides a conceptual design to incorporate such a variable habitat buffer and which accommodates the footprint of the proposed Shongweni Regional Retail/Commercial Development. This management approach is based on the following concepts:

- o The recommended 100m buffer for conservation of sensitive frog species is primarily for provision of terrestrial habitat for adult frogs to forage and hibernate, rather than a "blanket setback distance" *per se*. Approximately 3.9ha of the "hardened" development footprint (i.e. excluding the green open spaces) occurs within the 100m frog habitat buffer (Figure 4-1).
- o The development's proposed Green Open Space is considered adequate to offset the loss of 3.9ha from the initially recommended 100m frog buffer. Furthermore, the Green Open Space has the potential to provide additional terrestrial and aquatic habitat (about 12.2ha) for frogs thereby forming a variable-width buffer or ecological corridor. Environmental benefits provided by the Green Open Space would extend further downstream into the extended management area (Figure 4-1).
- o Revegetation and management of the Green Open Space (currently dominated by sugarcane) will be required with aquatic and terrestrial areas managed as natural wetland and KwaZulu-Natal Sandstone Sourveld grassland respectively.

- Ensure minimal or no disturbance outside of the development footprint area during construction. Buffer areas should preferably be revegetated with indigenous vegetation prior to construction to reduced impacts on wetland/riparian systems during the construction phase.
- Rehabilitate areas containing solid waste and remove all refuse/waste which has accumulated on the property, and thereafter maintaining the property in a refuse/litter-free state.
- Develop and implement a comprehensive alien weed control programme to eradicate and control problematic plant species and prevent further spread. Allowance should be made for follow-up work so that by the end of construction there is either no presence or a negligible presence of these plants. The

developer's obligation to continue with such control work should continue indefinitely. All alien plant control work should only be undertaken by a competent contractor.

- Ensuring that landscaping within the development comprises indigenous species appropriate to the regional vegetation.
- Ensure that the stormwater management plan for the development minimises flow-related impacts to the aquatic environment and associated buffers. This should include:
    - Detention/attenuation structures incorporated into the overall design layout. Open swales[7], properly sized to accommodate excess stormwater, could also be considered to receive stormwater from road/driveway drainage. Permeable pavers, which are effective for reducing stormwater runoff and encouraging infiltration of surface water, should be incorporated as much as possible in terms of design and construction of roads, driveways, parking areas, etc.
    - Multiple discharge points that are reasonably spread out across the development adjoining the riparian habitat to allow a diffuse spread of surface runoff, maximising the amount of infiltration.
    - Concentrated flows through buffer zones should be avoided through diffuse flow discharges and runoff entering the buffer zone should not exceed 1.5m/sec to enhance the pollutant removal performance of the buffer area (Cornelius-Carolina, 2004).
    - Accompanying each discharge point should be suitable baffle structures (e.g. gabion mattresses) to dissipate the energy of stormwater runoff and encourage infiltration.

  The latest design of the development contains multiple attenuation structures, allowing for controlled, diffuse flow releases, which will minimise flow-related impacts to the downstream aquatic environment. This will result in improved habitat integrity and functionality of wetland and riparian habitats within the Wekeweke River system.

- Pollutants, potentially carried in surface water runoff, should be limited through the use of best management practises and designs (e.g. first-flush pollutant traps and filters, permeable paving in driveways and parking areas, etc.).
- Incorporate the aforementioned recommendations into the Environmental Management Programme (EMPr) and include monitoring of riparian habitats, natural corridors and other open spaces to be implemented during both construction and operation phases.

[7] Open swales are vegetated, shallow depressions that are often used along roadsides to capture surface runoff. The increased surface roughness helps to reduce velocities of surface runoff thereby increasing infiltration of water into the soil layers.

- Implement a biennial or triennial fire burning regime in both grassland and wetland areas to increase grassland vigour. A fire management plan will therefore need to be compiled for the system.
- Considering the importance of flow for downstream systems and for the survival of *Gladiolus cruentus* population, no further reduction in the hydrology for the catchment should occur without further investigation of the system and its ecological water reserve.
- The use of chemical control is recommended in areas where *Pteridium aquilinum* has become locally dominant. Once plants form dense monotypic stands they are difficult to eradicate, as they are resistant to burning and secrete allelochemicals (biochemicals) into the soil that inhibit and suppress growth of other plants.

5. Acknowledgements

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7. Appendices

Appendix 1: List of plants recorded from the study area, 6th of March 2013

Scientific Name	Common Name	Growth Form	Habitat
Abrus laevigatus	-	Herb	Grassland
Acacia mearnsii *	Black Wattle	Tree	Wetland/Forest/Grassland
Aeollanthus parvifolius	Pink Spur Bush	Herb	Rock face
Aeschynomene micrantha	-	Herb	Grassland
Agapanthussp.	-	Herb	Rock face
Agathisanthemum chlorophyllum var. *chlorophyllum*	-	Herb	Grassland
Ageratum houstonianum *	Blue Weed	Herb	Grassland
Albizia adianthifolia	Flatcrown	Tree	Forest
Aloe arborescens	Krantz Aloe	Shrub	Rock face
Aloe parviflora	-	Herb	Grassland
Aneilema aequinoctiale	Clinging Aneilema	Herb	Forest
Anthospermum rigidum subsp. *pumilum*	-	Herb	Grassland
Asparagus virgatus	Broom Asparagus	Herb	Forest
Asystasia gangetica	Asystasia	Herb	Wetland/Forest/Grassland
Bidens sp. *		Herb	Grassland
Bridelia micrantha	Mitzeerie	Tree	Forest
Bulbine natalensis	Broad-leaved Bulbine	Herb	Rock face
Cassipourea gummiflua	Large-leaved Onionwood	Tree	Forest
Celtis africana	White Stinkwood	Tree	Forest
Chaetacanthus burchellii	Fairy Stars	Herb	Grassland
Chamaecrista mimosoides	Fishbone Dwarf Cassia	Herb	Grassland
Chromolaena odorata	Triffid Weed	Herb	Wetland/Forest/Grassland
Cineraria cf. *albicans*	-	Herb	Rock face
Coccinia sp.	-	Climber	Forest
Combretum molle	Velvet Bushwillow	Tree	Forest/Grassland
Commelina africana	Yellow Commelina	Herb	Grassland
Commelina eckloniana	Ecklon's Blue Commelina	Herb	Forest/Grassland
Conzya canadiensis *	-	Herb	Grassland
Crassula perfoliata	-	Herb	Rock face
Crassula perforata var. *heterotricha*	Pointed-leaved Crassula	Herb	Rock face
Crocosmia aurea	Falling Stars	Herb	Forest
Crotalaria globifera	Round Pod Rattle Bush	Herb	Grassland
Cryptocarya woodii	Cape Wild-quince	Tree	Forest
Cryptolepis oblongifolia	Red-stemmed Cryptolepis	Suffrutex	Grassland
Cyanotis robusta	-	Herb	Rock face
Cyanotis speciosa	Doll's Powderpuff	Herb	Grassland
Cyathea dregei	Grassland Tree Fern	Tree	Grassland/Wetland
Cyperus dives	Giant Sedge	Sedge	Wetland
Cyrtanthussanguineus	Large Red Cyrtanthus	Herb	Rock face

Scientific Name	Common Name	Growth Form	Habitat
Dalbergia armata	Hluhluwe Creeper	Tree	Forest
Dalbergia obovata	Climbing Flat-bean	Tree	Wetland/Forest
Delosperma velutinum	-	Herb	Rock face
Dietes grandiflora	Large Wild Iris	Herb	Forest
Dioscorea cotinifolia	Wild Yam	Climber	Forest
Dissotis canescens	Pink Marsh Dissotis	Shrub	Wetland
Eriosema salignum	Narrow-leaved Eriosema	Herb	Grassland
Eucalyptus grandis *	Saligna Gum	Tree	Wetland/Forest/Grassland
Eugenia sp. nov. B.	Krantz Myrtle	Tree	Forest
Euphorbia evansii	Small-tooth Euphorbia	Tree	Rock face
Ficus burkei	Common Wild Fig	Tree	Forest
Ficus burkei	Common Wild Fig	Tree	Forest
Ficus burtt-dayvii	Veld Fig	Tree	Rock face
Ficus glumosa	Mountain Rock Fig	Tree	Rock face
Ficus ingens	Red-leaved Rock Fig	Tree	Rock face
Ficus sur	Broom Cluster Fig	Tree	Forest
Gasteria croucheri subsp. *croucheri*	Gasteria	Herb	Rock face
Gerbera kraussii	-	Herb	Grassland
Gomphocarpus physocarphus	Milkweed	Herb	Grassland/Wetland
Halleria lucida	Tree Fuschia	Tree	Forest
Helichrysum auriceps	-	Herb	Grassland
Helichrysum nudifolium	Hottentot's Tea	Herb	Grassland
Helichrysum panduratum	-	Herb	Grassland
Helichrysum ruderale	-	Herb	Grassland
Hypoxis hemerocallidea	Star-flower	Herb	Grassland
Impatiens hochstetteri	Common Wild Impatiens	Herb	Forest
Indigofera crebra subsp. *multijuga*	-	Herb	Grassland
Indigofera williamsonii	-	Herb	Grassland
Ipomoea ficifolia	Fig-leaved Ipomoea	Climber	Forest
Ischaemum fasiculatum	Hippo Grass	Grass	Wetland
Isoglossa woodii	Buchweed	Herb	Forest
Justicia protracta	Veld Justicia	Herb	Grassland
Kniphofia cf. *linearifolia*	Common Marsh Poker	Herb	Wetland
Kohautia virgata	-	Herb	Grassland
Laggera alata	-	Herb	Grassland
Lantana camara *	Lantana	Shrub	Wetland/Forest/Grassland
Leucas martinicensis	Tumble Weed	Herb	Wetland/Grassland
Lobelia erinus	Edging Lobelia	Herb	Wetland
Lobelia pteropoda	-	Herb	Forest
Macaranga capensis	Wild Poplar	Tree	Forest
Maesa lanceolata *	False Assegai	Tree	Wetland/Forest/Grassland
Melia azedarach *	Syringa	Tree	Wetland/Forest/Grassland
Microglossa mespilifolia	Trailing Daisy	Climber	Forest
Mikania natalensis	Natal Mikania	Climber	Forest
Miscanthus capensis	Daba Grass	Grass	Wetland

Scientific Name	Common Name	Growth Form	Habitat
Pachystigma venosum	Dwarf Medlar	Suffrutex	Grassland
Pavonia columella	Pink Pavonia	Herb	Wetland/Forest/Grassland
Persicaria sp.	-	Herb	Wetland
Petopentia natalensis	Propeller Vine	Climber	Rock face
Phaulopsis imbricata	-	Herb	Forest
Phoenix reclinata	Wild Date Palm	Tree	Forest/Wetland
Phyllanthus meyerianus	-	Herb	Wetland
Phymaspermum pinnatifidum	-	Herb	Grassland
Plectranthus ciliatus	Speckled Spur-flower	Herb	Forest
Plectyranthus laxiflorus	Citronella Spur-flower	Herb	Wetland/Forest/Grassland
Populus x *canescens* *	Grey Poplar	Tree	Wetland/Forest
Protorhus longifolia	Red Beech	Tree	Forest
Psychotria capensis	Black Bird-berry	Tree	Forest
Pteridium aquilinum	Bracken	Herb	Grassland/Wetland
Rapanea melanophloeos	Cape Beech	Tree	Forest
Rhinacanthus gracilis	Dainty Spurs	Herb	Forest/Grassland
Rhus pallens	Ribbed Currant	Shrub	Forest/Grassland
Rubus sp.	Bramble	Shrub	Grassland/Wetland
Rumex saggitatus	Climbing Rumex	Herb	Grassland
Scadoxus puniceus	Snake Lily	Herb	Forest/Grassland
Schinus terebinthifolius *	Brazilian Pepper	Tree	Wetland/Forest/Grassland
Schistostephium heptalobum	-	Herb	Forest/Grassland
Searsia chirindensis	Red Currant	Tree	Forest
Senecio chrysocoma	-	Herb	Grassland
Senecio coronatus	Woody Grassland Senecio	Herb	Grassland
Senecio madagascariensis *	-	Herb	Grassland
Sida cordifolia *	Flannel Weed	Herb	Grassland
Smilax anceps	Wild Sarsaparilla	Climber	Forest/Grassland
Solanum mauritianum *	Bugweed	Tree	Forest/Grassland
Striga bilabiata	Small Witchweed	Herb	Grassland
Sutera floribunda	-	Herb	Grassland
Syzygium cordatum	Umdoni	Tree	Forest/Wetland
Talbotia elegans	-	Herb	Rock face
Tarchonanthus trilobus subsp. *trilobus*	Trident Camphor Tree	Tree	Forest
Tephrosia macropoda subsp. *macropoda*	Creeping Tephrosia	Herb	Grassland
Tephrosia shiluwanensis	-	Herb	Grassland/Wetland
Tetradenia riparia	-	Herb	Rock face/Forest
Tetraselgo natalensis	Misty Plume Bush	Herb	Grassland
Thunbergia alata	Black-eyed Susan	Climber	Forest/Wetland
Thunbergia atriplicifolia	Natal Primrose	Herb	Grassland
Typha capensis	Bulrush	Sedge	Wetland

Appendix 2: Benthic diatom presence and abundances in the Wekeweke system as sampled on the 6th of March 2013

Species Name	Count
Achnanthidium exiguum (Grunow) Czarnecki	2
Eolimna minima (Grunow) Lange-Bertalot	2
Eolimna subminuscula (Manguin) Moser Lange-Bertalot & Metzeltin	158
Fistulifera saprophila (Lange-Bertalot & Bonik) Lange-Bertalot	18
Lemnicola hungarica (Grunow) Round & Basson	1
Mayamaea atomus var. permitis (Hustedt) Lange-Bertalot	11
Nitzschia amphibia Grunow f.amphibia	1
Navicula gregaria Donkin	1
Nitzschia frustulum (Kützing)Grunow var.frustulum	99
Nitzschia palea (Kützing) W.Smith	89
Navicula rostellata Kützing	2
Navicula symmetrica Patrick	5
Navicula veneta Kützing	4
Sellaphora seminulum (Grunow) D.G. Mann	7

Appendix 3: SASS version 5 scoring sheet for the Wekeweke stream

Date (dd:mm:yr):	26/03/2013			(dd.ddddd)	
RHP Site Code:		**Grid reference (dd mm ss.s) Lat:**	S	29.82023	
Collector/Sampler:	Gary de Winnaar	**Long:**	E	30.73808	
River:	Wekeweke	**Datum (WGS84/Cape):**	WGS84		
Level 1 Ecoregion:	10. Eastern Coastal Belt	**Altitude (m):**	600		
Quaternary Catchment:	U60C	**Zonation:**	Foothill stream		
	Temp (°C): 22.0	**Routine or Project? (circle one)**	Flow:	Medium	
Site Description:	pH: 6.8	Project Name:	Clarity (cm):	75	
	DO (mg/L): 8.5	GTB036	Turbidity:	Low	
	Cond (mS/m): 13.5		Colour:	Light Brown	
	Riparian Disturbance:				
	Instream Disturbance:				

Biotopes Sampled (tick & rate)	Rating (1 - 5)	Time (min)
Stones In Current (SIC)		
Stones Out Of Current (SOOC)		
Bedrock		
Aquatic Veg		
MargVeg In Current		
MargVeg Out Of Current		
Gravel		
Sand		
Mud		
Hand picking/Visual observation		

Taxon	QV	S	Veg	GSM	TOT	Taxon	QV	S	Veg	GSM	TOT	Taxon	QV	S	Veg	GSM	TOT
PORIFERA (Sponge)	5					**HEMIPTERA (Bugs)**						**DIPTERA (Flies)**					
COELENTERATA (Cnidaria)	1					Belostomatidae* (Giant water bugs)	3		1		1	Athericidae (Snipe flies)	10				
TURBELLARIA (Flatworms)	3					Corixidae* (Water boatmen)	3					Blepharoceridae (Mountain midges)	15				
ANNELIDA						Gerridae* (Pond skaters/Water striders)	5					Ceratopogonidae (Biting midges)	5				
Oligochaeta (Earthworms)	1	1		1	A	Hydrometridae* (Water measurers)	6					Chironomidae (Midges)	2	A	A		A
Hirudinea (Leeches)	3					Naucoridae* (Creeping water bugs)	7					Culicidae* (Mosquitoes)	1		1		1
CRUSTACEA						Nepidae* (Water scorpions)	3					Dixidae* (Dixid midge)	10				
Amphipoda (Scuds)	13			1	1	Notonectidae* (Backswimmers)	3					Empididae (Dance flies)	6				
Potamonautidae* (Crabs)	3	A	1		A	Pleidae* (Pygmy backswimmers)	4					Ephydridae (Shore flies)	3				
Atyidae (Freshwater Shrimps)	8	A	B	B	B	Veliidae/M...veliidae* (Ripple bugs)	5					Muscidae (House flies, Stable flies)	1				
Palaemonidae (Freshwater Prawns)	10					**MEGALOPTERA (Fishflies, Dobsonflies & Alderflies)**						Psychodidae (Moth flies)	1				
HYDRACARINA (Mites)	8					Corydalidae (Fishflies & Dobsonflies)	8					Simuliidae (Blackflies)	5		A		A
PLECOPTERA (Stoneflies)						Sialidae (Alderflies)	6					Syrphidae* (Rat tailed maggots)	1				
Notonemouridae	14					**TRICHOPTERA (Caddisflies)**						Tabanidae (Horse flies)	5				
Perlidae	12					Dipseudopsidae	10					Tipulidae (Crane flies)	5	1		1	A
EPHEMEROPTERA (Mayflies)						Ecnomidae	8					**GASTROPODA (Snails)**					
Baetidae 1sp	4					Hydropsychidae 1 sp	4	B	A	1	B	Ancylidae (Limpets)	6				
Baetidae 2 sp	6	B	B	A		Hydropsychidae 2 sp	6					Bulininae*	3				
Baetidae > 2 sp	12				B	Hydropsychidae > 2 sp	12					Hydrobiidae*	3				
Caenidae (Squaregills/Cainfles)	6					Philopotamidae	10					Lymnaeidae* (Pond snails)	3				
Ephemeridae	15					Polycentropodidae	12					Physidae* (Pouch snails)	3				
Heptageniidae (Flatheaded mayflies)	13					Psychomyiidae/Xiphocentronidae	8					Planorbinae* (Orb snails)	3				
Leptophlebiidae (Prongills)	9					**Cased caddis:**						Thiaridae* (=Melanidae)	3				
Oligoneuridae (Brushlegged mayflies)	15					Barbarochthonidae SWC	13					Viviparidae* ST	5				
Polymitarcyidae (Pale Burrowers)	10					Calamoceratidae ST	11					**PELECYPODA (Bivalvles)**					
Prosopistomatidae (Water specs)	15					Glossosomatidae SWC	11					Corbiculidae (Clams)	5				
Teloganodidae SWC (Spiny Crawlers)	12					Hydroptilidae	6					Sphaeriidae (Pill clams)	3				
Tricorythidae (Stout Crawlers)	9					Hydrosalpingidae SWC	15					Unionidae (Perly mussels)	6				
ODONATA (Dragonflies & Damselflies)						Lepidostomatidae	10					**SASS Score**					113
Calopterygidae ST,T (Demoiselles)	10					Leptoceridae	6	1	B	1	B	**No. of Taxa**					20
Chlorocyphidae (Jewels)	10					Petrothrincidae SWC	11					**ASPT**					5.7
Synlestidae (Chlorolestidae)(Sylphs)	8					Pisuliidae	10		A		A	**Other biota:**					
Coenagrionidae (Sprites and blues)	4		A		A	Sericostomatidae SWC	13										
Lestidae (Emerald Damselflies/Spreadwings)	8					**COLEOPTERA (Beetles)**											
Platycnemidae (Stream Damselflies)	10					Dytiscidae/Noteridae* (Diving beetles)	5										
Protoneuridae (Threadwings)	8					Elmidae/Dryopidae* (Riffle beetles)	8	1			1						
Aeshnidae (Hawkers & Emperors)	8	A	A	1	B	Gyrinidae* (Whirligig beetles)	5	A	A	A	B	**Comments/Observations:**					
Corduliidae (Cruisers)	8					Haliplidae* (Crawling water beetles)	5										
Gomphidae (Clubtails)	6			A	A	Helodidae (Marsh beetles)	12										
Libellulidae (Darters/Skimmers)	4	A			A	Hydraenidae* (Minute moss beetles)	8										
LEPIDOPTERA (Aquatic Caterpillars/Moths)						Hydrophilidae* (Water scavenger beetles)	5	A			A						
Crambidae (Pyralidae)	12					Limnichidae (Marsh-Loving Beetles)	10										
						Psephenidae (Water Pennies)	10										

Summary sheet with calculated scores

Wetland name/reference number	HGM 1 Score	HGM 2 Score
Flood attenuation		
Effectiveness of the wetland		
Size of wetland relative to catchment	3,0	3,0
Slope of wetland	1,0	2,0
Surface roughness of wetland	1,0	1,0
Depressions	0,0	0,0
Frequency with which stormflows spread across the wetland	3,0	3,0
Sinuosity of the stream channel	1,0	1,0
Representation of different hydrological zones	1,0	2,0
Score for effectiveness:	***1,4***	***1,7***
Opportunity for attenuating floods		
Average slope of the wetland's catchment	2,0	3,0
Inherent runoff potential of soils in catchment	1,0	1,0
Contribution of catchment land-uses to changing runoff intensity from the natural co	2,0	2,0
Rainfall intensity	3,0	3,0
Extent of floodable property downstream	1,0	1,0
Score for opportunity:	***1,8***	***2,0***
Overall score/rating for flood attenuation	***1,6***	***1,9***
Stream flow regulation		
Link to the stream network	4,0	4,0
Representation of different hydrological zones	3,0	2,0
Presence of fibrous peat or unconsolidated sediments below floating marsh	0,0	0,0
Reduction in evapotranspiration through frosting back of the wetland vegetation	0,0	0,0
HGM unit occurs on underlying geology with strong surface-groundwater linkages	3,0	3,0
Presence of any important wetlands or aquatic systems downstream	4,0	4,0
Overall score/rating for stream flow augmentation	***2,3***	***2,2***
Sediment trapping		
Effectiveness of the wetland		
Effectiveness in attenuating floods	1,4	1,7
Direct evidence of sediment deposition	2,0	2,0
Score for effectiveness:	***1,7***	***1,9***
Opportunity		
Extent to which dams are reducing the input of sediment	4,0	4,0
Extent of sediment sources delivering sediment to the HGM unit	2,0	2,0
Presence of any important wetlands or aquatic systems downstream	4,0	4,0
Score for opportunity:	***3,3***	***3,3***
Overall score/rating for sediment trapping	***2,5***	***2,6***
Phosphate trapping		
Effectiveness of the wetland		
Effectiveness of trapping sediment	1,7	1,9
Pattern of low flows within the wetland	3,0	3,0
Extent of vegetation cover	3,0	3,0
Application of fertilizer/biocides directly in the HGM unit	2,0	2,0
Score for effectiveness:	***2,4***	***2,5***
Opportunity		
Extent of sediment sources	2,0	2,0
Extent of other potential sources - point source	2,0	2,0
Presence of any important wetlands or aquatic systems downstream	4,0	4,0
Score for opportunity:	***2,7***	***2,7***
Overall score/rating for phosphate trapping	***2,5***	***2,6***

Nitrate removal		
Effectiveness		
Hydrological zonation	3,0	2,0
Pattern of low flows	3,0	3,0
Extent of vegetation cover	3,0	3,0
Contribution of sub-surface water inputs relative to surface water inputs	3,0	3,0
Application of fertilizer/biocides directly in the HGM unit	2,0	2,0
Score for effectiveness:	***2,8***	***2,6***
Opportunity		
Extent of nitrate sources in the HGM unit's catchment	2,0	2,0
Presence of any important wetlands or aquatic systems downstream	4,0	4,0
Score for opportunity:	***3,0***	***3,0***
Overall score/rating for nitrate removal	***2,9***	***2,8***
Toxicant removal		
Effectiveness		
Hydrological zonation	3,0	2,0
Pattern of low flows	3,0	3,0
Extent of vegetation cover	3,0	3,0
Effectiveness in trapping sediment	1,7	1,9
Application of fertilizer/biocides directly in the HGM unit	2,0	2,0
Score for effectiveness:	***2,5***	***2,4***
Opportunity		
Extent of sediment sources	2,0	2,0
Extent of toxicant sources	2,0	2,0
Presence of any important wetlands or aquatic systems downstream	4,0	4,0
Score for opportunity:	***2,7***	***2,7***
Overall score/rating for toxicant removal	***2,6***	***2,5***
Erosion control		
Effectiveness		
Direct evidence of erosion	3,0	3,0
Extent of vegetation cover	3,0	3,0
Surface roughness	1,0	1,0
Level of soil disturbance in wetland	1,0	1,0
Score for effectiveness:	***2,0***	***2,0***
Opportunity		
Slope of wetland	1,0	2,0
Erodibility of the soil	2,0	2,0
Runoff intensity from the wetland's catchment	2,0	2,3
Score for opportunity:	***1,7***	***2,1***
Overall score/rating for erosion control	***1,8***	***2,0***
Carbon storage		
Hydrological zones	3,0	2,0
Abundance of peat	0,0	0,0
Level of soil disturbance in wetland	1,0	1,0
Overall score/rating for carbon storage	***1,3***	***1,0***
Biodiversity maintenance		
Noteworthiness		
HGM unit is of a rare type or is of a wetland type or vegetation type subjected to a h	4,0	4,0
Level of cumulative loss of wetlands in the overall catchment	4,0	4,0
Red Data species or suitable habitat for Red Data species	4,0	4,0
Level of significance of other special natural features	1,0	1,0
Score for noteworthiness:	***3,3***	***3,3***

Extent of buffer around wetland	0,0	0,0
Connectivity of wetland in landscape	4,0	4,0
Alteration of hydrological regime	3,0	2,0
Alteration of sediment regime	1,0	1,0
Alteration of nutrient/toxicant regime	2,0	2,0
Complete removal of indigenous vegetation	1,0	2,0
Invasive and pioneers species encroachment	2,0	2,0
Presence of hazardous/restrictive barriers	2,0	3,0
Score for integrity:	***1,9***	***2,0***
Overall score/rating for maintenance of biodiversity	***3,3***	***3,3***
		3,3
Water supply		
Hydrological zones	3,0	2,0
Importance for stream flow augmentation	2,3	2,2
Current use for agricultural purposes	1,0	0,0
Current use for domestic purposes	0,0	0,0
Number of households	0,0	0,0
Substitutability of wetland water source	4,0	4,0
Overall score/rating for water supply	***1,7***	***1,4***
Provision of harvestable natural resources		
Total number of resources	0,0	0,0
Location in rural communal area	0,0	0,0
Level of poverty	0,0	0,0
Number of households depending on wetland	0,0	0,0
Substitutability of the wetland resources	0,0	0,0
Overall score/rating for source of goods /resources	***0,0***	***0,0***
Provision of cultivated foods		
Total number of different crops cultivated in the HGM unit	1,0	0,0
Location in rural communal area	0,0	0,0
Level of poverty	0,0	0,0
Number of households who depend on the crops cultivated in the HGM unit	0,0	0,0
Substitutability of the crops cultivated in the wetland	0,0	0,0
Overall score/rating for source of goods /resources	***0,2***	***0,0***
Cultural significance		
Registered SAHRA site	0,0	0,0
Location in a communal rural area	0,0	0,0
Known cultural practices	0,0	0,0
Known taboos/beliefs	0,0	0,0
Overall score/rating for socio-cultural significance	***0,0***	***0,0***
Tourism and recreation		
Scenic beauty of the HGM unit	2,0	1,0
Presence of "charismatic" species	0,0	0,0
Currently used	0,0	0,0
Suitable locations for facilities	0,0	0,0
Location within a tourism route	0,0	0,0
Recreational hunting and fishing and birding opportunities	0,0	0,0
Extent of open water	0,0	0,0
Overall score/rating for tourism and recreation	***0,3***	***0,1***
Education and research		
Currently used	0,0	0,0
Reference site suitability	2,0	1,0
Existing long term research & data collected	0,0	0,0
Accessibility	0,0	0,0
Overall score/rating for education and research	***0,5***	***0,3***

Summary sheet with calculated scores

Wetland name/reference number

	Score
Flood attenuation	
Effectiveness of the wetland	
Size of wetland relative to catchment	4.0
Slope of wetland	0.0
Surface roughness of wetland	1.0
Depressions	0.0
Frequency with which stormflows spread across the wetland	1.0
Sinuosity of the stream channel	1.0
Representation of different hydrological zones	3.0
Score for effectiveness:	***1.4***
Opportunity for attenuating floods	
Average slope of the wetland's catchment	4.0
Inherent runoff potential of soils in catchment	1.0
Contribution of catchment land-uses to changing runoff intensity from the natural co	2.0
Rainfall intensity	3.0
Extent of floodable property downstream	1.0
Score for opportunity:	***2.2***
Overall score/rating for flood attenuation	***1.8***
Stream flow regulation	
Link to the stream network	4.0
Representation of different hydrological zones	1.0
Presence of fibrous peat or unconsolidated sediments below floating marsh	0.0
Reduction in evapotranspiration through frosting back of the wetland vegetation	0.0
HGM unit occurs on underlying geology with strong surface-groundwater linkages	3.0
Presence of any important wetlands or aquatic systems downstream	0.0
Overall score/rating for stream flow augmentation	***1.3***
Sediment trapping	
Effectiveness of the wetland	
Effectiveness in attenuating floods	1.4
Direct evidence of sediment deposition	0.0
Score for effectiveness:	***0.7***
Opportunity	
Extent to which dams are reducing the input of sediment	4.0
Extent of sediment sources delivering sediment to the HGM unit	2.0
Presence of any important wetlands or aquatic systems downstream	0.0
Score for opportunity:	***2.0***
Overall score/rating for sediment trapping	***1.4***
Phosphate trapping	
Effectiveness of the wetland	
Effectiveness of trapping sediment	0.7
Pattern of low flows within the wetland	2.0
Extent of vegetation cover	2.0
Application of fertilizer/biocides directly in the HGM unit	2.0
Score for effectiveness:	***1.7***
Opportunity	
Extent of sediment sources	2.0
Extent of other potential sources - point source	2.0
Presence of any important wetlands or aquatic systems downstream	0.0
Score for opportunity:	***1.3***
Overall score/rating for phosphate trapping	***1.5***

Nitrate removal

Effectiveness	
Hydrological zonation	1.0
Pattern of low flows	2.0
Extent of vegetation cover	2.0
Contribution of sub-surface water inputs relative to surface water inputs	3.0
Application of fertilizer/biocides directly in the HGM unit	2.0
Score for effectiveness:	***2.0***
Opportunity	
Extent of nitrate sources in the HGM unit's catchment	2.0
Presence of any important wetlands or aquatic systems downstream	0.0
Score for opportunity:	***1.0***
Overall score/rating for nitrate removal	***1.5***

Toxicant removal

Effectiveness	
Hydrological zonation	1.0
Pattern of low flows	2.0
Extent of vegetation cover	2.0
Effectiveness in trapping sediment	0.7
Application of fertilizer/biocides directly in the HGM unit	2.0
Score for effectiveness:	***1.5***
Opportunity	
Extent of sediment sources	2.0
Extent of toxicant sources	2.0
Presence of any important wetlands or aquatic systems downstream	0.0
Score for opportunity:	***1.3***
Overall score/rating for toxicant removal	***1.4***

Erosion control

Effectiveness	
Direct evidence of erosion	2.0
Extent of vegetation cover	2.0
Surface roughness	1.0
Level of soil disturbance in wetland	0.0
Score for effectiveness:	***1.3***
Opportunity	
Slope of wetland	0.0
Erodibility of the soil	2.0
Runoff intensity from the wetland's catchment	2.5
Score for opportunity:	***1.5***
Overall score/rating for erosion control	***1.4***

Carbon storage

Hydrological zones	1.0
Abundance of peat	0.0
Level of soil disturbance in wetland	0.0
Overall score/rating for carbon storage	***0.3***

Biodiversity maintenance

Noteworthiness	
HGM unit is of a rare type or is of a wetland type or vegetation type subjected to a h	4.0
Level of cumulative loss of wetlands in the overall catchment	4.0
Red Data species or suitable habitat for Red Data species	0.0
Level of significance of other special natural features	0.0
Score for noteworthiness:	***2.0***

Extent of buffer around wetland	0.0
Connectivity of wetland in landscape	2.0
Alteration of hydrological regime	0.0
Alteration of sediment regime	0.0
Alteration of nutrient/toxicant regime	2.0
Complete removal of indigenous vegetation	0.0
Invasive and pioneers species encroachment	0.0
Presence of hazardous/restrictive barriers	1.0
Score for integrity:	***0.6***
Overall score/rating for maintenance of biodiversity	***1.3***
Water supply	
Hydrological zones	1.0
Importance for stream flow augmentation	1.3
Current use for agricultural purposes	0.0
Current use for domestic purposes	0.0
Number of households	0.0
Substitutability of wetland water source	0.0
Overall score/rating for water supply	***0.4***
Provision of harvestable natural resources	
Total number of resources	0.0
Location in rural communal area	0.0
Level of poverty	0.0
Number of households depending on wetland	0.0
Substitutability of the wetland resources	0.0
Overall score/rating for source of goods /resources	***0.0***
Provision of cultivated foods	
Total number of different crops cultivated in the HGM unit	1.0
Location in rural communal area	0.0
Level of poverty	0.0
Number of households who depend on the crops cultivated in the HGM unit	0.0
Substitutability of the crops cultivated in the wetland	0.0
Overall score/rating for source of goods /resources	***0.2***
Cultural significance	
Registered SAHRA site	0.0
Location in a communal rural area	0.0
Known cultural practices	0.0
Known taboos/beliefs	0.0
Overall score/rating for socio-cultural significance	***0.0***
Tourism and recreation	
Scenic beauty of the HGM unit	0.0
Presence of "charismatic" species	0.0
Currently used	0.0
Suitable locations for facilities	0.0
Location within a tourism route	0.0
Recreational hunting and fishing and birding opportunities	0.0
Extent of open water	0.0
Overall score/rating for tourism and recreation	***0.0***
Education and research	
Currently used	0.0
Reference site suitability	0.0
Existing long term research & data collected	0.0
Accessibility	1.0
Overall score/rating for education and research	***0.3***

Summary sheet with calculated scores

Wetland name/reference number

	Score
Flood attenuation	
Effectiveness of the wetland	
Size of wetland relative to catchment	4.0
Slope of wetland	0.0
Surface roughness of wetland	1.0
Depressions	0.0
Frequency with which stormflows spread across the wetland	1.0
Sinuosity of the stream channel	1.0
Representation of different hydrological zones	1.0
Score for effectiveness:	***1.1***
Opportunity for attenuating floods	
Average slope of the wetland's catchment	4.0
Inherent runoff potential of soils in catchment	1.0
Contribution of catchment land-uses to changing runoff intensity from the natural cor	3.0
Rainfall intensity	3.0
Extent of floodable property downstream	0.0
Score for opportunity:	***2.2***
Overall score/rating for flood attenuation	***1.7***
Stream flow regulation	
Link to the stream network	4.0
Representation of different hydrological zones	3.0
Presence of fibrous peat or unconsolidated sediments below floating marsh	0.0
Reduction in evapotranspiration through frosting back of the wetland vegetation	0.0
HGM unit occurs on underlying geology with strong surface-groundwater linkages	3.0
Presence of any important wetlands or aquatic systems downstream	0.0
Overall score/rating for stream flow augmentation	***1.7***
Sediment trapping	
Effectiveness of the wetland	
Effectiveness in attenuating floods	1.1
Direct evidence of sediment deposition	1.0
Score for effectiveness:	***1.1***
Opportunity	
Extent to which dams are reducing the input of sediment	4.0
Extent of sediment sources delivering sediment to the HGM unit	2.0
Presence of any important wetlands or aquatic systems downstream	0.0
Score for opportunity:	***2.0***
Overall score/rating for sediment trapping	***1.5***
Phosphate trapping	
Effectiveness of the wetland	
Effectiveness of trapping sediment	1.1
Pattern of low flows within the wetland	2.0
Extent of vegetation cover	1.0
Application of fertilizer/biocides directly in the HGM unit	1.0
Score for effectiveness:	***1.3***
Opportunity	
Extent of sediment sources	2.0
Extent of other potential sources - point source	3.0
Presence of any important wetlands or aquatic systems downstream	0.0
Score for opportunity:	***1.7***
Overall score/rating for phosphate trapping	***1.5***

Nitrate removal	
Effectiveness	
Hydrological zonation	3.0
Pattern of low flows	2.0
Extent of vegetation cover	1.0
Contribution of sub-surface water inputs relative to surface water inputs	3.0
Application of fertilizer/biocides directly in the HGM unit	1.0
Score for effectiveness:	***2.0***
Opportunity	
Extent of nitrate sources in the HGM unit's catchment	3.0
Presence of any important wetlands or aquatic systems downstream	0.0
Score for opportunity:	***1.5***
Overall score/rating for nitrate removal	***1.8***
Toxicant removal	
Effectiveness	
Hydrological zonation	3.0
Pattern of low flows	2.0
Extent of vegetation cover	1.0
Effectiveness in trapping sediment	1.1
Application of fertilizer/biocides directly in the HGM unit	1.0
Score for effectiveness:	***1.6***
Opportunity	
Extent of sediment sources	2.0
Extent of toxicant sources	3.0
Presence of any important wetlands or aquatic systems downstream	0.0
Score for opportunity:	***1.7***
Overall score/rating for toxicant removal	***1.6***
Erosion control	
Effectiveness	
Direct evidence of erosion	3.0
Extent of vegetation cover	1.0
Surface roughness	1.0
Level of soil disturbance in wetland	1.0
Score for effectiveness:	***1.5***
Opportunity	
Slope of wetland	0.0
Erodibility of the soil	2.0
Runoff intensity from the wetland's catchment	2.8
Score for opportunity:	***1.6***
Overall score/rating for erosion control	***1.5***
Carbon storage	
Hydrological zones	3.0
Abundance of peat	0.0
Level of soil disturbance in wetland	1.0
Overall score/rating for carbon storage	***1.3***
Biodiversity maintenance	
Noteworthiness	
HGM unit is of a rare type or is of a wetland type or vegetation type subjected to a hi	4.0
Level of cumulative loss of wetlands in the overall catchment	4.0
Red Data species or suitable habitat for Red Data species	0.0
Level of significance of other special natural features	1.0
Score for noteworthiness:	***2.3***

Extent of buffer around wetland	0.0
Connectivity of wetland in landscape	1.0
Alteration of hydrological regime	1.0
Alteration of sediment regime	1.0
Alteration of nutrient/toxicant regime	1.0
Complete removal of indigenous vegetation	0.0
Invasive and pioneers species encroachment	1.0
Presence of hazardous/restrictive barriers	3.0
Score for integrity:	***1.0***
Overall score/rating for maintenance of biodiversity	***1.6***
Water supply	
Hydrological zones	3.0
Importance for stream flow augmentation	1.7
Current use for agricultural purposes	2.0
Current use for domestic purposes	0.0
Number of households	0.0
Substitutability of wetland water source	4.0
Overall score/rating for water supply	***1.8***
Provision of harvestable natural resources	
Total number of resources	1.0
Location in rural communal area	0.0
Level of poverty	0.0
Number of households depending on wetland	0.0
Substitutability of the wetland resources	0.0
Overall score/rating for source of goods /resources	***0.2***
Provision of cultivated foods	
Total number of different crops cultivated in the HGM unit	1.0
Location in rural communal area	0.0
Level of poverty	0.0
Number of households who depend on the crops cultivated in the HGM unit	0.0
Substitutability of the crops cultivated in the wetland	0.0
Overall score/rating for source of goods /resources	***0.2***
Cultural significance	
Registered SAHRA site	0.0
Location in a communal rural area	0.0
Known cultural practices	0.0
Known taboos/beliefs	0.0
Overall score/rating for socio-cultural significance	***0.0***
Tourism and recreation	
Scenic beauty of the HGM unit	1.0
Presence of "charismatic" species	0.0
Currently used	0.0
Suitable locations for facilities	1.0
Location within a tourism route	0.0
Recreational hunting and fishing and birding opportunities	0.0
Extent of open water	0.0
Overall score/rating for tourism and recreation	***0.3***
Education and research	
Currently used	0.0
Reference site suitability	0.0
Existing long term research & data collected	0.0
Accessibility	1.0
Overall score/rating for education and research	***0.3***

APPENDIX 11:

PROPOSED SHONGWENI MIXED USE DEVELOPMENT: VEGETATION ASSESSMENT & RAPID ASSESSMENT OF THE VEGETATION ASSOCIATED WITH A PROPOSED 500MM BULK WATER LINE (SIVEST)

TONGAAT HULETT DEVELOPMENTS (PTY) (LTD)

Proposed Shongweni Mixed Use Development: Vegetation Assessment

Draft Vegetation Assessment

Issue Date: July 2012
Revision No.: 1
Project No.: 11483

Date:	July 2012
Document Title:	**Proposed Shongweni Mixed Use Development: Vegetation Assessment**
Author:	Dr. R.G. Kinvig (*Pr. Sci. Nat.*)
Signature:	
Revision Number:	1
Checked by:	Ryan Edwards
Approved:	Ryan Edwards
Signature:	
For:	SiVEST Environmental Division
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Declaration

I, Dr. Richard Grant Kinvig, **declare that I** –

- act as an independent specialist consultant in the field of Ecology and Botany and have undertaken the **Vegetation Assessment** for the sites identified for assessment for the proposed development known as **Shongweni Mixed Use,** in the **Ethekwini Municipality**;
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2006;
- have and will not have any vested interest in the proposed activity proceeding;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2006; and
- will provide the competent authority with access to all information at our disposal regarding the application, whether such information is favourable to the applicant or not

PROPOSED SHONGWENI MIXED USE DEVELOPMENT: VEGETATION ASSESSMENT DRAFT VEGETATION ASSESSMENT

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PROPOSED SHONGWENI MIXED USE DEVELOPMENT: VEGETATION ASSESSMENT DRAFT VEGETATION ASSESSMENT

1. INTRODUCTION & BACKGROUND

SiVEST Environmental Division was requested by **Kerry Seppings Environmental Management Services (KSEMS)** to undertake a detailed vegetation and faunal assessment of the three (3) sites which have been proposed for investigation. From the above mentioned assessments, inferences can be made regarding the overarching ecological value of the three (3) sites which have been identified to potentially accept the proposed Shongweni Mixed Use Development. The three sites are all currently owned by **Tongaat Hulett Developments (THD**). This report forms the vegetation component of the assessment.

2. TERMS OF REFERENCE

The following Terms of Reference were provided by KSEMS regarding the requirements for the assessments.

- *Undertake a vegetation assessment of the three alternative sites proposed for the Shongweni Mixed Use Development*.

Further to the Terms of Reference supplied by KSEMS, the following protocol is extracted from the National Environmental Management Act, Act 108 of 1998. The relevant Section is Section 32 and is included below for your ease of reference.

Specialist reports and reports on specialised processes
32.
(1) An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialised process.
(2) the Person referred to in sub-regulation (1) must comply with the requirements of Regulation 17.
(3) A specialist report or a report on a specialised process prepared in terms of these Regulations must contain –
(a) details of –
(i) the person who prepared the report; and
(ii) the expertise of that person to carry out the specialist study or specialised process;
(b) a declaration that the person is independent in a form as may be specified by the competent authority;
(c) an indication of the scope of, and the purpose for which, the report was prepared;
(d) a description of the methodology adopted in preparing the report or carrying out the specialised process;
(e) a description of any assumptions made and any uncertainties or gaps in knowledge;
(f) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
(g) recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;
(h) a description of any consultation process that was undertaken during the course of carrying out the study;
(i) a summary and copies of any comments that were received during any consultation process; and
(j) any other information requested by the competent authority.

3. LOCAL SETTING

Various relatively coarse spatial datasets have been interrogated to inform the local setting of the three sites. All three sites are located in close proximity to one another, i.e. they fall within a five kilometre radius of one another. Therefore, the GIS information relating to the environmental features of the site overlap and as such the description of the local setting applied to all three sites, except where there may be some slight variations, which will be discussed individually.

3.1. Database Interrogation / desktop analysis

One of the major advantages that current technology provides is the access to a substantial amount of information. As a result of this and the ongoing pursuance of environmental knowledge, databases which can be interrogated to provide general information regarding the site have been developed.

Various national, provincial and municipal spatial datasets are available for the sites and provide information on what may occur on the site and the sites value from a regional / provincial perspective in terms of the conservation and biodiversity. The caveat here is that the majority of these databases are created at the landscape level (i.e. they are coarse scale). In addition, the factors which are often utilized to determine many of the outputs are related to abiotic characteristics, such as rainfall, temperature, soil types, underlying geology, elevation and aspect. The result therefore is the development of a database that provides a high level assessment of the area, but which requires substantial ground-truthing to illustrate the various components that comprise the landscape. The field survey will highlight areas of conservation significance and biodiversity richness as well as provide information regarding the *status quo* and what will be required in terms of management to ensure improvement in the *status quo* and ensure the long term viability and sustainability of the proposed development nodes.

A number of databases have been interrogated in the process of undertaking the Desktop Analysis. A summary of the methodology utilised for the generation of each of the databases, as well as the pertinent results for each are included below under the various titled sub-sections.

3.1.1. Ezemvelo KZN wildlife C-Plan & SEA Database

The C-Plan is a GIS based systematic conservation-planning package that analyses biodiversity features and landscape units. C-Plan is used to identify a national reserve system that will satisfy specified conservation targets for biodiversity features (**Lombard et al. 2003**). Biodiversity features can be land classes or species, and targets are set in area units either for land classes, or as numbers of occurrences of species for species locality data sets (**Lombard et al. 2003**). These units or measurements are used as surrogates for un-sampled data. The C-Plan is an effective conservation tool when determining priority areas at a regional level and is being used in South Africa to identify areas of high conservation value.

3.1.2. Irreplaceability Analysis

The following is referenced from **Goodman (2004)**: “The first product of the conservation planning analysis in C-Plan is an irreplaceability map of the planning area, in this case the province of KwaZulu-Natal. This map is divided into 1 by 1 km grid cells called ‘planning units’.

Each cell has associated with it an ‘Irreplaceability Value’, which is a reflection of the cells’ importance with respect to the conservation of biodiversity. Irreplaceability reflects the planning unit’s ability to meet set ‘targets’ for selected biodiversity ‘features’. The irreplaceability value is scaled between 0 and 1.

Irreplaceability value – 0. Where a planning unit has an irreplaceability value of 0, all biodiversity features recorded here are conserved to the target amount, and there is <u>unlikely</u> to be a biodiversity concern with the development of the site.

Irreplaceability value – 1. These planning units are referred to as totally irreplaceable and the conservation of the features within them is critical to meet conservation targets. (EIA very definitely required and depending on the nature of the proposal unlikely to be granted).

Irreplaceability value > 0 but < 1. Some of these planning units are required to meet biodiversity conservation targets. If the value is high (e.g. 0.9) then most units are required (few options available for alternative choices). If the value is low, then many options are available for meeting the biodiversity targets. (EIA required and depending on the nature of the proposed development, permission could be granted)."

3.1.3. C-Plan Biodiversity Features / Species within Project Area

In terms of the Ezemvelo KZN Wildlife C-Plan, the southern portion of Site 1, the northern portion of Site 2 and the northern and eastern portions of Site 3 are classified as **1**, i.e. **Totally Irreplaceable.** The other portions of the three sites are considered as already transformed. The Minset analysis mirrors the C-Plan data with the irreplaceable areas being deemed a **Mandatory Reserve.**

There are potentially five features present on site which are considered to be of environmental significance and conservation importance. The five features are as follows:

- Vegetation Type – KwaZulu-Natal Sandstone Plateau Sourveld
- Vegetation Type – Eastern Scarp Forest
- Vegetation Type – Moist Ngongoni Veld
- Fauna – *Doratogonus rubipodus* (Millipede)
- Flora – *Helichrysum woodii*

3.1.4. KZN Wildlife Strategic Environmental Assessment (SEA)

3.1.4.1. Site 1

In terms of the SEA data generated, through the physical characteristics that are present on site, a number of groups have been identified as potentially present on Site 1, and these groups are wholly significant in terms of conservation significance or parts thereof. **Table 1** below identifies which groups are significant.

Table 1. SEA Data taken from *Ezemvelo* KZN Wildlife for Site 1

YES	NO
Protected Plants	Vegetation - Wetlands
Invertebrates	Mammals
Aquatic Fauna	Vegetation - Forests
	Avi-faunal
	Vegetation - Grasslands
	Medicinal Plants
	Frogs
	Reptiles

3.1.4.2. Site 2

In terms of the SEA, no groups have been identified as potentially present on Site 2.

3.1.4.3. Site 3

In terms of the SEA, a number of groups have been identified as potentially present on site 3, and these groups are wholly significant in terms of conservation significance or parts thereof. **Table 2** below identifies which groups are significant.

Table 2. SEA Data taken from *Ezemvelo* KZN Wildlife for Site 3

YES	NO
Medicinal Plants	Vegetation - Wetlands
Protected Plants	Mammals
Vegetation - Grasslands	Vegetation - Forests
Invertebrates	Frogs
Aquatic Fauna	Reptiles
Avi-faunal	

3.1.5. Bio Resource Units

In terms of Camp, 1998, there are two Bio Resource Units for the sites.

Site 2, and the southern portion of Site 3, falls within Bio Resource Unit Yb15. The general characteristics of this unit are as follows:

Bioresource Group **3 - Moist Coast Hinterland Ngongoni Veld**

- **BRG Subgroup** 3.6
- **Vegetation pattern** Bushed Grassland
- **Indicator Species** *Acacia karroo, Acacia mearnsii, Acacia nilotica, Acacia sieberiana, Albizia adianthifolia, Aristida junciformis, Combretum spp., Digitaria eriantha, Halleria lucida, Lantana camara, Phoenix reclinata, Pteridium aquilinum, Rubus cuneifolia, Solanum mauritianum, Sporobolus pyramidalis, Strelitzia nicolai, Syzygium cordatum*

The rainfall average is 920 mm of rainfall. The mean temperature is 18.7 ^{0}C and the climate rating is C2, which has a slight limitation on crop growing. There is no frost hazard and the erosion rating for the site is 5.4, which translates to a moderate risk of erosion.

There are some wetlands, 1 perennial, and 1 annual rivers identified for the BRU. Please note there are a number of drainage lines, non-perennial streams and wetlands that are not captured at the coarse level at which this data has been defined.

Site 1, and the northern portion of Site 3, falls within Bio Resource Unit Wb16. The general characteristics of this unit are as follows:

Bioresource Group **3 - Moist Coast Hinterland Ngongoni Veld**

- **BRG Subgroup** 3.6
- **Vegetation pattern** Bushed Grassland
- **Indicator Species** *Acacia karroo, Acacia mearnsii, Acacia nilotica, Acacia sieberiana, Albizia adianthifolia, Aristida junciformis, Combretum spp., Digitaria eriantha, Halleria lucida, Lantana camara, Phoenix reclinata, Pteridium aquilinum, Rubus cuneifolia, Solanum mauritianum, Sporobolus pyramidalis, Strelitzia nicolai, Syzygium cordatum*

The rainfall average is 823 mm of rainfall. The mean temperature is 18.6 ^{0}C and the climate rating is C2, which has a slight limitation on crop growing. There is no frost hazard and the erosion rating for the site is 4.4, which translates to a high risk of erosion.

There are water resources identified for the BRU. Please note there are a number of drainage lines, non-perennial streams and wetlands that are not captured at the coarse level at which this data has been defined.

3.1.6. Environmental Potential Atlas (ENPAT)

The following is referenced from the Department of Environmental Affairs and Tourism (2007): The Environmental Potential Atlas (ENPAT) developed from a single map of Gauteng to a complete spatial data set of the entire South Africa.

ENPAT was updated in July 2001 and is used by the National Department of Environmental Affairs and Tourism and various provincial environmental management departments as a decision-making tool in the process of environmental impact assessments. ENPAT includes the decision-making parameters such as: high-risk development category indications and potential impacts are linked to the 1:250 000 spatial databases on national and provincial level.

The main purpose of ENPAT is to proactively indicate potential conflicts between development proposals and critical or sensitive environments. ENPAT can also be used for development planning since it indicates the environment's potential for development.

ENPAT consists of two distinct, parallel sets of information: natural or environmental characteristics, and social-economic factors. The environmental character maps depict geology, land types, soils, vegetation, and hydrology. The socio-economic factors consist of land cover, cadastral aspects and infrastructure, land use and culture.

These two sets of information are combined and assessed in terms of their potential or latent environmental sensitivity. Sensitivity is assigned based on the ability of a resource to absorb change or impact. A value of **0** indicates a **low sensitivity** - thus a high ability to accept change, and a value of **1** indicates a **high sensitivity**, or a low ability to accept change. Areas of low sensitivity are thus available or suitable for development.

The ENPAT data provides the following information about the site:

3.1.6.1. Soils and Geology

The geology of the site is comprised of Sandstone of the Natal Group. The soils on the site are dominated by Red-yellow apedal, freely drained soils with a humic horizon. These soils have a low sensitivity to disturbance and can accept development well.

3.1.7. Mucina and Rutherford's Vegetation Assessment

For both of the vegetation units predicted to occur across the three sites, **Mucina & Rutherford, 2006** compiled an inventory of species which includes the species which are most commonly occurring within these classifications, as well as the numerous rare and / or endemic species, likely to occur.

3.1.7.1. SVs 5 KwaZulu-Natal Sandstone Sourveld

KwaZulu-Natal Sandstone Sourveld is distributed in KwaZulu-Natal along elevated coastal inland sandstone plateaus from Mapumulo near Kranskop in the north to St Faiths near Port Shepstone in the south (including Noodsberg, Hillcrest, Kloof, Table Mountain, Inanda, Stony Hill, Umbumbulu, Mid-Illovo, Dumisa, Highflats). Altitude ranges from about 500–1100 m.

It is considered endangered, with a conservation target of 25%. Only 0.2% statutorily conserved in the Krantzkloof and Vernon Crookes Nature Reserves. Some 68% transformed for cultivation, plantations, urban development or road building. This highly transformed vegetation type is a prime agricultural area with mainly sugar cane and timber plantations.

The urban sprawl of the Ethekwini (Durban) Metropolitan Area and densely populated subsistence farming areas account for most of the remainder. Apart from the critically little conserved areas (only several hundred hectares), most remaining areas are subjected to high levels of grazing and frequent fire not conducive to the recruitment of seedlings of many of the shrubs and herbs. Erosion is low to very low.

SVs5 – KwaZulu-Natal Sandstone Sourveld Diagnostic Species

Important Taxa: Small Trees: *Protea caffra* (d), *Protea roupelliae* subsp. *roupelliae* (d). **Tall Shrubs:** *Aspalathus chortophila, Gnidia kraussiana, Pachystigma macrocalyx*. **Low Shrubs:** *Acalypha glandulifolia, Agathisanthemum bojeri, Erica cubica* var. *cubica, Erica natalitia, Protea simplex, Protea welwitschii* subsp. *welwitschii, Searsia grandidens, Senecio medley-woodii, Tetraselago natalensis, Thunbergia atriplicifolia, Turraea pulchella*. **Graminoids:** *Aristida junciformis* subsp. *junciformi*s (d), *Heteropogon contortus* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *Andropogon schirensis, Cymbopogon nardus, Digitaria diagonalis, Digitaria natalensis, Diheteropogon amplectens, Elionurus muticus, Eragrostis plana, Eragrostis racemosa, Eulalia villosa, Hyparrhenia hirta, Monocymbium ceresiiforme*. **Herbs:** *Aster bakerianus, Cyanotis speciosa, Dianthus zeyheri, Helichrysum allioides, Selago tarachodes, Senecio dregeanus, Zaluzianskya pilosa.* **Geophytic Herbs:** *Aspidoglossum ovalifolium, Brachystelma perditum, Brachystelma pygmaeum* subsp. *flavidum, Brachystelma tenellum, Eriospermum mackenii, Watsonia densiflora.* **Succulent Herbs:** *Aloe minima, Senecio oxyriifolius.*

Biogeographically Important Taxa: ([M] - Midlands endemic, [P] - Link to Pondoland, [F]- Fynbos generic element, [S] - Southern distribution limit) Low Shrubs: *Agathosma ovata*[F], *Erica aspalanthifolia*[P], *Eriosemopsis subanisophylla*[P], *Gnidia woodii*[P], *Leucospermum gerrardii*[F], *Muraltia lancifolia*[P,F], *Stangeria eriopus*[P], *Syncolostemon parviflorus*[P] **Herbs:** *Agathisanthemum chlorophyllum*[P], *Callilepis leptophylla*[S], *Helichrysum acutatum*[P], *Helichrysum griseum*[P], *Helichrysum pannosum*[P], **Geophytic Herbs:** *Dierama pallidum*[M], *Dierama pumilum*[M], *Disperis woodii*[P], *Gladiolus inandensis*[P] **Succulent Herbs:** *Bulbine inflata*[S], *Crassula multicava* subsp. *floribunda*[P] **Geoxylic Suffrutex:** *Searsia rudatisii*[P]. **Endemic Taxa: Low Shrubs:** *Helichrysum woodii, Tephrosia inandensis* **Succulent Herbaceous Climber:** *Crassula inandensis* **Herbs:** *Eriosema populifolium* subsp. *populifolium, Eriosema rossii, Phymaspermum pinnatifidum.* **Geophytic Herbs:** *Brachystelma modestum, Brachystelma natalense, Brachystelma pulchellum, Cynorkis compacta, Gladiolus cruentus, Hesperantha gracilis.*

3.1.7.2. SVs 4 Ngongoni Veld

Ngongoni Veld is distributed in KwaZulu-Natal and the Eastern Cape, from near Melmoth in the north, to near Libode in the former Transkei (including Eshowe, New Hanover, Camperdown, Eston, Richmond, Dumisa, Harding, Lusikisiki and the Libode area). Altitude ranges from about 400–900 m.

It is considered vulnerable, with a conservation target of 25%. Only less than 1% of the unit is statutorily conserved in the Ophathe and Vernon Crookes Nature Reserves.

Some 39% has been transformed for cultivation, plantations and urban development.

SVs4 – Ngongoni Veld

Small Trees: *Acacia natalitia, Acacia nilotica, Acacia sieberiana* var. *woodii* **Low Shrubs:** *Agathisanthemum bojeri, Euryops laxus, Gnidia anthylloides* **Graminoids:** *Aristida junciformis* subsp. *junciformis* (d)*, Bothriochloa insculpta, Eragrostis curvula, Hyparrhenia hirta, Panicum maximum, Paspalum scrobiculatum, Sporobolus africanus, Sporobolus pyramidalis, Themeda triandra* **Herbs:** *Chamaecrista mimosoides, Conostomium natalense, Gerbera ambigua, Helichrysum allioides, Hermannia grandistipula, Pentanisia prunelloides, Selago tarachodes, Senecio exuberans, Vernonia galpinii,* **Geophytic Herbs:** *Hypoxis argentea, Watsonia densiflora.* **Succulent Herb:** *Aloe minima*

4. METHODOLOGY

4.1. Vegetation Sampling

A random vegetation sampling technique was employed. A site walkover was conducted on the 3rd and 4th of July 2012, during which random areas were sampled. At each sample point/area, individual plant species observed were recorded to give an indication of species diversity and assemblage. Please note that the intensity of the sampling procedure is prescribed by budgetary constraints. The sampling procedure proposed for this study is satisfactory for providing a general overview and rapid assessment of the plant diversity and assemblages that occur onsite. The vegetation community units identified onsite were mapped using a hand-held GPS and ArcView 10 GIS software.

Please note that the majority of all three alternative sites are dominated by cultivation (sugar cane), with only small remnant patches of indigenous vegetation persisting in isolated fragments. One area, on the Shongweni Mixed Use Development Site 1, was historically planted to a *Eucalyptus* sp. compartment. All three sites are represented in the Map series attached at **Appendix 1**.

4.2. Conservation Importance Assessment

Within the context of this vegetation assessment, conservation importance is broadly defined as the importance of the onsite vegetation communities (vegetation fragment) as a whole in terms of the sites role in the preservation and maintenance of biodiversity in the local area. Biodiversity maintenance / importance is a function of the specific biodiversity attributes and noteworthiness of the vegetation communities in question and the biotic integrity and future viability of these features.

The biodiversity noteworthiness of the system is a function of the following:

- species richness/diversity;
- rarity of the system;
- conservation status of the system;
- habitat (real or potential) for Red Data Species; and
- presence of unique and/or special features,

The integrity and future viability of the system is a function of the following:

- Extent of buffer around the system;
- Connectivity of system to other natural areas in the landscape;
- Level of alteration to indigenous vegetation communities within the system;
- Level of invasive and pioneer species encroachment system; and
- Presence of hazardous and/or obstructive boundaries to fauna.

The scores for each function of biodiversity maintenance were determined according to the scoring system shown in **Table 3** below. The scores were totaled and averaged to determine the biodiversity maintenance services score. Thereafter, the overall scores were rated according to the rating scale in **Table 4** below.

Table 3. Biodiversity maintenance services score sheet (Template and Description)

	Scores				
Biodiversity Noteworthiness	**0**	**1**	**2**	**3**	**4**
Diversity	Low	Med-Low	Medium	Med-High	High
Rarity	Low	Med-Low	Medium	Med-High	High
Conservation Status	Least Concern	Near-Threatened	Vulnerable	Endangered	Critically Endangered
Red Data	No	-	-	-	Yes
Uniqueness / Special features	None	Med-Low	Medium	Med-High	High
Integrity & Future Viability	**0**	**1**	**2**	**3**	**4**
Buffer	Low	Med-Low	Medium	Med-High	High
Connectivity	Low	Med-Low	Medium	Med-High	High
Alteration	>50%	25-50%	5-25%	1-5%	<1%
Invasive/pioneers	>50%	25-50%	5-25%	1-5%	<1%
Size	<1 ha	1 – 2 ha	3 - 10 ha	10 – 15 ha	>15 ha

Table 4. Ranking Scale for Biodiversity Maintenance services based on Assessment scores

Score:	**0-0.8**	**0.9-1.6**	**1.7-2.4**	**2.5-3.2**	**3.3-4.0**
Rating of the likely extent to which a service is being performed	Low	Moderately Low	Intermediate	Moderately High	High

5. RESULTS & DISCUSSION

Given the fact that three sites were assessed in terms of their vegetation status and characteristics, it is pertinent that the three sites are discussed individually, based on the findings of the sites. Further, this approach will allow us to provide a comparative assessment of the three sites as well as determine the value of sites in terms of conservation significance.

5.1. Status Quo Assessment - Vegetation Communities Onsite

5.1.1. Shongweni Mixed Use Development Site 1

The first site assessed is positioned on the northern side of the N3, and is bounded by Kassier Road and a high density housing development to the west. The M13 forms the boundary on the north and north eastern side. On the eastern boundary a large alien infested drainage line separates this site from other agricultural practices. On the southern boundary the site is bounded by sugarcane cultivation which extends from the N3 to the property boundary. A locality plan is provided in **Appendix 1**.

Given that the majority of the site is currently under sugar cane cultivation, the sampling effort was focussed on areas where woody vegetation had been established around the last vestiges of remnant indigenous vegetation, i.e. the *Eucalyptus* wood lot, drainage line on the eastern boundary, woody vegetation dominated area along the M13, and wetland areas.

5.1.1.1. *Eucalyptus* species wood lot

The majority of the residual indigenous woody vegetation was located within the boundaries of the wood lot. Within the woodlot two significant drainage areas / wetlands existed. Given that these areas are relatively difficult to transform for agricultural purposes, some remnant indigenous vegetation existed. The most prevalent woody species were; *Halleria lucida, Psychotria capensis, Monanthotaxis cafra* and *Bridelia micrantha.* A number of other indigenous woody species were encountered, however their abundances were low and considered of very limited significance. The following woody species were recorded as singletons, or in very low abundances: *Ficus sur, Syzygium cordatum, Zanthoxylum capense, Peddiea africana, Ochna serrulata* and *Sclerocroton integerrimum.*

In terms of the under-storey of the woodlot, it was dominated by alien species. Limited indigenous species were encountered within the under-storey, with the majority being creeper species. The indigenous species that were encountered were: *Smilax anceps, Dioscorea cotinifolia, Peponium mackenii, Pupalia lappacea, Plectranthus fruticosus, Senecio chrysocoma, Senecio polyanthemoides* and *Conostomium natalense.*

The majority of the under-storey, particularly in the moister areas associated with the drainage lines, were completely dominated by an alien plant species assemblage, with the most prevalent aliens being *Hedychium coccineum* and *Ardisia crenata.* Along the lower reaches of the drainage line, once the two individual drainage lines have converged, and in close proximity to a major access road, a large stand of Bamboo has been planted. It is the author's opinion that this was planted to stabilise the drainage line above the road cut in order to protect the drainage line crossing. As the distance is increased from the drainage line so the alien species assemblage changes. On the drier more elevated slopes, species such as *Lantana camara, Rubus cuneifolius, Triumfetta rhomboidea* and *Solanum mauritianum* dominate the under-storey.

During the early part of 2011 the *Eucalyptus* trees were harvested. Attached as **Appendix 2** are a series of Google Earth Images which illustrate the harvested area and how the alien woody vegetation has encroached into "waste areas" below the major access road. The harvesting, and thus subsequent disturbance, will have impacted significantly on the establishment and proliferation of alien vegetation, most notably within the under-storey. Traditionally, under older and well managed *Eucalyptus* stands, the under-storey is poorly developed with very limited amounts of alien vegetation. It is postulated that the current under-storey is well vegetated as a result of the recent perturbations imparted as a result of harvesting. In addition, the light conditions (light intensity) would favour the development of an under-storey which over time would be reduced as the light intensity was limited by over-shadowing resulting from the *Eucalyptus* species having grown taller. The conditions therefore in the under-storey would exhibit less than optimum conditions for the growth and development of the under-storey, and the majority of the vegetation would therefore senesce over time, falling out of the system. The current situation is therefore of a temporary nature. The seed bank will persist and therefore, after the next harvesting event, the cycle will repeat itself. The scenario as it currently plays out is not ideal, however, the presence of vegetation does have a positive impact in preventing significantly higher levels of erosion which would be experienced if this under-storey, even though dominated by aliens, was not present.

5.1.1.2. Non-woody Wetlands

Only three wetland / drainage lines exist on Site 1 which are not under woody vegetation. These areas, for the most part, have been exposed to regular disturbance and cultivation, either historically or currently. The current impacts being imparted on the wetlands currently comprise; cultivation, central artificial drains and access roads crossings. All of these practices are having a significant impact on the vegetation which would traditionally be associated with Open Valley Bottom Wetlands. In terms of the indigenous vegetation which is currently growing in the wetlands, it is mono-specific, i.e. shows limited diversity (Please note that wetlands, particularly permanent wetlands, are by nature mono-specific due to the high level of clonality evident in the way plant communities assemble in wetlands. Thus, mono-specifity does not necessarily indicate degradation/disturbance in wetlands.

Disturbance in wetlands is reflected more in the percentage occurrence of pioneer species, alien encroachment or observed direct and indirect disturbances). The most prevalent species are *Cyperus prolifer, Cyperus sphaerospermus* and *Cyperus textilis.* Limited abundances of *Typha capensis, Eleocharis limosa* and *Ischaemum fasciculatum* currently occupy the wetland areas. In one of the drainage lines, identified on **Map 1** of **Appendix 3,** two individuals of the protected tree fern species, *Cyathea dregeana* occur. The current state of the wetlands is therefore considered highly transformed from a vegetation perspective; however, it is anticipated by the Author that a specific wetland assessment will speak to these features and their current status and value.

5.1.1.3. Umhlatuzana River on Eastern Boundary and Giba Gorge Beyond

The Umhlatuzana River on the eastern boundary is dominated by alien plant species, the most commonly species were *Eucalyptus* sp. 1, *Eucalyptus* sp. 2, *Populus canescens, Solanum mauritianum, Lantana camara, Tithonia diversifolia* and *Montanoa hibiscifolia.* As this site formed the boundary to the study area, only the periphery of the drainage line was assessed. The River system though extremely transformed and not represented strongly by indigenous vegetation components is an extremely important landscape feature due to the ecological linkage that it creates between the Upper and Lower Umhlatuzana River catchments. Above the Proposed Site 1 the Umhlatuzana River is characterised by large Open Valley Bottom Wetlands, which currently show limited transformation and are essential in providing attenuation for storm water during high or peak rainfall events. Below the site is the protected environment of the Giba Gorge, which has a significant number of rare and threatened plant species, and is a registered Protected Area within the eThekwini Municipality.

5.1.1.4. Road Verges / Homesteads / Labour Housing Areas

These areas for the most part exhibit high levels of alien vegetation, with most of the alien vegetation being woody in nature and of limited ornamental value. The most common species were; *Platanus* x *acerifolia, Schinus terebinthifolius, Euphorbia pulcherrima, Melia azedarach, Eucalyptus* sp., *Spathodea campanulata, Persea* sp. *Prunus persica, Eriobotrya japonica* and *Musa* sp. In terms of herbaceous species the most common species were *Nicandra physalodes, Wedelia triloba, Centella asiatica, Hedychium coccineum* and *Canna indica.* These areas also had limited indigenous vegetation, the most notable being *Ficus burkei* and *Albizia adianthifolia.* These areas do not have any significant indigenous species assemblage and would therefore not contribute significantly to the conservation of biodiversity.

The area close to the M13, where significant woody vegetation was identified, extends along the periphery of the site in the road reserve of the M13, and contains limited indigenous vegetation. The majority of the vegetation is alien in nature, with a high localised abundance of *Caesalpinia decapetala* in the vicinity of the cane road M13 underpass. Further, in areas where the vegetation was less dense, *Vernonia angulifolia* dominated along the ecotone between the cane roads and the woody vegetation. Other species that were identified in these areas, in varying degrees of abundance, and as a direct result of the microclimatic conditions available were; *Setaria megaphylla, Lantana camara, Chromolaena odorata, Solanum mauritianum, Rubus cuneifolius, Ageratum conyzoides, Canna indica, Senecio polyanthemoides* and *Senecio deltoideus.*

5.1.2. Shongweni Mixed Use Development Site 2

The second alternative site that was identified for sampling and assessment is on the southern side of the N3. It is bounded on the east by the J.B. McIntosh Drive (extension of Kassier Road). On the North it is bounded by the N3 road reserve. To the south and west the property is bounded by sugar cane lands.

5.1.2.1. Wetland Area & Drainage Lines

The only remaining natural vegetation that occurs on this particular parcel of land occurs within the wetland / drainage line area. The wetland runs in a north east - south west orientation. This system merges with another system to the west of the site, just off the boundary of the proposed development site. This system combines to form a large system which extends away from the site in a southerly direction, and a significant number of *Cyathea dregea* occur within the centralised drainage channel, This wetland system appeared to be in a relatively intact state.

The vegetation is relatively transformed within the wetland areas on the site as a result of the disturbances which are taking place during the cultivation on either side of the drainage line. The most notable vegetation was large stands of *Ischaemum fasciculatum* and *Christella dentata.* In addition three *Cyathea dregea* individuals were identified and marked on Map 2 attached at **Appendix 3.** Other species that were encountered at low abundances were *Typha capensis*, *Halleria lucida, Laggera alata, Isolepis prolifer, Persicaria senegalensis* forma *albotomentosa, Senecio madagascarensis, Commelina* sp., *Gomphocarpus physocarpus, Juncus lomatophyllus, Pycreus nitidus, Paspalum urvillei* and *Ranunculus multifidus.* A number of alien species were also encountered, but the majority of these currently occur in low abundances. The following species were recorded: *Amaranthus* cf. *hybridus, Bidens pilosa, Galinsoga parviflora, Gamochaeta pensylvanica, Plantago major, Verbena officinalis, Taraxacum officinale, Rubus cuneifolius, Solanum mauritianum* and *Coronopus didymus.*

5.1.2.2. Soccer Field & Labour Housing

The soccer field and Labour Housing areas are dominated by alien invasive species. In terms of woody species, numerous *Acacia mearnsii* individuals are located around the sports field. Only four individual indigenous species were growing in the surrounds of the sports field namely: *Halleria lucida, Bridelia micrantha, Trichilia emetica* and *Ficus burkei.* It is assumed that these species were either planted or grew as a result of the presence of an *A. mearnsii* stand. The presence of *A. mearnsii* resulted in the area being unmanaged, and this provided an undisturbed sheltered microhabitat for their germination and establishment. In terms of herbaceous species, the majority were alien in nature and comprised, *Canna indica, Lantana camara, Solanum mauritianum* and *Ageratum conyzoides.* One indigenous creeper species present was identified as *Senecio deltoideus.* In terms of the area around the labour housing, the most dominant species was *Ceiba pentandra* (Kapok Tree). An alien *Ficus benjamina,* a species most commonly associated with the indoor pot plant industry, has been planted, having outgrown its office space. *Pyrostegia venusta* was growing in abundance on the old wire fence that separates the labour housing from the sugar cane cultivation. Some indigenous species were present, though most of these were restricted to species utilised in horticulture. The most prevalent was *Agapanthus praecox,* however, it was not very abundant.

5.1.2.3. Land form and utilisation

Currently the majority of the site is utilised for sugarcane production. The Open Space Areas are limited with the only single land form feature being the wetland area which traverses the site in close proximity to Kassier Road. *Shongweni Mixed Use Development Site 3*

This alternative lies to the east of Kassier Road and is bounded on the north by the N3, to the south by the MR 559 RTE and Denny Mushrooms. The eastern boundary has limited sugar cane and then opens onto grassland which abuts the site. Further, in close proximity to the N3, woody vegetation extends up the drainage line from the Open Space System known as Giba Gorge.

5.1.3.1. Grassland Area abutting Site 3

The grassland area that was identified and sampled had been burnt in the recent past and therefore, many of the flowering species, which would be expected to occur in the assemblage only in spring or the onset of summer, were available to be sampled and recorded. The grassland occurs on soils derived from sandstone, and had a significant number of sandstone boulders and sandstone rock which day-lighted on the areas sampled. This grassland area extends off the site, with only an extremely small portion thereof falling within the site, approximately 10 metres off the current sugar cane access road. The grassland had a high herbaceous content; however, most of the species recorded are species renowned for responding and appearing in the species assemblage immediately after fire.

It is therefore difficult to assess the true species richness and diversity of the grassland at such a period of the year. However, given the relative isolation, the author would postulate that a visit later in the season, November / December would see a significantly higher species return, with some of the endemic and rare species having the potential to be reflected within the assemblage. Further, the species of grass identified were predominantly described as Decreaser[1] species, which in the presence of poor management, under / over-grazing, regular burning, tend to fall out of the system and are replaced by Increaser I or II species, in this instance species such as *Aristida junciformis.* The dominance of this categorisation of species alludes to the good health and functionality of the grassland at present. Limited alien invasive species were identified, with the only significant concern indentified currently is the presence of *Pteridium aquilinum* an indigenous invader species, which has the potential to colonise and destroy grassland.

Currently, a relatively diverse herbaceous species assemblage was recorded, with the most common species being: *Aster bakerianus, Athrixia phylicoides, Acalypha glandulifolia, Berkheya speciosa, Cyanotis speciosa, Eriosema kraussianum, Gerbera ambigua, Gnidia kraussiana, Indigofera crebra, Helichrysum pilosellum, Helichrysum nudifolium, Psammotropha myriantha, Senecio variabilis, Schistostephium heptalobum, Vernonia capensis, Vernonia natalensis* and *Vernonia oligocephala*. In terms of the graminoid species assemblage, the most common species recorded were; *Alloteropsis semialata, Themeda triandra, Heteropogon contortus, Trachypogon spicatus, Diheteropogon amplectens, Tristachya leucothrix* and *Urelytrum agropyroides*.

The grassland areas that are off the proposed alternative site have relatively steep slopes, and in areas where rocky outcrops are present, woody vegetation has established itself. The most common tree species identified were *Sclerocroton integerrimum, Canthium inerme, Syzygium cordatum* and *Halleria lucida.*

5.1.3.2. Alien infested Fallow Areas

These areas adjoin the drainage line which flows into the Giba Gorge. These areas are currently dominated by *Lantana camara, Chromolaena odorata, Solanum mauritianum* and *Acacia mearnsii.* In terms of the indigenous vegetation, it was limited with the majority of the species being of a ruderal nature. The most common species were *Helichrysum ruderale* and *Senecio polyanthemoides.*

5.1.3.3. Wetland Area & Drainage Line

The portion of the drainage line closest to the steep scarp is dominated by alien woody vegetation. The most common species are *Acacia mearnsii, Psidium guajava, Solanum mauritianum, Lantana camara, Canna indica* and *Ageratum conyzoides.* Limited indigenous woody vegetation exists, with only a few randomly placed indigenous tree species present. The tree species that were recorded are considered to be precursor woody species, namely, *Albizia adianthifolia, Ficus sur, Protorhus longifolia, Trema orientalis* and *Syzygium cordatum.* Two other species, one a tree species, *Vangueria infausta*, and the other a woody shrub *Tetradenia riparia*, were recorded only as singletons.

Once the valley bottom shallows out, as the topography allows for a more open channel, the woody vegetation is replaced with herbaceous and graminoid based species. The open nature, and limited woody vegetation, may be as a result of the fact that the areas on both sides of the wetland are currently cultivated.

The most common species that were encountered along the wetland were; *Cyperus prolifer, Cyperus sphaerospermus, Cyperus textilis, Eleocharis limosa*, *Ischaemum fasciculatum, Persicaria serrulata,*

[1] Decreaser species – palatable and productive grass species that decrease when rangeland is under- or over-grazed; Increaser I species – less palatable and productive grass species that dominate when rangeland is under- or selectively grazed; Increaser II species – less palatable and productive pioneer grass species that increase when rangeland is over-grazed.

Setaria sphacelata var. sericea, Typha capensis and *Zantedeschia aethiopica.* Less common species included two woody species, namely *Harpephyllum caffrum* and *Rauvolfia caffra*, both of which are assumed to have been planted. A protected plant species namely, *Cyathea dregea* was also recorded and a GPS point taken (see **Map 3** of **Appendix 3**). An individual of *Kniphofia* sp. (probably *K. linearifolia*) was also recorded. This species is provincially protected under the KZN Ordinance of 1976 as amended.

5.1.3.4. Garden Areas and Tree Avenues

These areas are almost completely dominated by alien vegetation, with some of the most common species being *Platanus* x *acerifolia* and numerous species of fruiting trees, such as, *Persea americana, Musa* sp. and *Prunus persica.* These areas hold very limited indigenous vegetation and what vegetation may be present is a result of landscaping, or species such as *Ficus burkei* establishing itself, having been vectored into the area through birds and / or bats.

5.2 Status Quo Assessment - Neighbouring Areas of Conservation Value

Currently there are three significant landscape features or ecosystems, which fall on the periphery of the alternative sites and may potentially be impacted upon by the proposed development of one of the alternatives.

5.2.1 Site 1

Site 1 is bounded by the Umhlatuzana River on the eastern boundary. This system has been identified in D'MOSS as Scarp Forest. In terms of our findings it was extremely degraded and transformed with the majority of the tree species present being classed as alien invasive. In addition, the Umhlatuzana River has a flood plain associated with it that has been transformed and drained in order to facilitate the planting of Sugar cane. Having inspected the area it appeared that a River bed does exist, however, the stream has incised and eroded as a result of increased flood peaks. The flood peaks are a result of the change in catchment land use above the proposed development site, where urban storm water has not been effectively controlled and attenuated. Once the River leaves the site the River steepens abruptly through the Giba Gorge and becomes a steep bedrock channel. It is therefore concluded that this system would potentially be more resilient to a change in the hydrology, as opposed to the two other sites.

However, as alluded to in **Section 5.1.1.3** the Giba Gorge is a significant biodiversity hotspot within the eThekwini Municipality, and all opportunities to ensure its protection and linkage to other systems must be strongly considered and where possible taken.

In **Table 5** below are the rare and threatened plant species that have been identified within the Giba Gorge Complex.

Table 5. Rare and Threatened Plant Species recorded within the Giba Gorge complex.

Common Name	Scientific Name	Red Data Category
iMfingo	*Stangeria eriopus*	Vulnerable
Wild Maple	*Seemannaralia gerrardii*	Least concern
-	*Helichrysum woodii*	Least concern
-	*Senecio medley-woodii*	Least concern*
-	*Senecio rhyncholaenus*	Least concern
Wild Begonia	*Begonia dregei*	Endangered
-	*Maytenus cordata*	Least concern
-	*Crassula inandensis*	Least concern
Mountain Peach	*Aphloia theiformis*	Least concern
Beautiful Brachystelma	*Brachystelma pulchellum*	Near threatened
-	*Streptocarpus prolixus*	Least concern
Pondo Bride's Bush	*Pavetta bowkeri*	Least concern
-	*Aloe linearifolia*	Near threatened
Natal Lily	*Crinum moorei*	Vulnerable
-	*Merwilla plumbea*	Near threatened
-	*Stenoglottis* sp. nov.	?
Common Tree Fern	*Cyathea dregei*	Least concern
Gerrard's Brachystelma	*Brachystelma gerrardii*	Endangered
-	*Plectranthus purpuratus* ssp. *purpuratus*	Least concern
-	*Streptocarpus molweniensis* ssp. *molweniensis*	Vulnerable
-	*Cynorkis compacta*	Vulnerable
Blood-red Gladiolus	*Gladiolus cruentus**	Critically Endangered
-	*Geranium ornithopodioides*	Endangered
Forest Elephant's Foot	*Dioscorea sylvatica*	Vulnerable
Large-leaf Onionwood	*Cassipourea gummiflua*	Vulnerable

Land Legal relating to Giba Gorge

The Giba Gorge is classified as a Special Rating Area under Section 22 of the Municipal Property Rates Act [No. 6 of 2004] and is bound by Section 8 of the eThekwini Municipal Rates Policy, 2009/2010.

DMOSS relating to Giba Gorge

The conservation areas in the GGEP form part of the Durban Metropolitan Open Space System (DMOSS). DMOSS is a regulatory spatial layer of the EM which identifies areas of significance for biodiversity conservation and ecosystem goods and services and regulates development activities in these areas.

Non-user Conservation Servitudes (NUCS) relating to Giba Gorge

NUCS are registered against the title deeds of a property and limit the use of that portion (or the entire property if registered over this extent) to that of conservation-related activities.

5.2.2 Site 2

Site 2 hosts a valley bottom wetland system which feeds into a larger valley bottom system that extends beyond the site. This system eventually feeds into the Wekeweke River, and thereafter the Shongweni Dam. The wetland on site may be deemed to be relatively transformed, however, once it has converged with another wetland system and leaves the site, the wetland, from a vegetative perspective, improves significantly and appears to be less transformed and degraded than the wetland arm occurring on the site. The wetland offsite is dominated by species such as *Cyathea dregea* as well as numerous other indigenous wetland species, all of which are representative of a healthy and well functioning system, which will deliver considerable Ecological Goods & Services. It appears as if the hydrological regime is functioning well as wetland areas adjoining the centralised channel have well established and typical wetland vegetation. The low abundance and presence of alien invasive species also alludes to the fact that the other functions of nutrient removal, toxicant removal and attenuation of hydrograph spikes are functioning at a high level.

5.2.3 Site 3

Site 3 is bounded on the eastern side by a Sandstone Sourveld Grassland, which has relatively high species richness, given that the assessment was undertaken in winter. Further, this grassland type is extremely rare and considered to be Endangered in terms of the categorisation provided by **Mucina & Rutherford, (2006)**. The current species composition, most notably the graminoid component, alludes to strong functionality and a healthy system.

5.3 Conservation Value Assessment

The majority of all three of the alternative sites were assessed as being of **low** conservation and biodiversity value from a floral perspective as they are all currently under cane cultivation and/or *Eucalypts* sp. woodlots (steeper slopes of Site 1). However, small portions of conservation worthy vegetation communities were identified along the edges, bordering and within the vicinity of the three sites. The conservation value of these communities is discussed below.

However, although the vegetation communities on site are limited it is imperative that the Author looks beyond the sites to identify whether development on any of the sites will result in a potentially higher impact at various levels relating to current land uses around the sites, as well as at the landscape level, as opposed to a site specific level. Please note that the considerations and viewpoints taken below speak at an ecological connectivity, ecological value scale, and the vegetation level as it currently presents itself.

5.3.1 Site 1

The only conservation worthy vegetation community identified on and within the vicinity of the site was the disturbed scarp forest associated with the Umhlatuzana River that runs along the eastern boundary of the site. In its current state, the scarp forest unit assessed as providing an **intermediate** level of biodiversity maintenance services as shown in **Table 6** below. Therefore, in terms of the vegetation which is currently present on site, the vegetation is of **intermediate** importance from a biodiversity conservation perspective.

Table 6. Biodiversity maintenance services score sheet for the disturbed scarp forest along the edge of the site.

Biodiversity Features	Score
species richness/diversity	2
rarity of the system	3
conservation status of the system	4
habitat (real or potential) for Red Data Species	1
presence of unique and/or special features	1
Biodiversity noteworthiness	***2.2***
extent of buffer around the system	0
connectivity of system to other natural areas in the landscape	3
level of alteration to indigenous vegetation community	1
level of invasive and pioneer species encroachment system	1
size	2
Integrity & Viability	***1.4***
Overall Score for Biodiversity Maintenance	**1.8**

5.3.2 Site 2

No conservation worthy vegetation communities were identified onsite. However, a conservation worthy vegetation community was identified within the vicinity of the western boundary of the site. In its current state, the wetland unit is assessed as providing an **intermediate** level of biodiversity maintenance services as shown in **Table 7** below. Therefore, in terms of the vegetation which is currently present on site, the vegetation is of **intermediate** importance from a biodiversity conservation perspective.

Table 7. Biodiversity maintenance services score sheet for the wetland plant community west of the site.

Biodiversity Features	Score
species richness/diversity	0
rarity of the system	3
conservation status of the system	4
habitat (real or potential) for Red Data Species	4
presence of unique and/or special features	2
Biodiversity noteworthiness	***2.6***
extent of buffer around the system	0
connectivity of system to other natural areas in the landscape	2
level of alteration to indigenous vegetation community	2
level of invasive and pioneer species encroachment system	3
size	2
Integrity & Viability	***1.8***
Overall Score for Biodiversity Maintenance	**2.2**

5.3.3 Site 3

The only conservation worthy vegetation communities identified on and within the vicinity of the site was the KwaZulu-Natal Sandstone Sourveld grassland areas and scarp forest areas located along the eastern boundary of the site. In its current state, the KZN Sandstone Sourveld was assessed as providing a **high** level of biodiversity maintenance services as shown in **Table 8** below. Therefore, in terms of the vegetation which is currently present on site, the vegetation is of **high** importance from a biodiversity conservation perspective.

Table 8. Biodiversity maintenance services score sheet for the KwaZulu-Natal Sandstone Sourveld.

Biodiversity Features	Score
species richness/diversity	4
rarity of the system	4
conservation status of the system	4
habitat (real or potential) for Red Data Species	4
presence of unique and/or special features	4
Biodiversity noteworthiness	***4.0***
extent of buffer around the system	2
connectivity of system to other natural areas in the landscape	2
level of alteration to indigenous vegetation community	3
level of invasive and pioneer species encroachment system	3
size	2
Integrity & Viability	***2.2***
Overall Score for Biodiversity Maintenance	**3.1**

5.4 Impacts on Floral Biodiversity

As all three sites are generally of a low conservation value when the floral diversity of sites is assessed, at a site specific level, no impacts will be imparted should development be undertaken. However, the exceptions to this are the two small areas of valuable vegetation communities adjacent to sites 1 & 3. It is important therefore to consider what impacts the development of either the three sites will have on the neighbouring vegetation communities as described in **Section 5.2** and/or ecological linkages, which currently exist.

5.4.1 Disturbed D'MOSS Scarp Forest and Giba Gorge System

Considering the above described agreements and the special nature of the Giba Gorge which is in extremely close proximity to Site 1, an argument exists for this Site not to be developed. The following reasons add weight to Site 1 not being the preferred development Option:

- The steep valley slopes above the Umhlatuzana River and associated erosion risks during development;
- Secondary impacts to the Umhlatuzana River and downstream Giba Gorge riparian areas in terms of increased storm water runoff, erosion and sedimentation rates;
- The current *status quo* appears not to be resulting in significant storm water generation and damage to the Umhlatuzana River.
- Very limited residual vegetation in pockets surrounded by transformed land uses;
- The continuous open space linkage between the Upper and Lower portions of the Umhlatuzana River, with no development along it will result in the *status quo* remaining, with opportunities for utilisation of the cultivated and non cultivated areas to provide limited refuge and habitat for faunal species.
- The *status quo* remaining with D'MOSS areas identified off site not being impacted upon by development.

However, there is a single negative impact associated with the no-development option on Site 1. The current high levels of alien invasive species, which exist on Site 1 will remain intact, and continue to provide propagules into the system below. As identified in the in the **Giba Gorge Environmental Precinct (GGEP): Conservation Management Plan Version 3 June 2011**, one of the most significant threats and impacts is alien invasive species and the continued re-introduction of these species as a result of surrounding infestations. Below is an extract from the GGEP Conservation

Management Plan, which speaks directly to this issue and the proposed plans and by-laws that may potentially be instituted in the near future.

"The surrounding suburbs of Giba have high levels of alien invasive plant infestations that will continue to be a source of re-infestation in the GGEP..... The EPCPD has recently produced an Alien Invasive Species Strategy and Action Plan for the city which, once implemented, will see coordinated efforts formed to combat these species on a large scale. The EPCPD is also in the process of developing a Green By-law which will give the municipality more legislative powers with regards to enforcement in this regard. Once these two processes come into action and if they are successful, this threat should become more manageable."

5.4.2 D'MOSS Wetland System

The development of Site 2 will likely result in the substantial hardening of a portion of the wetland unit's catchment which will result in increased floodpeaks and decreased subsurface water inputs if storm water generated by the proposed development is not allowed to infiltrate back into the developed area and/or the storm water is not adequately controlled and attenuated. Therefore it is important that the hydrology of the wetland systems onsite be maintained post-development by incorporating storm water infiltration and attenuation into the design of the development.

5.4.3 KwaZulu-Natal Sandstone Sourveld grassland

The potential for the balance to be altered with the advent of development does exist as the land use proposed may not be conducive to regular burning, i.e. the proposed land uses may be incompatible.

Additionally, the establishment of a development may curtail the grazing of the grassland, altering the current scenario, which may also result in a species assemblage shift. This grassland is currently a D'MOSS site and the wetland system which it adjoins in the valley bottom extends through the site. It is crucial to note that the sustainability of individual systems is linked inextricably to their landscape context, i.e. whether the system that you are trying to conserve has high connectivity to other ecosystems, and their functionality and the size of the landscape mosaic into which the system in question fits are extremely important factors to consider.

A summary of the above discussions, and relative development impact risks to the valuable features neighbouring the three alternative sites are provided below. From **Table 9** we are able to provide a comparative analysis of the sites at a broad scale, and the potential for each to accept change, based on the vegetation and wetlands that were encountered on the site.

Table 9. Biodiversity Features occurring on the sites and on the periphery of the sites, with an associated rating in terms of their importance.

Biodiversity Features	Umhlatuzana River	D'MOSS wetland system	Disturbed wetlands	KZN Sandstone Sourveld	Umhlatuzana Scarp Forest	Giba Gorge Precinct
Location	Eastern boundary of **Site 1**	Western boundary of **Site 2**	Occur within **Sites 1, 2 & 3**	Eastern boundary of **Site 3**	Eastern boundary of **Site 1**	Below **Site 1&3**
Current State	Moderately modified	Slightly modified	Highly modified	Slightly modified	Highly modified	Slightly Modified
Impact Risks	Increased flood peaks & erosion (**High**)	Increased flood peaks & erosion (**Medium**)	Increased flood peaks & erosion (**Medium**)	Erosion & sedimentation (**High**)	Erosion & sedimentation (**Medium**)	Erosion sedimentation impacts on riparian areas (**Medium)**
	Sedimentation (**High**)	Reduced base/subsurface flow (**Medium-High**)	Reduced base/subsurface flow (**Medium**)	Edge disturbances (**High**)	Edge disturbances (**Medium**)	
		Sedimentation (**High**)	Sedimentation (**Medium-Low**)			

5.4.4 Open Space Systems

The opportunity for the incorporation of all or any parts of the three sites into the current Open Space System are limited, with the majority of the land cover being sugar cane. However, as with any development, areas of ecological or biodiversity sensitivity should be incorporated into development proposals to promote sustainability and landscape connectivity. Numerous wetland areas exist on the three alternative sites, and these should be incorporated into any development proposal. Further wetland systems, and thus their associated wetland vegetation, are protected by current Legislation, most notably the National Water Act and the National Environmental Management Act.

6. RECOMMENDATIONS

It is the author's opinion that all three sites could accept development; however, Site 2 is the preferred option from an ecological and vegetation impact perspective provided the following mitigation measures are adhered to:

- The control and management of alien invasive plant species is legislated by the Conservation of Agricultural Resources Act, Act 43 of 1983. It is therefore imperative that an alien management plan be implemented on Site 1 to control the alien species, most notably the *Ardisia crenata* and *Hedychium coccineum.* This will provide alien plant control benefits to the D'MOSS areas downstream, particularly the Giba Gorge Environmental Precinct.
- Similarly, all the alien vegetation that currently exists on Sites 2 and 3 should be removed and controlled.
- The wetlands on and neighbouring the site must be afforded a suitable buffer as determined by a wetland specialist.
- The wetlands within Site 2 should be rehabilitated.
- Storm water generated by the proposed development must be allowed to infiltrate back into the groundwater across the site to ensure that the wetland system downstream is not negatively impacted.
- Similarly, storm water generated by the proposed development must be effectively controlled and attenuated to ensure that the erosion and sedimentation risks associated with increased floodpeaks is mitigated and/or avoided.

7. ASSUMPTIONS, UNCERTAINTIES & LIMITATIONS

The following limitations require noting;

- The vegetation assessment was undertaken in winter and therefore the species assemblage that has been recorded is not comprehensive, most notably for the grassland and wetland components that were assessed.
- The vegetation in certain areas was extremely dense and infested with alien species and certain smaller species may have been overlooked.
- The assessment of the vegetation was undertaken over two days and therefore some species may not have been detected as a simple function of time spent on site.
- Certain species that were present in the assemblage (grassland areas) were not flowering and were only emerging (vegetative parts only) and therefore identification to species level was not possible.
- Geophytic species were absent from the species assemblage, due to the season in which the assessment was undertaken.

The following assumptions were made;

- Wetland areas and the associated vegetation would potentially be afforded the relevant legislated protection and therefore were not as intensively sampled as the areas which fall

outside of these specific landscape features, however, the protected species were GPS referenced.
- An assumption as too when the woodlot area was clear-felled was made. This assumption has bearing on the species composition and assemblage that was recorded.

The following uncertainties require noting;
- The type and extent of the development that is proposed,
- The timeframes in which the development will proceed should development be authorised.

8. CONCLUSION

Having undertaken the assessment of the three alternative sites proposed to receive a Mixed Use Development, the Author has drawn the following conclusions.

Looked at in isolation, all three sites are of low biodiversity value from a floral perspective with the majority of the vegetation communities that once existed on the sites having all been transformed by cultivation.

Nevertheless, the development of either of the three sites may result in substantial impacts to neighbouring vegetation communities of conservation value. In this regard, it is concluded that the development of Site 1 and/or Site 3 stand to have the most severe impacts on biodiversity and related conservation worthy systems for the following reasons:

- Site 2 is gently to moderately sloping and will require the least amount of earthworks to create developable areas. Site 1 and 3 are characterised by moderately to steep slopes and will require the most amount of earthworks. As a result, the development of Sites 1 and 3 poses the most severe erosion and sedimentation risks.

- Sites 1 and 3 are bounded by sensitive environments that may potentially be negatively impacted upon should development proceed whereas Site 2 is not bounded by any such features. The only natural vegetation present within Site 2 is limited wetland vegetation communities that occur within the narrow wetland corridor. However, this area will, through legislation, be afforded protection.

- Site 1 forms an important linkage between the Upper and Lower Umhlatuzana River, which feeds directly into the Giba Gorge Environmental Precinct. It has been shown through rigorous research that Open Space Systems are extremely significant for the persistence of areas of conservation significance and that perturbations that may disrupt these linkages may have highly detrimental impacts on the area designated to be conserved.

- Site 3 abuts the Giba Gorge Environmental Precinct and therefore, impacts may be directly imparted on this system, which requires a buffer between itself and development.

Therefore it is our conclusion, not considering any features other than the vegetation currently on site, that the preferred option for development would be Site 2 assuming that best practice storm water management measures are incorporated into the development. Should the other factors be included then this would simply add weighting to the argument that Site 2 should be the preferred development site for the proposed Shongweni Mixed Use Development.

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RAPID ASSESSMENT OF THE VEGETATION ASSOCIATED WITH A PROPOSED 500 MM BULK WATER LINE

DRAFT REPORT

Issue Date: 18th October 2013
Revision No.: 1
Project No.: 12365

SPECIALIST REPORT DETAILS

This report has been prepared as per the requirements of Section 32 of Government Notice No. R. 543 dated 18 June 2010 (Environmental Impact Assessment Regulations) under sections 24(5), 24M and 44 of the National Environmental Management Act, 1998 (Act 107 of 1998).

I, **Dr. Richard Kinvig** declare that this report has been prepared independently of any influence or prejudice as may be specified by the Department of Agriculture and Environmental Affairs (DAEA).

Signed: Richard Kinvig Date: 18/10/2013

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Revision Number:	# 1
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For:	**Tongaat Hulett Developments**
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RAPID ASSESSMENT OF THE VEGETATION ASSOCIATED WITH A PROPOSED 500 MM BULK WATER LINE DRAFT REPORT

RAPID ASSESSMENT OF THE VEGETATION ASSOCIATED WITH A PROPOSED 500 MM BULK WATER LINE DRAFT REPORT

1. INTRODUCTION

SiVEST Environmental Division was requested by **Tongaat Hulett Developments** to undertake a rapid assessment of the proposed pipe line alignment for a 500 mm diameter steel pipe that will serve as the Bulk Water Supply line to the proposed Shongweni Mixed Use Development Node. The pipe line for the most part traverses land owned and or managed by Tongaat Hulett Sugar.

2. BACKGROUND

The proposed pipe line will T-Off the current Umgeni Water Western Aqueduct, in the vicinity of the Hillcrest Hospital. It will run for a length of approximately 5.5 kilometres, and terminate in a reservoir on the southern side of the N3 freeway on land owned by Tongaat Hulett.

3. DATABASE INTERROGATION / DESKTOP ANALYSIS

One of the major advantages that technology has provided is the access to information. As a result of this and the ongoing pursuance of environmental knowledge, databases which can be interrogated to provide general information regarding the pipeline route have been developed.

This information in turn potentially records what may occur on the site and the sites value from a regional / provincial perspective in terms of conservation and biodiversity. The caveat here is that the majority of these databases are created at the landscape level. In addition, the factors which are often utilized to determine many of the outputs are related to abiotic characteristics, such as rainfall, temperature, soil types, underlying geology, elevation and aspect. The result therefore is the development of a database that provides a high level assessment of the area, which requires substantial ground-truthing to illustrate the various components that comprise the landscape. The field survey highlights areas of conservation significance and biodiversity richness as well as provides information regarding the *status quo* and what will be required in terms of management to ensure improvement in the *status quo* and ensure the long term viability and sustainability of the proposed development corridor.

A number of databases have been interrogated in the process of undertaking the Desktop Analysis. A summary of the methodology utilised for the generation of each of the databases, as well as the pertinent results for each are included below under the various titled sub-sections.

3.1 Ezemvelo KZN wildlife C-Plan & SEA Database

The C-Plan is a systematic conservation-planning package that runs with the GIS software ArcGIS, which analyses biodiversity features and landscape units. C-Plan is used to identify a national reserve system that will satisfy specified conservation targets for biodiversity features (**Lombard et al. 2003**). Biodiversity features can be land classes or species, and targets are set in area units either for land classes, or as numbers of occurrences of species for species locality data sets (**Lombard et al. 2003**). These units or measurements are used as surrogates for un-sampled data. The C-Plan is an effective conservation tool when determining priority areas at a regional level and is being used in South Africa to identify areas of high conservation value.

3.1.1 Irreplaceability Analysis

The following is referenced from **Goodman (2004)**: "The first product of the conservation planning analysis in C-Plan is an irreplaceability map of the planning area, in this case the province of KwaZulu-Natal. This map is divided into 1 by 1 km grid cells called 'planning units'.

Each cell has associated with it an 'Irreplaceability Value', which is a reflection of the cells' importance with respect to the conservation of biodiversity. Irreplaceability reflects the planning unit's ability to meet set 'targets' for selected biodiversity 'features'. The irreplaceability value is scaled between 0 and 1.

Irreplaceability value – 0. Where a planning unit has an irreplaceability value of 0, all biodiversity features recorded here are conserved to the target amount, and there is unlikely to be a biodiversity concern with the development of the site.

Irreplaceability value – 1. These planning units are referred to as totally irreplaceable and the conservation of the features within them is critical to meet conservation targets. (EIA very definitely required and depending on the nature of the proposal unlikely to be granted).

Irreplaceability value > 0 but < 1. Some of these planning units are required to meet biodiversity conservation targets. If the value is high (e.g. 0.9) then most units are required (few options available for alternative choices). If the value is low, then many options are available for meeting the biodiversity targets. (EIA required and depending on the nature of the proposed development, permission could be granted)."

3.1.2 C-Plan Biodiversity Features / Species within Project Area

In terms of the desktop analysis undertaken, almost the entire pipeline route is considered as a Biodiversity Priority Area 1, and is considered essential to meet the conservation goals of the province**.**

There are potentially eleven features present on site which are considered to be of environmental significance and conservation importance. These features are as follows:

- Vegetation Type – KwaZulu-Natal Sandstone Sourveld
- Vegetation Type – Eastern Scarp Forest
- Fauna – *Eremidium erectus* (Grasshopper)
- Fauna – *Doratogonus rubipodus* (Millipede)
- Fauna – *Cochlitoma semidecussata* (Mollusc)
- Flora – *Helichrysum woodii*
- Flora – *Gerrardanthus tomentosus*
- Flora – *Pseudoscolopia polyantha*
- Flora – *Dahlgrenodendron natalense*
- Flora – *Begonia rudatisii*
- Flora – *Drimia Flagellaris*

3.1.3 KZN Wildlife SEA

In terms of the SEA data generated, through the physical characteristics that are present along the pipeline route, a number of groups have been identified as potentially present, and these groups are wholly significant in terms of conservation significance or parts thereof. The Table below identifies which groups are significant.

Table 1. SEA Data taken from *Ezemvelo* KZN Wildlife for the proposed pipeline route

YES	NO
Protected Plants	Vegetation - Wetlands
Invertebrates	Reptiles
Aquatic Fauna	Vegetation - Forests
Mammals	Avi-faunal
	Vegetation - Grasslands
	Medicinal Plants
	Frogs

3.2 Bio Resource Units

In terms of Camp, 1998, there are two Bio Resource Units for the pipeline route, Yb15 and Wb16.

The general characteristics of Yb15 are as follows:

Bioresource Group 3 - Moist Coast Hinterland Ngongoni Veld

- **BRG Subgroup** 3.6
- **Vegetation pattern** Bushed Grassland
- **Indicator Species** *Acacia karroo, Acacia mearnsii, Acacia nilotica, Acacia sieberiana, Albizia adianthifolia, Aristida junciformis, Combretum* spp.*, Digitaria eriantha, Halleria lucida, Lantana camara, Phoenix reclinata, Pteridium aquilinum, Rubus cuneifolia, Solanum mauritianum, Sporobolus pyramidalis, Strelitzia nicolai, Syzygium cordatum.*

The mean annual rainfall is 920 mm of which the majority falls within the summer months. The mean temperature is 18.7 ^{0}C and the climate rating is C2, which has a slight limitation on crop growing. There is no frost hazard and the erosion rating for the site is 5.4, which translates to a moderate risk of erosion.

There are some wetlands, 1 perennial, and 1 annual rivers identified for the BRU. Please note there are a number of drainage lines, non-perennial streams and wetlands that are not captured at the coarse level at which this data has been defined.

The general characteristics of Wb16 are as follows:

Bioresource Group 3 - Moist Coast Hinterland Ngongoni Veld

- **BRG Subgroup** 3.6
- **Vegetation pattern** Bushed Grassland
- **Indicator Species** *Acacia karroo, Acacia mearnsii, Acacia nilotica, Acacia sieberiana, Albizia adianthifolia, Aristida junciformis, Combretum* spp.*, Digitaria eriantha, Halleria lucida, Lantana camara, Phoenix reclinata, Pteridium aquilinum, Rubus cuneifolia, Solanum mauritianum, Sporobolus pyramidalis, Strelitzia nicolai, Syzygium cordatum.*

The mean annual rainfall is 823 mm of which the majority falls within the summer months. The mean temperature is 18.6 ^{0}C and the climate rating is C2, which has a slight limitation on crop growing.

There is no frost hazard and the erosion rating for the site is 4.4, which translates to a high risk of erosion.

There are water resources identified for the BRU. Please note there are a number of drainage lines, non-perennial streams and wetlands that are not captured at the coarse level at which this data has been defined.

3.3 Environmental Potential Atlas

The following is referenced from the Department of Environmental Affairs and Tourism (2007): The Environmental Potential Atlas (ENPAT) developed from a single map of Gauteng to a complete spatial data set of the entire South Africa.

ENPAT was updated in July 2001 and is used by the National Department of Environmental Affairs and Tourism and various provincial environmental management departments as a decision-making tool in the process of environmental impact assessments. ENPAT includes the decision-making parameters such as: high-risk development category indications and potential impacts are linked to the 1:250 000 spatial databases on national and provincial level.

The main purpose of ENPAT is to proactively indicate potential conflicts between development proposals and critical or sensitive environments. ENPAT can also be used for development planning since it indicates the environment's potential for development.

ENPAT consists of two distinct, parallel sets of information: natural or environmental characteristics, and social-economic factors. The environmental character maps depict geology, land types, soils, vegetation, and hydrology. The socio-economic factors consist of land cover, cadastral aspects and infrastructure, land use and culture.

These two sets of information are combined and assessed in terms of their potential or latent environmental sensitivity. Sensitivity is assigned based on the ability of a resource to absorb change or impact. A value of **0** indicates a **low sensitivity** - thus a high ability to accept change, and a value of **1** indicates a **high sensitivity**, or a low ability to accept change. Areas of low sensitivity are thus available or suitable for development.

The ENPAT data provides the following information about the site:

3.3.1 Soils and Geology

The geology of the pipeline is comprised of Sandstone of the Natal Group. Sandstone is not sensitive to disturbance and development. The soils along the pipeline route are dominated by Red-yellow apedal, freely drained soils with a humic horizon. These soils have a low sensitivity to disturbance, and can accept development well.

3.4 Mucina and Rutherford's Vegetation Assessment

KwaZulu-Natal (KZN) province is rich in natural diversity. In terms of vegetation the pipeline route falls within the Sub-Escarpment Savanna Bioregion.

In terms of the vegetation on site the general classification is made at a very coarse scale, i.e. low resolution and the pipeline falls entirely within the KwaZulu-Natal Sandstone Sourveld vegetation type.

3.4.1 SVs 5 KwaZulu-Natal Sandstone Sourveld

KwaZulu-Natal Sandstone Sourveld is distributed in KwaZulu-Natal along elevated coastal inland sandstone plateaus from Mapumulo near Kranskop in the north to St Faiths near Port Shepstone in the south (including Noodsberg, Hillcrest, Kloof, Table Mountain, Inanda, Stony Hill, Umbumbulu, Mid-Illovo, Dumisa, Highflats). Altitude ranges from about 500–1100 m. It is considered endangered, with a conservation target of 25%. Only 0.2% statutorily conserved in the Krantzkloof and Vernon Crookes

Nature Reserves. Some 68% transformed for cultivation, plantations, urban development or road building. This highly transformed vegetation type is a prime agricultural area with mainly sugar cane and timber plantations. The urban sprawl of the Ethekwini (Durban) Metropolitan Area and densely populated subsistence farming areas account for most of the remainder. Apart from the critically little conserved areas (only several hundred hectares), most remaining areas are subjected to high levels of grazing and frequent fire not conducive to the recruitment of seedlings of many of the shrubs and herbs. Erosion is low to very low.

The following species are considered to be indicative of the Sandstone Sourveld Vegetation Type that is listed as occurring in this area, currently, and what would have been encountered historically prior to the transformation to agriculture.

Important Taxa: Small Trees: *Protea caffra* (d), *Protea roupelliae* subsp. *roupelliae* (d). **Tall Shrubs:** *Aspalathus chortophila, Gnidia kraussiana, Pachystigma macrocalyx*. **Low Shrubs:** *Acalypha glandulifolia, Agathisanthemum bojeri, Erica cubica* var. *cubica, Erica natalitia, Protea simplex, Protea welwitschii* subsp. *welwitschii, Searsia grandidens, Senecio medley-woodii, Tetraselago natalensis, Thunbergia atriplicifolia, Turraea pulchella*. **Graminoids:** *Aristida junciformis* subsp. *junciformis* (d), *Heteropogon contortus* (d), *Themeda triandra* (d), *Trachypogon spicatus* (d), *Tristachya leucothrix* (d), *Andropogon schirensis, Cymbopogon nardus, Digitaria diagonalis, Digitaria natalensis, Diheteropogon amplectens, Elionurus muticus, Eragrostis plana, Eragrostis racemosa, Eulalia villosa, Hyparrhenia hirta, Monocymbium ceresiiforme*. **Herbs:** *Aster bakerianus, Cyanotis speciosa, Dianthus zeyheri, Helichrysum allioides, Selago tarachodes, Senecio dregeanus, Zaluzianskya pilosa.* **Geophytic Herbs:** *Aspidoglossum ovalifolium, Brachystelma perditum, Brachystelma pygmaeum* subsp. *flavidum, Brachystelma tenellum, Eriospermum mackenii, Watsonia densiflora.* **Succulent Herbs:** *Aloe minima, Senecio oxyriifolius.*

Biogeographically Important Taxa: ([M] - Midlands endemic, [P] - Link to Pondoland, [F]- Fynbos generic element, [S] - Southern distribution limit) Low Shrubs: *Agathosma ovata*[F], *Erica aspalanthifolia*[P], *Eriosemopsis subanisophylla*[P], *Gnidia woodii*[P], *Leucospermum gerrardii*[F], *Muraltia lancifolia*[P,F], *Stangeria eriopus*[P], *Syncolostemon parviflorus*[P] **Herbs:** *Agathisanthemum chlorophyllum*[P], *Callilepis leptophylla*[S], *Helichrysum acutatum*[P], *Helichrysum griseum*[P], *Helichrysum pannosum*[P], **Geophytic Herbs:** *Dierama pallidum*[M], *Dierama pumilum*[M], *Disperis woodii*[P], *Gladiolus inandensis*[P] **Succulent Herbs:** *Bulbine inflata*[S], *Crassula multicava* subsp. *floribunda*[P] **Geoxylic Suffrutex:** *Searsia rudatisii*[P]. **Endemic Taxa: Low Shrubs:** *Helichrysum woodii, Tephrosia inandensis* **Succulent Herbaceous Climber:** *Crassula inandensis* **Herbs:** *Eriosema populifolium* subsp. *populifolium, Eriosema rossii, Phymaspermum pinnatifidum.* **Geophytic Herbs:** *Brachystelma modestum, Brachystelma natalense, Brachystelma pulchellum, Cynorkis compacta, Gladiolus cruentus, Hesperantha gracilis.*

4. ON-SITE VEGETATION

The proposed pipe line alignment is routed through areas which are considered to be highly transformed. This transformation is as a consequence of the intensive agricultural activities (commercial sugar cane production) that are currently being undertaken on the land. In areas where the pipe line is not running through sugar cane dominated areas, it is aligned next to roads and or areas considered to be unsuitable for sustainable agricultural production. These areas are considered unsuitable for one of the following reasons:

- The slopes are over steep and farming activities are not possible;
- The areas are along boundary fences and which are associated with roadways, fence lines;
- Abandoned areas which were historically under cultivation but have become so marginal that farming these lands are not financially sustainable;
- The soil types preclude intensive sugar cane production.

Given the linear nature of the proposed pipe line, the author has broken the pipe line down into like vegetation elements; i.e. areas where there is sugar cane will be grouped together and indicated on the map attached at Appendix 1B.

4.1. Abandoned farmlands

Previously cultivated lands which have subsequently been abandoned due to the lack of sustainable production, have been left fallow and as a result the vegetation which has invaded and established itself is all considered to be pioneer or alien in nature. Most common indigenous species which were encountered were *Panicum maximum, Eragrostis curvula, Melinis repens, Sorghum halepense* and then short creeping species of grass, namely *Cynodon dactylon. Lolium perenne* a grass species which is commonly utilised as green compost in sugar cane fields was also present. In terms of the herbaceous plant species encountered these species were all ruderal or pioneer species and the most common of these were *Helichrysum ruderale, Senecio polyanthemoides, Senecio madagascarensis, Acalypha peduncularis* and *Pentanisia prunelloides.* The following alien herbaceous species were extremely common; *Lantana camara Solanum mauritianum, Ageratum conyzoides Taraxacum officinale, Conyza* sp., *Lepidium* sp., *Tagetes minuta, Oenothera indecora, Oenothera rosea, Triumfetta rhomboidea, Verbena bonariensis, Centella asiatica, Malvastrum coromandelianum, Plantago major, Sigesbeckia orientalis, Gamochaeta pensylvanica, Hypochaeris radicata* and *Canna indica.* In terms of woody species that were recorded the two most significant alien species were *Eucalyptus* sp. and *Melia azedarach.* To a lesser extent there were a number of *Acacia mearnsii* which were identified. These individuals however, were small and it appeared as if the area was being managed to prevent the infestation of the fallow areas by woody species. Three species of indigenous tree were identified, namely; *Burchellia bubalina*, *Ficus sur* and *Maesa lanceolata.*

4.2. Fence Lines

The vegetation that comprises the fence line areas is predominantly alien. In terms of the woody species that were encountered the majority (98%) occurred on the adjacent properties and thus by inference would not be impacted upon by the proposed pipe line.

4.2.1 Fence line species North of the M13

The most common plant species that were identified were; *Anisochaeta mikanioides, Cyphostemma cirrhosum* both of which are creeper species, and both indigenous. The most common trees were alien species, namely; *Bougainvillea* sp., *Viburnum odoratissum, Pinus* sp., *Tabebuia pallida, Psidium guajava, Phytolacca dioica, Persea* sp., *Clerodendrum glabrum.* Three wetland plants were common; *Ischaemum fasciculatum, Typha capensis, Persicaria lapathifolia.* The remainder of the species were grass species or herbaceous plant species and shrubs. The following three species were indigenous, *Chrysanthemoides monilifera, Acacia kraussiana, Setaria megaphylla, Gomphocarpus physocarpus* and *Cyperus sexangularis,* with the remainder comprising alien species. *Tagetes minuta, Lantana camara, Plectranthus comosus, Ageratum conyzoides, Morus alba, Agave sisalana, Cirsium vulgare, Amaranthus hybridus, Ciclospermum leptophyllum, Ambrosia artemisiifolia, Conyza* sp.

4.2.2 Fence line species in close proximity to the Shongweni Polo Club

The following species were dominant in the area adjoining the Shongweni Polo Club and the homestead adjoining the polo club; *Lantana camara, Solanum mauritianum, Solanum nigrum, Melia azedarach, Canna indica, Jacaranda mimosifolia, Cupressus* sp., and *Eriobotrya japonica.* The only indigenous species that were encountered were *Anisochaeta mikanioides* and *Scadoxus puniceus,* the latter being a provincially protected plant species. This species being bulbous will be easily transplantable and of least concern when considering its relocation as well as its current status within KZN.

4.3. Actively Cultivated Sugar Cane Fields

The sugar cane fields adjoin nearly the entire pipe line routing. These areas are commercially farmed and thus are monotypic in terms of their vegetative component, namely; *Saccharum* sp.

4.4. Road Verges

The road verges that the proposed pipe line will run along are all dominated by alien invasive plant species or species which are commonly associated with disturbance. In terms of the road verges that were sampled, many of them have a number of woody elements occurring on them. For the most part these are alien species; however, *Halleria lucida, Bridelia micrantha, Maesa lanceolata* and *Syzygium cordatum* are indigenous species which were recorded as either singletons or in very low abundances. Further the majority of these indigenous species were encountered in the area where a storm water culvert passes under the N3 and will potentially fall outside of the pipe line alignment and its associated working area. It is our recommendation that in this specific area, effort must be taken to try and alleviate the need to remove these trees. A number of indigenous herbaceous and or shrubby species were also recorded, the bulk of these being associated with disturbance and or the ecotone. The following species were recorded; *Senecio chrysocoma, Gomphocarpus physocarpus, Sida dregei, Malvastrum coromandelianum, Abutilon sonneratianum, Hibiscus cannabinus, Smilax anceps, Halleria lucida, Phoenix reclinata, Helichrysum ruderale, Blumea elata, Digitaria eriantha,* and *Eragrostis curvula.* The alien species that dominated the road verges were; *Solanum mauritianum, Tagetes minuta, Bidens pilosa, Physalis viscosa, Acacia mearnsii, Cinnamomum camphora, Acacia mearnsii, Melia azedarach* and *Malvastrum coromandelianum.*

4.5. Dam Embankments

The edge of the dam, which sits directly adjacent to the N3 road embankment, is extremely transformed and is for the most part dominated by alien vegetation, particularly on the eastern side of the dam. A number of indigenous woody species were encountered, namely; *Maesa lanceolata*, *Bridelia micrantha, Halleria lucida, Syzygium cordatum, Strelitzia nicolai* and *Protorhus longifolia.* These trees are all positioned in the wet area at the base of the embankment, and therefore will potentially require removal during the construction of the pipe line. If these individuals require removal the overall loss and significance thereof is low. The benefit and thus gain to the immediate environment is that a large number of alien plant species will be removed during the construction process and thus mitigate the loss of these limited number of indigenous tree species. The under-storey in this particular area was dominated by *Lantana camara*, *Tithonia diversifolia* and *Achyranthes aspera.* One indigenous species was relatively common, the species being *Ludwigia octovalvis.* The following species were recorded however they were not dominant; *Passiflora edulis, Psidium guajava, Plantago major, Spathodea campanulata, Acacia mearnsii, Pinus sp., Cinnamomum camphora, Lepidium* sp. and *Schinus terebinthifolius.*

4.6. Alien Woody Vegetation Areas

A relatively small portion of steep land, which is considered to be waste land as it could not be viably placed under cultivation, requires crossing by the proposed pipe line. The vegetation for the most part comprises alien species, namely *acacia mearnsii* (occurring on the upper steeper slopes) and *Eucalyptus* sp. which seems to be confined to the lower more moist areas of the valley bottom. A number of relatively large *Albizia adianthifolia* occur within this area, however, it is envisaged that the loss of individuals will be minimised based on the current alignment selected. This species is not protected and therefore no licence will be required for its removal. During the field survey a singleton of *Bridelia micrantha* and *Canthium ciliatum* were identified, however, these appeared to fall outside of the corridor that would be required to construct the water pipe line. The under-storey in this particular section of the alignment is dominated by *Pteridium aquilinum.*

4.7. Remnant Sandstone Sourveld invaded and infested by Alien Species

This portion of the proposed pipe line alignment is adjacent to the sugar cane lands and separated from them by a roadway. Having looked at the topography and the terrain we would assume that the pipe line would be placed within the sugarcane cordon, and therefore not impact on the limited natural vegetation restricted to the steeper slopes. However, if this is not the proposed alignment, then the following indigenous species may be impacted upon; *Vernonia capensis, Helichrysum nudifolium, Aloe plurinodis, Senecio inornatus, Helichrysum macrocephalum, Helichrysum pilosellum, Cussonia* *sphaerocephala, Eulophia streptopetala, Eriosema salignum, Clerodendrum glabrum, Pteridium aquilinum, Searsia pyroides* var. *integrifolia, Pycnostachys urticifolia* and *Trema orientalis.*

The *C. sphaerocephala* is a large individual and we would postulate that it is relatively old, and would recommend that if possible the pipe line is aligned on the upper slope above the cane road to alleviate the loss of this individual. The *E. streptopetala,* being an Orchid is protected under the provincial legislation and therefore would require that an application to *E*KZN Wildlife be submitted for its up-liftment and relocation. This would apply to the *Scadoxus puniceus* individual recorded near the Shongweni Polo Club. Three species of alien were prevalent and dominated the species assemblage, *Tithonia diversifolia, Acacia mearnsii* and *Achyranthes aspera. A*ll the indigenous species, apart from *P. urticifolia* were relict species and were simply surviving given the change in the microclimate that had been bought about by the prevalence of the alien species.

5. RECOMMENDATIONS

Given the rapid assessment of the pipe line alignment the following recommendations are provided. Please note that the assessment was rapid and not all plant species may have been recorded. However, given the receiving environment and the condition of said environment the recommendations provided are given with a strong level of confidence, and will result in extremely limited loss of indigenous vegetation and a no nett loss of any rare, threatened or protected plant species.

- Where possible ensure that the pipe line and associated working servitude are maintained within the current property(s) to reduce any impact on the vegetation on the other side of the fence lines;
- Where possible try and avoid the need to remove any tree species, especially indigenous species;
- An alien management plan must be in place to ensure that the construction area and pipe line servitude are maintained free of alien plant species;
- The areas which are disturbed should be rehabilitated with a standard NPA mix of grass species as the area will either be retained as a road or will abut the commercial sugarcane farming activities, therefore the merits of trying to re-establish any form of indigenous and diverse vegetation would prove fruitless.
- The up-liftment and relocation of the two Provincially protected plant species will be required. Additionally a permit from *E*KZN Wildlife would be required to ensure compliance with the current legislation;
- In steep areas where all the vegetation has been removed there will need to be some form of berms and swales to prevent riff and gulley erosion from occurring;
- We would recommend a combination of geofabric and regrassing immediately after the construction has ceased to reduce the potential for erosion to occur and the resultant silting up of wetlands, dams and streams that are in close proximity to the construction area.

6. CONCLUSIONS

Given the current status of the vegetation that was sampled during the site visit, we do not envisage that the proposed pipe line is going to create any significant environmental issues, particularly when considering the vegetation as a stand-alone biophysical characteristic. Two plant species namely, *Scadoxus puniceus* and *Eulophia streptopetala* will require a permit from *E*KZN Wildlife to have them relocated out of the working servitude into an area where they will be able to persist. Where possible large indigenous trees should not be removed and if the requirement exists to do so, the possibility of re-planting similar individuals of the species removed, within the site should be investigated.

The construction of the pipe line will need to be managed as the potential for erosion to result and the infestation of the disturbed pipe line corridor is high. Erosion protection measures and re-grassing should commence immediately post construction, and should not be left until the entire pipe line has been constructed. A budgetary amount should be allowed for in the construction Bill of Quantities to ensure that the rehabilitation is undertaken correctly.

It is therefore our recommendation that no further assessment of the pipe line is required from a vegetation perspective and the impact that will be imparted is very low.

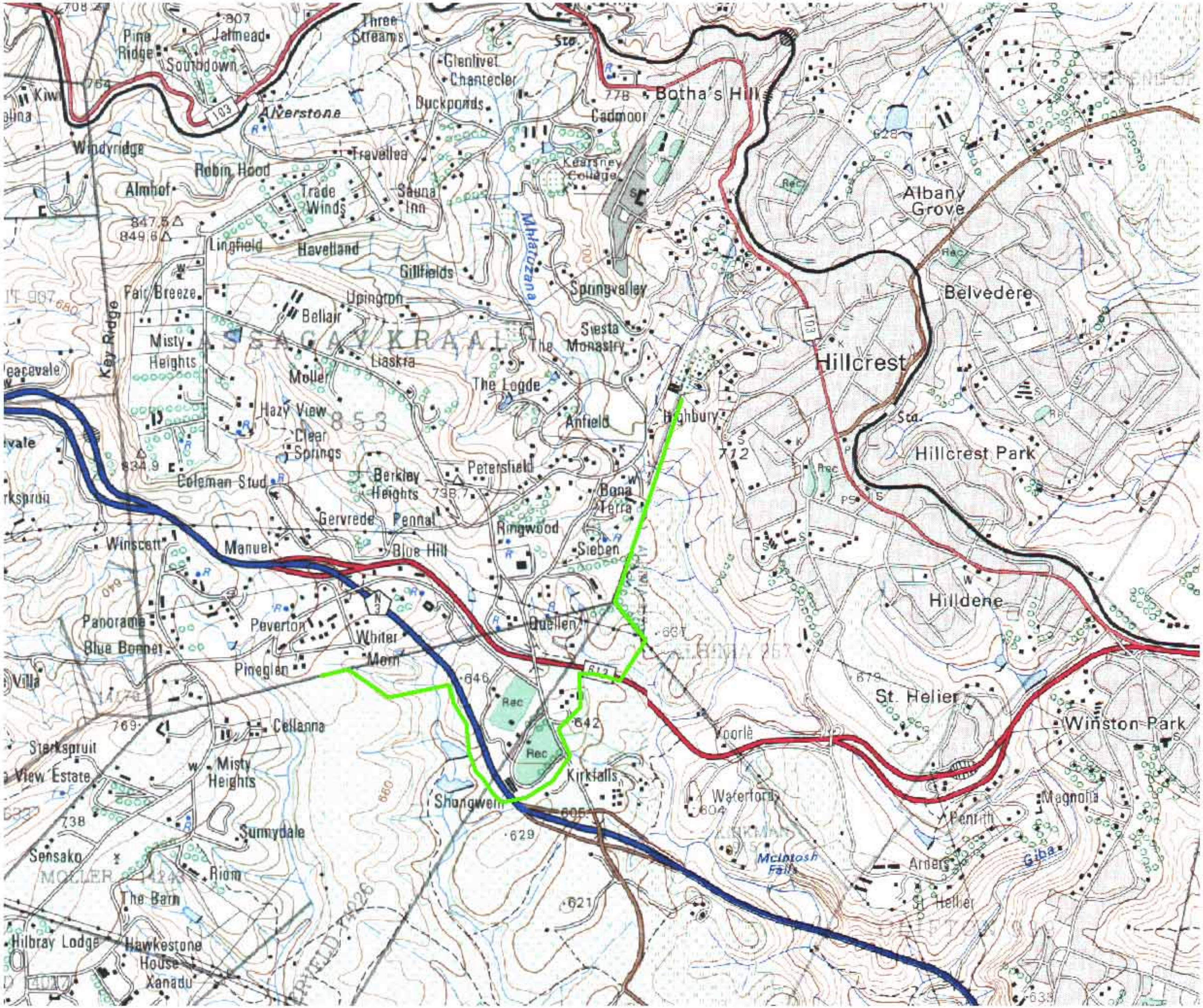
APPENDIX 1

MAPPING

1A:

LOCALITY MAP 1:50000

Appendix 1 A



SHONGWENI BULK WATER PIPELINE ECOLOGICAL ASSESSMENT

LOCALITY MAP 1: 25 000

Legend

Proposed Bulk Water Pipeline Route

SOURCE: Chief Directorate of Survey & Mapping

N

Kilometers

SiVEST

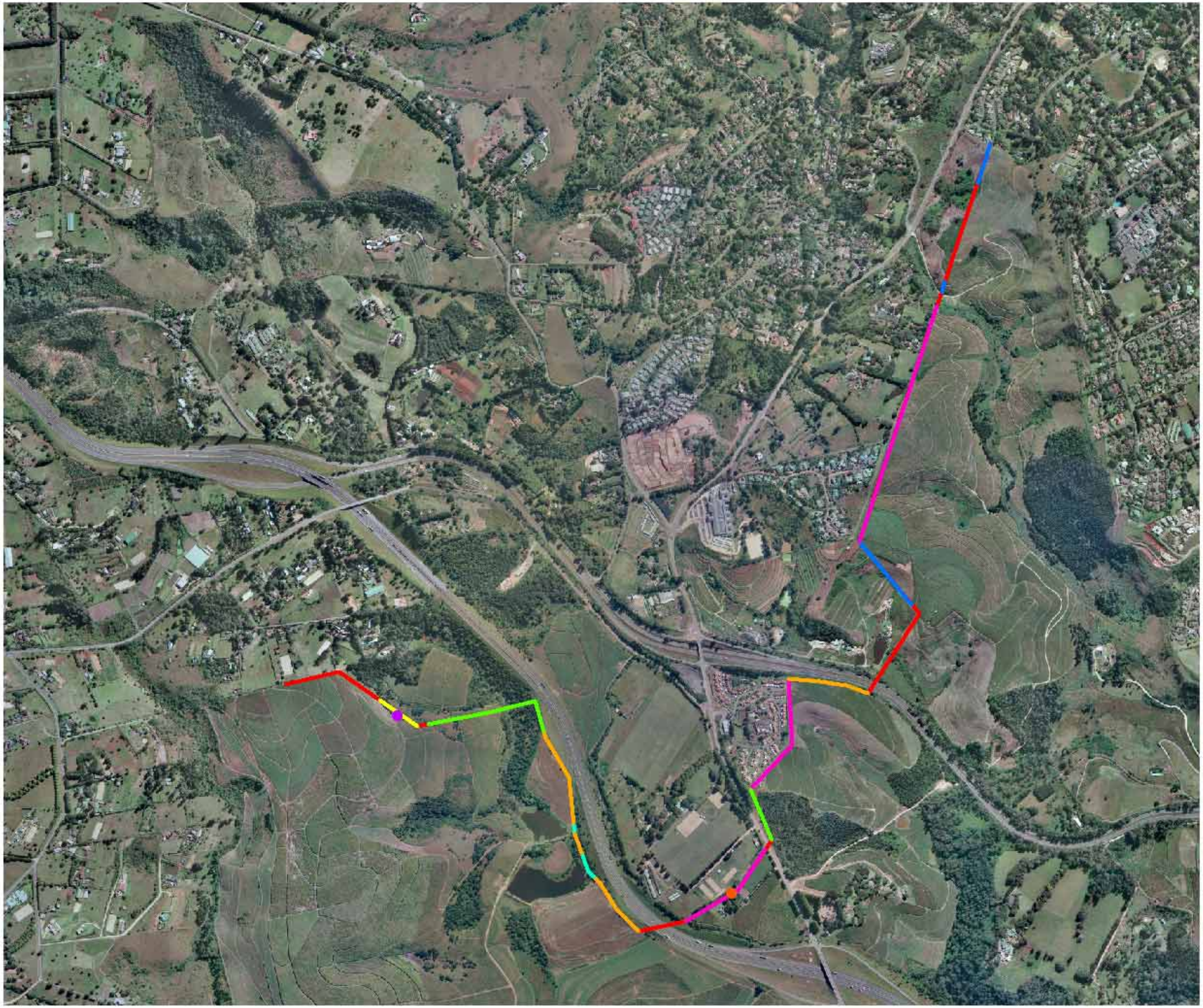
ENVIRONMENTAL DIVISION

Project No	Map Ref No	Prepared By	Date
12365	12365/01	SLB	18/10/2013

THIS MAP HAS BEEN PREPARED UNDER THE CONTROLS ESTABLISHED BY THE SIVEST QUALITY MANAGEMENT SYSTEM AND MEETS THE REQUIREMENTS OF THE SETA QUALITY GRADING SYSTEM THAT IS ISO COMPLIANT

1B:

VEGETATION CLASSIFICATION



SHONGWENI BULK WATER PIPELINE ECOLOGICAL ASSESSMENT

AERIAL VIEW

Legend

- Remnant Sandstone Sourveld
- Alien Woody Vegetation
- Dam Embankments
- Road Verges
- Fence Lines
- Abandoned Cultivation Areas
- Sugar Cane
- *Eulophia streptopetala*
- *Scadoxus puniceus*

SOURCE: Chief Directorate of Survey & Mapping

N

0 0.1 0.2 Kilometers

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Project No	Map Ref No	Prepared By	Date
12365	12365/02	SLB	18/10/2013

Appendix 1 B

APPENDIX 2

PLATES

Plate 1. Abandoned farmlands in foreground

Plate 2. Fence line and Sugarcane fields

Plate 3. Culvert under N3, silted up and infested with alien invasive species and pioneer indigenous species.

Plate 4. *Acacia mearnsii* on embankment next to N3

Plate 5. Roadway associated with abandoned lands.

Plate 6. Alien dominated vegetation between the dams and the N3 embankment.

Plate 7. ***Eulophia streptapetala*** **in flower**

Plate 8. Vegetative parts of ***E. streptopetala.***

Plate 9. Area to the left of road is where we would recommend that the pipe line is aligned. Foreground is remnant Sandstone Sourveld infested with aliens, note the ***Pteridium aquilinum.***

APPENDIX 12:

PROPOSED SHONGWENI MIXED USE DEVELOPMENT: FAUNAL ASSESSMENT & PROPOSED SHONGWENI BULK WATER PIPELINE: FAUNAL ASSESSMENT (SIVEST)

TONGAAT HULETT DEVELOPMENTS (PTY) (LTD)

Proposed Shongweni Mixed Use Development: Faunal Assessment

Faunal Assessment Report

Project No: **11483**
Revision No: **1**
Date: **July 2012**

Date:	23 July 2012
Document Title:	**Proposed Shongweni Mixed Use Development: Faunal Assessment**
Author:	Stephen Burton (*M.Sc. Zoology*)
Signature:	
Revision Number:	# 1.0
Checked by:	Dr. Richard Kinvig (*Ph.D Zoology/Entomology)*
Approved:	Dr. Richard Kinvig (*Ph.D Zoology/Entomology*)
Signature:	
For:	TONGAAT HULETT DEVELOPMENTS (PTY) (LTD)
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Declaration

I, **Stephen Leslie Burton**, declare that I –

- act as an independent specialist consultant in the field of Ecology and Zoology and have undertaken the **Faunal Assessment** for the sites identified for assessment for the proposed development known as **Shongweni Mixed Use,** in the **Ethekwini Municipality**;
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2010;
- have and will not have any vested interest in the proposed activity proceeding;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2010; and
- will provide the competent authority with access to all information at our disposal regarding the application, whether such information is favourable to the applicant or not.

TONGAAT HULETT DEVELOPMENTS (PTY) (LTD)

PROPOSED SHONGWENI MIXED USE DEVELOPMENT

FAUNAL ASSESSMENT REPORT

TONGAAT HULETT DEVELOPMENTS (PTY) (LTD)

PROPOSED SHONGWENI MIXED USE DEVELOPMENT

FAUNAL ASSESSMENT REPORT

1. INTRODUCTION & BACKGROUND

SiVEST Environmental Division was requested by **Kerry Seppings Environmental Management Services (KSEMS)** to undertake a detailed vegetation and faunal assessment of the three (3) sites which have been proposed for investigation. From the above mentioned assessments, inferences can be made regarding the overarching ecological value of the three (3) sites which have been identified to potentially accept the proposed Shongweni Mixed Use Development. The three sites are all currently owned by **Tongaat Hulett Developments (THD**).

2. TERMS OF REFERENCE

SiVEST Environmental Division was requested by KSEMS to undertake the vegetation, faunal and Ecological Assessment of the three sites, in order to inform the Basic Assessment Process currently being undertaken by KSEMS. The following Terms of Reference were provided by KSEMS regarding the requirements for the assessments.

- Undertake a vegetation and faunal assessment of the three alternative sites proposed for the Shongweni Mixed Use Development (Locality Map attached at **Appendix 1**).

Further to the Terms of Reference supplied by KSEMS, the following protocol was extracted from the National Environmental Management Act, Act 108 of 1998. The relevant Section is Section 32 and is included below for your ease of reference.

Specialist reports and reports on specialised processes
32.
(1) An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialised process.
(2) /the Person referred to in sub-regulation (1) must comply with the requirements of Regulation 17.
(3) A specialist report or a report on a specialised process prepared in terms of these Regulations must contain –
(a) details of –
(i) the person who prepared the report; and
(ii) the expertise of that person to carry out the specialist study or specialised process;
(b) a declaration that the person is independent in a form as may be specified by the competent authority;
(c) an indication of the scope of, and the purpose for which, the report was prepared;
(d) a description of the methodology adopted in preparing the report or carrying out the specialised process;
(e) a description of any assumptions made and any uncertainties or gaps in knowledge;
(f) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
(g) recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;
(h) a description of any consultation process that was undertaken during the course of carrying out the study;
(i) a summary and copies of any comments that were received during any consultation process; and
(j) any other information requested by the competent authority.

3. LOCAL SETTING

The majority of all three alternative sites are dominated by cultivation (sugar cane), with only small remnant patches of indigenous vegetation persisting in isolated fragments. All three sites are represented in the Aerial Map attached at **Appendix 2**.

The first site assessed is positioned on the northern side of the N3, and is bounded by Kassier Road and a high density housing development to the west. The M13 creates the boundary on the north and north eastern side. On the eastern boundary a large alien infested drainage line (Umhlatuzana River) separates this site from other agricultural practices. On the southern boundary the site is bounded by sugarcane cultivation which extends from the N3 to the property boundary.

The second alternative site that was identified for sampling and assessment is on the southern side of the N3. It is bounded on the east by the J.B. Mcintosh Drive (extension of Kassier Road). On the North it is bounded by the N3 road reserve. To the south and west the property is bounded by sugar cane lands.

This third alternative site lies to the east of Kassier Road and is bounded on the north by the N3, to the south by the MR 559 RTE and Denny Mushrooms. The eastern boundary has limited sugar cane and then opens onto grassland which abuts the site. Further, in close proximity to the N3, woody vegetation extends up the drainage line from the Open Space System known as Giba Gorge.

Due to the strong correlation between vegetation and faunal assemblages, this report should be read in conjunction with the vegetation assessment for the site.

4. METHODOLOGY

A site walkover was conducted on the 3rd of July 2012, during which indigenous vegetation units were sampled for evidence of terrestrial faunal species. The large areas of sugarcane are depauperate in faunal species, and were assessed in a cursory manner. Bird species that could potentially occur on site were assessed through the South African Bird Atlas Project (SABAP) database of previously recorded species for the area.

5. FAUNA ON SITE

5.1 Predicted Important Species by Ezemvelo KZN Wildlife

Ezemvelo KZN Wildlife's C-Plan database predicts that the following species of conservation significance may occur on the site, and that the site is considered totally irreplaceable.

- *Doratogonus rubipodus* (Ruby-legged Black Millipede) - This millipede is known from a restricted distribution within the Giba Gorge (McIntosh Falls), and an area of forest in Eston. It is unlikely to occur on any of the sites due to the transformation that has occurred historically.

- *Cochlitoma semidecussata* (Mollusc) - This species may occur on the site, but its preferred habitat is coastal lowland and scarp forest, and is most likely to occur off of the sites in the Giba Gorge Complex of secondary and primary scarp forest.

- *Bradypodion melanocephalum* (Black-headed Dwarf Chameleon) - This species may occur on the site, and prefers ecotones between thickets and more open areas for hunting. This species prefers tall grasslands for hunting, and is will not occur in short, or regularly burnt, grasslands.

After having undertaken a site visit, and having undertaken focused active searches for the species listed above, it is concluded that the species listed above do not occur within the majority of the proposed development sites. The only areas of concern are the alien infested drainage line on the Eastern boundary of Site 1, and the highly disturbed woodlot on Site 1. Specifically, the drainage line along the Eastern boundary of Site 1 may be occupied by *Bradypodion melanocephalum*, as it provides the ideal mix of tall grasses, and woody vegetation that this species prefers. This area is however highly infested with alien plant species.

5.2 Other Faunal Species noted within the Study Area

It was noted during the site visit that there is strong evidence of Bushpigs (*Potamchoerus porcus*) within the woodlot on Site 1 (see **Figure 1** below), as well as evidence of antelope species within the grassland areas of Site 3 (See **Figure 2 & 3** below), and the woodlot on Site 1 (see **Figure 4** below). These antelope species are most likely Common Duiker (*Sylvicapra grimmia*), and Bushbuck (*Tragelaphus scriptus*). There is also evidence of Vervet Monkeys (*Cercopithecus pygerythrus*) on the site. No raptor nests were identified on any of the sites, and this is due to the lack of appropriate nesting trees on all three sites. Site 1 is most likely to support raptor breeding, due to the presence of the woodlots on site. However, these woodlots show regular disturbance and this probably accounts for the lack of nests. A night time survey for chameleons identified Flap-necked Chameleons (*Chamaeleo dilepis* - see **Figure 5** below) present in the woodlots on Site 1. In addition, dung, of what is probably one of the mongoose species, was found on Site 3 (see **Figure 6** below).

Figure 1: Bushpig rooting noted in woodlot on Site 1.

Figure 2: Grey Duiker dung pile noted on Site 3.

Figure 3: Bushbuck dung pile noted on Site 3.

Figure 4: Grey Duiker dung pile noted on Site 1.

Figure 5: Flap-neck Chameleon noted on Site 1.


Figure 6: Probable mongoose dung on Site 3.

5.3 Threatened Birds

Appendix 3 lists all the birds that have been recorded in the area surrounding the site. While many of these bird species are listed as near threatened, vulnerable or endangered, only a few of these conservation significant species are likely to make use of the sites. The various stork species may make use of the various vegetation units on the sites for foraging, but most of these species are unlikely to occur, as they are normally associated with wetland areas, and large freshwater bodies. The various eagle species are also likely to hunt over the sites, but are unlikely to make use of the site 2 or 3 for nesting and breeding, due to a lack of large appropriate trees. Various other species may occur on the sites, such as the Blue Crane (*Anthropoides paradiseus*) and the Grey Crowned Crane (*Balearica regulorum*), but are unlikely to use the sites extensively due to the level of disturbance that historically occurred there. The Spotted Ground-thrush (*Zoothera guttata*) may occur within the forest fragments (Giba Gorge Complex) to the east of the sites. The Broad-tailed Warbler (*Schoenicola brevirostris*) may occur on the sites, and is closely associated with wet areas, and rank grass, and therefore is most likely to occur in the wetland systems that traverse all three sites. The Bush Blackcap (*Lioptilus nigricapillus*), is unlikely to occur on the sites due to its predilection for Montane Forest, but may use the forests to the East of the sites during the winter months.

6. IMPACT ASSESSMENT ON THE CURRENT FAUNA

The impact descriptions below are rated according to the current status of the sites as determined by the findings of the site visit undertaken. The faunal conservation values are assigned values between 1 and 5, with 1 being low value, and 5 being high value.

6.1 Impact of the development on the faunal assemblage

The sites are heavily disturbed, with most of each of the sites under cultivation, and the small woodlot patches are disturbed by the infestation of alien invasive plants. The value of the sites to faunal conservation are limited at present, with low faunal conservation value over all the sites

Site 1 Assessment

Pre-Mitigation Measures

Value & Health	Current Numerical Rating	Current Categorisation
Conservation Value for Fauna	1*	Low
Ecosystem Health for Fauna	1	Low

* This score is subject to change, should a viable population of Black-headed Dwarf Chameleon's be found on site.

Proposed Mitigation Measures

- Remove alien vegetation through proper management.
- Set aside the existing forest fragments within the woodlot areas.
- Buffer all wetland and drainage lines appropriately.
- Careful management of construction within the proposed development.

Post-Mitigation Measures

Value & Health	Predicted Rating post mitigation	Predicted Categorisation
Conservation Value for Fauna	2	Medium-Low
Ecosystem Health for Fauna	2	Medium-Low

Site 2 Assessment

Pre-Mitigation Measures

Value & Health	Current Numerical Rating	Current Categorisation
Conservation Value for Fauna	1	Low
Ecosystem Health for Fauna	1	Low

Proposed Mitigation Measures

- Remove alien vegetation through proper management.
- Buffer all wetland and drainage lines appropriately.
- Careful management of construction within the proposed development.

Post-Mitigation Measures

Value & Health	Predicted Rating post mitigation	Predicted Categorisation
Conservation Value for Fauna	2	Medium Low
Ecosystem Health for Fauna	2	Medium Low

Site 3 Assessment

Pre-Mitigation Measures

Value & Health	Current Numerical Rating	Current Categorisation
Conservation Value for Fauna	1	Low
Ecosystem Health for Fauna	1	Low

Proposed Mitigation Measures

- Remove alien vegetation through proper management.
- Buffer all wetland and drainage lines appropriately.
- Careful management of construction within the proposed development.

Post-Mitigation Measures

Value & Health	Predicted Rating post mitigation	Predicted Categorisation
Conservation Value for Fauna	2	Medium Low
Ecosystem Health for Fauna	2	Medium Low

6.2 Preferred Site

From a faunal perspective there is very little to choose between the three sites. However, Site 2 is considered the best option from a faunal perspective, as it has the least impact on fauna at a landscape level. Both Site 1 and Site 3 abut the Giba Gorge Environmental Precinct (GGEP), and the associated Durban Metropolitan Open Space System (DMOSS).

The Giba Gorge Environmental Precinct to the east of Sites 1 and 3, contains a number of locally endemic, and IUCN Red Listed species. These include the Blue Duiker *(Philantomba monticola*), Large-eared Free-tailed Bat (*Otomops martiensseni*), Spotted Ground Thrush (*Zoothera guttata*), Kloof Frog (*Natalobatrachus bonebergi*), Spotted Shovel-nosed Frog (*Hemisus guttatus*), Natal Leaf-folding Frog (*Afrixalus spinifrons*) and the Pink-footed Giant Black Millipede (*Doratogonus rubipodus*). Many of these species have very restricted ranges, and the GGEP constitutes an important area for the conservation of these species.

From an ecological perspective, all the sites are relatively equal, but the development of Site 2 will have the least impact on the linkages that exist between the Umhlatuzana catchment, and the Giba Gorge Conservation Precinct.

7. RECOMMENDATIONS

From a faunal perspective, the sites are degraded and currently of low conservation value. However, Site 1 does present an opportunity to create linkages between areas of higher conservation significance to the north and south-east of the site, while Site 3 abuts endangered grassland, and the Giba Gorge Conservation Precinct. Site 2 is therefore the preferred site for development, from a faunal perspective. The fauna of the site is directly dependent on the vegetation units of the site, and the restoration, and careful management of these vegetation units will benefit the fauna of the area. Therefore, the following is recommended:

- ✓ Alien clearing must be undertaken within the entire development zone;
- ✓ No development should occur within the wetland and drainage line areas, and any development should take into account the hydrology of the wetland systems;
- ✓ Should Site 1 be preferred, it is recommended that an extensive nighttime survey be done to assess the potential presence of the Black-headed Dwarf Chameleon in the woodlot, and the alien infested drainage line;
- ✓ Should it be found that Black-headed Dwarf Chameleon are present, any specimens of the Black-headed Dwarf Chameleon need to be removed carefully before clearing of any area for construction, and relocated to an identified release site. The release site should be identified in consultation with Ezemvelo KZN Wildlife and eThekwini Environmental Management Division.

8. CONCLUSIONS

The majority of the sites are currently cultivated and the areas that are not cultivated have also been negatively impacted by woodcutting and alien invasive infestations. A large number of alien plant species have invaded the sites and the area has therefore been further degraded. The proposed development properties are therefore of little value to faunal conservation in their current state. However, should the wetlands, drainage lines and forest fragments (on Site 1) be rehabilitated, it is likely that the faunal conservation significance would increase.

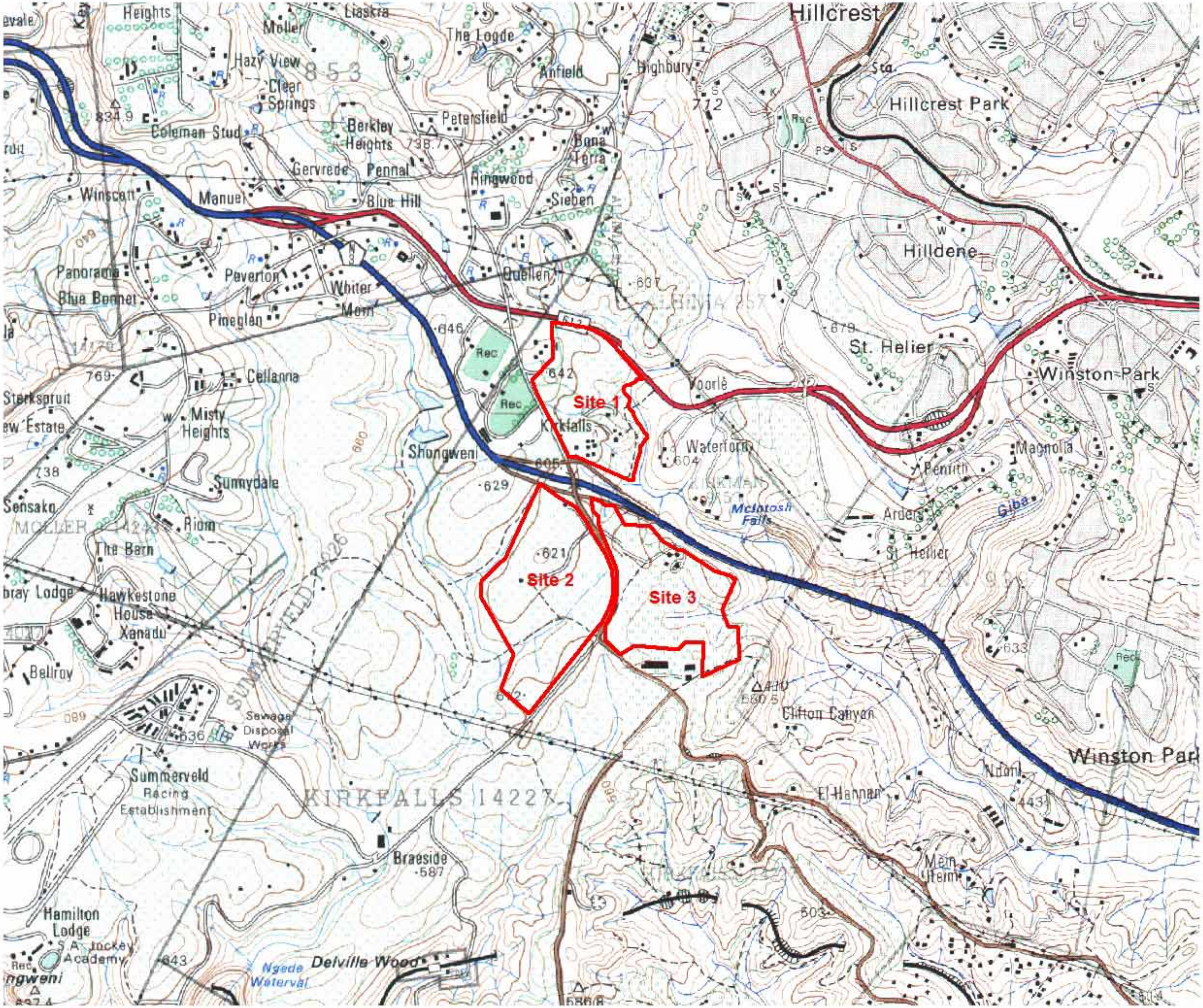
The proposed development would in all probability add value to the land and provide much needed funding for the improvement of the conservation significance of the sites. However, the conservation worthy areas of the sites need to be avoided, specifically the wetlands on all the sites, the drainage line on Site 1, and the grassland area on Site 3.

Based on the site visit, and taking into account the vegetation assessment of the three sites, we feel that Site 2 is the best site for development from a faunal perspective.

Appendix 1

LOCALITY MAP

Appendix 1



NTSHONGWENI MIXED USE ECOLOGICAL ASSESSMENT

LOCALITY MAP
1: 25 000

Legend

Three Potential Sites for Development

SOURCE: Chief Directorate of Survey & Mapping

N

0 0.2 0.4 Kilometers

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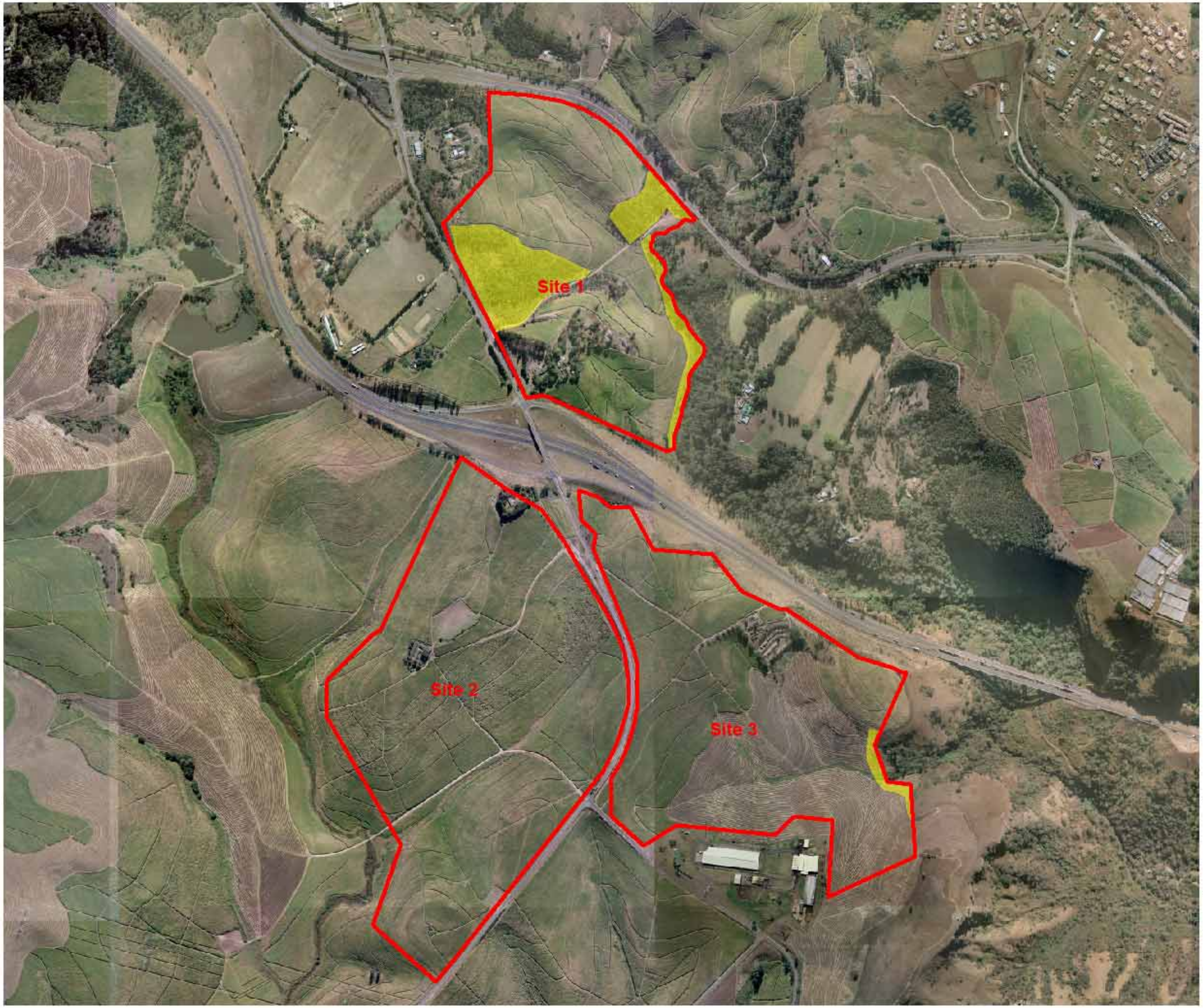
Project No	Map Ref No	Prepared By	Date
11483	11483/01	SLB	18/07/2012

THIS MAP HAS BEEN PREPARED UNDER THE CONTROLS ESTABLISHED BY THE SIVEST QUALITY MANAGEMENT SYSTEM AND MEETS THE REQUIREMENTS OF THE SETA QUALITY GRADING SYSTEM THAT IS ISO COMPLIANT

Appendix 2

AREAS OF POTENTIAL FAUNAL SENSITIVITY

Appendix 2



NTSHONGWENI MIXED USE ECOLOGICAL ASSESSMENT

AREAS OF POTENTIAL FAUNAL SENSITIVITY

Legend

- Three Potential Sites for Development
- Potential Faunally Sensitive Areas

SOURCE: Chief Directorate of Survey & Mapping

N

0 0.1 0.2 Kilometers

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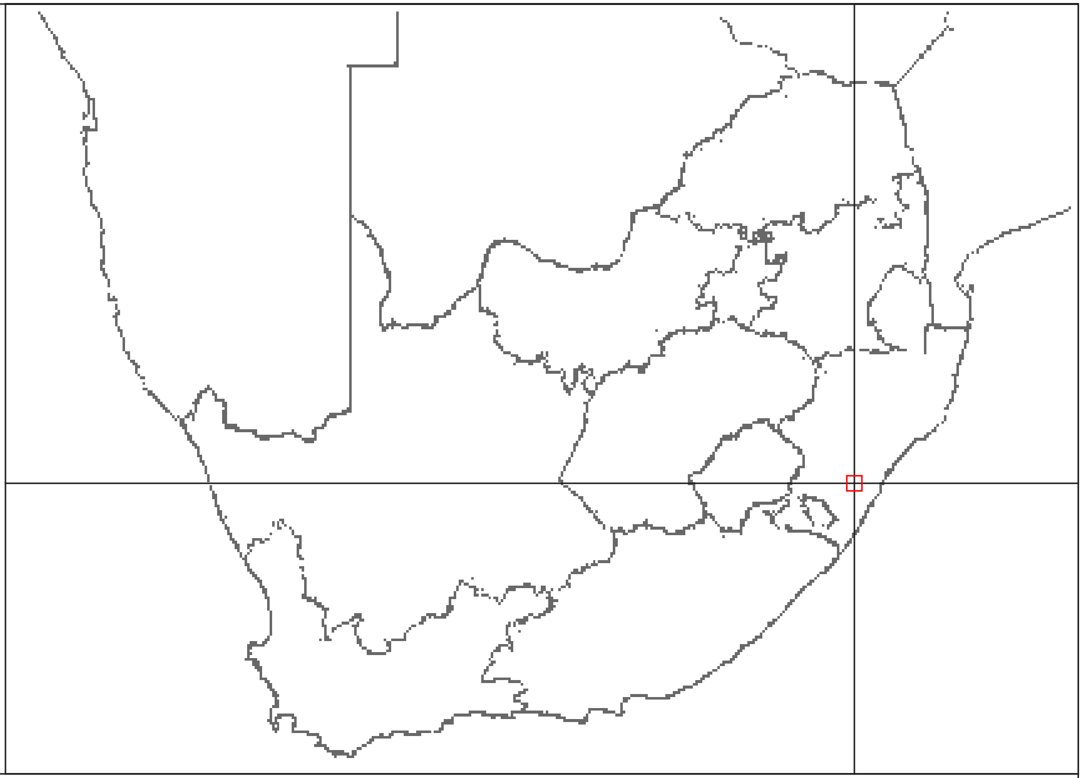
Project No	Map Ref No	Prepared By	Date
11483	11483/02	SLB	18/07/2012

Appendix 3

SABAP SUMMARIES OF SPECIES THAT HAVE BEEN RECORDED IN THE AREA

Southern African

Bird Atlas Project



Occurrence:
n indicates the total number of cards on which the species was recorded. We also give this as a percentage (%) of the total cards for the site. The monthly breakdown shows the number of times the species was reported, as a percentage of the total cards for the month (ie: reporting rate).

Breeding:
n represents the number of cards on which confirmed breeding activity was reported. The monthly breakdown is the number of times the species was recorded breeding.

Site summary for:

Site Name: HAMMARSDALE (2930DC)
Province: KwaZulu-Natal

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Total cards per month	**9**	**7**	**11**	**11**	**6**	**16**	**16**	**12**	**9**	**8**	**5**	**12**	**122**
Total number species	**197**	**185**	**192**	**181**	**139**	**167**	**183**	**181**	**153**	**140**	**141**	**188**	**286**
Total number species breeding	**8**	**7**	**7**	**5**	**3**	**3**	**5**	**6**	**3**	**8**	**9**	**15**	**47**

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
8	Little Grebe (Dabchick)		31	25	44	57	36	9	17	13	44	33	11	13	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
55	White-breasted (Great) Cormorant		57	47	44	43	82	45	17	6	56	58	67	63	40	42	0	-	-	-	-	-	-	-	-	-	-	-	-
58	Reed (Long-tailed) Cormorant		36	30	56	14	9	-	17	31	31	42	56	38	20	33	0	-	-	-	-	-	-	-	-	-	-	-	-
60	African Darter		49	40	44	43	36	45	50	44	63	33	44	25	20	17	0	-	-	-	-	-	-	-	-	-	-	-	-
62	Grey Heron		47	39	67	57	36	55	33	38	44	25	33	38	20	17	1	-	-	-	-	-	-	-	-	-	1	-	-
63	Black-headed Heron		32	26	44	57	36	36	-	19	19	25	11	25	40	17	0	-	-	-	-	-	-	-	-	-	-	-	-
64	Goliath Heron		1	1	11	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
65	Purple Heron		5	4	11	-	9	-	-	6	13	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
66	Great Egret		6	5	11	29	-	-	-	6	-	8	11	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
67	Little Egret		10	8	11	14	9	-	-	-	25	8	-	13	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
68	Yellow-billed (Intermediate) Egret		3	2	11	-	9	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
71	Cattle Egret		41	34	22	29	45	36	33	38	44	50	44	25	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
72	Squacco Heron		1	1	11	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
74	Green-backed (Striated) Heron		14	11	22	14	9	9	-	6	25	17	11	-	20	-	0	-	-	-	-	-	-	-	-	-	-	-	-
76	Black-crowned Night-Heron		2	2	11	-	-	-	-	-	-	-	-	13	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
78	Little Bittern		2	2	11	-	-	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
81	Hamerkop		82	67	89	57	91	64	33	50	75	67	89	63	40	67	1	-	1	-	-	-	-	-	-	-	-	-	-
83	White Stork		2	2	11	14	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
84	Black Stork	NT	41	34	-	29	9	9	17	56	38	58	67	38	20	33	11	-	-	-	-	1	2	1	2	1	2	1	1
91	African Sacred (Sacred) Ibis		17	14	22	-	18	9	-	13	25	25	11	-	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
94	Hadeda Ibis		109	89	67	86	100	100	83	81	100	92	89	88	80	92	4	1	-	-	-	-	-	-	1	1	-	-	1
95	African Spoonbill		9	7	11	-	9	-	-	6	6	17	-	-	-	25	0	-	-	-	-	-	-	-	-	-	-	-	-
99	White-faced (Whistling-) Duck		16	13	33	14	27	18	-	13	6	8	-	-	-	25	0	-	-	-	-	-	-	-	-	-	-	-	-
100	Fulvous (Whistling) Duck		1	1	-	-	-	-	17	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
101	White-backed Duck		4	3	22	14	-	-	-	-	-	8	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
102	Egyptian Goose		71	58	56	43	82	36	50	69	81	42	56	63	60	42	3	1	1	-	-	-	-	-	-	-	1	-	-
104	Yellow-billed Duck		49	40	78	43	64	45	-	38	31	33	22	50	40	33	2	-	-	-	-	-	1	1	-	-	-	-	-
105	African Black Duck		37	30	44	14	27	18	17	19	31	25	56	50	40	33	0	-	-	-	-	-	-	-	-	-	-	-	-
106	Cape Teal		3	2	11	-	9	-	-	6	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
107	Hottentot Teal		1	1	-	-	-	-	-	-	-	8	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
108	Red-billed Teal (Duck)		3	2	11	14	9	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
112	Cape Shoveler		2	2	-	-	-	-	-	-	6	8	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
113	Southern Pochard		3	2	11	14	-	-	17	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
114	African Pygmy-Goose	NT	1	1	11	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
116	Spur-winged Goose		25	20	33	29	18	-	-	19	63	25	11	-	-	8	1	-	-	1	-	-	-	-	-	-	-	-	-
126	Black & Yellowbilled Kite (pre-split)		10	8	11	43	9	-	-	-	-	-	22	38	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
127	Black-shouldered (Winged) Kite		13	11	22	-	27	9	-	13	13	17	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
128	African Cuckoo Hawk		2	2	-	-	18	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
131	Verreaux's (Black) Eagle		3	2	-	-	-	-	17	-	-	17	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
135	Wahlberg's Eagle		6	5	11	-	9	9	17	-	-	-	-	-	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
139	Long-crested Eagle		11	9	11	14	-	18	33	13	13	8	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-
140	Martial Eagle	VU	3	2	-	-	9	-	-	-	-	8	11	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
141	African Crowned (Crowned) Eagle	NT	24	20	11	43	27	27	17	6	25	17	11	13	-	33	2	-	-	-	1	-	-	-	-	-	1	-	-
142	Brown Snake-Eagle		3	2	11	-	9	9	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
148	African Fish-Eagle		70	57	33	71	73	27	50	75	50	67	56	63	60	58	3	-	-	-	-	1	-	-	-	-	1	-	1

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
149	Steppe (Common) Buzzard		30	25	67	57	45	18	-	-	-	-	-	25	60	67	0	-	-	-	-	-	-	-	-	-	-	-	-
152	Jackal Buzzard		10	8	11	-	9	18	17	6	13	8	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
157	Little Sparrowhawk		6	5	11	-	-	9	-	-	13	8	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
158	Black Sparrowhawk (Goshawk)		13	11	11	-	27	9	17	-	19	17	11	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
160	African Goshawk (incl. Red-chested)		15	12	11	-	18	9	33	13	13	8	-	-	20	25	0	-	-	-	-	-	-	-	-	-	-	-	-
161	Gabar Goshawk		1	1	-	-	-	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
165	African Marsh-Harrier	VU	8	7	22	14	9	-	-	6	6	17	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
169	African Harrier-Hawk (Gymnogene)		20	16	22	14	18	9	-	19	-	17	22	38	20	25	1	-	-	-	-	-	-	-	-	-	-	-	1
170	Osprey		2	2	-	14	-	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
172	Lanner Falcon	NT	37	30	22	29	36	18	50	19	31	50	33	63	20	8	1	-	-	-	-	-	-	-	-	-	1	-	-
181	Rock Kestrel		11	9	-	-	9	9	33	19	13	8	-	-	20	-	0	-	-	-	-	-	-	-	-	-	-	-	-
191	Shelley's Francolin		8	7	22	14	9	-	-	6	6	8	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
192	Red-winged Francolin		2	2	-	-	-	-	17	6	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
196	Natal Spurfowl (Francolin)		39	32	44	57	45	27	33	19	25	33	33	13	20	42	0	-	-	-	-	-	-	-	-	-	-	-	-
200	Common Quail		7	6	22	14	-	9	17	-	6	8	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
203	Helmeted Guineafowl		24	20	22	14	18	18	33	19	19	25	11	-	60	17	1	-	-	-	1	-	-	-	-	-	-	-	-
208	Blue Crane	VU	3	2	-	-	-	-	-	-	6	8	11	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
209	Grey Crowned- (Crowned) Crane	VU	5	4	11	-	9	-	-	6	6	8	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-
213	Black Crake		9	7	22	14	9	-	-	6	19	8	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
217	Red-chested Flufftail		1	1	11	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
218	Buff-spotted Flufftail		4	3	11	-	-	-	-	-	-	-	-	-	20	17	0	-	-	-	-	-	-	-	-	-	-	-	-
223	African Purple (Purple) Swamphen (Gallinule)		3	2	11	14	9	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
226	Common Moorhen		13	11	33	14	9	9	-	6	13	17	-	13	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
228	Red-knobbed Coot		19	16	33	29	36	18	-	6	13	25	-	-	-	17	1	-	-	-	-	-	-	-	1	-	-	-	-
240	African Jacana		10	8	22	-	9	-	-	19	13	17	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
242	Greater Painted-snipe	NT	1	1	-	-	-	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
245	Common Ringed Plover		1	1	-	-	9	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
248	Kittlitz's Plover		1	1	-	-	-	9	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
249	Three-banded Plover		25	20	56	29	36	18	17	6	25	8	22	-	20	17	0	-	-	-	-	-	-	-	-	-	-	-	-
255	Crowned Lapwing (Plover)		3	2	-	-	-	9	-	-	6	8	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
257	Black-winged Lapwing (Plover)	NT	1	1	-	-	-	9	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
258	Blacksmith Lapwing (Plover)		23	19	22	29	55	18	-	19	25	25	11	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
264	Common Sandpiper		30	25	44	57	45	9	-	-	-	8	56	63	40	25	0	-	-	-	-	-	-	-	-	-	-	-	-
266	Wood Sandpiper		9	7	22	14	18	9	-	-	-	8	-	-	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
269	Marsh Sandpiper		3	2	22	-	-	-	-	-	-	-	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
270	Common Greenshank		7	6	22	14	-	-	-	-	6	-	-	13	20	8	0	-	-	-	-	-	-	-	-	-	-	-	-
272	Curlew Sandpiper		2	2	-	-	18	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
284	Ruff		1	1	-	-	9	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
297	Spotted Thick-knee (Dikkop)		3	2	-	-	-	-	-	6	6	8	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
298	Water Thick-knee (Dikkop)		33	27	11	29	36	27	-	-	19	33	44	50	80	33	0	-	-	-	-	-	-	-	-	-	-	-	-
303	Bronze-winged Courser		1	1	-	-	-	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
338	Whiskered Tern		1	1	11	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
348	Rock (Feral) Dove (Pigeon)		5	4	-	14	-	9	17	-	-	-	-	-	40	-	0	-	-	-	-	-	-	-	-	-	-	-	-
349	Speckled (Rock) Pigeon		50	41	33	29	9	55	17	50	56	67	44	50	20	25	1	-	-	-	-	-	-	1	-	-	-	-	-
350	African Olive- (Rameron) Pigeon		5	4	-	-	-	18	17	-	6	-	-	-	-	8	1	-	-	-	1	-	-	-	-	-	-	-	-
352	Red-eyed Dove		94	77	67	86	91	45	67	81	94	83	67	88	60	75	1	1	-	-	-	-	-	-	-	-	-	-	-
354	Cape Turtle (Ring-necked) Dove		41	34	56	57	27	36	33	25	44	42	11	-	-	50	0	-	-	-	-	-	-	-	-	-	-	-	-
355	Laughing (Palm) Dove		37	30	33	43	18	36	17	13	19	42	44	38	40	42	1	-	-	-	-	-	-	1	-	-	-	-	-
356	Namaqua Dove		3	2	-	-	-	9	17	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
358	Emerald-spotted Wood-Dove		73	60	44	71	55	36	50	69	50	67	78	63	80	67	0	-	-	-	-	-	-	-	-	-	-	-	-
359	Tambourine Dove		28	23	11	14	18	18	33	13	44	8	11	38	60	25	0	-	-	-	-	-	-	-	-	-	-	-	-
360	Lemon (Cinnamon) Dove		1	1	-	-	-	9	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
361	African Green-Pigeon		7	6	-	-	-	18	17	6	13	8	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
370	Knysna Lourie (pre-split)		7	6	-	-	18	9	17	6	6	-	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
371	Purple-crested Turaco		74	61	44	71	64	27	67	50	63	50	56	88	100	83	0	-	-	-	-	-	-	-	-	-	-	-	-
374	Common (Eurasian) Cuckoo		2	2	11	14	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
377	Red-chested Cuckoo		27	22	33	14	-	-	-	-	-	-	33	50	100	92	0	-	-	-	-	-	-	-	-	-	-	-	-
378	Black Cuckoo		13	11	22	-	9	-	-	-	-	-	-	25	60	42	0	-	-	-	-	-	-	-	-	-	-	-	-
382	Jacobin (Pied) Cuckoo		1	1	-	14	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
384	African Emerald (Emerald) Cuckoo		11	9	22	-	9	-	17	-	-	-	33	-	20	25	0	-	-	-	-	-	-	-	-	-	-	-	-
385	Klaas's Cuckoo		18	15	11	14	-	-	-	6	-	8	33	25	80	42	0	-	-	-	-	-	-	-	-	-	-	-	-
386	Dideric (Diederik) Cuckoo		24	20	78	14	18	9	17	-	-	-	11	38	40	50	0	-	-	-	-	-	-	-	-	-	-	-	-
391	Burchell's Coucal (pre-split)		40	33	44	57	36	-	17	31	13	25	33	50	40	67	0	-	-	-	-	-	-	-	-	-	-	-	-
392	Barn Owl		1	1	-	-	-	-	-	-	-	-	11	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
401	Spotted Eagle-Owl		1	1	-	-	-	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
405	Fiery-necked Nightjar		8	7	-	14	-	-	17	6	6	17	11	13	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
411	Common (European) Swift		1	1	-	-	-	-	-	-	-	-	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
412	African Black (Black) Swift		41	34	33	57	27	18	17	6	13	42	56	63	60	58	0	-	-	-	-	-	-	-	-	-	-	-	-
415	White-rumped Swift		17	14	22	29	18	9	-	-	-	-	11	38	20	42	0	-	-	-	-	-	-	-	-	-	-	-	-
416	Horus Swift		1	1	-	-	-	-	-	-	-	-	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
417	Little Swift		18	15	22	29	9	9	-	6	-	8	33	38	20	25	0	-	-	-	-	-	-	-	-	-	-	-	-
418	Alpine Swift		9	7	11	14	-	-	-	-	-	25	22	-	20	8	0	-	-	-	-	-	-	-	-	-	-	-	-
421	African Palm-Swift		9	7	-	-	9	9	-	13	-	8	-	-	-	33	0	-	-	-	-	-	-	-	-	-	-	-	-
424	Speckled Mousebird		70	57	44	43	73	36	67	56	88	50	67	13	40	75	0	-	-	-	-	-	-	-	-	-	-	-	-
426	Red-faced Mousebird		1	1	-	-	-	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
427	Narina Trogon		14	11	-	-	18	-	-	6	-	8	33	25	20	33	0	-	-	-	-	-	-	-	-	-	-	-	-
428	Pied Kingfisher		41	34	33	29	27	27	17	44	19	42	67	50	40	17	0	-	-	-	-	-	-	-	-	-	-	-	-
429	Giant Kingfisher		50	41	44	29	55	9	17	44	50	58	67	38	20	33	1	-	-	-	-	-	-	-	1	-	-	-	-
430	Half-collared Kingfisher	NT	1	1	11	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
431	Malachite Kingfisher		17	14	44	14	45	18	-	13	19	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
432	African Pygmy-Kingfisher		7	6	11	-	9	-	-	-	-	-	-	-	40	25	0	-	-	-	-	-	-	-	-	-	-	-	-
435	Brown-hooded Kingfisher		81	66	56	43	82	45	50	63	69	75	78	88	80	67	2	-	-	1	-	1	-	-	-	-	-	-	-
444	Little Bee-eater		9	7	-	14	18	9	-	-	6	8	-	25	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
446	European Roller		1	1	-	-	-	-	-	-	-	-	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
451	African Hoopoe		28	23	11	-	27	-	17	31	44	17	33	25	40	17	0	-	-	-	-	-	-	-	-	-	-	-	-
452	Green (Red-billed) Wood-hoopoe		58	48	22	43	64	27	50	56	44	58	56	50	60	42	0	-	-	-	-	-	-	-	-	-	-	-	-
455	Trumpeter Hornbill		42	34	22	29	18	9	50	38	38	33	44	63	60	33	0	-	-	-	-	-	-	-	-	-	-	-	-
460	Crowned Hornbill		26	21	11	14	-	9	33	38	25	25	22	38	20	17	0	-	-	-	-	-	-	-	-	-	-	-	-
463	Southern Ground-Hornbill	VU	9	7	11	14	9	18	17	-	6	8	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
464	Black-collared Barbet		95	78	56	86	73	45	67	88	94	83	89	75	100	75	2	-	1	-	-	-	-	-	-	-	-	-	1
469	Red-fronted Tinkerbird		24	20	-	14	45	9	-	6	25	8	22	38	20	42	0	-	-	-	-	-	-	-	-	-	-	-	-
471	Yellow-rumped (Golden-rumped) Tinkerbird (Tinker Barbet)		5	4	-	29	-	-	-	-	-	-	11	-	20	8	0	-	-	-	-	-	-	-	-	-	-	-	-
473	Crested Barbet		26	21	-	-	-	-	17	31	31	42	22	25	40	33	0	-	-	-	-	-	-	-	-	-	-	-	-
474	Greater Honeyguide		3	2	-	-	-	-	-	6	6	8	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
475	Scaly-throated Honeyguide		9	7	-	-	9	9	17	13	6	-	11	-	20	8	0	-	-	-	-	-	-	-	-	-	-	-	-
476	Lesser Honeyguide		21	17	-	29	9	-	-	13	13	25	-	38	60	42	0	-	-	-	-	-	-	-	-	-	-	-	-
478	Brown-backed (Sharp-billed) Honeybird (Honeyguide)		9	7	-	-	18	9	-	6	-	17	22	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
483	Golden-tailed Woodpecker		52	43	33	57	55	18	33	50	56	33	44	38	60	33	0	-	-	-	-	-	-	-	-	-	-	-	-
486	Cardinal Woodpecker		33	27	22	29	55	9	33	13	19	50	33	25	40	17	0	-	-	-	-	-	-	-	-	-	-	-	-
488	Olive Woodpecker		7	6	-	-	-	-	-	19	6	-	-	-	20	17	0	-	-	-	-	-	-	-	-	-	-	-	-
489	Red-throated Wryneck		21	17	11	-	9	9	33	19	19	17	11	38	40	17	1	-	-	-	-	-	-	-	1	-	-	-	-
494	Rufous-naped Lark		20	16	44	43	9	9	-	6	19	25	-	38	20	-	1	-	1	-	-	-	-	-	-	-	-	-	-
507	Red-capped Lark		1	1	-	-	9	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
518	Barn (European) Swallow		36	30	56	100	64	36	-	-	-	-	-	25	40	75	0	-	-	-	-	-	-	-	-	-	-	-	-
520	White-throated Swallow		18	15	33	29	27	9	-	-	-	33	11	13	40	8	0	-	-	-	-	-	-	-	-	-	-	-	-
526	Greater Striped-Swallow		8	7	11	14	27	27	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
527	Lesser Striped-Swallow		47	39	44	71	45	9	-	-	-	33	78	75	100	83	2	1	-	-	-	-	-	-	-	-	-	1	-
529	Rock Martin		38	31	11	14	27	18	33	31	25	58	22	38	60	42	0	-	-	-	-	-	-	-	-	-	-	-	-
532	Sand Martin (Bank Swallow)		3	2	-	-	-	-	-	-	-	-	-	-	-	25	0	-	-	-	-	-	-	-	-	-	-	-	-
533	Brown-throated (Plain) Martin		10	8	-	-	18	9	-	13	19	-	-	13	20	-	0	-	-	-	-	-	-	-	-	-	-	-	-
536	Black Saw-wing		38	31	22	43	55	36	17	13	19	25	11	50	60	50	0	-	-	-	-	-	-	-	-	-	-	-	-
538	Black Cuckooshrike		26	21	11	-	27	9	17	31	38	8	11	38	20	25	0	-	-	-	-	-	-	-	-	-	-	-	-

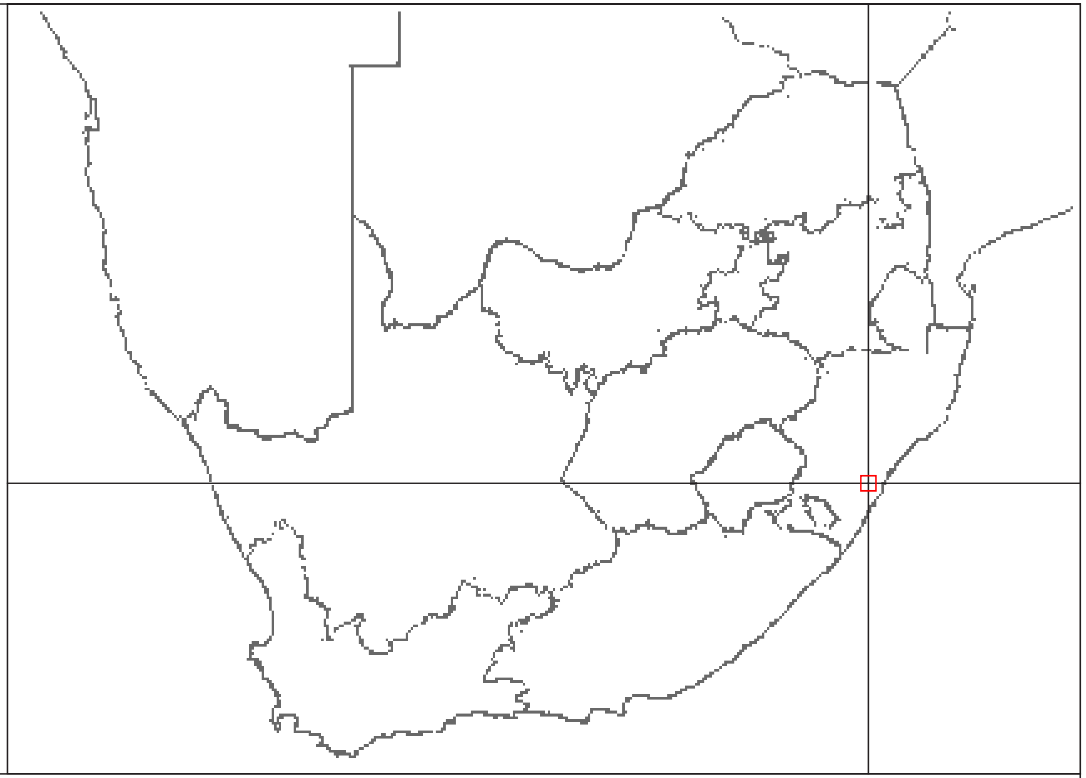
Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
540	Grey Cuckooshrike		9	7	-	-	-	-	17	6	19	25	11	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
541	Fork-tailed Drongo		109	89	67	100	100	64	83	94	100	100	89	75	100	92	0	-	-	-	-	-	-	-	-	-	-	-	-
542	Square-tailed Drongo		12	10	-	14	-	9	-	-	25	17	11	13	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
543	Eurasian Golden-Oriole		1	1	-	-	-	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
545	Black-headed (Eastern) Oriole		83	68	33	86	91	64	83	75	63	92	56	38	80	58	0	-	-	-	-	-	-	-	-	-	-	-	-
547	Cape (Black) Crow		13	11	22	14	18	9	-	13	13	17	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
548	Pied Crow		34	28	33	14	-	18	17	44	44	33	22	25	40	25	0	-	-	-	-	-	-	-	-	-	-	-	-
550	White-necked Raven		62	51	22	57	82	45	33	56	56	58	56	38	60	33	2	-	-	1	-	-	-	1	-	-	-	-	-
554	Southern Black Tit		77	63	44	71	73	55	50	69	69	75	67	50	60	58	1	-	-	-	-	-	-	-	-	-	-	1	-
568	Dark-capped (Black-eyed) Bulbul		115	94	89	100	100	82	100	94	100	100	89	100	80	92	1	-	-	1	-	-	-	-	-	-	-	-	-
569	Terrestrial Brownbul (Bulbul)		33	27	11	43	27	9	33	31	31	25	22	25	40	33	0	-	-	-	-	-	-	-	-	-	-	-	-
572	Sombre Greenbul (Bulbul)		73	60	44	71	73	45	33	56	69	67	44	75	60	67	0	-	-	-	-	-	-	-	-	-	-	-	-
574	Yellow-bellied Greenbul (Bulbul)		4	3	-	-	9	-	-	13	-	-	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
576	Kurrichane Thrush		32	26	-	-	-	27	50	44	31	25	22	25	60	33	0	-	-	-	-	-	-	-	-	-	-	-	-
577	Olive Thrush (pre-split)		22	18	11	-	9	-	17	19	6	25	22	38	20	50	0	-	-	-	-	-	-	-	-	-	-	-	-
579	Orange Ground-Thrush	NT	2	2	-	-	-	-	-	-	-	-	22	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
580	Groundscraper Thrush		1	1	-	-	-	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
581	Cape Rock-Thrush		35	29	11	29	27	27	-	38	13	33	33	25	60	50	1	-	-	-	1	-	-	-	-	-	-	-	-
582	Sentinel Rock-Thrush		1	1	-	14	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
589	Familiar Chat		8	7	-	-	9	-	-	13	-	17	11	-	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
593	Mocking Cliff-Chat		36	30	22	57	45	45	33	19	13	25	44	50	-	17	2	-	-	-	-	-	-	-	-	-	1	-	1
596	African (Common) Stonechat		70	57	56	71	73	45	83	50	63	67	44	50	40	50	1	-	-	-	-	-	-	-	1	-	-	-	-
600	Red-capped (Natal) Robin-Chat		30	25	22	14	36	27	33	25	13	8	11	38	20	50	0	-	-	-	-	-	-	-	-	-	-	-	-
601	Cape Robin-Chat		32	26	11	14	45	36	33	25	38	25	22	13	20	17	0	-	-	-	-	-	-	-	-	-	-	-	-
613	White-browed (Red-backed) Scrub-Robin		44	36	11	43	55	18	33	44	31	33	22	50	40	50	0	-	-	-	-	-	-	-	-	-	-	-	-
619	Garden Warbler		1	1	-	-	9	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
628	Great Reed-Warbler		1	1	-	14	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
631	African (African Marsh-Warbler) Reed-Warbler		1	1	-	-	-	9	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
633	Marsh (European Marsh) Warbler		4	3	11	14	9	9	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
634	Sedge Warbler		1	1	-	14	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
635	Lesser Swamp- (Cape Reed) Warbler		7	6	11	29	9	9	-	-	-	8	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
637	Dark-capped Yellow (Yellow) Warbler		4	3	11	14	-	9	-	6	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
638	Little Rush- (African Sedge) Warbler		16	13	22	14	18	18	17	13	6	8	11	-	-	25	0	-	-	-	-	-	-	-	-	-	-	-	-
639	Barratt's Warbler		4	3	-	-	-	9	17	-	13	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
643	Willow Warbler		16	13	22	29	45	27	-	-	-	-	-	-	-	33	0	-	-	-	-	-	-	-	-	-	-	-	-
644	Yellow-throated (Woodland-) Warbler		2	2	-	-	-	9	17	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
645	Bar-throated Apalis		57	47	22	43	64	36	50	38	56	25	67	63	60	50	0	-	-	-	-	-	-	-	-	-	-	-	-
648	Yellow-breasted Apalis		4	3	-	14	-	-	-	6	-	-	-	-	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
651	Long-billed (Cape) Crombec		1	1	-	-	-	-	-	-	-	-	11	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
657	Bleating Warbler (pre-split)		69	57	44	57	64	36	17	50	56	67	67	75	80	67	0	-	-	-	-	-	-	-	-	-	-	-	-
661	Cape Grassbird		8	7	11	14	18	9	17	-	-	8	-	13	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
664	Zitting (Fan-tailed) Cisticola		12	10	22	43	36	9	-	-	-	-	-	13	20	-	0	-	-	-	-	-	-	-	-	-	-	-	-
667	Wing-snapping (Ayre's) Cisticola		2	2	11	-	-	9	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
672	Rattling Cisticola		17	14	22	43	9	-	-	-	-	8	11	25	40	42	0	-	-	-	-	-	-	-	-	-	-	-	-
674	Red-faced Cisticola		4	3	-	-	18	-	17	-	-	-	-	13	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
677	Le Vaillant's (Tinkling) Cisticola		8	7	33	14	9	9	-	-	-	8	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
678	Croaking (Striped) Cisticola		5	4	-	29	9	9	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
679	Lazy Cisticola		13	11	-	-	9	18	17	6	13	-	11	13	-	33	0	-	-	-	-	-	-	-	-	-	-	-	-
681	Neddicky (Piping Cisticola)		42	34	44	29	36	18	17	25	25	42	11	63	60	58	0	-	-	-	-	-	-	-	-	-	-	-	-
683	Tawny-flanked Prinia		79	65	67	57	73	45	50	56	75	75	78	63	60	67	1	-	-	-	-	-	-	-	-	-	-	1	-
689	Spotted Flycatcher		7	6	33	14	9	-	-	-	-	-	-	13	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
690	African Dusky Flycatcher		61	50	11	57	64	55	33	50	50	58	56	50	60	50	0	-	-	-	-	-	-	-	-	-	-	-	-
691	Ashy Flycatcher (Alseonax)		13	11	-	14	27	9	17	19	13	-	11	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
694	Southern Black-Flycatcher		59	48	11	57	36	36	33	56	75	58	33	25	80	58	0	-	-	-	-	-	-	-	-	-	-	-	-
700	Cape Batis		18	15	11	14	18	27	17	6	13	8	22	25	20	8	0	-	-	-	-	-	-	-	-	-	-	-	-
701	Chinspot Batis		39	32	44	29	27	9	33	31	56	33	33	38	-	25	0	-	-	-	-	-	-	-	-	-	-	-	-

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
708	Blue-mantled Crested-Flycatcher		2	2	-	-	-	-	17	-	-	-	11	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
710	African Paradise-Flycatcher		58	48	33	43	64	45	67	56	25	17	33	50	100	75	2	-	-	-	-	-	-	-	-	-	-	2	-
711	African Pied Wagtail		70	57	33	71	73	36	33	56	75	58	78	50	60	50	0	-	-	-	-	-	-	-	-	-	-	-	-
712	Mountain (Long-tailed) Wagtail		9	7	-	-	9	18	17	6	6	-	-	25	20	-	0	-	-	-	-	-	-	-	-	-	-	-	-
713	Cape Wagtail		74	61	78	86	82	55	33	56	81	50	33	50	60	50	0	-	-	-	-	-	-	-	-	-	-	-	-
716	African (Grassveld/Grassland) Pipit		6	5	11	14	18	9	-	-	-	8	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
720	Striped Pipit		17	14	11	-	9	18	-	13	19	25	11	25	-	17	1	-	-	-	-	-	-	-	-	-	1	-	-
727	Cape (Orange-throated) Longclaw		7	6	22	14	9	9	17	-	6	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-
728	Yellow-throated Longclaw		16	13	11	29	9	9	17	19	19	17	11	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
732	Common Fiscal		82	67	56	86	73	73	67	63	81	67	67	63	20	67	0	-	-	-	-	-	-	-	-	-	-	-	-
733	Red-backed Shrike		2	2	-	-	9	-	-	-	-	-	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
736	Southern Boubou		82	67	33	57	73	45	50	75	63	83	100	75	60	75	0	-	-	-	-	-	-	-	-	-	-	-	-
740	Black-backed (Southern) Puffback		37	30	11	29	45	9	33	25	50	33	22	38	20	33	0	-	-	-	-	-	-	-	-	-	-	-	-
741	Brubru		7	6	-	14	9	-	-	6	-	8	-	13	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
742	Southern Tchagra		20	16	22	29	9	9	17	13	25	17	22	13	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
744	Black-crowned Tchagra		16	13	33	29	27	18	-	6	6	-	-	-	20	25	0	-	-	-	-	-	-	-	-	-	-	-	-
746	Bokmakierie		1	1	-	14	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
747	Gorgeous Bush-Shrike		28	23	22	14	36	9	33	-	13	33	22	13	60	50	0	-	-	-	-	-	-	-	-	-	-	-	-
748	Orange-breasted Bush-Shrike		35	29	22	29	45	9	17	19	25	33	22	38	40	50	0	-	-	-	-	-	-	-	-	-	-	-	-
750	Olive Bush-Shrike		2	2	-	-	-	-	-	-	-	-	11	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
751	Grey-headed Bush-Shrike		28	23	11	29	27	27	33	25	13	17	33	13	20	33	0	-	-	-	-	-	-	-	-	-	-	-	-
758	Common Myna		88	72	89	71	55	64	67	63	75	75	56	75	100	92	2	1	-	-	-	-	-	-	-	-	-	1	-
761	Violet-backed (Plum-coloured, Amethyst) Starling		16	13	11	29	9	-	-	-	-	-	-	25	60	58	1	-	-	-	-	-	-	-	-	-	-	-	1
764	Cape Glossy (Glossy) Starling		64	52	44	57	73	27	83	50	63	67	44	38	60	33	0	-	-	-	-	-	-	-	-	-	-	-	-
768	Black-bellied Starling		35	29	11	43	45	9	17	25	31	17	44	25	40	42	1	-	-	-	-	-	-	-	-	-	-	-	1
769	Red-winged Starling		78	64	67	71	55	36	67	69	81	67	67	63	80	50	1	-	-	-	-	-	-	-	-	-	-	-	1
775	Malachite Sunbird		1	1	-	-	-	9	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
783	Southern Double-collared Sunbird		4	3	11	-	-	-	-	6	6	-	-	-	20	-	0	-	-	-	-	-	-	-	-	-	-	-	-
785	Greater Double-collared Sunbird		15	12	-	-	-	18	33	19	19	25	22	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
787	White-bellied (breasted) Sunbird		55	45	44	14	27	27	17	38	63	33	44	63	100	75	0	-	-	-	-	-	-	-	-	-	-	-	-
789	Grey (Mouse-coloured) Sunbird		26	21	11	14	27	9	17	13	13	42	11	38	20	42	0	-	-	-	-	-	-	-	-	-	-	-	-
790	Olive Sunbird		29	24	-	29	27	9	50	44	38	8	-	13	20	33	0	-	-	-	-	-	-	-	-	-	-	-	-
791	Scarlet-chested Sunbird		5	4	-	-	-	9	17	-	6	8	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
792	Amethyst (Black) Sunbird		73	60	33	57	82	45	50	63	56	50	56	50	100	83	2	-	-	1	-	-	-	-	-	-	-	-	1
793	Collared Sunbird		35	29	11	14	45	9	33	31	44	17	33	13	60	33	0	-	-	-	-	-	-	-	-	-	-	-	-
796	Cape White-eye (pre-split)		90	74	67	71	91	27	50	69	88	67	89	100	100	75	0	-	-	-	-	-	-	-	-	-	-	-	-
801	House Sparrow		38	31	11	29	27	36	33	31	31	33	22	25	20	58	1	-	-	-	-	-	1	-	-	-	-	-	-
803	Cape Sparrow		9	7	22	14	9	-	-	13	6	8	-	-	-	8	1	1	-	-	-	-	-	-	-	-	-	-	-
804	Greyheaded Sparrow (pre-split)		26	21	33	29	18	18	17	19	13	8	33	13	40	33	4	1	1	-	-	-	-	-	-	-	-	-	2
805	Yellow-throated Petronia (Sparrow)		11	9	-	-	-	9	17	6	-	25	22	25	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
807	Thick-billed (Grosbeak) Weaver		35	29	22	57	45	18	17	6	31	42	33	-	20	50	4	-	1	-	-	-	-	-	-	-	-	1	2
808	Dark-backed (Forest) Weaver		21	17	-	14	27	9	33	25	19	8	22	-	20	25	0	-	-	-	-	-	-	-	-	-	-	-	-
810	Spectacled Weaver		62	51	44	86	64	18	33	56	56	58	33	38	80	50	0	-	-	-	-	-	-	-	-	-	-	-	-
811	Village (Spotted-backed) Weaver		60	49	44	43	36	18	33	50	38	75	78	50	80	58	5	1	-	-	-	-	-	-	-	1	-	1	2
813	Cape Weaver		17	14	11	29	-	9	17	13	13	17	22	25	20	8	0	-	-	-	-	-	-	-	-	-	-	-	-
814	Southern Masked-Weaver		5	4	11	-	-	-	-	-	6	8	11	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
816	Golden-Weaver		1	1	-	-	-	-	-	-	-	-	-	-	-	8	1	-	-	-	-	-	-	-	-	-	-	-	1
817	Yellow (African Golden) Weaver		20	16	22	29	-	9	17	6	6	8	22	25	40	42	4	-	1	-	-	-	-	-	-	-	-	1	2
821	Red-billed Quelea		1	1	-	-	-	-	-	-	-	-	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
824	Southern Red (Red) Bishop		17	14	33	29	36	9	17	-	-	8	-	-	20	33	0	-	-	-	-	-	-	-	-	-	-	-	-
828	Fan-tailed (Red-shouldered) Widowbird		39	32	56	57	55	27	33	6	19	17	11	38	40	58	0	-	-	-	-	-	-	-	-	-	-	-	-
829	White-winged Widowbird		3	2	-	14	9	9	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
831	Red-collared Widowbird		21	17	56	43	36	9	-	6	6	-	-	-	20	42	0	-	-	-	-	-	-	-	-	-	-	-	-
832	Long-tailed Widowbird		7	6	11	29	-	-	-	-	6	8	11	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
835	Green Twinspot		2	2	-	-	-	-	-	-	-	8	-	13	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
840	African (Blue-billed) Firefinch		55	45	11	71	64	36	67	50	44	42	33	38	40	50	0	-	-	-	-	-	-	-	-	-	-	-	-

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D		Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
844	Blue Waxbill		4	3	-	14	-	-	-	6	-	17	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
846	Common Waxbill		43	35	44	71	73	27	17	38	31	25	11	25	20	33		0	-	-	-	-	-	-	-	-	-	-	-	-
848	Grey (Black-tailed) Waxbill		16	13	11	14	-	-	-	19	25	17	22	13	40	-		0	-	-	-	-	-	-	-	-	-	-	-	-
850	Swee (Black-faced) Waxbill (Swee)		20	16	11	14	9	27	33	6	31	-	22	13	20	17		0	-	-	-	-	-	-	-	-	-	-	-	-
852	African Quailfinch		2	2	11	14	-	-	-	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
854	Orange-breasted (Zebra) Waxbill		3	2	11	14	-	9	-	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
857	Bronze Mannikin		63	52	33	43	73	27	50	63	69	50	33	25	60	67		0	-	-	-	-	-	-	-	-	-	-	-	-
858	Red-backed Mannikin		4	3	-	-	-	-	-	6	-	17	-	-	20	-		0	-	-	-	-	-	-	-	-	-	-	-	-
860	Pin-tailed Whydah		43	35	67	71	100	27	17	-	13	-	11	13	80	75		0	-	-	-	-	-	-	-	-	-	-	-	-
864	Dusky Indigobird		21	17	44	43	27	27	-	-	-	-	-	-	20	58		0	-	-	-	-	-	-	-	-	-	-	-	-
869	Yellow-fronted (eyed) Canary		84	69	56	71	91	45	50	63	75	75	78	63	80	75		0	-	-	-	-	-	-	-	-	-	-	-	-
872	Cape (Yellow-crowned) Canary		15	12	-	14	-	9	-	6	13	33	33	13	-	17		0	-	-	-	-	-	-	-	-	-	-	-	-
873	Forest Canary		9	7	11	14	-	18	17	-	19	-	-	-	20	-		0	-	-	-	-	-	-	-	-	-	-	-	-
877	Brimstone (Bully) Canary		17	14	11	14	18	-	-	13	19	33	11	13	-	17		0	-	-	-	-	-	-	-	-	-	-	-	-
881	Streaky-headed Seedeater (Canary)		16	13	33	14	18	9	-	13	6	8	11	-	20	25		0	-	-	-	-	-	-	-	-	-	-	-	-
884	Golden-breasted Bunting		32	26	11	43	36	27	17	19	31	33	11	-	40	42		0	-	-	-	-	-	-	-	-	-	-	-	-
888	Yellow-billed Kite		51	42	78	57	55	9	-	-	-	50	67	63	80	100		0	-	-	-	-	-	-	-	-	-	-	-	-

Southern African

Bird Atlas Project



Occurrence:
n indicates the total number of cards on which the species was recorded. We also give this as a percentage (%) of the total cards for the site. The monthly breakdown shows the number of times the species was reported, as a percentage of the total cards for the month (ie: reporting rate).

Breeding:
n represents the number of cards on which confirmed breeding activity was reported. The monthly breakdown is the number of times the species was recorded breeding.

Site summary for:

Site Name: DURBAN WEST (2930DD)
Province: KwaZulu-Natal

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Total cards per month	112	71	98	114	120	120	126	116	105	97	88	93	1260
Total number species	280	246	265	274	261	248	252	262	260	261	269	275	355
Total number species breeding	67	39	36	28	28	22	42	50	58	67	68	69	137

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
8	Little Grebe (Dabchick)		209	17	6	10	10	13	20	23	22	14	19	20	19	19	0	-	-	-	-	-	-	-	-	-	-	-	-
49	Great White Pelican	NT	172	14	21	11	10	11	13	13	11	10	11	18	19	14	0	-	-	-	-	-	-	-	-	-	-	-	-
50	Pink-backed Pelican	VU	157	12	13	11	10	7	10	10	15	12	13	19	16	14	0	-	-	-	-	-	-	-	-	-	-	-	-
53	Cape Gannet	VU	2	0	-	-	-	2	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
55	White-breasted (Great) Cormorant		298	24	30	27	18	21	23	22	21	22	22	28	28	26	10	-	-	-	-	-	2	3	3	2	-	-	-
56	Cape Cormorant	NT	13	1	1	-	1	1	1	2	2	2	2	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
58	Reed (Long-tailed) Cormorant		300	24	19	20	19	22	26	28	22	23	24	30	27	26	2	-	-	-	-	-	-	2	-	-	-	-	-
60	African Darter		244	19	13	13	16	22	24	24	21	17	21	24	18	15	0	-	-	-	-	-	-	-	-	-	-	-	-
62	Grey Heron		416	33	38	37	23	35	36	33	33	35	30	31	33	32	22	1	-	-	-	-	2	4	5	2	5	1	2
63	Black-headed Heron		453	36	46	35	36	37	34	31	28	30	40	38	41	39	12	1	-	1	-	-	-	-	3	2	5	-	-
64	Goliath Heron		191	15	15	13	9	6	14	13	17	16	18	21	20	19	11	-	-	-	-	-	-	1	2	3	2	1	2
65	Purple Heron		104	8	8	4	8	7	8	8	8	8	7	11	14	9	6	1	-	-	-	-	-	-	1	1	3	-	-
66	Great Egret		125	10	6	4	9	10	18	14	13	9	9	11	8	3	0	-	-	-	-	-	-	-	-	-	-	-	-
67	Little Egret		241	19	13	18	13	21	23	19	21	13	19	23	26	20	0	-	-	-	-	-	-	-	-	-	-	-	-
68	Yellow-billed (Intermediate) Egret		65	5	2	-	4	4	10	9	10	6	3	5	3	1	0	-	-	-	-	-	-	-	-	-	-	-	-
69	Black Heron		7	1	3	1	1	1	-	-	-	-	1	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
71	Cattle Egret		373	30	31	30	19	28	32	33	33	36	31	29	24	25	2	-	1	-	-	-	-	-	-	1	-	-	-
72	Squacco Heron		93	7	8	4	5	4	8	7	6	6	5	12	17	8	0	-	-	-	-	-	-	-	-	-	-	-	-
74	Green-backed (Striated) Heron		132	10	9	17	14	11	14	8	10	7	5	9	13	13	2	-	-	-	-	-	-	-	-	-	-	-	2
76	Black-crowned Night-Heron		72	6	6	8	3	2	3	5	6	3	6	14	6	9	3	-	-	-	-	-	-	-	-	1	2	-	-
78	Little Bittern		21	2	4	8	1	3	1	-	2	-	2	2	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
81	Hamerkop		494	39	49	39	38	47	47	38	39	31	30	34	38	39	3	-	-	-	-	-	-	1	1	1	-	-	-
83	White Stork		2	0	-	-	2	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
84	Black Stork	NT	6	0	1	1	-	-	1	-	-	-	3	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
86	Woolly-necked Stork	NT	4	0	-	-	-	-	-	-	-	1	-	1	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
89	Marabou Stork	NT	1	0	-	-	1	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
90	Yellow-billed Stork	NT	2	0	-	-	-	-	-	-	-	-	-	-	2	-	0	-	-	-	-	-	-	-	-	-	-	-	-
91	African Sacred (Sacred) Ibis		315	25	28	21	18	23	25	25	21	24	26	32	34	24	12	2	1	-	-	-	-	-	1	1	2	3	2
92	Southern Bald (Bald) Ibis	VU	1	0	-	-	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
93	Glossy Ibis		16	1	-	-	-	-	3	1	2	-	-	3	5	2	0	-	-	-	-	-	-	-	-	-	-	-	-
94	Hadeda Ibis		1148	91	95	97	89	89	88	86	94	91	91	94	92	91	22	4	2	1	-	-	-	2	-	5	3	3	2
95	African Spoonbill		159	13	5	4	14	13	15	20	16	13	14	16	9	5	19	-	-	1	2	3	1	4	3	3	2	-	-
96	Greater Flamingo	NT	5	0	2	1	-	-	-	-	-	1	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
97	Lesser Flamingo	NT	2	0	-	-	1	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
99	White-faced (Whistling-) Duck		315	25	31	28	20	26	22	20	20	21	26	28	33	30	15	1	3	4	4	-	-	-	-	-	-	2	1
100	Fulvous (Whistling) Duck		47	4	6	-	2	3	2	2	2	5	4	8	10	2	0	-	-	-	-	-	-	-	-	-	-	-	-
101	White-backed Duck		42	3	3	4	3	7	4	2	-	3	6	4	5	1	0	-	-	-	-	-	-	-	-	-	-	-	-
102	Egyptian Goose		363	29	29	28	24	27	28	32	29	28	25	26	35	34	18	1	1	-	2	-	1	3	1	1	1	4	3
103	South African Shelduck		49	4	4	3	5	6	4	7	3	3	2	2	6	2	0	-	-	-	-	-	-	-	-	-	-	-	-
104	Yellow-billed Duck		324	26	30	27	22	22	23	23	28	21	26	25	32	33	5	-	-	-	-	-	-	2	-	1	-	1	1
105	African Black Duck		66	5	5	4	4	6	2	4	7	8	6	7	3	5	0	-	-	-	-	-	-	-	-	-	-	-	-
106	Cape Teal		18	1	2	3	2	-	1	1	1	-	1	1	5	3	0	-	-	-	-	-	-	-	-	-	-	-	-
107	Hottentot Teal		158	13	13	14	12	13	9	7	9	16	12	18	17	15	0	-	-	-	-	-	-	-	-	-	-	-	-
108	Red-billed Teal (Duck)		97	8	4	7	7	6	8	8	11	11	10	3	8	6	0	-	-	-	-	-	-	-	-	-	-	-	-
112	Cape Shoveler		165	13	15	15	11	8	11	9	13	13	8	18	22	18	3	-	-	-	-	-	-	-	1	-	-	2	-

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
113	Southern Pochard		124	10	11	6	4	2	3	6	12	12	15	20	17	13	2	-	-	-	-	-	-	1	-	1	-	-	-
115	Comb (Knob-billed) Duck		25	2	2	1	1	2	4	5	3	2	1	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
116	Spur-winged Goose		165	13	16	14	7	17	12	13	11	12	13	18	14	11	2	-	-	-	1	-	-	1	-	-	-	-	-
118	Secretarybird	NT	1	0	-	-	-	-	1	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
126	Black & Yellowbilled Kite (pre-split)		201	16	29	15	13	1	-	-	1	14	32	30	32	38	0	-	-	-	-	-	-	-	-	-	-	-	-
127	Black-shouldered (Winged) Kite		17	1	1	-	-	2	2	-	-	2	3	3	-	4	0	-	-	-	-	-	-	-	-	-	-	-	-
131	Verreaux's (Black) Eagle		11	1	1	-	1	3	2	-	-	-	2	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
135	Wahlberg's Eagle		11	1	1	-	-	1	-	-	-	3	-	4	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
136	Booted Eagle		4	0	-	-	3	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
139	Long-crested Eagle		29	2	2	-	-	4	1	4	5	3	2	3	2	1	0	-	-	-	-	-	-	-	-	-	-	-	-
140	Martial Eagle	VU	10	1	-	-	2	1	1	2	2	1	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
141	African Crowned (Crowned) Eagle	NT	60	5	8	-	2	4	6	3	2	7	8	5	6	5	10	2	-	-	1	-	-	-	2	1	2	-	2
143	Black-chested (Breasted) Snake-Eagle		1	0	-	-	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
148	African Fish-Eagle		201	16	23	18	10	15	23	18	10	19	10	12	19	12	2	-	-	-	-	-	1	-	1	-	-	-	-
149	Steppe (Common) Buzzard		78	6	21	15	9	2	-	-	-	1	1	4	11	18	0	-	-	-	-	-	-	-	-	-	-	-	-
152	Jackal Buzzard		6	0	2	-	-	-	-	-	2	-	-	-	-	2	0	-	-	-	-	-	-	-	-	-	-	-	-
154	Lizard Buzzard		1	0	-	-	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
157	Little Sparrowhawk		35	3	2	3	2	4	3	1	5	3	2	6	2	-	0	-	-	-	-	-	-	-	-	-	-	-	-
158	Black Sparrowhawk (Goshawk)		111	9	10	7	5	9	10	8	11	16	7	7	8	6	15	-	-	-	1	-	1	5	3	2	3	-	-
160	African Goshawk (incl. Red-chested)		324	26	25	28	27	26	21	27	28	28	27	26	23	25	3	1	-	-	-	-	-	-	1	-	-	-	1
161	Gabar Goshawk		1	0	-	-	-	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
165	African Marsh-Harrier	VU	6	0	2	3	-	-	-	-	-	1	-	1	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
169	African Harrier-Hawk (Gymnogene)		73	6	5	6	2	4	9	10	5	9	8	3	2	4	0	-	-	-	-	-	-	-	-	-	-	-	-
170	Osprey		10	1	1	1	1	-	1	1	1	2	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
171	Peregrine Falcon	NT	1	0	-	-	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
172	Lanner Falcon	NT	129	10	13	4	7	15	8	11	10	11	13	10	10	8	2	1	-	-	-	-	1	-	-	-	-	-	-
173	Eurasian Hobby		2	0	-	-	1	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
175	Sooty Falcon		3	0	-	-	1	1	1	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
180	Amur (Eastern Red-footed) Falcon (Kestrel)		3	0	-	-	-	1	-	-	-	-	-	-	2	-	0	-	-	-	-	-	-	-	-	-	-	-	-
181	Rock Kestrel		2	0	-	-	-	-	-	1	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
188	Coqui Francolin		2	0	1	-	-	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
191	Shelley's Francolin		59	5	4	3	4	4	3	5	5	4	9	6	5	5	0	-	-	-	-	-	-	-	-	-	-	-	-
196	Natal Spurfowl (Francolin)		121	10	13	11	14	9	8	5	6	10	6	12	11	13	0	-	-	-	-	-	-	-	-	-	-	-	-
200	Common Quail		5	0	-	-	-	1	-	-	-	-	-	4	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
203	Helmeted Guineafowl		108	9	12	8	8	5	8	8	9	8	11	13	8	4	1	1	-	-	-	-	-	-	-	-	-	-	-
205	Kurrichane (Small) Buttonquail		4	0	1	-	-	-	1	-	-	-	1	1	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
208	Blue Crane	VU	5	0	1	-	-	-	-	-	-	-	1	1	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
209	Grey Crowned- (Crowned) Crane	VU	1	0	1	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
210	African Rail		11	1	-	-	-	4	2	-	-	2	1	2	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
211	Corn Crake	VU	4	0	3	-	-	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
213	Black Crake		168	13	7	20	6	17	13	13	13	18	12	14	14	13	2	-	-	-	-	1	-	1	-	-	-	-	-
217	Red-chested Flufftail		21	2	3	6	1	1	-	1	1	-	4	1	-	5	0	-	-	-	-	-	-	-	-	-	-	-	-
218	Buff-spotted Flufftail		27	2	5	4	1	1	-	1	1	1	1	3	3	6	1	-	-	-	-	-	-	-	-	1	-	-	-
223	African Purple (Purple) Swamphen (Gallinule)		92	7	6	4	7	7	8	4	10	9	8	10	8	6	5	-	-	1	1	-	-	1	-	-	2	-	-
226	Common Moorhen		286	23	24	25	19	20	21	23	18	26	22	23	27	27	10	1	-	-	1	-	-	5	2	-	1	-	-
228	Red-knobbed Coot		313	25	29	24	22	25	24	19	25	22	22	28	32	28	15	1	1	-	1	1	2	1	1	-	4	2	1
240	African Jacana		352	28	34	30	23	33	31	20	27	22	26	28	30	33	17	1	1	2	6	2	1	-	-	-	-	2	2
245	Common Ringed Plover		16	1	-	1	7	-	1	1	1	-	-	-	2	3	0	-	-	-	-	-	-	-	-	-	-	-	-
246	White-fronted Plover		11	1	1	1	1	2	-	1	-	1	2	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
248	Kittlitz's Plover		49	4	2	4	1	2	4	5	3	8	6	3	7	2	0	-	-	-	-	-	-	-	-	-	-	-	-
249	Three-banded Plover		183	15	17	14	16	12	16	13	17	14	10	14	17	15	0	-	-	-	-	-	-	-	-	-	-	-	-
251	Greater Sand Plover		2	0	1	1	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
254	Grey (Black-bellied) Plover		4	0	1	1	-	-	-	-	-	2	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
255	Crowned Lapwing (Plover)		2	0	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-	-	-	-	1	-	-	-	-
258	Blacksmith Lapwing (Plover)		267	21	24	24	19	23	19	15	18	18	19	25	30	25	21	3	1	1	3	5	2	-	3	-	-	1	2
262	Ruddy Turnstone		5	0	1	1	-	-	-	-	-	2	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
263	Terek Sandpiper		2	0	1	-	-	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
264	Common Sandpiper		135	11	19	20	11	4	1	-	2	9	12	19	23	22	0	-	-	-	-	-	-	-	-	-	-	-	-
265	Green Sandpiper		1	0	-	-	-	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
266	Wood Sandpiper		170	13	22	20	18	14	2	1	6	11	12	19	24	24	0	-	-	-	-	-	-	-	-	-	-	-	-
269	Marsh Sandpiper		42	3	10	4	2	1	-	1	-	-	1	5	10	10	0	-	-	-	-	-	-	-	-	-	-	-	-
270	Common Greenshank		52	4	7	7	8	1	2	1	-	3	3	5	9	8	0	-	-	-	-	-	-	-	-	-	-	-	-
272	Curlew Sandpiper		79	6	13	8	9	2	2	-	1	3	6	10	14	13	0	-	-	-	-	-	-	-	-	-	-	-	-
274	Little Stint		65	5	12	7	9	4	1	-	-	1	2	9	14	10	0	-	-	-	-	-	-	-	-	-	-	-	-
279	Pectoral Sandpiper		1	0	-	-	-	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
281	Sanderling		1	0	-	-	-	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
284	Ruff		154	12	22	21	15	10	1	2	-	9	12	18	26	24	0	-	-	-	-	-	-	-	-	-	-	-	-
286	African (Ethiopian) Snipe		5	0	-	-	-	-	1	-	2	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
289	Eurasian (Curlew) Curlew		1	0	-	1	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
290	Common (Whimbrel) Whimbrel		7	1	1	1	-	-	1	1	-	2	1	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
295	Black-winged Stilt		73	6	7	7	10	4	3	4	2	2	5	7	13	11	0	-	-	-	-	-	-	-	-	-	-	-	-
297	Spotted Thick-knee (Dikkop)		3	0	-	-	-	1	1	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-
298	Water Thick-knee (Dikkop)		4	0	-	-	-	2	2	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
312	Kelp Gull		55	4	3	3	8	5	6	5	5	6	2	3	2	3	9	1	1	1	-	1	-	1	-	1	-	1	2
315	Grey-headed Gull		112	9	4	4	10	3	8	8	6	7	10	19	20	11	8	1	1	1	-	2	-	-	-	1	-	1	1
322	Caspian Tern	NT	30	2	-	1	-	1	3	3	4	5	2	4	3	-	0	-	-	-	-	-	-	-	-	-	-	-	-
324	Swift (Great Crested) Tern		20	2	1	1	2	2	-	2	1	3	1	1	3	2	1	-	-	-	-	-	-	-	1	-	-	-	-
325	Lesser Crested Tern		1	0	-	1	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
326	Sandwich Tern		8	1	2	1	-	2	-	-	-	2	-	1	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-
327	Common Tern		96	8	16	15	10	10	13	5	6	3	2	4	3	6	0	-	-	-	-	-	-	-	-	-	-	-	-
328	Arctic Tern		1	0	-	-	-	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
335	Little Tern		5	0	2	-	-	1	-	-	1	-	1	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
338	Whiskered Tern		6	0	-	3	1	-	-	-	-	-	-	-	1	2	0	-	-	-	-	-	-	-	-	-	-	-	-
339	White-winged Tern		122	10	21	20	14	8	5	3	1	3	5	7	19	20	0	-	-	-	-	-	-	-	-	-	-	-	-
348	Rock (Feral) Dove (Pigeon)		240	19	15	21	22	16	23	19	21	19	16	25	17	15	14	2	1	2	2	2	-	1	-	1	-	1	2
349	Speckled (Rock) Pigeon		9	1	-	-	2	-	-	-	2	2	2	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
350	African Olive- (Rameron) Pigeon		27	2	-	-	2	1	4	4	5	3	3	1	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
352	Red-eyed Dove		932	74	73	72	67	69	78	74	75	75	73	76	76	77	23	2	1	2	-	3	1	3	2	4	1	2	2
354	Cape Turtle (Ring-necked) Dove		239	19	22	17	18	20	17	20	22	17	21	16	13	22	9	1	2	1	1	1	-	1	-	1	1	-	-
355	Laughing (Palm) Dove		958	76	76	77	80	80	81	69	71	76	73	75	81	75	40	3	3	3	3	2	2	3	7	5	3	4	2
358	Emerald-spotted Wood-Dove		81	6	11	6	3	4	5	7	5	8	7	9	7	8	0	-	-	-	-	-	-	-	-	-	-	-	-
359	Tambourine Dove		431	34	34	30	31	26	37	38	34	37	35	33	30	45	0	-	-	-	-	-	-	-	-	-	-	-	-
360	Lemon (Cinnamon) Dove		58	5	6	1	6	5	3	3	5	4	5	7	2	5	2	1	-	-	-	1	-	-	-	-	-	-	-
370	Knysna Lourie (pre-split)		49	4	4	1	4	1	3	3	4	3	4	4	7	10	0	-	-	-	-	-	-	-	-	-	-	-	-
371	Purple-crested Turaco		806	64	72	72	65	55	56	56	60	65	74	68	67	65	6	1	-	-	-	-	-	-	-	-	2	1	2
374	Common (Eurasian) Cuckoo		5	0	-	4	1	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
375	African Cuckoo		1	0	-	-	-	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
377	Red-chested Cuckoo		99	8	16	8	3	3	-	-	-	-	2	21	25	27	1	-	-	-	-	-	-	-	-	-	-	-	1
378	Black Cuckoo		21	2	1	3	-	-	2	-	-	-	-	2	10	5	0	-	-	-	-	-	-	-	-	-	-	-	-
382	Jacobin (Pied) Cuckoo		7	1	1	1	1	-	-	-	-	-	-	1	3	-	0	-	-	-	-	-	-	-	-	-	-	-	-
384	African Emerald (Emerald) Cuckoo		72	6	7	-	-	2	3	3	1	1	4	21	18	15	1	-	-	-	-	-	-	-	-	-	1	-	-
385	Klaas's Cuckoo		255	20	26	13	7	4	12	16	8	22	39	40	33	29	1	-	-	-	-	-	-	-	-	-	1	-	-
386	Dideric (Diederik) Cuckoo		264	21	54	32	11	2	2	-	-	-	5	52	65	57	3	2	-	-	-	-	-	-	-	-	-	1	-
387	Green Malkoha (Coucal)		27	2	3	-	1	1	1	3	2	3	2	5	2	4	0	-	-	-	-	-	-	-	-	-	-	-	-
391	Burchell's Coucal (pre-split)		466	37	54	31	29	31	24	23	25	36	41	54	55	52	2	-	-	1	-	-	-	-	-	-	-	-	1
392	Barn Owl		9	1	1	-	1	1	-	-	-	2	2	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
394	African Wood-Owl		20	2	3	-	-	3	1	-	-	3	2	5	-	2	3	-	-	-	-	-	-	-	1	1	1	-	-
395	Marsh Owl		1	0	-	-	-	-	-	1	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
396	African Scops-Owl		1	0	-	-	-	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
401	Spotted Eagle-Owl		103	8	8	11	8	8	7	4	5	8	9	7	13	15	0	-	-	-	-	-	-	-	-	-	-	-	-
404	European Nightjar		8	1	1	-	2	4	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
405	Fiery-necked Nightjar		119	9	4	4	13	12	12	11	13	12	13	6	3	4	0	-	-	-	-	-	-	-	-	-	-	-	-

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D		Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
408	Freckled Nightjar		2	0	-	-	-	1	1	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
409	Square-tailed (Mozambique) Nightjar		8	1	2	1	1	1	-	-	-	-	-	-	1	2		0	-	-	-	-	-	-	-	-	-	-	-	-
411	Common (European) Swift		5	0	1	-	-	1	-	-	-	-	-	-	1	2		0	-	-	-	-	-	-	-	-	-	-	-	-
412	African Black (Black) Swift		139	11	13	3	8	9	18	13	9	9	17	10	9	11		0	-	-	-	-	-	-	-	-	-	-	-	-
415	White-rumped Swift		253	20	37	31	22	18	9	3	1	1	18	39	41	42		0	-	-	-	-	-	-	-	-	-	-	-	-
417	Little Swift		205	16	24	24	14	14	14	12	10	8	17	18	30	18		0	-	-	-	-	-	-	-	-	-	-	-	-
418	Alpine Swift		16	1	-	-	1	1	5	1	1	1	3	2	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
421	African Palm-Swift		307	24	29	27	17	14	24	23	24	26	29	25	31	27		1	-	-	-	-	-	-	-	-	-	-	-	1
424	Speckled Mousebird		964	77	75	76	74	75	78	77	74	79	72	76	77	84		22	3	1	1	-	1	1	3	2	3	3	2	2
426	Red-faced Mousebird		15	1	2	-	-	2	1	3	2	2	2	1	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
427	Narina Trogon		77	6	3	1	5	3	9	8	4	5	10	13	5	6		1	-	-	-	-	-	-	-	-	-	1	-	-
428	Pied Kingfisher		248	20	26	24	17	18	23	18	19	13	17	13	27	24		0	-	-	-	-	-	-	-	-	-	-	-	-
429	Giant Kingfisher		194	15	13	17	16	20	24	13	14	8	11	8	19	20		1	-	-	-	-	-	-	-	-	-	-	-	1
431	Malachite Kingfisher		214	17	27	21	23	25	20	13	14	11	7	8	15	22		0	-	-	-	-	-	-	-	-	-	-	-	-
432	African Pygmy-Kingfisher		55	4	7	3	8	4	-	-	1	-	1	13	9	10		1	-	-	-	-	-	-	-	-	-	-	1	-
434	Mangrove Kingfisher	VU	4	0	-	-	-	-	1	-	1	-	-	1	-	1		0	-	-	-	-	-	-	-	-	-	-	-	-
435	Brown-hooded Kingfisher		709	56	63	59	57	54	53	56	55	53	61	58	49	57		13	2	-	-	-	-	-	1	1	3	1	3	2
444	Little Bee-eater		379	30	33	34	30	32	34	37	29	33	30	21	19	25		0	-	-	-	-	-	-	-	-	-	-	-	-
446	European Roller		3	0	-	-	-	-	-	-	-	-	-	-	-	3		0	-	-	-	-	-	-	-	-	-	-	-	-
451	African Hoopoe		95	8	10	7	7	6	4	3	6	8	11	10	10	10		0	-	-	-	-	-	-	-	-	-	-	-	-
452	Green (Red-billed) Wood-hoopoe		295	23	21	25	22	23	26	24	21	26	23	27	24	19		0	-	-	-	-	-	-	-	-	-	-	-	-
455	Trumpeter Hornbill		63	5	4	1	1	4	8	6	7	8	5	6	5	4		0	-	-	-	-	-	-	-	-	-	-	-	-
460	Crowned Hornbill		24	2	-	-	2	-	3	3	2	6	3	1	2	-		0	-	-	-	-	-	-	-	-	-	-	-	-
463	Southern Ground-Hornbill	VU	3	0	2	-	1	-	-	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
464	Black-collared Barbet		1004	80	75	83	74	76	83	83	83	83	79	81	75	77		40	5	2	3	-	3	2	5	2	2	3	6	7
466	White-eared Barbet		131	10	12	13	6	12	11	13	9	13	10	10	7	9		4	1	-	-	-	-	1	-	-	-	-	-	2
469	Red-fronted Tinkerbird		305	24	33	31	29	19	18	18	19	16	33	29	24	29		0	-	-	-	-	-	-	-	-	-	-	-	-
471	Yellow-rumped (Golden-rumped) Tinkerbird (Tinker Barbet)		350	28	29	34	38	25	27	28	23	18	29	40	23	24		8	1	-	-	-	1	1	-	-	1	2	2	-
473	Crested Barbet		19	2	2	1	1	2	-	1	1	1	3	4	2	1		0	-	-	-	-	-	-	-	-	-	-	-	-
474	Greater Honeyguide		41	3	3	1	1	2	2	3	3	3	8	6	3	4		0	-	-	-	-	-	-	-	-	-	-	-	-
475	Scaly-throated Honeyguide		16	1	4	-	-	-	-	2	1	2	3	2	-	2		0	-	-	-	-	-	-	-	-	-	-	-	-
476	Lesser Honeyguide		72	6	4	6	7	4	7	8	5	4	7	3	8	5		0	-	-	-	-	-	-	-	-	-	-	-	-
478	Brown-backed (Sharp-billed) Honeybird (Honeyguide)		40	3	3	1	3	2	3	5	3	2	10	-	1	4		0	-	-	-	-	-	-	-	-	-	-	-	-
483	Golden-tailed Woodpecker		471	37	33	39	37	32	41	37	39	39	43	43	32	34		11	-	1	-	-	-	-	-	1	1	3	4	1
486	Cardinal Woodpecker		269	21	22	21	24	16	24	24	21	24	18	19	19	22		1	-	-	-	-	-	-	-	-	-	1	-	-
488	Olive Woodpecker		4	0	-	-	-	-	-	1	-	-	1	2	-	-		1	-	-	-	-	-	1	-	-	-	-	-	-
489	Red-throated Wryneck		98	8	10	6	6	4	8	5	8	11	10	8	9	9		1	-	-	-	-	-	-	1	-	-	-	-	-
494	Rufous-naped Lark		103	8	15	4	5	6	5	4	2	10	12	12	8	14		0	-	-	-	-	-	-	-	-	-	-	-	-
507	Red-capped Lark		6	0	-	-	-	1	1	1	-	2	-	1	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
518	Barn (European) Swallow		335	27	61	62	46	27	4	-	-	4	4	22	58	66		0	-	-	-	-	-	-	-	-	-	-	-	-
520	White-throated Swallow		137	11	16	11	14	8	1	1	2	9	12	16	22	26		1	-	-	1	-	-	-	-	-	-	-	-	-
522	Wire-tailed Swallow		88	7	4	1	5	6	12	8	10	9	6	5	2	11		0	-	-	-	-	-	-	-	-	-	-	-	-
526	Greater Striped-Swallow		33	3	5	7	3	4	1	-	-	-	1	2	3	9		5	1	-	1	-	-	-	-	-	-	1	-	2
527	Lesser Striped-Swallow		555	44	75	65	40	16	8	2	17	53	67	69	73	76		21	4	2	1	-	-	-	-	1	2	2	7	2
529	Rock Martin		137	11	8	6	7	8	16	12	17	14	11	10	9	9		1	-	-	-	-	-	-	-	-	-	1	-	-
530	Common House-Martin		9	1	2	1	-	1	-	1	-	-	1	2	1	-		0	-	-	-	-	-	-	-	-	-	-	-	-
532	Sand Martin (Bank Swallow)		13	1	4	1	1	1	-	-	-	-	-	-	2	3		0	-	-	-	-	-	-	-	-	-	-	-	-
533	Brown-throated (Plain) Martin		222	18	17	13	15	14	20	18	19	21	18	20	19	15		0	-	-	-	-	-	-	-	-	-	-	-	-
536	Black Saw-wing		233	18	22	25	18	15	19	13	12	16	23	28	18	18		1	-	-	-	-	-	-	-	-	-	-	1	-
538	Black Cuckooshrike		102	8	1	1	5	7	12	12	16	12	13	8	1	2		0	-	-	-	-	-	-	-	-	-	-	-	-
540	Grey Cuckooshrike		49	4	1	-	3	5	6	9	5	6	3	4	-	1		0	-	-	-	-	-	-	-	-	-	-	-	-
541	Fork-tailed Drongo		1033	82	80	82	80	78	85	83	81	84	80	82	89	81		19	3	1	2	-	1	1	1	1	-	2	3	4
542	Square-tailed Drongo		361	29	22	31	23	29	30	37	35	30	22	29	26	27		8	1	-	1	-	-	-	-	-	-	4	1	1
543	Eurasian Golden-Oriole		3	0	1	-	1	1	-	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
545	Black-headed (Eastern) Oriole		343	27	26	28	20	25	23	33	28	27	26	34	26	30		0	-	-	-	-	-	-	-	-	-	-	-	-
547	Cape (Black) Crow		20	2	1	-	-	3	4	3	2	3	2	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-

Spp Code	English	Cons Status	Occurrence														Breeding												
			n	%	J	F	M	A	M	J	J	A	S	O	N	D	n	J	F	M	A	M	J	J	A	S	O	N	D
548	Pied Crow		573	45	36	42	37	49	49	52	60	51	43	40	39	41	17	2	1	1	1	1	-	1	3	2	2	1	2
549	House Crow		142	11	13	10	13	5	8	13	6	13	13	18	14	11	2	-	-	-	-	-	-	-	-	-	1	-	1
550	White-necked Raven		124	10	6	11	5	7	7	9	10	13	12	19	15	6	1	-	-	-	-	-	-	-	-	-	1	-	-
554	Southern Black Tit		601	48	43	44	47	39	50	53	48	53	50	57	47	41	2	-	-	-	-	-	-	1	-	-	-	-	1
565	Bush Blackcap	NT	2	0	-	-	-	-	-	-	1	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
568	Dark-capped (Black-eyed) Bulbul		1171	93	96	93	92	89	94	96	93	92	93	92	89	96	30	3	3	3	-	2	1	2	1	2	2	6	5
569	Terrestrial Brownbul (Bulbul)		317	25	28	14	18	22	24	35	28	33	27	29	18	18	1	-	-	-	-	-	-	-	-	-	-	1	-
572	Sombre Greenbul (Bulbul)		656	52	50	54	45	40	55	63	56	52	52	61	44	49	4	-	-	-	2	-	-	-	-	-	1	1	-
574	Yellow-bellied Greenbul (Bulbul)		202	16	20	17	13	18	16	17	20	17	16	12	10	14	0	-	-	-	-	-	-	-	-	-	-	-	-
576	Kurrichane Thrush		336	27	13	17	26	21	29	22	27	27	36	42	33	29	2	-	-	-	-	-	-	1	-	-	-	1	-
577	Olive Thrush (pre-split)		235	19	13	13	17	15	17	22	17	29	21	23	20	15	3	-	-	-	-	-	-	-	1	1	-	1	-
578	Spotted (Natal) Ground-Thrush	EN	61	5	-	-	-	5	6	11	11	14	4	1	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
580	Groundscraper Thrush		1	0	-	-	-	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
581	Cape Rock-Thrush		43	3	4	-	1	4	6	4	3	3	6	1	5	3	2	1	-	-	1	-	-	-	-	-	-	-	-
582	Sentinel Rock-Thrush		2	0	-	-	-	-	-	-	1	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
589	Familiar Chat		34	3	3	4	1	5	5	2	2	3	1	-	5	2	0	-	-	-	-	-	-	-	-	-	-	-	-
593	Mocking Cliff-Chat		55	4	5	3	5	4	5	4	7	5	5	3	2	2	0	-	-	-	-	-	-	-	-	-	-	-	-
596	African (Common) Stonechat		184	15	6	4	5	25	25	23	24	26	10	5	1	6	0	-	-	-	-	-	-	-	-	-	-	-	-
598	Chorister Robin-Chat		25	2	-	1	-	-	4	5	5	3	1	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
600	Red-capped (Natal) Robin-Chat		639	51	46	31	40	53	58	56	52	51	51	56	52	55	7	1	-	1	-	-	-	1	-	1	-	1	2
601	Cape Robin-Chat		121	10	4	3	3	8	16	13	15	16	9	8	7	9	3	-	-	-	-	-	-	-	-	-	1	1	1
606	White-starred (Starred) Robin		11	1	-	-	-	-	1	4	2	-	3	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
613	White-browed (Red-backed) Scrub-Robin		254	20	25	11	14	18	21	19	17	22	27	24	22	22	1	1	-	-	-	-	-	-	-	-	-	-	-
616	Brown Scrub-Robin		8	1	1	-	-	-	-	1	1	1	1	2	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
619	Garden Warbler		18	1	4	4	5	-	-	-	-	-	-	1	-	4	0	-	-	-	-	-	-	-	-	-	-	-	-
625	Icterine Warbler		4	0	2	-	-	-	-	-	-	-	-	-	-	2	0	-	-	-	-	-	-	-	-	-	-	-	-
628	Great Reed-Warbler		23	2	4	7	5	2	-	-	-	-	-	-	-	6	0	-	-	-	-	-	-	-	-	-	-	-	-
631	African (African Marsh-Warbler) Reed-Warbler		26	2	5	1	1	-	2	3	3	2	2	-	1	3	0	-	-	-	-	-	-	-	-	-	-	-	-
633	Marsh (European Marsh) Warbler		20	2	5	7	6	-	-	-	-	-	-	-	-	3	0	-	-	-	-	-	-	-	-	-	-	-	-
634	Sedge Warbler		47	4	11	11	11	5	-	-	-	-	1	-	3	6	0	-	-	-	-	-	-	-	-	-	-	-	-
635	Lesser Swamp- (Cape Reed) Warbler		193	15	17	10	13	13	18	10	13	14	11	21	23	23	1	-	-	-	-	-	-	-	-	-	-	1	-
637	Dark-capped Yellow (Yellow) Warbler		31	2	-	-	1	5	4	4	6	3	2	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
638	Little Rush- (African Sedge) Warbler		237	19	25	21	14	15	18	12	13	16	20	26	25	26	0	-	-	-	-	-	-	-	-	-	-	-	-
639	Barratt's Warbler		9	1	-	1	-	-	2	2	2	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
642	Broad-tailed Warbler	NT	31	2	3	-	2	3	3	1	2	4	2	4	3	2	0	-	-	-	-	-	-	-	-	-	-	-	-
643	Willow Warbler		94	7	14	18	15	7	2	-	-	-	2	6	14	22	0	-	-	-	-	-	-	-	-	-	-	-	-
644	Yellow-throated (Woodland-) Warbler		12	1	-	-	1	-	1	1	2	1	2	1	2	1	0	-	-	-	-	-	-	-	-	-	-	-	-
645	Bar-throated Apalis		473	38	41	34	32	25	38	40	38	36	39	46	38	44	3	-	-	-	-	-	-	-	-	1	1	-	1
648	Yellow-breasted Apalis		54	4	4	1	3	3	5	6	5	5	7	5	-	6	0	-	-	-	-	-	-	-	-	-	-	-	-
657	Bleating Warbler (pre-split)		562	45	49	45	38	33	41	43	42	45	48	52	50	55	2	-	-	-	-	-	-	-	-	-	2	-	-
661	Cape Grassbird		179	14	22	15	13	6	11	11	13	16	15	12	16	22	2	1	-	-	-	-	-	-	1	-	-	-	-
664	Zitting (Fan-tailed) Cisticola		140	11	13	14	12	11	8	8	8	12	9	13	14	17	0	-	-	-	-	-	-	-	-	-	-	-	-
667	Wing-snapping (Ayre's) Cisticola		1	0	-	-	-	-	-	-	-	-	-	1	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
668	Pale-crowned Cisticola		3	0	-	-	-	-	-	-	-	-	-	-	2	1	0	-	-	-	-	-	-	-	-	-	-	-	-
670	Wailing Cisticola		2	0	-	-	-	-	1	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
672	Rattling Cisticola		215	17	28	23	13	11	12	6	6	14	16	26	24	37	0	-	-	-	-	-	-	-	-	-	-	-	-
674	Red-faced Cisticola		144	11	19	14	14	6	11	8	7	6	10	12	17	17	0	-	-	-	-	-	-	-	-	-	-	-	-
675	Blackbacked Cisticola (pre-split)		142	11	19	11	9	7	8	7	6	6	10	20	18	19	1	-	-	-	-	-	-	-	-	-	-	1	-
677	Le Vaillant's (Tinkling) Cisticola		47	4	4	4	5	4	1	3	4	5	2	5	3	5	0	-	-	-	-	-	-	-	-	-	-	-	-
678	Croaking (Striped) Cisticola		72	6	8	7	5	-	5	1	2	8	6	7	9	15	1	1	-	-	-	-	-	-	-	-	-	-	-
679	Lazy Cisticola		68	5	5	8	7	3	3	3	6	5	7	7	3	8	1	-	-	-	-	-	-	-	-	-	-	-	1
681	Neddicky (Piping Cisticola)		357	28	38	23	19	16	27	24	22	28	34	35	30	46	4	1	-	-	-	1	1	-	-	-	-	1	-
683	Tawny-flanked Prinia		669	53	63	55	44	41	51	53	50	54	48	60	63	60	15	2	1	1	-	-	-	-	-	-	5	3	3
689	Spotted Flycatcher		66	5	21	10	14	4	-	-	-	-	-	2	5	12	0	-	-	-	-	-	-	-	-	-	-	-	-
690	African Dusky Flycatcher		470	37	29	24	33	33	44	44	47	44	40	38	28	32	6	1	-	1	-	-	-	-	-	-	1	1	2
691	Ashy Flycatcher (Alseonax)		120	10	9	1	9	9	14	17	13	12	9	8	2	4	1	-	-	-	-	-	-	-	-	-	-	-	1

Spp Code	English	Cons Status	Occurrence															Breeding												
			n	%	J	F	M	A	M	J	J	A	S	O	N	D		n	J	F	M	A	M	J	J	A	S	O	N	D
694	Southern Black-Flycatcher		485	38	30	34	37	38	35	50	40	42	37	43	31	41		7	1	-	1	-	-	-	-	-	-	1	3	1
698	Fiscal Flycatcher		70	6	2	-	-	12	13	11	6	6	7	3	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
700	Cape Batis		247	20	13	8	14	15	32	32	29	22	21	20	11	6		3	-	-	-	1	-	-	-	-	-	-	2	-
701	Chinspot Batis		361	29	26	31	24	24	28	33	26	37	31	29	28	27		1	-	-	-	-	-	-	-	-	-	-	-	1
705	Black-throated (Wattle-eyed) Wattle-eye (Flycatcher)	NT	2	0	-	-	-	-	-	1	-	-	-	-	-	1		0	-	-	-	-	-	-	-	-	-	-	-	-
708	Blue-mantled Crested-Flycatcher		18	1	-	-	-	-	2	1	3	5	2	2	1	-		0	-	-	-	-	-	-	-	-	-	-	-	-
710	African Paradise-Flycatcher		634	50	62	62	58	54	34	32	32	27	61	74	61	67		18	5	1	-	-	-	-	-	-	1	3	3	5
711	African Pied Wagtail		224	18	22	14	17	18	21	18	15	12	12	18	24	24		1	-	-	-	-	1	-	-	-	-	-	-	-
712	Mountain (Long-tailed) Wagtail		185	15	21	17	17	6	8	14	17	10	15	27	11	13		3	2	-	-	-	-	-	-	-	-	-	-	1
713	Cape Wagtail		445	35	38	35	34	35	44	29	36	32	33	35	38	35		1	-	-	-	-	-	-	-	-	1	-	-	-
716	African (Grassveld/Grassland) Pipit		120	10	13	13	9	7	9	9	7	12	9	9	13	6		0	-	-	-	-	-	-	-	-	-	-	-	-
720	Striped Pipit		18	1	1	-	1	2	3	2	-	2	1	2	2	2		0	-	-	-	-	-	-	-	-	-	-	-	-
727	Cape (Orange-throated) Longclaw		3	0	1	-	-	-	-	1	-	1	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
728	Yellow-throated Longclaw		277	22	25	25	13	22	23	25	21	23	20	19	19	29		2	-	-	-	-	-	-	-	-	1	1	-	-
732	Common Fiscal		780	62	59	63	61	67	67	63	60	59	54	59	66	66		12	1	-	-	1	1	-	-	2	1	1	3	2
733	Red-backed Shrike		14	1	4	3	1	1	-	-	-	-	-	-	1	5		0	-	-	-	-	-	-	-	-	-	-	-	-
736	Southern Boubou		495	39	39	30	30	29	40	41	40	44	51	42	36	46		1	1	-	-	-	-	-	-	-	-	-	-	-
740	Black-backed (Southern) Puffback		387	31	28	23	30	18	36	38	29	32	33	39	26	33		0	-	-	-	-	-	-	-	-	-	-	-	-
741	Brubru		5	0	-	1	-	1	-	1	1	-	-	1	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
742	Southern Tchagra		155	12	19	10	14	3	8	8	7	14	15	21	14	19		0	-	-	-	-	-	-	-	-	-	-	-	-
744	Black-crowned Tchagra		33	3	4	3	1	3	3	3	-	3	4	1	1	6		0	-	-	-	-	-	-	-	-	-	-	-	-
746	Bokmakierie		5	0	-	3	-	1	-	-	-	1	-	1	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
747	Gorgeous Bush-Shrike		59	5	7	1	3	3	4	3	2	3	7	9	6	9		1	-	-	-	-	-	-	-	-	-	-	1	-
748	Orange-breasted Bush-Shrike		130	10	6	6	8	4	8	4	10	16	15	14	19	17		0	-	-	-	-	-	-	-	-	-	-	-	-
750	Olive Bush-Shrike		24	2	2	-	3	-	1	2	2	3	5	1	2	1		0	-	-	-	-	-	-	-	-	-	-	-	-
751	Grey-headed Bush-Shrike		92	7	4	7	11	7	5	4	7	6	11	10	11	4		0	-	-	-	-	-	-	-	-	-	-	-	-
753	White-crested Helmet-Shrike		1	0	-	-	-	-	-	-	-	-	-	-	1	-		0	-	-	-	-	-	-	-	-	-	-	-	-
757	Common (European) Starling		3	0	-	-	-	-	-	1	1	-	-	-	-	1		0	-	-	-	-	-	-	-	-	-	-	-	-
758	Common Myna		1044	83	91	87	78	79	73	83	79	84	78	88	89	91		67	8	5	5	3	2	-	3	4	7	10	11	9
760	Wattled Starling		11	1	-	-	-	3	2	2	2	-	-	1	1	-		0	-	-	-	-	-	-	-	-	-	-	-	-
761	Violet-backed (Plum-coloured, Amethyst) Starling		44	3	9	-	2	3	2	-	1	-	1	2	8	17		1	-	-	-	-	-	-	-	-	-	-	-	1
764	Cape Glossy (Glossy) Starling		226	18	18	14	10	16	18	23	16	21	18	24	19	18		0	-	-	-	-	-	-	-	-	-	-	-	-
768	Black-bellied Starling		194	15	13	17	6	13	17	13	13	21	20	16	15	23		0	-	-	-	-	-	-	-	-	-	-	-	-
769	Red-winged Starling		516	41	38	48	40	39	40	41	42	41	38	46	47	33		6	-	1	-	-	-	-	-	-	2	-	2	1
774	Gurney's Sugarbird		1	0	-	-	1	-	-	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
775	Malachite Sunbird		7	1	-	-	-	3	2	-	1	1	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
780	Purple-banded Sunbird		5	0	-	1	1	2	1	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
783	Southern Double-collared Sunbird		27	2	3	1	2	2	3	2	2	4	1	-	1	4		0	-	-	-	-	-	-	-	-	-	-	-	-
785	Greater Double-collared Sunbird		62	5	2	4	3	6	3	8	6	6	5	4	6	4		2	-	1	-	-	-	-	-	1	-	-	-	-
787	White-bellied (breasted) Sunbird		594	47	38	35	36	33	51	48	56	60	53	55	50	43		9	1	-	-	-	-	-	1	-	2	1	1	3
789	Grey (Mouse-coloured) Sunbird		202	16	12	13	12	11	20	23	20	16	20	16	14	13		5	-	1	-	-	-	-	-	1	2	1	-	-
790	Olive Sunbird		483	38	35	42	33	30	35	46	34	46	46	46	32	37		5	-	-	-	-	-	-	-	-	2	1	1	1
791	Scarlet-chested Sunbird		33	3	2	3	3	4	4	3	5	3	-	2	2	1		0	-	-	-	-	-	-	-	-	-	-	-	-
792	Amethyst (Black) Sunbird		658	52	51	62	45	47	53	63	52	61	50	48	51	42		17	2	1	-	1	-	-	-	4	1	3	2	3
793	Collared Sunbird		440	35	30	27	31	34	43	43	38	35	40	38	25	27		8	1	-	-	-	-	-	-	1	1	2	2	1
796	Cape White-eye (pre-split)		1012	80	79	80	77	73	78	81	82	84	83	86	81	82		16	2	2	-	1	2	-	1	1	1	4	1	1
801	House Sparrow		665	53	51	48	53	51	55	44	49	53	45	60	65	63		45	4	1	1	2	3	-	5	4	5	8	5	7
803	Cape Sparrow		14	1	2	1	1	-	2	1	2	-	2	-	2	-		0	-	-	-	-	-	-	-	-	-	-	-	-
804	Greyheaded Sparrow (pre-split)		38	3	4	-	4	2	3	3	4	4	2	3	6	1		0	-	-	-	-	-	-	-	-	-	-	-	-
805	Yellow-throated Petronia (Sparrow)		16	1	-	-	-	-	1	1	2	3	1	3	1	3		0	-	-	-	-	-	-	-	-	-	-	-	-
807	Thick-billed (Grosbeak) Weaver		531	42	52	37	39	36	42	47	40	41	32	53	44	44		32	7	3	1	-	-	-	1	3	1	7	3	6
808	Dark-backed (Forest) Weaver		178	14	10	11	10	8	18	21	15	15	15	16	15	13		11	-	-	-	-	-	-	-	-	1	7	3	-
810	Spectacled Weaver		718	57	53	52	52	55	62	61	56	60	60	63	56	52		40	4	-	-	-	1	-	1	5	7	14	3	5
811	Village (Spotted-backed) Weaver		688	55	68	45	46	39	44	41	57	63	58	66	70	61		112	13	8	3	1	4	2	9	13	15	22	12	10
813	Cape Weaver		110	9	12	7	4	2	4	7	9	10	9	10	17	17		13	-	-	-	-	-	-	-	3	2	3	3	2
814	Southern Masked-Weaver		49	4	7	7	2	2	2	4	5	3	4	2	7	4		14	2	2	-	1	-	-	1	1	2	1	2	2

Spp Code	English	Cons Status	Occurrence n	Occurrence %	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
816	Golden-Weaver		13	1	-	-	-	1	1	3	-	1	1	2	1	2	0	-	-	-	-	-	-	-	-	-	-	-	-
817	Yellow (African Golden) Weaver		234	19	31	24	14	11	7	5	6	20	24	32	32	29	26	2	2	-	-	-	-	1	3	7	7	2	2
818	Southern Brown-throated Weaver		18	1	3	-	-	1	-	-	-	3	-	3	5	3	1	-	-	-	-	-	-	-	-	-	1	-	-
821	Red-billed Quelea		2	0	-	-	1	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
822	Red-headed Quelea		2	0	-	-	1	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
824	Southern Red (Red) Bishop		274	22	41	32	23	18	14	9	9	10	10	27	43	39	12	4	1	-	-	-	-	-	-	-	1	3	3
828	Fan-tailed (Red-shouldered) Widowbird		368	29	46	38	21	20	19	20	21	24	29	36	40	47	3	2	1	-	-	-	-	-	-	-	-	-	-
829	White-winged Widowbird		2	0	-	-	-	-	-	-	-	-	-	2	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
831	Red-collared Widowbird		122	10	18	18	11	4	4	2	2	2	7	21	17	23	3	-	1	2	-	-	-	-	-	-	-	-	-
832	Long-tailed Widowbird		4	0	1	-	-	-	-	-	-	1	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
835	Green Twinspot		26	2	2	-	1	1	2	3	4	4	4	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
840	African (Blue-billed) Firefinch		236	19	21	17	23	15	24	28	17	14	15	21	11	16	1	-	-	-	-	-	-	-	-	-	-	1	-
844	Blue Waxbill		12	1	3	1	1	1	3	-	-	1	-	1	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
846	Common Waxbill		358	28	38	37	30	31	29	23	17	22	21	29	33	41	0	-	-	-	-	-	-	-	-	-	-	-	-
848	Grey (Black-tailed) Waxbill		72	6	4	4	3	4	5	13	9	8	3	7	5	2	2	1	-	-	-	-	-	-	-	-	-	-	1
850	Swee (Black-faced) Waxbill (Swee)		39	3	3	6	1	3	4	4	1	3	4	4	5	2	0	-	-	-	-	-	-	-	-	-	-	-	-
854	Orange-breasted (Zebra) Waxbill		18	1	2	-	1	3	1	2	2	-	-	2	3	1	0	-	-	-	-	-	-	-	-	-	-	-	-
857	Bronze Mannikin		912	72	62	73	74	75	82	79	74	74	63	72	73	66	41	5	3	3	5	2	2	3	3	4	5	2	4
858	Red-backed Mannikin		110	9	7	10	9	11	8	9	9	8	11	7	10	6	2	1	-	-	-	-	-	-	-	-	-	1	-
860	Pin-tailed Whydah		279	22	37	34	28	14	8	11	6	14	25	34	30	42	15	1	1	2	1	-	-	-	-	2	-	5	3
864	Dusky Indigobird		34	3	9	3	7	3	-	-	-	1	-	-	6	6	1	-	-	1	-	-	-	-	-	-	-	-	-
867	Village Indigobird		1	0	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-
869	Yellow-fronted (eyed) Canary		869	69	77	73	69	65	65	63	65	64	64	77	74	77	6	-	-	-	1	-	-	1	-	-	1	2	1
872	Cape (Yellow-crowned) Canary		86	7	1	-	1	-	4	12	13	14	14	10	5	3	0	-	-	-	-	-	-	-	-	-	-	-	-
873	Forest Canary		14	1	2	-	-	2	1	-	2	2	1	2	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
877	Brimstone (Bully) Canary		223	18	20	14	14	17	13	17	22	22	26	20	13	12	0	-	-	-	-	-	-	-	-	-	-	-	-
881	Streaky-headed Seedeater (Canary)		210	17	13	14	14	14	15	16	17	20	20	22	18	18	0	-	-	-	-	-	-	-	-	-	-	-	-
884	Golden-breasted Bunting		27	2	1	-	-	3	6	4	2	3	1	2	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
888	Yellow-billed Kite		402	32	54	65	37	5	-	-	6	51	53	51	44	47	14	1	-	1	-	-	-	-	2	4	4	1	1
889	Black Kite		22	2	3	4	2	-	-	-	-	-	-	6	2	6	0	-	-	-	-	-	-	-	-	-	-	-	-

Tongaat Hulett DEVELOPMENTS

SiVEST

TONGAAT HULETT DEVELOPMENTS (PTY) (LTD)

Proposed Shongweni Bulk Water Pipeline: Faunal Assessment

Faunal Assessment Report

Project No: **12365**
Revision No: **1**
Date: **Oct2013**

Date:	18 October 2013
Document Title:	**Proposed Shongweni Bulk Water Pipeline: Faunal Assessment**
Author:	Stephen Burton (*M.Sc. Zoology*)
Signature:	
Revision Number:	# 1.0
Checked by:	Kurt Barichievy (Pr.Sci.Nat.)
Approved:	Kurt Barichievy (Pr.Sci.Nat.)
Signature:	
For:	TONGAAT HULETT DEVELOPMENTS (PTY) (LTD)

Declaration

I, **Stephen Leslie Burton**, declare that I –

- act as an independent specialist consultant in the field of Ecology and Zoology and have undertaken the **Faunal Assessment** for the corridor identified for assessment for the proposed development known as **Shongweni Bulk Water Pipeline,** in the **Ethekwini Municipality**;
- do not have and will not have any financial interest in the undertaking of the activity, other than remuneration for work performed in terms of the Environmental Impact Assessment Regulations, 2010;
- have and will not have any vested interest in the proposed activity proceeding;
- have no, and will not engage in, conflicting interests in the undertaking of the activity;
- undertake to disclose, to the competent authority, any material information that have or may have the potential to influence the decision of the competent authority or the objectivity of any report, plan or document required in terms of the Environmental Impact Assessment Regulations, 2010; and
- will provide the competent authority with access to all information at our disposal regarding the application, whether such information is favourable to the applicant or not.

TONGAAT HULETT DEVELOPMENTS (PTY) (LTD)

PROPOSED SHONGWENI BULK WATER PIPELINE

FAUNAL ASSESSMENT REPORT

APPENDIX 1: LOCALITY MAP
APPENDIX 2: AERIAL MAP
APPENDIX 3: SABAP SUMMARIES OF SPECIES THAT HAVE BEEN RECORDED IN THE AREA

TONGAAT HULETT DEVELOPMENTS (PTY) (LTD)

PROPOSED SHONGWENI BULK WATER PIPELINE

FAUNAL ASSESSMENT REPORT

1. INTRODUCTION&BACKGROUND

SiVEST Environmental Division was requested by **Tongaat Hulett Developments (THD**)to undertake a detailed vegetation and faunal assessment of the proposed bulk water pipeline route. From the above mentioned assessment, inferences can be made regarding the overarching ecological value of corridor which has been identified to potentially accept the proposed Shongweni Bulk Water Pipeline.

2. TERMS OF REFERENCE

The following Terms of Reference were provided by THD regarding the requirements of the assessments.

- Undertake a vegetation and faunal assessment of the corridor proposed for the Shongweni Bulk Water Pipeline (Locality Map attached at **Appendix 1**).

Further to the Terms of Reference supplied by THD, the following protocol was extracted from the National Environmental Management Act, Act 108 of 1998. The relevant Section is Section 32 and is included below for your ease of reference.

Specialist reports and reports on specialised processes
32.
(1) An applicant or the EAP managing an application may appoint a person who is independent to carry out a specialist study or specialised process.
(2) /the Person referred to in sub-regulation (1) must comply with the requirements of Regulation 17.
(3) A specialist report or a report on a specialised process prepared in terms of these Regulations must contain –
(a) details of –
(i) the person who prepared the report; and
(ii) the expertise of that person to carry out the specialist study or specialised process;
(b) a declaration that the person is independent in a form as may be specified by the competent authority;
(c) an indication of the scope of, and the purpose for which, the report was prepared;
(d) a description of the methodology adopted in preparing the report or carrying out the specialised process;
(e) a description of any assumptions made and any uncertainties or gaps in knowledge;
(f) a description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment;
(g) recommendations in respect of any mitigation measures that should be considered by the applicant and the competent authority;
(h) a description of any consultation process that was undertaken during the course of carrying out the study;
(i) a summary and copies of any comments that were received during any consultation process; and
(j) any other information requested by the competent authority.

3. LOCAL SETTING

The majority of thecorridor is dominated by cultivation (sugar cane), with only small remnant patches of indigenous vegetation persisting in isolated fragments. The corridor is represented in the Aerial Map attached at **Appendix 2**.

Due to the strong correlation between vegetation and faunal assemblages, this report should be read in conjunction with the vegetation assessment for the corridor.

4. METHODOLOGY

A site walkover was conducted on the 14th of October 2013, during which indigenous vegetation units were sampled for evidence of terrestrial faunal species. The large areas of sugarcane are depauperate in faunal species, and were assessed in a cursory manner. Bird species that could potentially occur on site were assessed through the South African Bird Atlas Project (SABAP) database of previously recorded species for the area.

5. FAUNA ON SITE

5.1 Predicted Important Species by Ezemvelo KZN Wildlife

Ezemvelo KZN Wildlife's C-Plan database predicts that the following species of conservation significance may occur on the site, and that the site is considered totally irreplaceable.

- *Doratogonus rubipodus* (Ruby-legged Black Millipede) - This millipede is known from a restricted distribution within the Giba Gorge (McIntosh Falls), and an area of forest in Eston. It is unlikely to occur on any of the sites due to the transformation that has occurred historically.

- *Cochlitoma semidecussata* (Mollusc) - This species may occur on the site, but its preferred habitat is coastal lowland and scarp forest, and is most likely to occur off of the sites in the Giba Gorge Complex of secondary and primary scarp forest.

- *Bradypodion melanocephalum* (Black-headed Dwarf Chameleon) - This species may occur on the site, and prefers ecotones between thickets and more open areas for hunting. This species prefers tall grasslands for hunting, and is will not occur in short, or regularly burnt, grasslands.

After having undertaken a site visit, and having undertaken focused active searches for the species listed above,it is concluded that the species listed above do not occur within the majority of the proposed development sites. The only areas of concern are the alien infested woody vegetation (see Appendix 1B of Vegetation Report), as these areas may be occupied by *Bradypodion melanocephalum*, as it provides the ideal mix of tall grasses, and woody vegetation that this species prefers. This area is however highly infested with alien plant species.

5.2 Other Faunal Species noted within the Study Area

It was noted during the site visit that there is evidence of antelope species within the sugarcane fields across the site (See **Figure 1&2** below). These antelope species are most likely Common Duiker (*Sylvicapra grimmia*), and Bushbuck (*Tragelaphus scriptus*). There is also evidence of Vervet Monkeys (*Cercopithecus pygerythrus*) on the site. No raptor nests were identified on any of the sites, and this is due to the lack of appropriate nesting trees on all three sites.

Figure 1: Grey Duiker dung pile noted.

Figure 2: Bushbuck dung pile noted on Site 3.

5.3 Threatened Birds

Appendix 3 lists all the birds that have been recorded in the area surrounding the corridor.While many of these bird species are listed as near threatened, vulnerable or endangered, only a few of these conservation significant species are likely to make use of the corridor. The variousstork species may make use of the various vegetation units alongthe corridor for foraging, but most of these species are unlikely to occur, as they are normally associated with wetland areas, and large freshwater bodies. The various eagle species are also likely to hunt over the corridor, but are unlikely to make use of the corridor for nesting and breeding, due to a lack of large appropriate trees. Various otherspecies may occur along the corridor, such as the Blue Crane (*Anthropoides paradiseus*) and the Grey Crowned Crane (*Balearica regulorum*), but are unlikely to use the corridor extensively due to the level of disturbance that has historically occurred there. The Spotted Ground-thrush (*Zoothera guttata*) may occur within the forest fragments (Giba Gorge Complex) to the east of the corridor.The Broad-tailed Warbler (*Schoenicola brevirostris*) may occur along the corridor, and is closely associated with wet areas, and rank grass, and therefore is most likely to occur in the wetland systems that are traversedby the proposed pipeline. The Bush Blackcap (*Lioptilus nigricapillus*), is unlikely to occur along the proposed pipeline corridor due to its predilection for Montane Forest, but may use the forests to the East of the area during the winter months.

6. RECOMMENDATIONS

From a faunal perspective, the proposed pipeline corridor is degraded and currently of low conservation value. The fauna of the corridor is directly dependent on the vegetation units of the corridor, and the restoration, and careful management of these vegetation units will benefit the fauna of the area. Therefore, the followingis recommended:

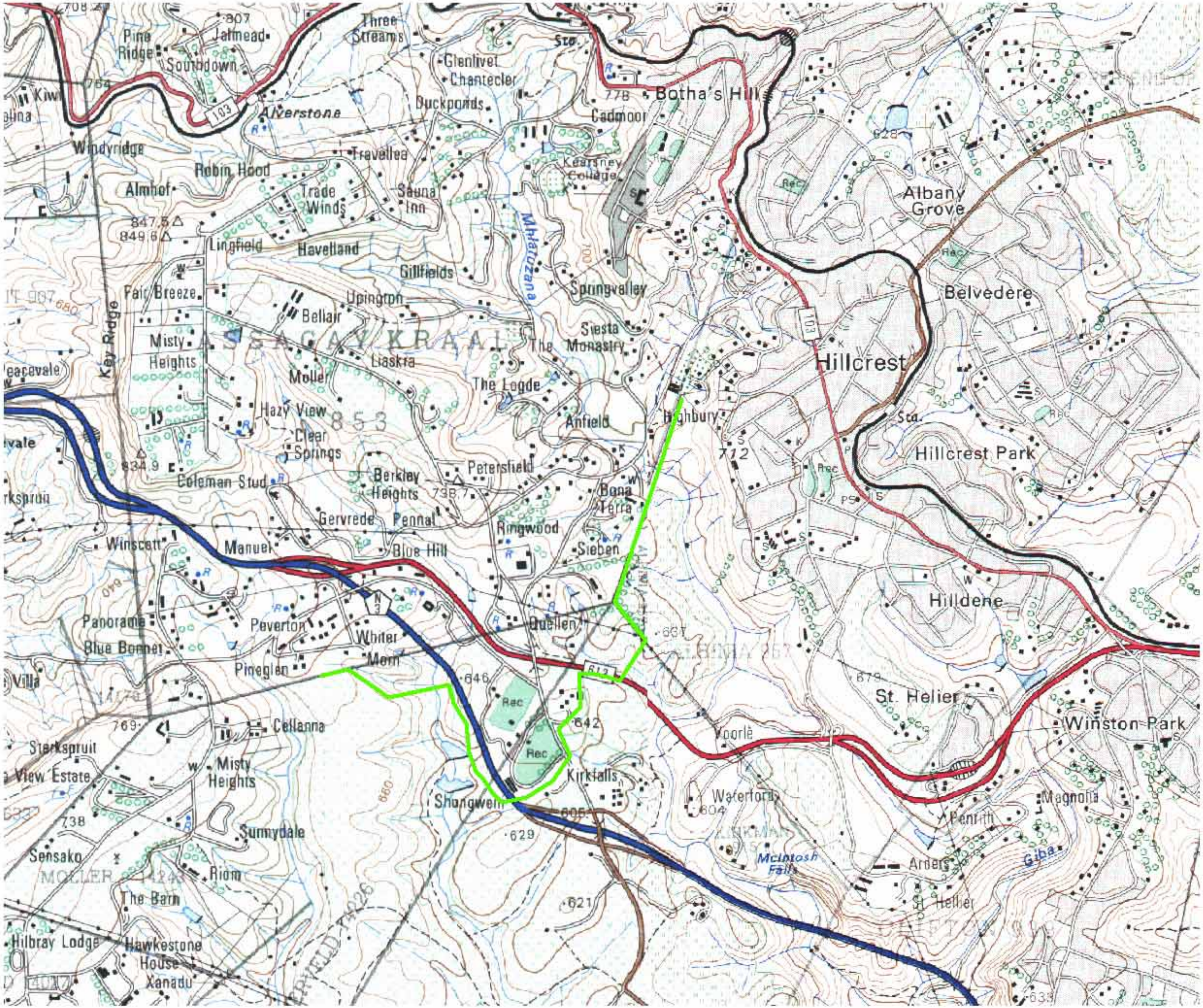
- ✓ Alien clearing must be undertaken within the entire development corridor;
- ✓ The proposed pipeline route should be realigned to avoid the remnant sandstone sourveld grasslandarea;
- ✓ Should it be found that Black-headed Dwarf Chameleon are present, any specimens of the Black-headed Dwarf Chameleon need to be removed carefully before clearing of any area for construction, and relocated to an identified release site. The release site should be identified in consultation with Ezemvelo KZN Wildlife and eThekwini Environmental Management Division.

7. CONCLUSIONS

The majority of the proposed bulk water pipeline corridor is currently cultivated and the areas that are not cultivated have also been negatively impacted by woodcutting and alien invasive infestations. A large number of alien plant species have invaded the corridor and the area has therefore been further degraded.

The proposed development would in all probability add value to the land and provide much needed funding for the improvement of the conservation significance of the sites. However, the conservation worthy areas of the sites need to be avoided, specifically the remnant sandstone sourveld grassland.

Appendix 1



SHONGWENI BULK WATER PIPELINE ECOLOGICAL ASSESSMENT

LOCALITY MAP
1: 25 000

Legend

Proposed Bulk Water Pipeline Route

SOURCE: Chief Directorate of Survey & Mapping

N

0 0.2 0.4
Kilometers

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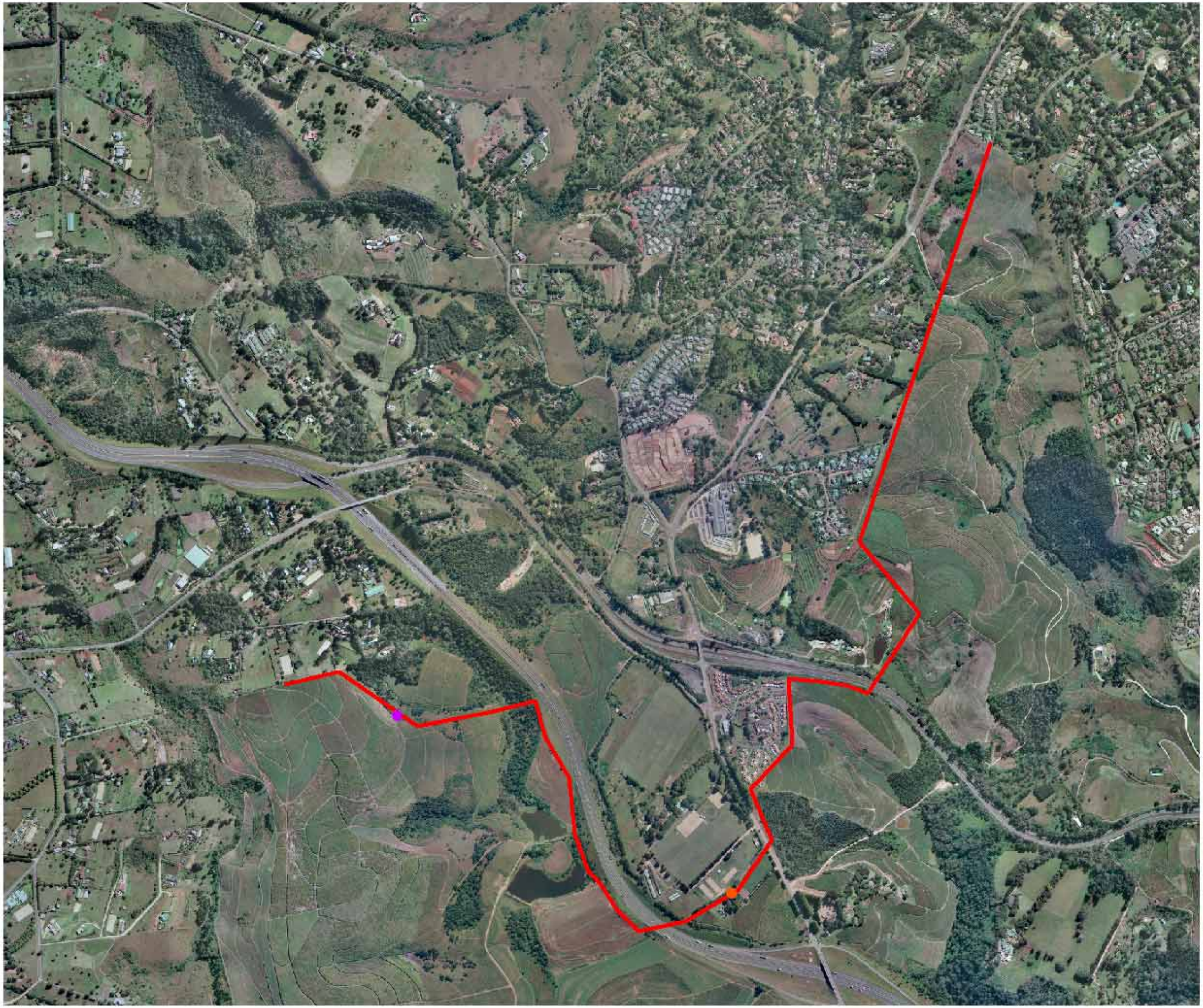
Project No	Map Ref No	Prepared By	Date
12365	12365/01	SLB	18/10/2013

THIS MAP HAS BEEN PREPARED UNDER THE CONTROLS ESTABLISHED BY THE SIVEST QUALITY MANAGEMENT SYSTEM AND MEETS THE REQUIREMENTS OF THE SETA QUALITY GRADING SYSTEM THAT IS ISO COMPLIANT

Appendix 2



SHONGWENI BULK WATER PIPELINE ECOLOGICAL ASSESSMENT

AERIAL VIEW

Legend

Proposed Shongweni Bulk Water Pipeline Route

SOURCE: Chief Directorate of Survey & Mapping

N

0 0.1 0.2 Kilometers

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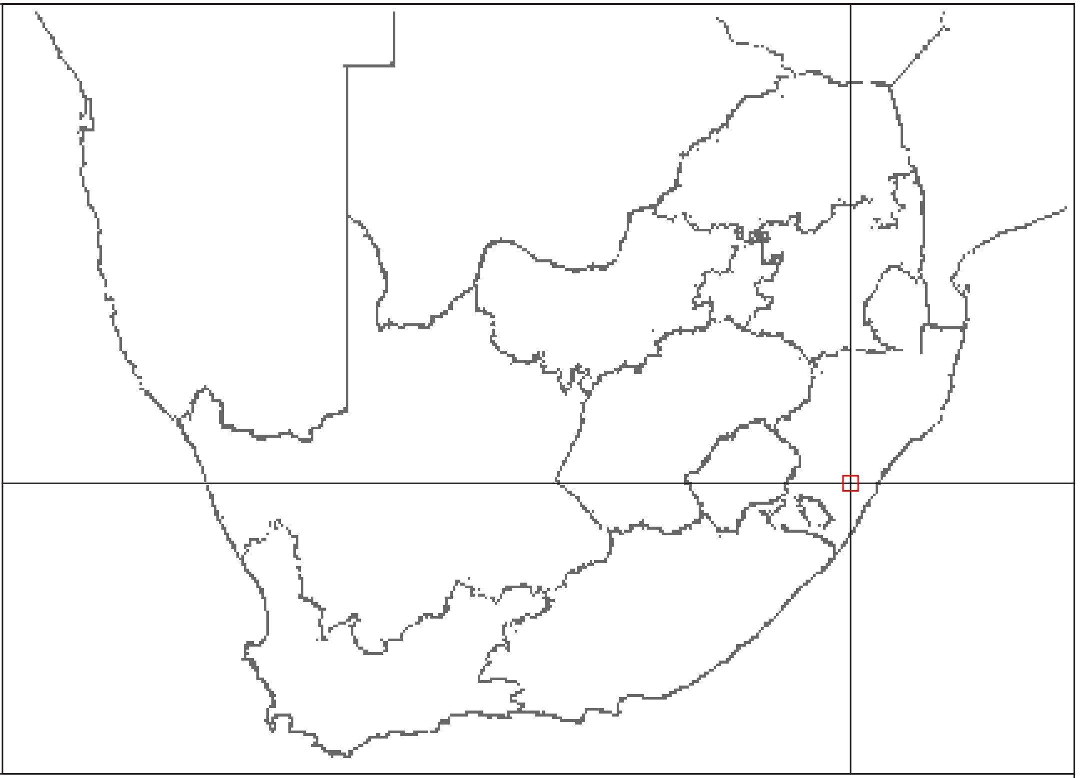
Project No	Map Ref No	Prepared By	Date
12365	12365/02	SLB	18/10/2013

Appendix 3

SABAP SUMMARIES OF SPECIES THAT HAVE BEEN RECORDED IN THE AREA

Southern African

Bird Atlas Project



Occurrence:
n indicates the total number of cards on which the species was recorded. We also give this as a percentage (%) of the total cards for the site. The monthly breakdown shows the number of times the species was reported, as a percentage of the total cards for the month (ie: reporting rate).

Breeding:
n represents the number of cards on which confirmed breeding activity was reported. The monthly breakdown is the number of times the species was recorded breeding.

Site summary for:

Site Name: HAMMARSDALE (2930DC)
Province: KwaZulu-Natal

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Total cards per month	**9**	**7**	**11**	**11**	**6**	**16**	**16**	**12**	**9**	**8**	**5**	**12**	**122**
Total number species	**197**	**185**	**192**	**181**	**139**	**167**	**183**	**181**	**153**	**140**	**141**	**188**	**286**
Total number species breeding	**8**	**7**	**7**	**5**	**3**	**3**	**5**	**6**	**3**	**8**	**9**	**15**	**47**

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
8	Little Grebe (Dabchick)		31	25	44	57	36	9	17	13	44	33	11	13	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
55	White-breasted (Great) Cormorant		57	47	44	43	82	45	17	6	56	58	67	63	40	42	0	-	-	-	-	-	-	-	-	-	-	-	-
58	Reed (Long-tailed) Cormorant		36	30	56	14	9	-	17	31	31	42	56	38	20	33	0	-	-	-	-	-	-	-	-	-	-	-	-
60	African Darter		49	40	44	43	36	45	50	44	63	33	44	25	20	17	0	-	-	-	-	-	-	-	-	-	-	-	-
62	Grey Heron		47	39	67	57	36	55	33	38	44	25	33	38	20	17	1	-	-	-	-	-	-	-	-	-	1	-	-
63	Black-headed Heron		32	26	44	57	36	36	-	19	19	25	11	25	40	17	0	-	-	-	-	-	-	-	-	-	-	-	-
64	Goliath Heron		1	1	11	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
65	Purple Heron		5	4	11	-	9	-	-	6	13	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
66	Great Egret		6	5	11	29	-	-	-	6	-	8	11	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
67	Little Egret		10	8	11	14	9	-	-	-	25	8	-	13	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
68	Yellow-billed (Intermediate) Egret		3	2	11	-	9	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
71	Cattle Egret		41	34	22	29	45	36	33	38	44	50	44	25	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
72	Squacco Heron		1	1	11	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
74	Green-backed (Striated) Heron		14	11	22	14	9	9	-	6	25	17	11	-	20	-	0	-	-	-	-	-	-	-	-	-	-	-	-
76	Black-crowned Night-Heron		2	2	11	-	-	-	-	-	-	-	-	13	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
78	Little Bittern		2	2	11	-	-	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
81	Hamerkop		82	67	89	57	91	64	33	50	75	67	89	63	40	67	1	-	1	-	-	-	-	-	-	-	-	-	-
83	White Stork		2	2	11	14	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
84	Black Stork	NT	41	34	-	29	9	9	17	56	38	58	67	38	20	33	11	-	-	-	-	1	2	1	2	1	2	1	1
91	African Sacred (Sacred) Ibis		17	14	22	-	18	9	-	13	25	25	11	-	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
94	Hadeda Ibis		109	89	67	86	100	100	83	81	100	92	89	88	80	92	4	1	-	-	-	-	-	-	1	1	-	-	1
95	African Spoonbill		9	7	11	-	9	-	-	6	6	17	-	-	-	25	0	-	-	-	-	-	-	-	-	-	-	-	-
99	White-faced (Whistling-) Duck		16	13	33	14	27	18	-	13	6	8	-	-	-	25	0	-	-	-	-	-	-	-	-	-	-	-	-
100	Fulvous (Whistling) Duck		1	1	-	-	-	-	17	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
101	White-backed Duck		4	3	22	14	-	-	-	-	-	8	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
102	Egyptian Goose		71	58	56	43	82	36	50	69	81	42	56	63	60	42	3	1	1	-	-	-	-	-	-	-	1	-	-
104	Yellow-billed Duck		49	40	78	43	64	45	-	38	31	33	22	50	40	33	2	-	-	-	-	-	1	1	-	-	-	-	-
105	African Black Duck		37	30	44	14	27	18	17	19	31	25	56	50	40	33	0	-	-	-	-	-	-	-	-	-	-	-	-
106	Cape Teal		3	2	11	-	9	-	-	6	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
107	Hottentot Teal		1	1	-	-	-	-	-	-	-	8	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
108	Red-billed Teal (Duck)		3	2	11	14	9	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
112	Cape Shoveler		2	2	-	-	-	-	-	-	6	8	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
113	Southern Pochard		3	2	11	14	-	-	17	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
114	African Pygmy-Goose	NT	1	1	11	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
116	Spur-winged Goose		25	20	33	29	18	-	-	19	63	25	11	-	-	8	1	-	-	1	-	-	-	-	-	-	-	-	-
126	Black & Yellowbilled Kite (pre-split)		10	8	11	43	9	-	-	-	-	-	22	38	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
127	Black-shouldered (Winged) Kite		13	11	22	-	27	9	-	13	13	17	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
128	African Cuckoo Hawk		2	2	-	-	18	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
131	Verreaux's (Black) Eagle		3	2	-	-	-	-	17	-	-	17	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
135	Wahlberg's Eagle		6	5	11	-	9	9	17	-	-	-	-	-	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
139	Long-crested Eagle		11	9	11	14	-	18	33	13	13	8	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	-	-
140	Martial Eagle	VU	3	2	-	-	9	-	-	-	-	8	11	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
141	African Crowned (Crowned) Eagle	NT	24	20	11	43	27	27	17	6	25	17	11	13	-	33	2	-	-	-	1	-	-	-	-	-	1	-	-
142	Brown Snake-Eagle		3	2	11	-	9	9	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
148	African Fish-Eagle		70	57	33	71	73	27	50	75	50	67	56	63	60	58	3	-	-	-	-	1	-	-	-	-	1	-	1

Spp Code	English	Cons Status	Occurrence														Breeding												
			n	%	J	F	M	A	M	J	J	A	S	O	N	D		n	J	F	M	A	M	J	J	A	S	O	N	D
149	Steppe (Common) Buzzard		30	25	67	57	45	18	-	-	-	-	-	25	60	67		0	-	-	-	-	-	-	-	-	-	-	-	-
152	Jackal Buzzard		10	8	11	-	9	18	17	6	13	8	-	-	-	8		0	-	-	-	-	-	-	-	-	-	-	-	-
157	Little Sparrowhawk		6	5	11	-	-	9	-	-	13	8	-	-	-	8		0	-	-	-	-	-	-	-	-	-	-	-	-
158	Black Sparrowhawk (Goshawk)		13	11	11	-	27	9	17	-	19	17	11	-	-	8		0	-	-	-	-	-	-	-	-	-	-	-	-
160	African Goshawk (incl. Red-chested)		15	12	11	-	18	9	33	13	13	8	-	-	20	25		0	-	-	-	-	-	-	-	-	-	-	-	-
161	Gabar Goshawk		1	1	-	-	-	-	-	-	6	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
165	African Marsh-Harrier	VU	8	7	22	14	9	-	-	6	6	17	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
169	African Harrier-Hawk (Gymnogene)		20	16	22	14	18	9	-	19	-	17	22	38	20	25		1	-	-	-	-	-	-	-	-	-	-	-	1
170	Osprey		2	2	-	14	-	-	-	-	6	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
172	Lanner Falcon	NT	37	30	22	29	36	18	50	19	31	50	33	63	20	8		1	-	-	-	-	-	-	-	-	-	1	-	-
181	Rock Kestrel		11	9	-	-	9	9	33	19	13	8	-	-	20	-		0	-	-	-	-	-	-	-	-	-	-	-	-
191	Shelley's Francolin		8	7	22	14	9	-	-	6	6	8	-	-	-	8		0	-	-	-	-	-	-	-	-	-	-	-	-
192	Red-winged Francolin		2	2	-	-	-	-	17	6	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
196	Natal Spurfowl (Francolin)		39	32	44	57	45	27	33	19	25	33	33	13	20	42		0	-	-	-	-	-	-	-	-	-	-	-	-
200	Common Quail		7	6	22	14	-	9	17	-	6	8	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
203	Helmeted Guineafowl		24	20	22	14	18	18	33	19	19	25	11	-	60	17		1	-	-	-	1	-	-	-	-	-	-	-	-
208	Blue Crane	VU	3	2	-	-	-	-	-	-	6	8	11	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
209	Grey Crowned- (Crowned) Crane	VU	5	4	11	-	9	-	-	6	6	8	-	-	-	-		1	-	-	1	-	-	-	-	-	-	-	-	-
213	Black Crake		9	7	22	14	9	-	-	6	19	8	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
217	Red-chested Flufftail		1	1	11	-	-	-	-	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
218	Buff-spotted Flufftail		4	3	11	-	-	-	-	-	-	-	-	-	20	17		0	-	-	-	-	-	-	-	-	-	-	-	-
223	African Purple (Purple) Swamphen (Gallinule)		3	2	11	14	9	-	-	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
226	Common Moorhen		13	11	33	14	9	9	-	6	13	17	-	13	-	8		0	-	-	-	-	-	-	-	-	-	-	-	-
228	Red-knobbed Coot		19	16	33	29	36	18	-	6	13	25	-	-	-	17		1	-	-	-	-	-	-	-	1	-	-	-	-
240	African Jacana		10	8	22	-	9	-	-	19	13	17	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
242	Greater Painted-snipe	NT	1	1	-	-	-	-	-	-	6	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
245	Common Ringed Plover		1	1	-	-	9	-	-	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
248	Kittlitz's Plover		1	1	-	-	-	9	-	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
249	Three-banded Plover		25	20	56	29	36	18	17	6	25	8	22	-	20	17		0	-	-	-	-	-	-	-	-	-	-	-	-
255	Crowned Lapwing (Plover)		3	2	-	-	-	9	-	-	6	8	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
257	Black-winged Lapwing (Plover)	NT	1	1	-	-	-	9	-	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
258	Blacksmith Lapwing (Plover)		23	19	22	29	55	18	-	19	25	25	11	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
264	Common Sandpiper		30	25	44	57	45	9	-	-	-	8	56	63	40	25		0	-	-	-	-	-	-	-	-	-	-	-	-
266	Wood Sandpiper		9	7	22	14	18	9	-	-	-	8	-	-	-	17		0	-	-	-	-	-	-	-	-	-	-	-	-
269	Marsh Sandpiper		3	2	22	-	-	-	-	-	-	-	-	-	-	8		0	-	-	-	-	-	-	-	-	-	-	-	-
270	Common Greenshank		7	6	22	14	-	-	-	-	6	-	-	13	20	8		0	-	-	-	-	-	-	-	-	-	-	-	-
272	Curlew Sandpiper		2	2	-	-	18	-	-	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
284	Ruff		1	1	-	-	9	-	-	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
297	Spotted Thick-knee (Dikkop)		3	2	-	-	-	-	-	6	6	8	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
298	Water Thick-knee (Dikkop)		33	27	11	29	36	27	-	-	19	33	44	50	80	33		0	-	-	-	-	-	-	-	-	-	-	-	-
303	Bronze-winged Courser		1	1	-	-	-	-	-	-	6	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
338	Whiskered Tern		1	1	11	-	-	-	-	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
348	Rock (Feral) Dove (Pigeon)		5	4	-	14	-	9	17	-	-	-	-	-	40	-		0	-	-	-	-	-	-	-	-	-	-	-	-
349	Speckled (Rock) Pigeon		50	41	33	29	9	55	17	50	56	67	44	50	20	25		1	-	-	-	-	-	-	1	-	-	-	-	-
350	African Olive- (Rameron) Pigeon		5	4	-	-	-	18	17	-	6	-	-	-	-	8		1	-	-	-	1	-	-	-	-	-	-	-	-
352	Red-eyed Dove		94	77	67	86	91	45	67	81	94	83	67	88	60	75		1	1	-	-	-	-	-	-	-	-	-	-	-
354	Cape Turtle (Ring-necked) Dove		41	34	56	57	27	36	33	25	44	42	11	-	-	50		0	-	-	-	-	-	-	-	-	-	-	-	-
355	Laughing (Palm) Dove		37	30	33	43	18	36	17	13	19	42	44	38	40	42		1	-	-	-	-	-	-	1	-	-	-	-	-
356	Namaqua Dove		3	2	-	-	-	9	17	-	6	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
358	Emerald-spotted Wood-Dove		73	60	44	71	55	36	50	69	50	67	78	63	80	67		0	-	-	-	-	-	-	-	-	-	-	-	-
359	Tambourine Dove		28	23	11	14	18	18	33	13	44	8	11	38	60	25		0	-	-	-	-	-	-	-	-	-	-	-	-
360	Lemon (Cinnamon) Dove		1	1	-	-	-	9	-	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
361	African Green-Pigeon		7	6	-	-	-	18	17	6	13	8	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-
370	Knysna Lourie (pre-split)		7	6	-	-	18	9	17	6	6	-	-	-	-	8		0	-	-	-	-	-	-	-	-	-	-	-	-
371	Purple-crested Turaco		74	61	44	71	64	27	67	50	63	50	56	88	100	83		0	-	-	-	-	-	-	-	-	-	-	-	-
374	Common (Eurasian) Cuckoo		2	2	11	14	-	-	-	-	-	-	-	-	-	-		0	-	-	-	-	-	-	-	-	-	-	-	-

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
377	Red-chested Cuckoo		27	22	33	14	-	-	-	-	-	-	33	50	100	92	0	-	-	-	-	-	-	-	-	-	-	-	-
378	Black Cuckoo		13	11	22	-	9	-	-	-	-	-	-	25	60	42	0	-	-	-	-	-	-	-	-	-	-	-	-
382	Jacobin (Pied) Cuckoo		1	1	-	14	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
384	African Emerald (Emerald) Cuckoo		11	9	22	-	9	-	17	-	-	-	33	-	20	25	0	-	-	-	-	-	-	-	-	-	-	-	-
385	Klaas's Cuckoo		18	15	11	14	-	-	-	6	-	8	33	25	80	42	0	-	-	-	-	-	-	-	-	-	-	-	-
386	Dideric (Diederik) Cuckoo		24	20	78	14	18	9	17	-	-	-	11	38	40	50	0	-	-	-	-	-	-	-	-	-	-	-	-
391	Burchell's Coucal (pre-split)		40	33	44	57	36	-	17	31	13	25	33	50	40	67	0	-	-	-	-	-	-	-	-	-	-	-	-
392	Barn Owl		1	1	-	-	-	-	-	-	-	-	11	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
401	Spotted Eagle-Owl		1	1	-	-	-	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
405	Fiery-necked Nightjar		8	7	-	14	-	-	17	6	6	17	11	13	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
411	Common (European) Swift		1	1	-	-	-	-	-	-	-	-	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
412	African Black (Black) Swift		41	34	33	57	27	18	17	6	13	42	56	63	60	58	0	-	-	-	-	-	-	-	-	-	-	-	-
415	White-rumped Swift		17	14	22	29	18	9	-	-	-	-	11	38	20	42	0	-	-	-	-	-	-	-	-	-	-	-	-
416	Horus Swift		1	1	-	-	-	-	-	-	-	-	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
417	Little Swift		18	15	22	29	9	9	-	6	-	8	33	38	20	25	0	-	-	-	-	-	-	-	-	-	-	-	-
418	Alpine Swift		9	7	11	14	-	-	-	-	-	25	22	-	20	8	0	-	-	-	-	-	-	-	-	-	-	-	-
421	African Palm-Swift		9	7	-	-	9	9	-	13	-	8	-	-	-	33	0	-	-	-	-	-	-	-	-	-	-	-	-
424	Speckled Mousebird		70	57	44	43	73	36	67	56	88	50	67	13	40	75	0	-	-	-	-	-	-	-	-	-	-	-	-
426	Red-faced Mousebird		1	1	-	-	-	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
427	Narina Trogon		14	11	-	-	18	-	-	6	-	8	33	25	20	33	0	-	-	-	-	-	-	-	-	-	-	-	-
428	Pied Kingfisher		41	34	33	29	27	27	17	44	19	42	67	50	40	17	0	-	-	-	-	-	-	-	-	-	-	-	-
429	Giant Kingfisher		50	41	44	29	55	9	17	44	50	58	67	38	20	33	1	-	-	-	-	-	-	-	1	-	-	-	-
430	Half-collared Kingfisher	NT	1	1	11	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
431	Malachite Kingfisher		17	14	44	14	45	18	-	13	19	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
432	African Pygmy-Kingfisher		7	6	11	-	9	-	-	-	-	-	-	-	40	25	0	-	-	-	-	-	-	-	-	-	-	-	-
435	Brown-hooded Kingfisher		81	66	56	43	82	45	50	63	69	75	78	88	80	67	2	-	-	1	-	1	-	-	-	-	-	-	-
444	Little Bee-eater		9	7	-	14	18	9	-	-	6	8	-	25	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
446	European Roller		1	1	-	-	-	-	-	-	-	-	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
451	African Hoopoe		28	23	11	-	27	-	17	31	44	17	33	25	40	17	0	-	-	-	-	-	-	-	-	-	-	-	-
452	Green (Red-billed) Wood-hoopoe		58	48	22	43	64	27	50	56	44	58	56	50	60	42	0	-	-	-	-	-	-	-	-	-	-	-	-
455	Trumpeter Hornbill		42	34	22	29	18	9	50	38	38	33	44	63	60	33	0	-	-	-	-	-	-	-	-	-	-	-	-
460	Crowned Hornbill		26	21	11	14	-	9	33	38	25	25	22	38	20	17	0	-	-	-	-	-	-	-	-	-	-	-	-
463	Southern Ground-Hornbill	VU	9	7	11	14	9	18	17	-	6	8	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
464	Black-collared Barbet		95	78	56	86	73	45	67	88	94	83	89	75	100	75	2	-	1	-	-	-	-	-	-	-	-	-	1
469	Red-fronted Tinkerbird		24	20	-	14	45	9	-	6	25	8	22	38	20	42	0	-	-	-	-	-	-	-	-	-	-	-	-
471	Yellow-rumped (Golden-rumped) Tinkerbird (Tinker Barbet)		5	4	-	29	-	-	-	-	-	-	11	-	20	8	0	-	-	-	-	-	-	-	-	-	-	-	-
473	Crested Barbet		26	21	-	-	-	-	17	31	31	42	22	25	40	33	0	-	-	-	-	-	-	-	-	-	-	-	-
474	Greater Honeyguide		3	2	-	-	-	-	-	6	6	8	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
475	Scaly-throated Honeyguide		9	7	-	-	9	9	17	13	6	-	11	-	20	8	0	-	-	-	-	-	-	-	-	-	-	-	-
476	Lesser Honeyguide		21	17	-	29	9	-	-	13	13	25	-	38	60	42	0	-	-	-	-	-	-	-	-	-	-	-	-
478	Brown-backed (Sharp-billed) Honeybird (Honeyguide)		9	7	-	-	18	9	-	6	-	17	22	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
483	Golden-tailed Woodpecker		52	43	33	57	55	18	33	50	56	33	44	38	60	33	0	-	-	-	-	-	-	-	-	-	-	-	-
486	Cardinal Woodpecker		33	27	22	29	55	9	33	13	19	50	33	25	40	17	0	-	-	-	-	-	-	-	-	-	-	-	-
488	Olive Woodpecker		7	6	-	-	-	-	-	19	6	-	-	-	20	17	0	-	-	-	-	-	-	-	-	-	-	-	-
489	Red-throated Wryneck		21	17	11	-	9	9	33	19	19	17	11	38	40	17	1	-	-	-	-	-	-	-	1	-	-	-	-
494	Rufous-naped Lark		20	16	44	43	9	9	-	6	19	25	-	38	20	-	1	-	1	-	-	-	-	-	-	-	-	-	-
507	Red-capped Lark		1	1	-	-	9	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
518	Barn (European) Swallow		36	30	56	100	64	36	-	-	-	-	-	25	40	75	0	-	-	-	-	-	-	-	-	-	-	-	-
520	White-throated Swallow		18	15	33	29	27	9	-	-	-	33	11	13	40	8	0	-	-	-	-	-	-	-	-	-	-	-	-
526	Greater Striped-Swallow		8	7	11	14	27	27	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
527	Lesser Striped-Swallow		47	39	44	71	45	9	-	-	-	33	78	75	100	83	2	1	-	-	-	-	-	-	-	-	-	1	-
529	Rock Martin		38	31	11	14	27	18	33	31	25	58	22	38	60	42	0	-	-	-	-	-	-	-	-	-	-	-	-
532	Sand Martin (Bank Swallow)		3	2	-	-	-	-	-	-	-	-	-	-	-	25	0	-	-	-	-	-	-	-	-	-	-	-	-
533	Brown-throated (Plain) Martin		10	8	-	-	18	9	-	13	19	-	-	13	20	-	0	-	-	-	-	-	-	-	-	-	-	-	-
536	Black Saw-wing		38	31	22	43	55	36	17	13	19	25	11	50	60	50	0	-	-	-	-	-	-	-	-	-	-	-	-
538	Black Cuckooshrike		26	21	11	-	27	9	17	31	38	8	11	38	20	25	0	-	-	-	-	-	-	-	-	-	-	-	-

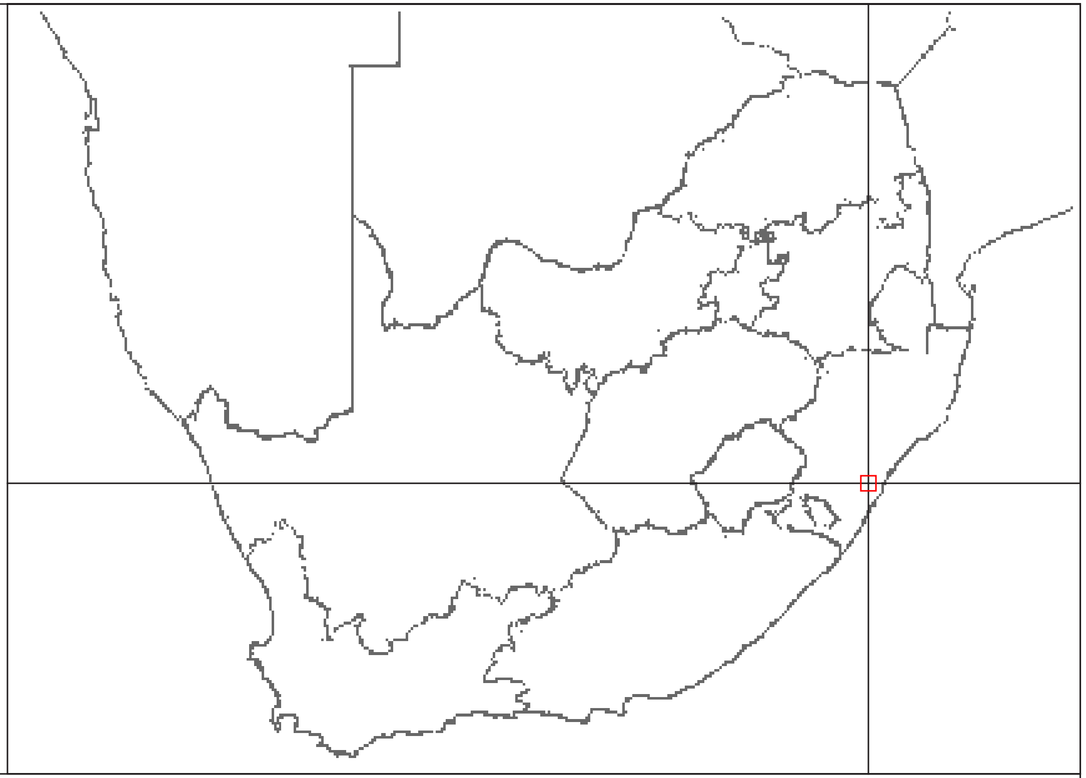
Spp Code	English	Cons Status	Occurrence														Breeding												
			n	%	J	F	M	A	M	J	J	A	S	O	N	D	n	J	F	M	A	M	J	J	A	S	O	N	D
540	Grey Cuckooshrike		9	7	-	-	-	-	17	6	19	25	11	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
541	Fork-tailed Drongo		109	89	67	100	100	64	83	94	100	100	89	75	100	92	0	-	-	-	-	-	-	-	-	-	-	-	-
542	Square-tailed Drongo		12	10	-	14	-	9	-	-	25	17	11	13	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
543	Eurasian Golden-Oriole		1	1	-	-	-	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
545	Black-headed (Eastern) Oriole		83	68	33	86	91	64	83	75	63	92	56	38	80	58	0	-	-	-	-	-	-	-	-	-	-	-	-
547	Cape (Black) Crow		13	11	22	14	18	9	-	13	13	17	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
548	Pied Crow		34	28	33	14	-	18	17	44	44	33	22	25	40	25	0	-	-	-	-	-	-	-	-	-	-	-	-
550	White-necked Raven		62	51	22	57	82	45	33	56	56	58	56	38	60	33	2	-	-	1	-	-	-	1	-	-	-	-	-
554	Southern Black Tit		77	63	44	71	73	55	50	69	69	75	67	50	60	58	1	-	-	-	-	-	-	-	-	-	-	1	-
568	Dark-capped (Black-eyed) Bulbul		115	94	89	100	100	82	100	94	100	100	89	100	80	92	1	-	-	1	-	-	-	-	-	-	-	-	-
569	Terrestrial Brownbul (Bulbul)		33	27	11	43	27	9	33	31	31	25	22	25	40	33	0	-	-	-	-	-	-	-	-	-	-	-	-
572	Sombre Greenbul (Bulbul)		73	60	44	71	73	45	33	56	69	67	44	75	60	67	0	-	-	-	-	-	-	-	-	-	-	-	-
574	Yellow-bellied Greenbul (Bulbul)		4	3	-	-	9	-	-	13	-	-	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
576	Kurrichane Thrush		32	26	-	-	-	27	50	44	31	25	22	25	60	33	0	-	-	-	-	-	-	-	-	-	-	-	-
577	Olive Thrush (pre-split)		22	18	11	-	9	-	17	19	6	25	22	38	20	50	0	-	-	-	-	-	-	-	-	-	-	-	-
579	Orange Ground-Thrush	NT	2	2	-	-	-	-	-	-	-	-	22	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
580	Groundscraper Thrush		1	1	-	-	-	-	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
581	Cape Rock-Thrush		35	29	11	29	27	27	-	38	13	33	33	25	60	50	1	-	-	-	1	-	-	-	-	-	-	-	-
582	Sentinel Rock-Thrush		1	1	-	14	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
589	Familiar Chat		8	7	-	-	9	-	-	13	-	17	11	-	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
593	Mocking Cliff-Chat		36	30	22	57	45	45	33	19	13	25	44	50	-	17	2	-	-	-	-	-	-	-	-	-	1	-	1
596	African (Common) Stonechat		70	57	56	71	73	45	83	50	63	67	44	50	40	50	1	-	-	-	-	-	-	-	1	-	-	-	-
600	Red-capped (Natal) Robin-Chat		30	25	22	14	36	27	33	25	13	8	11	38	20	50	0	-	-	-	-	-	-	-	-	-	-	-	-
601	Cape Robin-Chat		32	26	11	14	45	36	33	25	38	25	22	13	20	17	0	-	-	-	-	-	-	-	-	-	-	-	-
613	White-browed (Red-backed) Scrub-Robin		44	36	11	43	55	18	33	44	31	33	22	50	40	50	0	-	-	-	-	-	-	-	-	-	-	-	-
619	Garden Warbler		1	1	-	-	9	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
628	Great Reed-Warbler		1	1	-	14	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
631	African (African Marsh-Warbler) Reed-Warbler		1	1	-	-	-	9	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
633	Marsh (European Marsh) Warbler		4	3	11	14	9	9	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
634	Sedge Warbler		1	1	-	14	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
635	Lesser Swamp- (Cape Reed) Warbler		7	6	11	29	9	9	-	-	-	8	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
637	Dark-capped Yellow (Yellow) Warbler		4	3	11	14	-	9	-	6	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
638	Little Rush- (African Sedge) Warbler		16	13	22	14	18	18	17	13	6	8	11	-	-	25	0	-	-	-	-	-	-	-	-	-	-	-	-
639	Barratt's Warbler		4	3	-	-	-	9	17	-	13	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
643	Willow Warbler		16	13	22	29	45	27	-	-	-	-	-	-	-	33	0	-	-	-	-	-	-	-	-	-	-	-	-
644	Yellow-throated (Woodland-) Warbler		2	2	-	-	-	9	17	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
645	Bar-throated Apalis		57	47	22	43	64	36	50	38	56	25	67	63	60	50	0	-	-	-	-	-	-	-	-	-	-	-	-
648	Yellow-breasted Apalis		4	3	-	14	-	-	-	6	-	-	-	-	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
651	Long-billed (Cape) Crombec		1	1	-	-	-	-	-	-	-	-	11	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
657	Bleating Warbler (pre-split)		69	57	44	57	64	36	17	50	56	67	67	75	80	67	0	-	-	-	-	-	-	-	-	-	-	-	-
661	Cape Grassbird		8	7	11	14	18	9	17	-	-	8	-	13	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
664	Zitting (Fan-tailed) Cisticola		12	10	22	43	36	9	-	-	-	-	-	13	20	-	0	-	-	-	-	-	-	-	-	-	-	-	-
667	Wing-snapping (Ayre's) Cisticola		2	2	11	-	-	9	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
672	Rattling Cisticola		17	14	22	43	9	-	-	-	-	8	11	25	40	42	0	-	-	-	-	-	-	-	-	-	-	-	-
674	Red-faced Cisticola		4	3	-	-	18	-	17	-	-	-	-	13	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
677	Le Vaillant's (Tinkling) Cisticola		8	7	33	14	9	9	-	-	-	8	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
678	Croaking (Striped) Cisticola		5	4	-	29	9	9	-	-	6	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
679	Lazy Cisticola		13	11	-	-	9	18	17	6	13	-	11	13	-	33	0	-	-	-	-	-	-	-	-	-	-	-	-
681	Neddicky (Piping Cisticola)		42	34	44	29	36	18	17	25	25	42	11	63	60	58	0	-	-	-	-	-	-	-	-	-	-	-	-
683	Tawny-flanked Prinia		79	65	67	57	73	45	50	56	75	75	78	63	60	67	1	-	-	-	-	-	-	-	-	-	-	1	-
689	Spotted Flycatcher		7	6	33	14	9	-	-	-	-	-	-	13	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
690	African Dusky Flycatcher		61	50	11	57	64	55	33	50	50	58	56	50	60	50	0	-	-	-	-	-	-	-	-	-	-	-	-
691	Ashy Flycatcher (Alseonax)		13	11	-	14	27	9	17	19	13	-	11	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
694	Southern Black-Flycatcher		59	48	11	57	36	36	33	56	75	58	33	25	80	58	0	-	-	-	-	-	-	-	-	-	-	-	-
700	Cape Batis		18	15	11	14	18	27	17	6	13	8	22	25	20	8	0	-	-	-	-	-	-	-	-	-	-	-	-
701	Chinspot Batis		39	32	44	29	27	9	33	31	56	33	33	38	-	25	0	-	-	-	-	-	-	-	-	-	-	-	-

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
708	Blue-mantled Crested-Flycatcher		2	2	-	-	-	-	17	-	-	-	11	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
710	African Paradise-Flycatcher		58	48	33	43	64	45	67	56	25	17	33	50	100	75	2	-	-	-	-	-	-	-	-	-	-	2	-
711	African Pied Wagtail		70	57	33	71	73	36	33	56	75	58	78	50	60	50	0	-	-	-	-	-	-	-	-	-	-	-	-
712	Mountain (Long-tailed) Wagtail		9	7	-	-	9	18	17	6	6	-	-	25	20	-	0	-	-	-	-	-	-	-	-	-	-	-	-
713	Cape Wagtail		74	61	78	86	82	55	33	56	81	50	33	50	60	50	0	-	-	-	-	-	-	-	-	-	-	-	-
716	African (Grassveld/Grassland) Pipit		6	5	11	14	18	9	-	-	-	8	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
720	Striped Pipit		17	14	11	-	9	18	-	13	19	25	11	25	-	17	1	-	-	-	-	-	-	-	-	-	1	-	-
727	Cape (Orange-throated) Longclaw		7	6	22	14	9	9	17	-	6	-	-	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-
728	Yellow-throated Longclaw		16	13	11	29	9	9	17	19	19	17	11	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
732	Common Fiscal		82	67	56	86	73	73	67	63	81	67	67	63	20	67	0	-	-	-	-	-	-	-	-	-	-	-	-
733	Red-backed Shrike		2	2	-	-	9	-	-	-	-	-	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
736	Southern Boubou		82	67	33	57	73	45	50	75	63	83	100	75	60	75	0	-	-	-	-	-	-	-	-	-	-	-	-
740	Black-backed (Southern) Puffback		37	30	11	29	45	9	33	25	50	33	22	38	20	33	0	-	-	-	-	-	-	-	-	-	-	-	-
741	Brubru		7	6	-	14	9	-	-	6	-	8	-	13	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
742	Southern Tchagra		20	16	22	29	9	9	17	13	25	17	22	13	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
744	Black-crowned Tchagra		16	13	33	29	27	18	-	6	6	-	-	-	20	25	0	-	-	-	-	-	-	-	-	-	-	-	-
746	Bokmakierie		1	1	-	14	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
747	Gorgeous Bush-Shrike		28	23	22	14	36	9	33	-	13	33	22	13	60	50	0	-	-	-	-	-	-	-	-	-	-	-	-
748	Orange-breasted Bush-Shrike		35	29	22	29	45	9	17	19	25	33	22	38	40	50	0	-	-	-	-	-	-	-	-	-	-	-	-
750	Olive Bush-Shrike		2	2	-	-	-	-	-	-	-	-	11	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
751	Grey-headed Bush-Shrike		28	23	11	29	27	27	33	25	13	17	33	13	20	33	0	-	-	-	-	-	-	-	-	-	-	-	-
758	Common Myna		88	72	89	71	55	64	67	63	75	75	56	75	100	92	2	1	-	-	-	-	-	-	-	-	-	1	-
761	Violet-backed (Plum-coloured, Amethyst) Starling		16	13	11	29	9	-	-	-	-	-	-	25	60	58	1	-	-	-	-	-	-	-	-	-	-	-	1
764	Cape Glossy (Glossy) Starling		64	52	44	57	73	27	83	50	63	67	44	38	60	33	0	-	-	-	-	-	-	-	-	-	-	-	-
768	Black-bellied Starling		35	29	11	43	45	9	17	25	31	17	44	25	40	42	1	-	-	-	-	-	-	-	-	-	-	-	1
769	Red-winged Starling		78	64	67	71	55	36	67	69	81	67	67	63	80	50	1	-	-	-	-	-	-	-	-	-	-	-	1
775	Malachite Sunbird		1	1	-	-	-	9	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
783	Southern Double-collared Sunbird		4	3	11	-	-	-	-	6	6	-	-	-	20	-	0	-	-	-	-	-	-	-	-	-	-	-	-
785	Greater Double-collared Sunbird		15	12	-	-	-	18	33	19	19	25	22	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
787	White-bellied (breasted) Sunbird		55	45	44	14	27	27	17	38	63	33	44	63	100	75	0	-	-	-	-	-	-	-	-	-	-	-	-
789	Grey (Mouse-coloured) Sunbird		26	21	11	14	27	9	17	13	13	42	11	38	20	42	0	-	-	-	-	-	-	-	-	-	-	-	-
790	Olive Sunbird		29	24	-	29	27	9	50	44	38	8	-	13	20	33	0	-	-	-	-	-	-	-	-	-	-	-	-
791	Scarlet-chested Sunbird		5	4	-	-	-	9	17	-	6	8	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
792	Amethyst (Black) Sunbird		73	60	33	57	82	45	50	63	56	50	56	50	100	83	2	-	-	1	-	-	-	-	-	-	-	-	1
793	Collared Sunbird		35	29	11	14	45	9	33	31	44	17	33	13	60	33	0	-	-	-	-	-	-	-	-	-	-	-	-
796	Cape White-eye (pre-split)		90	74	67	71	91	27	50	69	88	67	89	100	100	75	0	-	-	-	-	-	-	-	-	-	-	-	-
801	House Sparrow		38	31	11	29	27	36	33	31	31	33	22	25	20	58	1	-	-	-	-	-	1	-	-	-	-	-	-
803	Cape Sparrow		9	7	22	14	9	-	-	13	6	8	-	-	-	8	1	1	-	-	-	-	-	-	-	-	-	-	-
804	Greyheaded Sparrow (pre-split)		26	21	33	29	18	18	17	19	13	8	33	13	40	33	4	1	1	-	-	-	-	-	-	-	-	-	2
805	Yellow-throated Petronia (Sparrow)		11	9	-	-	-	9	17	6	-	25	22	25	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
807	Thick-billed (Grosbeak) Weaver		35	29	22	57	45	18	17	6	31	42	33	-	20	50	4	-	1	-	-	-	-	-	-	-	-	1	2
808	Dark-backed (Forest) Weaver		21	17	-	14	27	9	33	25	19	8	22	-	20	25	0	-	-	-	-	-	-	-	-	-	-	-	-
810	Spectacled Weaver		62	51	44	86	64	18	33	56	56	58	33	38	80	50	0	-	-	-	-	-	-	-	-	-	-	-	-
811	Village (Spotted-backed) Weaver		60	49	44	43	36	18	33	50	38	75	78	50	80	58	5	1	-	-	-	-	-	-	-	1	-	1	2
813	Cape Weaver		17	14	11	29	-	9	17	13	13	17	22	25	20	8	0	-	-	-	-	-	-	-	-	-	-	-	-
814	Southern Masked-Weaver		5	4	11	-	-	-	-	-	6	8	11	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
816	Golden-Weaver		1	1	-	-	-	-	-	-	-	-	-	-	-	8	1	-	-	-	-	-	-	-	-	-	-	-	1
817	Yellow (African Golden) Weaver		20	16	22	29	-	9	17	6	6	8	22	25	40	42	4	-	1	-	-	-	-	-	-	-	-	1	2
821	Red-billed Quelea		1	1	-	-	-	-	-	-	-	-	-	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
824	Southern Red (Red) Bishop		17	14	33	29	36	9	17	-	-	8	-	-	20	33	0	-	-	-	-	-	-	-	-	-	-	-	-
828	Fan-tailed (Red-shouldered) Widowbird		39	32	56	57	55	27	33	6	19	17	11	38	40	58	0	-	-	-	-	-	-	-	-	-	-	-	-
829	White-winged Widowbird		3	2	-	14	9	9	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
831	Red-collared Widowbird		21	17	56	43	36	9	-	6	6	-	-	-	20	42	0	-	-	-	-	-	-	-	-	-	-	-	-
832	Long-tailed Widowbird		7	6	11	29	-	-	-	-	6	8	11	-	-	8	0	-	-	-	-	-	-	-	-	-	-	-	-
835	Green Twinspot		2	2	-	-	-	-	-	-	-	8	-	13	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
840	African (Blue-billed) Firefinch		55	45	11	71	64	36	67	50	44	42	33	38	40	50	0	-	-	-	-	-	-	-	-	-	-	-	-

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
844	Blue Waxbill		4	3	-	14	-	-	-	6	-	17	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
846	Common Waxbill		43	35	44	71	73	27	17	38	31	25	11	25	20	33	0	-	-	-	-	-	-	-	-	-	-	-	-
848	Grey (Black-tailed) Waxbill		16	13	11	14	-	-	-	19	25	17	22	13	40	-	0	-	-	-	-	-	-	-	-	-	-	-	-
850	Swee (Black-faced) Waxbill (Swee)		20	16	11	14	9	27	33	6	31	-	22	13	20	17	0	-	-	-	-	-	-	-	-	-	-	-	-
852	African Quailfinch		2	2	11	14	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
854	Orange-breasted (Zebra) Waxbill		3	2	11	14	-	9	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
857	Bronze Mannikin		63	52	33	43	73	27	50	63	69	50	33	25	60	67	0	-	-	-	-	-	-	-	-	-	-	-	-
858	Red-backed Mannikin		4	3	-	-	-	-	-	6	-	17	-	-	20	-	0	-	-	-	-	-	-	-	-	-	-	-	-
860	Pin-tailed Whydah		43	35	67	71	100	27	17	-	13	-	11	13	80	75	0	-	-	-	-	-	-	-	-	-	-	-	-
864	Dusky Indigobird		21	17	44	43	27	27	-	-	-	-	-	-	20	58	0	-	-	-	-	-	-	-	-	-	-	-	-
869	Yellow-fronted (eyed) Canary		84	69	56	71	91	45	50	63	75	75	78	63	80	75	0	-	-	-	-	-	-	-	-	-	-	-	-
872	Cape (Yellow-crowned) Canary		15	12	-	14	-	9	-	6	13	33	33	13	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
873	Forest Canary		9	7	11	14	-	18	17	-	19	-	-	-	20	-	0	-	-	-	-	-	-	-	-	-	-	-	-
877	Brimstone (Bully) Canary		17	14	11	14	18	-	-	13	19	33	11	13	-	17	0	-	-	-	-	-	-	-	-	-	-	-	-
881	Streaky-headed Seedeater (Canary)		16	13	33	14	18	9	-	13	6	8	11	-	20	25	0	-	-	-	-	-	-	-	-	-	-	-	-
884	Golden-breasted Bunting		32	26	11	43	36	27	17	19	31	33	11	-	40	42	0	-	-	-	-	-	-	-	-	-	-	-	-
888	Yellow-billed Kite		51	42	78	57	55	9	-	-	-	50	67	63	80	100	0	-	-	-	-	-	-	-	-	-	-	-	-

Southern African

Bird Atlas Project



Occurrence:
n indicates the total number of cards on which the species was recorded. We also give this as a percentage (%) of the total cards for the site. The monthly breakdown shows the number of times the species was reported, as a percentage of the total cards for the month (ie: reporting rate).

Breeding:
n represents the number of cards on which confirmed breeding activity was reported. The monthly breakdown is the number of times the species was recorded breeding.

Site summary for:

Site Name: DURBAN WEST (2930DD)
Province: KwaZulu-Natal

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
Total cards per month	**112**	**71**	**98**	**114**	**120**	**120**	**126**	**116**	**105**	**97**	**88**	**93**	**1260**
Total number species	**280**	**246**	**265**	**274**	**261**	**248**	**252**	**262**	**260**	**261**	**269**	**275**	**355**
Total number species breeding	**67**	**39**	**36**	**28**	**28**	**22**	**42**	**50**	**58**	**67**	**68**	**69**	**137**

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
8	Little Grebe (Dabchick)		209	17	6	10	10	13	20	23	22	14	19	20	19	19	0	-	-	-	-	-	-	-	-	-	-	-	-
49	Great White Pelican	NT	172	14	21	11	10	11	13	13	11	10	11	18	19	14	0	-	-	-	-	-	-	-	-	-	-	-	-
50	Pink-backed Pelican	VU	157	12	13	11	10	7	10	10	15	12	13	19	16	14	0	-	-	-	-	-	-	-	-	-	-	-	-
53	Cape Gannet	VU	2	0	-	-	-	2	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
55	White-breasted (Great) Cormorant		298	24	30	27	18	21	23	22	21	22	22	28	28	26	10	-	-	-	-	-	2	3	3	2	-	-	-
56	Cape Cormorant	NT	13	1	1	-	1	1	1	2	2	2	2	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
58	Reed (Long-tailed) Cormorant		300	24	19	20	19	22	26	28	22	23	24	30	27	26	2	-	-	-	-	-	-	2	-	-	-	-	-
60	African Darter		244	19	13	13	16	22	24	24	21	17	21	24	18	15	0	-	-	-	-	-	-	-	-	-	-	-	-
62	Grey Heron		416	33	38	37	23	35	36	33	33	35	30	31	33	32	22	1	-	-	-	-	2	4	5	2	5	1	2
63	Black-headed Heron		453	36	46	35	36	37	34	31	28	30	40	38	41	39	12	1	-	1	-	-	-	-	3	2	5	-	-
64	Goliath Heron		191	15	15	13	9	6	14	13	17	16	18	21	20	19	11	-	-	-	-	-	-	1	2	3	2	1	2
65	Purple Heron		104	8	8	4	8	7	8	8	8	8	7	11	14	9	6	1	-	-	-	-	-	-	1	1	3	-	-
66	Great Egret		125	10	6	4	9	10	18	14	13	9	9	11	8	3	0	-	-	-	-	-	-	-	-	-	-	-	-
67	Little Egret		241	19	13	18	13	21	23	19	21	13	19	23	26	20	0	-	-	-	-	-	-	-	-	-	-	-	-
68	Yellow-billed (Intermediate) Egret		65	5	2	-	4	4	10	9	10	6	3	5	3	1	0	-	-	-	-	-	-	-	-	-	-	-	-
69	Black Heron		7	1	3	1	1	1	-	-	-	-	1	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
71	Cattle Egret		373	30	31	30	19	28	32	33	33	36	31	29	24	25	2	-	1	-	-	-	-	-	-	1	-	-	-
72	Squacco Heron		93	7	8	4	5	4	8	7	6	6	5	12	17	8	0	-	-	-	-	-	-	-	-	-	-	-	-
74	Green-backed (Striated) Heron		132	10	9	17	14	11	14	8	10	7	5	9	13	13	2	-	-	-	-	-	-	-	-	-	-	-	2
76	Black-crowned Night-Heron		72	6	6	8	3	2	3	5	6	3	6	14	6	9	3	-	-	-	-	-	-	-	-	1	2	-	-
78	Little Bittern		21	2	4	8	1	3	1	-	2	-	2	2	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
81	Hamerkop		494	39	49	39	38	47	47	38	39	31	30	34	38	39	3	-	-	-	-	-	-	1	1	1	-	-	-
83	White Stork		2	0	-	-	2	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
84	Black Stork	NT	6	0	1	1	-	-	1	-	-	-	3	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
86	Woolly-necked Stork	NT	4	0	-	-	-	-	-	-	-	1	-	1	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
89	Marabou Stork	NT	1	0	-	-	1	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
90	Yellow-billed Stork	NT	2	0	-	-	-	-	-	-	-	-	-	-	2	-	0	-	-	-	-	-	-	-	-	-	-	-	-
91	African Sacred (Sacred) Ibis		315	25	28	21	18	23	25	25	21	24	26	32	34	24	12	2	1	-	-	-	-	-	1	1	2	3	2
92	Southern Bald (Bald) Ibis	VU	1	0	-	-	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
93	Glossy Ibis		16	1	-	-	-	-	3	1	2	-	-	3	5	2	0	-	-	-	-	-	-	-	-	-	-	-	-
94	Hadeda Ibis		1148	91	95	97	89	89	88	86	94	91	91	94	92	91	22	4	2	1	-	-	-	2	-	5	3	3	2
95	African Spoonbill		159	13	5	4	14	13	15	20	16	13	14	16	9	5	19	-	-	1	2	3	1	4	3	3	2	-	-
96	Greater Flamingo	NT	5	0	2	1	-	-	-	-	-	1	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
97	Lesser Flamingo	NT	2	0	-	-	1	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
99	White-faced (Whistling-) Duck		315	25	31	28	20	26	22	20	20	21	26	28	33	30	15	1	3	4	4	-	-	-	-	-	-	2	1
100	Fulvous (Whistling) Duck		47	4	6	-	2	3	2	2	2	5	4	8	10	2	0	-	-	-	-	-	-	-	-	-	-	-	-
101	White-backed Duck		42	3	3	4	3	7	4	2	-	3	6	4	5	1	0	-	-	-	-	-	-	-	-	-	-	-	-
102	Egyptian Goose		363	29	29	28	24	27	28	32	29	28	25	26	35	34	18	1	1	-	2	-	1	3	1	1	1	4	3
103	South African Shelduck		49	4	4	3	5	6	4	7	3	3	2	2	6	2	0	-	-	-	-	-	-	-	-	-	-	-	-
104	Yellow-billed Duck		324	26	30	27	22	22	23	23	28	21	26	25	32	33	5	-	-	-	-	-	-	2	-	1	-	1	1
105	African Black Duck		66	5	5	4	4	6	2	4	7	8	6	7	3	5	0	-	-	-	-	-	-	-	-	-	-	-	-
106	Cape Teal		18	1	2	3	2	-	1	1	1	-	1	1	5	3	0	-	-	-	-	-	-	-	-	-	-	-	-
107	Hottentot Teal		158	13	13	14	12	13	9	7	9	16	12	18	17	15	0	-	-	-	-	-	-	-	-	-	-	-	-
108	Red-billed Teal (Duck)		97	8	4	7	7	6	8	8	11	11	10	3	8	6	0	-	-	-	-	-	-	-	-	-	-	-	-
112	Cape Shoveler		165	13	15	15	11	8	11	9	13	13	8	18	22	18	3	-	-	-	-	-	-	-	1	-	-	2	-

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
113	Southern Pochard		124	10	11	6	4	2	3	6	12	12	15	20	17	13	2	-	-	-	-	-	-	1	-	1	-	-	-
115	Comb (Knob-billed) Duck		25	2	2	1	1	2	4	5	3	2	1	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
116	Spur-winged Goose		165	13	16	14	7	17	12	13	11	12	13	18	14	11	2	-	-	-	1	-	-	1	-	-	-	-	-
118	Secretarybird	NT	1	0	-	-	-	-	1	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
126	Black & Yellowbilled Kite (pre-split)		201	16	29	15	13	1	-	-	1	14	32	30	32	38	0	-	-	-	-	-	-	-	-	-	-	-	-
127	Black-shouldered (Winged) Kite		17	1	1	-	-	2	2	-	-	2	3	3	-	4	0	-	-	-	-	-	-	-	-	-	-	-	-
131	Verreaux's (Black) Eagle		11	1	1	-	1	3	2	-	-	-	2	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
135	Wahlberg's Eagle		11	1	1	-	-	1	-	-	-	3	-	4	1	1	1	1	-	-	-	-	-	-	-	-	-	-	-
136	Booted Eagle		4	0	-	-	3	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
139	Long-crested Eagle		29	2	2	-	-	4	1	4	5	3	2	3	2	1	0	-	-	-	-	-	-	-	-	-	-	-	-
140	Martial Eagle	VU	10	1	-	-	2	1	1	2	2	1	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
141	African Crowned (Crowned) Eagle	NT	60	5	8	-	2	4	6	3	2	7	8	5	6	5	10	2	-	-	1	-	-	-	2	1	2	-	2
143	Black-chested (Breasted) Snake-Eagle		1	0	-	-	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
148	African Fish-Eagle		201	16	23	18	10	15	23	18	10	19	10	12	19	12	2	-	-	-	-	-	1	-	1	-	-	-	-
149	Steppe (Common) Buzzard		78	6	21	15	9	2	-	-	-	1	1	4	11	18	0	-	-	-	-	-	-	-	-	-	-	-	-
152	Jackal Buzzard		6	0	2	-	-	-	-	-	2	-	-	-	-	2	0	-	-	-	-	-	-	-	-	-	-	-	-
154	Lizard Buzzard		1	0	-	-	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
157	Little Sparrowhawk		35	3	2	3	2	4	3	1	5	3	2	6	2	-	0	-	-	-	-	-	-	-	-	-	-	-	-
158	Black Sparrowhawk (Goshawk)		111	9	10	7	5	9	10	8	11	16	7	7	8	6	15	-	-	-	1	-	1	5	3	2	3	-	-
160	African Goshawk (incl. Red-chested)		324	26	25	28	27	26	21	27	28	28	27	26	23	25	3	1	-	-	-	-	-	-	1	-	-	-	1
161	Gabar Goshawk		1	0	-	-	-	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
165	African Marsh-Harrier	VU	6	0	2	3	-	-	-	-	-	1	-	1	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
169	African Harrier-Hawk (Gymnogene)		73	6	5	6	2	4	9	10	5	9	8	3	2	4	0	-	-	-	-	-	-	-	-	-	-	-	-
170	Osprey		10	1	1	1	1	-	1	1	1	2	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
171	Peregrine Falcon	NT	1	0	-	-	-	-	-	-	1	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
172	Lanner Falcon	NT	129	10	13	4	7	15	8	11	10	11	13	10	10	8	2	1	-	-	-	-	1	-	-	-	-	-	-
173	Eurasian Hobby		2	0	-	-	1	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
175	Sooty Falcon		3	0	-	-	1	1	1	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
180	Amur (Eastern Red-footed) Falcon (Kestrel)		3	0	-	-	-	1	-	-	-	-	-	-	2	-	0	-	-	-	-	-	-	-	-	-	-	-	-
181	Rock Kestrel		2	0	-	-	-	-	-	1	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
188	Coqui Francolin		2	0	1	-	-	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
191	Shelley's Francolin		59	5	4	3	4	4	3	5	5	4	9	6	5	5	0	-	-	-	-	-	-	-	-	-	-	-	-
196	Natal Spurfowl (Francolin)		121	10	13	11	14	9	8	5	6	10	6	12	11	13	0	-	-	-	-	-	-	-	-	-	-	-	-
200	Common Quail		5	0	-	-	-	1	-	-	-	-	-	4	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
203	Helmeted Guineafowl		108	9	12	8	8	5	8	8	9	8	11	13	8	4	1	1	-	-	-	-	-	-	-	-	-	-	-
205	Kurrichane (Small) Buttonquail		4	0	1	-	-	-	1	-	-	-	1	1	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
208	Blue Crane	VU	5	0	1	-	-	-	-	-	-	-	1	1	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
209	Grey Crowned- (Crowned) Crane	VU	1	0	1	-	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
210	African Rail		11	1	-	-	-	4	2	-	-	2	1	2	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
211	Corn Crake	VU	4	0	3	-	-	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
213	Black Crake		168	13	7	20	6	17	13	13	13	18	12	14	14	13	2	-	-	-	-	1	-	1	-	-	-	-	-
217	Red-chested Flufftail		21	2	3	6	1	1	-	1	1	-	4	1	-	5	0	-	-	-	-	-	-	-	-	-	-	-	-
218	Buff-spotted Flufftail		27	2	5	4	1	1	-	1	1	1	1	3	3	6	1	-	-	-	-	-	-	-	-	1	-	-	-
223	African Purple (Purple) Swamphen (Gallinule)		92	7	6	4	7	7	8	4	10	9	8	10	8	6	5	-	-	1	1	-	-	1	-	-	2	-	-
226	Common Moorhen		286	23	24	25	19	20	21	23	18	26	22	23	27	27	10	1	-	-	1	-	-	5	2	-	1	-	-
228	Red-knobbed Coot		313	25	29	24	22	25	24	19	25	22	22	28	32	28	15	1	1	-	1	1	2	1	1	-	4	2	1
240	African Jacana		352	28	34	30	23	33	31	20	27	22	26	28	30	33	17	1	1	2	6	2	1	-	-	-	-	2	2
245	Common Ringed Plover		16	1	-	1	7	-	1	1	1	-	-	-	2	3	0	-	-	-	-	-	-	-	-	-	-	-	-
246	White-fronted Plover		11	1	1	1	1	2	-	1	-	1	2	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
248	Kittlitz's Plover		49	4	2	4	1	2	4	5	3	8	6	3	7	2	0	-	-	-	-	-	-	-	-	-	-	-	-
249	Three-banded Plover		183	15	17	14	16	12	16	13	17	14	10	14	17	15	0	-	-	-	-	-	-	-	-	-	-	-	-
251	Greater Sand Plover		2	0	1	1	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
254	Grey (Black-bellied) Plover		4	0	1	1	-	-	-	-	-	2	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
255	Crowned Lapwing (Plover)		2	0	-	-	-	-	-	-	-	1	-	-	-	1	1	-	-	-	-	-	-	-	1	-	-	-	-
258	Blacksmith Lapwing (Plover)		267	21	24	24	19	23	19	15	18	18	19	25	30	25	21	3	1	1	3	5	2	-	3	-	-	1	2
262	Ruddy Turnstone		5	0	1	1	-	-	-	-	-	2	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
263	Terek Sandpiper		2	0	1	-	-	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
264	Common Sandpiper		135	11	19	20	11	4	1	-	2	9	12	19	23	22	0	-	-	-	-	-	-	-	-	-	-	-	-
265	Green Sandpiper		1	0	-	-	-	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
266	Wood Sandpiper		170	13	22	20	18	14	2	1	6	11	12	19	24	24	0	-	-	-	-	-	-	-	-	-	-	-	-
269	Marsh Sandpiper		42	3	10	4	2	1	-	1	-	-	1	5	10	10	0	-	-	-	-	-	-	-	-	-	-	-	-
270	Common Greenshank		52	4	7	7	8	1	2	1	-	3	3	5	9	8	0	-	-	-	-	-	-	-	-	-	-	-	-
272	Curlew Sandpiper		79	6	13	8	9	2	2	-	1	3	6	10	14	13	0	-	-	-	-	-	-	-	-	-	-	-	-
274	Little Stint		65	5	12	7	9	4	1	-	-	1	2	9	14	10	0	-	-	-	-	-	-	-	-	-	-	-	-
279	Pectoral Sandpiper		1	0	-	-	-	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
281	Sanderling		1	0	-	-	-	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
284	Ruff		154	12	22	21	15	10	1	2	-	9	12	18	26	24	0	-	-	-	-	-	-	-	-	-	-	-	-
286	African (Ethiopian) Snipe		5	0	-	-	-	-	1	-	2	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
289	Eurasian (Curlew) Curlew		1	0	-	1	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
290	Common (Whimbrel) Whimbrel		7	1	1	1	-	-	1	1	-	2	1	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
295	Black-winged Stilt		73	6	7	7	10	4	3	4	2	2	5	7	13	11	0	-	-	-	-	-	-	-	-	-	-	-	-
297	Spotted Thick-knee (Dikkop)		3	0	-	-	-	1	1	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-
298	Water Thick-knee (Dikkop)		4	0	-	-	-	2	2	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
312	Kelp Gull		55	4	3	3	8	5	6	5	5	6	2	3	2	3	9	1	1	1	-	1	-	1	-	1	-	1	2
315	Grey-headed Gull		112	9	4	4	10	3	8	8	6	7	10	19	20	11	8	1	1	1	-	2	-	-	-	1	-	1	1
322	Caspian Tern	NT	30	2	-	1	-	1	3	3	4	5	2	4	3	-	0	-	-	-	-	-	-	-	-	-	-	-	-
324	Swift (Great Crested) Tern		20	2	1	1	2	2	-	2	1	3	1	1	3	2	1	-	-	-	-	-	-	-	1	-	-	-	-
325	Lesser Crested Tern		1	0	-	1	-	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
326	Sandwich Tern		8	1	2	1	-	2	-	-	-	2	-	1	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-
327	Common Tern		96	8	16	15	10	10	13	5	6	3	2	4	3	6	0	-	-	-	-	-	-	-	-	-	-	-	-
328	Arctic Tern		1	0	-	-	-	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
335	Little Tern		5	0	2	-	-	1	-	-	1	-	1	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
338	Whiskered Tern		6	0	-	3	1	-	-	-	-	-	-	-	1	2	0	-	-	-	-	-	-	-	-	-	-	-	-
339	White-winged Tern		122	10	21	20	14	8	5	3	1	3	5	7	19	20	0	-	-	-	-	-	-	-	-	-	-	-	-
348	Rock (Feral) Dove (Pigeon)		240	19	15	21	22	16	23	19	21	19	16	25	17	15	14	2	1	2	2	2	-	1	-	1	-	1	2
349	Speckled (Rock) Pigeon		9	1	-	-	2	-	-	-	2	2	2	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
350	African Olive- (Rameron) Pigeon		27	2	-	-	2	1	4	4	5	3	3	1	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
352	Red-eyed Dove		932	74	73	72	67	69	78	74	75	75	73	76	76	77	23	2	1	2	-	3	1	3	2	4	1	2	2
354	Cape Turtle (Ring-necked) Dove		239	19	22	17	18	20	17	20	22	17	21	16	13	22	9	1	2	1	1	1	-	1	-	1	1	-	-
355	Laughing (Palm) Dove		958	76	76	77	80	80	81	69	71	76	73	75	81	75	40	3	3	3	3	2	2	3	7	5	3	4	2
358	Emerald-spotted Wood-Dove		81	6	11	6	3	4	5	7	5	8	7	9	7	8	0	-	-	-	-	-	-	-	-	-	-	-	-
359	Tambourine Dove		431	34	34	30	31	26	37	38	34	37	35	33	30	45	0	-	-	-	-	-	-	-	-	-	-	-	-
360	Lemon (Cinnamon) Dove		58	5	6	1	6	5	3	3	5	4	5	7	2	5	2	1	-	-	-	1	-	-	-	-	-	-	-
370	Knysna Lourie (pre-split)		49	4	4	1	4	1	3	3	4	3	4	4	7	10	0	-	-	-	-	-	-	-	-	-	-	-	-
371	Purple-crested Turaco		806	64	72	72	65	55	56	56	60	65	74	68	67	65	6	1	-	-	-	-	-	-	-	-	2	1	2
374	Common (Eurasian) Cuckoo		5	0	-	4	1	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
375	African Cuckoo		1	0	-	-	-	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
377	Red-chested Cuckoo		99	8	16	8	3	3	-	-	-	-	2	21	25	27	1	-	-	-	-	-	-	-	-	-	-	-	1
378	Black Cuckoo		21	2	1	3	-	-	2	-	-	-	-	2	10	5	0	-	-	-	-	-	-	-	-	-	-	-	-
382	Jacobin (Pied) Cuckoo		7	1	1	1	1	-	-	-	-	-	-	1	3	-	0	-	-	-	-	-	-	-	-	-	-	-	-
384	African Emerald (Emerald) Cuckoo		72	6	7	-	-	2	3	3	1	1	4	21	18	15	1	-	-	-	-	-	-	-	-	-	1	-	-
385	Klaas's Cuckoo		255	20	26	13	7	4	12	16	8	22	39	40	33	29	1	-	-	-	-	-	-	-	-	-	1	-	-
386	Dideric (Diederik) Cuckoo		264	21	54	32	11	2	2	-	-	-	5	52	65	57	3	2	-	-	-	-	-	-	-	-	-	1	-
387	Green Malkoha (Coucal)		27	2	3	-	1	1	1	3	2	3	2	5	2	4	0	-	-	-	-	-	-	-	-	-	-	-	-
391	Burchell's Coucal (pre-split)		466	37	54	31	29	31	24	23	25	36	41	54	55	52	2	-	-	1	-	-	-	-	-	-	-	-	1
392	Barn Owl		9	1	1	-	1	1	-	-	-	2	2	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
394	African Wood-Owl		20	2	3	-	-	3	1	-	-	3	2	5	-	2	3	-	-	-	-	-	-	-	1	1	1	-	-
395	Marsh Owl		1	0	-	-	-	-	-	1	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
396	African Scops-Owl		1	0	-	-	-	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
401	Spotted Eagle-Owl		103	8	8	11	8	8	7	4	5	8	9	7	13	15	0	-	-	-	-	-	-	-	-	-	-	-	-
404	European Nightjar		8	1	1	-	2	4	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
405	Fiery-necked Nightjar		119	9	4	4	13	12	12	11	13	12	13	6	3	4	0	-	-	-	-	-	-	-	-	-	-	-	-

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
408	Freckled Nightjar		2	0	-	-	-	1	1	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
409	Square-tailed (Mozambique) Nightjar		8	1	2	1	1	1	-	-	-	-	-	-	1	2	0	-	-	-	-	-	-	-	-	-	-	-	-
411	Common (European) Swift		5	0	1	-	-	1	-	-	-	-	-	-	1	2	0	-	-	-	-	-	-	-	-	-	-	-	-
412	African Black (Black) Swift		139	11	13	3	8	9	18	13	9	9	17	10	9	11	0	-	-	-	-	-	-	-	-	-	-	-	-
415	White-rumped Swift		253	20	37	31	22	18	9	3	1	1	18	39	41	42	0	-	-	-	-	-	-	-	-	-	-	-	-
417	Little Swift		205	16	24	24	14	14	14	12	10	8	17	18	30	18	0	-	-	-	-	-	-	-	-	-	-	-	-
418	Alpine Swift		16	1	-	-	1	1	5	1	1	1	3	2	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
421	African Palm-Swift		307	24	29	27	17	14	24	23	24	26	29	25	31	27	1	-	-	-	-	-	-	-	-	-	-	-	1
424	Speckled Mousebird		964	77	75	76	74	75	78	77	74	79	72	76	77	84	22	3	1	1	-	1	1	3	2	3	3	2	2
426	Red-faced Mousebird		15	1	2	-	-	2	1	3	2	2	2	1	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
427	Narina Trogon		77	6	3	1	5	3	9	8	4	5	10	13	5	6	1	-	-	-	-	-	-	-	-	-	1	-	-
428	Pied Kingfisher		248	20	26	24	17	18	23	18	19	13	17	13	27	24	0	-	-	-	-	-	-	-	-	-	-	-	-
429	Giant Kingfisher		194	15	13	17	16	20	24	13	14	8	11	8	19	20	1	-	-	-	-	-	-	-	-	-	-	-	1
431	Malachite Kingfisher		214	17	27	21	23	25	20	13	14	11	7	8	15	22	0	-	-	-	-	-	-	-	-	-	-	-	-
432	African Pygmy-Kingfisher		55	4	7	3	8	4	-	-	1	-	1	13	9	10	1	-	-	-	-	-	-	-	-	-	-	1	-
434	Mangrove Kingfisher	VU	4	0	-	-	-	-	1	-	1	-	-	1	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
435	Brown-hooded Kingfisher		709	56	63	59	57	54	53	56	55	53	61	58	49	57	13	2	-	-	-	-	-	1	1	3	1	3	2
444	Little Bee-eater		379	30	33	34	30	32	34	37	29	33	30	21	19	25	0	-	-	-	-	-	-	-	-	-	-	-	-
446	European Roller		3	0	-	-	-	-	-	-	-	-	-	-	-	3	0	-	-	-	-	-	-	-	-	-	-	-	-
451	African Hoopoe		95	8	10	7	7	6	4	3	6	8	11	10	10	10	0	-	-	-	-	-	-	-	-	-	-	-	-
452	Green (Red-billed) Wood-hoopoe		295	23	21	25	22	23	26	24	21	26	23	27	24	19	0	-	-	-	-	-	-	-	-	-	-	-	-
455	Trumpeter Hornbill		63	5	4	1	1	4	8	6	7	8	5	6	5	4	0	-	-	-	-	-	-	-	-	-	-	-	-
460	Crowned Hornbill		24	2	-	-	2	-	3	3	2	6	3	1	2	-	0	-	-	-	-	-	-	-	-	-	-	-	-
463	Southern Ground-Hornbill	VU	3	0	2	-	1	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
464	Black-collared Barbet		1004	80	75	83	74	76	83	83	83	83	79	81	75	77	40	5	2	3	-	3	2	5	2	2	3	6	7
466	White-eared Barbet		131	10	12	13	6	12	11	13	9	13	10	10	7	9	4	1	-	-	-	-	1	-	-	-	-	-	2
469	Red-fronted Tinkerbird		305	24	33	31	29	19	18	18	19	16	33	29	24	29	0	-	-	-	-	-	-	-	-	-	-	-	-
471	Yellow-rumped (Golden-rumped) Tinkerbird (Tinker Barbet)		350	28	29	34	38	25	27	28	23	18	29	40	23	24	8	1	-	-	-	1	1	-	-	1	2	2	-
473	Crested Barbet		19	2	2	1	1	2	-	1	1	1	3	4	2	1	0	-	-	-	-	-	-	-	-	-	-	-	-
474	Greater Honeyguide		41	3	3	1	1	2	2	3	3	3	8	6	3	4	0	-	-	-	-	-	-	-	-	-	-	-	-
475	Scaly-throated Honeyguide		16	1	4	-	-	-	-	2	1	2	3	2	-	2	0	-	-	-	-	-	-	-	-	-	-	-	-
476	Lesser Honeyguide		72	6	4	6	7	4	7	8	5	4	7	3	8	5	0	-	-	-	-	-	-	-	-	-	-	-	-
478	Brown-backed (Sharp-billed) Honeybird (Honeyguide)		40	3	3	1	3	2	3	5	3	2	10	-	1	4	0	-	-	-	-	-	-	-	-	-	-	-	-
483	Golden-tailed Woodpecker		471	37	33	39	37	32	41	37	39	39	43	43	32	34	11	-	1	-	-	-	-	-	1	1	3	4	1
486	Cardinal Woodpecker		269	21	22	21	24	16	24	24	21	24	18	19	19	22	1	-	-	-	-	-	-	-	-	-	1	-	-
488	Olive Woodpecker		4	0	-	-	-	-	-	1	-	-	1	2	-	-	1	-	-	-	-	-	1	-	-	-	-	-	-
489	Red-throated Wryneck		98	8	10	6	6	4	8	5	8	11	10	8	9	9	1	-	-	-	-	-	-	1	-	-	-	-	-
494	Rufous-naped Lark		103	8	15	4	5	6	5	4	2	10	12	12	8	14	0	-	-	-	-	-	-	-	-	-	-	-	-
507	Red-capped Lark		6	0	-	-	-	1	1	1	-	2	-	1	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
518	Barn (European) Swallow		335	27	61	62	46	27	4	-	-	4	4	22	58	66	0	-	-	-	-	-	-	-	-	-	-	-	-
520	White-throated Swallow		137	11	16	11	14	8	1	1	2	9	12	16	22	26	1	-	-	1	-	-	-	-	-	-	-	-	-
522	Wire-tailed Swallow		88	7	4	1	5	6	12	8	10	9	6	5	2	11	0	-	-	-	-	-	-	-	-	-	-	-	-
526	Greater Striped-Swallow		33	3	5	7	3	4	1	-	-	-	1	2	3	9	5	1	-	1	-	-	-	-	-	-	1	-	2
527	Lesser Striped-Swallow		555	44	75	65	40	16	8	2	17	53	67	69	73	76	21	4	2	1	-	-	-	-	1	2	2	7	2
529	Rock Martin		137	11	8	6	7	8	16	12	17	14	11	10	9	9	1	-	-	-	-	-	-	-	-	-	1	-	-
530	Common House-Martin		9	1	2	1	-	1	-	1	-	-	1	2	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
532	Sand Martin (Bank Swallow)		13	1	4	1	1	1	-	-	-	-	-	-	2	3	0	-	-	-	-	-	-	-	-	-	-	-	-
533	Brown-throated (Plain) Martin		222	18	17	13	15	14	20	18	19	21	18	20	19	15	0	-	-	-	-	-	-	-	-	-	-	-	-
536	Black Saw-wing		233	18	22	25	18	15	19	13	12	16	23	28	18	18	1	-	-	-	-	-	-	-	-	-	-	1	-
538	Black Cuckooshrike		102	8	1	1	5	7	12	12	16	12	13	8	1	2	0	-	-	-	-	-	-	-	-	-	-	-	-
540	Grey Cuckooshrike		49	4	1	-	3	5	6	9	5	6	3	4	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
541	Fork-tailed Drongo		1033	82	80	82	80	78	85	83	81	84	80	82	89	81	19	3	1	2	-	1	1	1	1	-	2	3	4
542	Square-tailed Drongo		361	29	22	31	23	29	30	37	35	30	22	29	26	27	8	1	-	1	-	-	-	-	-	-	4	1	1
543	Eurasian Golden-Oriole		3	0	1	-	1	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
545	Black-headed (Eastern) Oriole		343	27	26	28	20	25	23	33	28	27	26	34	26	30	0	-	-	-	-	-	-	-	-	-	-	-	-
547	Cape (Black) Crow		20	2	1	-	-	3	4	3	2	3	2	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-

Spp Code	English	Cons Status	Occurrence n	%	J	F	M	A	M	J	J	A	S	O	N	D	Breeding n	J	F	M	A	M	J	J	A	S	O	N	D
548	Pied Crow		573	45	36	42	37	49	49	52	60	51	43	40	39	41	17	2	1	1	1	1	-	1	3	2	2	1	2
549	House Crow		142	11	13	10	13	5	8	13	6	13	13	18	14	11	2	-	-	-	-	-	-	-	-	-	1	-	1
550	White-necked Raven		124	10	6	11	5	7	7	9	10	13	12	19	15	6	1	-	-	-	-	-	-	-	-	-	1	-	-
554	Southern Black Tit		601	48	43	44	47	39	50	53	48	53	50	57	47	41	2	-	-	-	-	-	-	1	-	-	-	-	1
565	Bush Blackcap	NT	2	0	-	-	-	-	-	-	1	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
568	Dark-capped (Black-eyed) Bulbul		1171	93	96	93	92	89	94	96	93	92	93	92	89	96	30	3	3	3	-	2	1	2	1	2	2	6	5
569	Terrestrial Brownbul (Bulbul)		317	25	28	14	18	22	24	35	28	33	27	29	18	18	1	-	-	-	-	-	-	-	-	-	-	1	-
572	Sombre Greenbul (Bulbul)		656	52	50	54	45	40	55	63	56	52	52	61	44	49	4	-	-	-	2	-	-	-	-	-	1	1	-
574	Yellow-bellied Greenbul (Bulbul)		202	16	20	17	13	18	16	17	20	17	16	12	10	14	0	-	-	-	-	-	-	-	-	-	-	-	-
576	Kurrichane Thrush		336	27	13	17	26	21	29	22	27	27	36	42	33	29	2	-	-	-	-	-	-	1	-	-	-	1	-
577	Olive Thrush (pre-split)		235	19	13	13	17	15	17	22	17	29	21	23	20	15	3	-	-	-	-	-	-	-	1	1	-	1	-
578	Spotted (Natal) Ground-Thrush	EN	61	5	-	-	-	5	6	11	11	14	4	1	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
580	Groundscraper Thrush		1	0	-	-	-	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
581	Cape Rock-Thrush		43	3	4	-	1	4	6	4	3	3	6	1	5	3	2	1	-	-	1	-	-	-	-	-	-	-	-
582	Sentinel Rock-Thrush		2	0	-	-	-	-	-	-	1	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
589	Familiar Chat		34	3	3	4	1	5	5	2	2	3	1	-	5	2	0	-	-	-	-	-	-	-	-	-	-	-	-
593	Mocking Cliff-Chat		55	4	5	3	5	4	5	4	7	5	5	3	2	2	0	-	-	-	-	-	-	-	-	-	-	-	-
596	African (Common) Stonechat		184	15	6	4	5	25	25	23	24	26	10	5	1	6	0	-	-	-	-	-	-	-	-	-	-	-	-
598	Chorister Robin-Chat		25	2	-	1	-	-	4	5	5	3	1	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
600	Red-capped (Natal) Robin-Chat		639	51	46	31	40	53	58	56	52	51	51	56	52	55	7	1	-	1	-	-	-	1	-	1	-	1	2
601	Cape Robin-Chat		121	10	4	3	3	8	16	13	15	16	9	8	7	9	3	-	-	-	-	-	-	-	-	-	1	1	1
606	White-starred (Starred) Robin		11	1	-	-	-	-	1	4	2	-	3	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
613	White-browed (Red-backed) Scrub-Robin		254	20	25	11	14	18	21	19	17	22	27	24	22	22	1	1	-	-	-	-	-	-	-	-	-	-	-
616	Brown Scrub-Robin		8	1	1	-	-	-	-	1	1	1	1	2	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
619	Garden Warbler		18	1	4	4	5	-	-	-	-	-	-	1	-	4	0	-	-	-	-	-	-	-	-	-	-	-	-
625	Icterine Warbler		4	0	2	-	-	-	-	-	-	-	-	-	-	2	0	-	-	-	-	-	-	-	-	-	-	-	-
628	Great Reed-Warbler		23	2	4	7	5	2	-	-	-	-	-	-	-	6	0	-	-	-	-	-	-	-	-	-	-	-	-
631	African (African Marsh-Warbler) Reed-Warbler		26	2	5	1	1	-	2	3	3	2	2	-	1	3	0	-	-	-	-	-	-	-	-	-	-	-	-
633	Marsh (European Marsh) Warbler		20	2	5	7	6	-	-	-	-	-	-	-	-	3	0	-	-	-	-	-	-	-	-	-	-	-	-
634	Sedge Warbler		47	4	11	11	11	5	-	-	-	-	1	-	3	6	0	-	-	-	-	-	-	-	-	-	-	-	-
635	Lesser Swamp- (Cape Reed) Warbler		193	15	17	10	13	13	18	10	13	14	11	21	23	23	1	-	-	-	-	-	-	-	-	-	-	1	-
637	Dark-capped Yellow (Yellow) Warbler		31	2	-	-	1	5	4	4	6	3	2	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
638	Little Rush- (African Sedge) Warbler		237	19	25	21	14	15	18	12	13	16	20	26	25	26	0	-	-	-	-	-	-	-	-	-	-	-	-
639	Barratt's Warbler		9	1	-	1	-	-	2	2	2	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
642	Broad-tailed Warbler	NT	31	2	3	-	2	3	3	1	2	4	2	4	3	2	0	-	-	-	-	-	-	-	-	-	-	-	-
643	Willow Warbler		94	7	14	18	15	7	2	-	-	-	2	6	14	22	0	-	-	-	-	-	-	-	-	-	-	-	-
644	Yellow-throated (Woodland-) Warbler		12	1	-	-	1	-	1	1	2	1	2	1	2	1	0	-	-	-	-	-	-	-	-	-	-	-	-
645	Bar-throated Apalis		473	38	41	34	32	25	38	40	38	36	39	46	38	44	3	-	-	-	-	-	-	-	-	1	1	-	1
648	Yellow-breasted Apalis		54	4	4	1	3	3	5	6	5	5	7	5	-	6	0	-	-	-	-	-	-	-	-	-	-	-	-
657	Bleating Warbler (pre-split)		562	45	49	45	38	33	41	43	42	45	48	52	50	55	2	-	-	-	-	-	-	-	-	-	2	-	-
661	Cape Grassbird		179	14	22	15	13	6	11	11	13	16	15	12	16	22	2	1	-	-	-	-	-	-	1	-	-	-	-
664	Zitting (Fan-tailed) Cisticola		140	11	13	14	12	11	8	8	8	12	9	13	14	17	0	-	-	-	-	-	-	-	-	-	-	-	-
667	Wing-snapping (Ayre's) Cisticola		1	0	-	-	-	-	-	-	-	-	-	1	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
668	Pale-crowned Cisticola		3	0	-	-	-	-	-	-	-	-	-	-	2	1	0	-	-	-	-	-	-	-	-	-	-	-	-
670	Wailing Cisticola		2	0	-	-	-	-	1	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
672	Rattling Cisticola		215	17	28	23	13	11	12	6	6	14	16	26	24	37	0	-	-	-	-	-	-	-	-	-	-	-	-
674	Red-faced Cisticola		144	11	19	14	14	6	11	8	7	6	10	12	17	17	0	-	-	-	-	-	-	-	-	-	-	-	-
675	Blackbacked Cisticola (pre-split)		142	11	19	11	9	7	8	7	6	6	10	20	18	19	1	-	-	-	-	-	-	-	-	-	-	1	-
677	Le Vaillant's (Tinkling) Cisticola		47	4	4	4	5	4	1	3	4	5	2	5	3	5	0	-	-	-	-	-	-	-	-	-	-	-	-
678	Croaking (Striped) Cisticola		72	6	8	7	5	-	5	1	2	8	6	7	9	15	1	1	-	-	-	-	-	-	-	-	-	-	-
679	Lazy Cisticola		68	5	5	8	7	3	3	3	6	5	7	7	3	8	1	-	-	-	-	-	-	-	-	-	-	-	1
681	Neddicky (Piping Cisticola)		357	28	38	23	19	16	27	24	22	28	34	35	30	46	4	1	-	-	-	1	1	-	-	-	-	1	-
683	Tawny-flanked Prinia		669	53	63	55	44	41	51	53	50	54	48	60	63	60	15	2	1	1	-	-	-	-	-	-	5	3	3
689	Spotted Flycatcher		66	5	21	10	14	4	-	-	-	-	-	2	5	12	0	-	-	-	-	-	-	-	-	-	-	-	-
690	African Dusky Flycatcher		470	37	29	24	33	33	44	44	47	44	40	38	28	32	6	1	-	1	-	-	-	-	-	-	1	1	2
691	Ashy Flycatcher (Alseonax)		120	10	9	1	9	9	14	17	13	12	9	8	2	4	1	-	-	-	-	-	-	-	-	-	-	-	1

Spp Code	English	Cons Status	Occurrence														Breeding												
			n	%	J	F	M	A	M	J	J	A	S	O	N	D	n	J	F	M	A	M	J	J	A	S	O	N	D
694	Southern Black-Flycatcher		485	38	30	34	37	38	35	50	40	42	37	43	31	41	7	1	-	1	-	-	-	-	-	-	1	3	1
698	Fiscal Flycatcher		70	6	2	-	-	12	13	11	6	6	7	3	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
700	Cape Batis		247	20	13	8	14	15	32	32	29	22	21	20	11	6	3	-	-	-	1	-	-	-	-	-	-	2	-
701	Chinspot Batis		361	29	26	31	24	24	28	33	26	37	31	29	28	27	1	-	-	-	-	-	-	-	-	-	-	-	1
705	Black-throated (Wattle-eyed) Wattle-eye (Flycatcher)	NT	2	0	-	-	-	-	-	1	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
708	Blue-mantled Crested-Flycatcher		18	1	-	-	-	-	2	1	3	5	2	2	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
710	African Paradise-Flycatcher		634	50	62	62	58	54	34	32	32	27	61	74	61	67	18	5	1	-	-	-	-	-	-	1	3	3	5
711	African Pied Wagtail		224	18	22	14	17	18	21	18	15	12	12	18	24	24	1	-	-	-	-	1	-	-	-	-	-	-	-
712	Mountain (Long-tailed) Wagtail		185	15	21	17	17	6	8	14	17	10	15	27	11	13	3	2	-	-	-	-	-	-	-	-	-	-	1
713	Cape Wagtail		445	35	38	35	34	35	44	29	36	32	33	35	38	35	1	-	-	-	-	-	-	-	-	1	-	-	-
716	African (Grassveld/Grassland) Pipit		120	10	13	13	9	7	9	9	7	12	9	9	13	6	0	-	-	-	-	-	-	-	-	-	-	-	-
720	Striped Pipit		18	1	1	-	1	2	3	2	-	2	1	2	2	2	0	-	-	-	-	-	-	-	-	-	-	-	-
727	Cape (Orange-throated) Longclaw		3	0	1	-	-	-	-	1	-	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
728	Yellow-throated Longclaw		277	22	25	25	13	22	23	25	21	23	20	19	19	29	2	-	-	-	-	-	-	-	-	1	1	-	-
732	Common Fiscal		780	62	59	63	61	67	67	63	60	59	54	59	66	66	12	1	-	-	1	1	-	-	2	1	1	3	2
733	Red-backed Shrike		14	1	4	3	1	1	-	-	-	-	-	-	1	5	0	-	-	-	-	-	-	-	-	-	-	-	-
736	Southern Boubou		495	39	39	30	30	29	40	41	40	44	51	42	36	46	1	1	-	-	-	-	-	-	-	-	-	-	-
740	Black-backed (Southern) Puffback		387	31	28	23	30	18	36	38	29	32	33	39	26	33	0	-	-	-	-	-	-	-	-	-	-	-	-
741	Brubru		5	0	-	1	-	1	-	1	1	-	-	1	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
742	Southern Tchagra		155	12	19	10	14	3	8	8	7	14	15	21	14	19	0	-	-	-	-	-	-	-	-	-	-	-	-
744	Black-crowned Tchagra		33	3	4	3	1	3	3	3	-	3	4	1	1	6	0	-	-	-	-	-	-	-	-	-	-	-	-
746	Bokmakierie		5	0	-	3	-	1	-	-	-	1	-	1	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
747	Gorgeous Bush-Shrike		59	5	7	1	3	3	4	3	2	3	7	9	6	9	1	-	-	-	-	-	-	-	-	-	-	1	-
748	Orange-breasted Bush-Shrike		130	10	6	6	8	4	8	4	10	16	15	14	19	17	0	-	-	-	-	-	-	-	-	-	-	-	-
750	Olive Bush-Shrike		24	2	2	-	3	-	1	2	2	3	5	1	2	1	0	-	-	-	-	-	-	-	-	-	-	-	-
751	Grey-headed Bush-Shrike		92	7	4	7	11	7	5	4	7	6	11	10	11	4	0	-	-	-	-	-	-	-	-	-	-	-	-
753	White-crested Helmet-Shrike		1	0	-	-	-	-	-	-	-	-	-	-	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
757	Common (European) Starling		3	0	-	-	-	-	-	1	1	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
758	Common Myna		1044	83	91	87	78	79	73	83	79	84	78	88	89	91	67	8	5	5	3	2	-	3	4	7	10	11	9
760	Wattled Starling		11	1	-	-	-	3	2	2	2	-	-	1	1	-	0	-	-	-	-	-	-	-	-	-	-	-	-
761	Violet-backed (Plum-coloured, Amethyst) Starling		44	3	9	-	2	3	2	-	1	-	1	2	8	17	1	-	-	-	-	-	-	-	-	-	-	-	1
764	Cape Glossy (Glossy) Starling		226	18	18	14	10	16	18	23	16	21	18	24	19	18	0	-	-	-	-	-	-	-	-	-	-	-	-
768	Black-bellied Starling		194	15	13	17	6	13	17	13	13	21	20	16	15	23	0	-	-	-	-	-	-	-	-	-	-	-	-
769	Red-winged Starling		516	41	38	48	40	39	40	41	42	41	38	46	47	33	6	-	1	-	-	-	-	-	-	2	-	2	1
774	Gurney's Sugarbird		1	0	-	-	1	-	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
775	Malachite Sunbird		7	1	-	-	-	3	2	-	1	1	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
780	Purple-banded Sunbird		5	0	-	1	1	2	1	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
783	Southern Double-collared Sunbird		27	2	3	1	2	2	3	2	2	4	1	-	1	4	0	-	-	-	-	-	-	-	-	-	-	-	-
785	Greater Double-collared Sunbird		62	5	2	4	3	6	3	8	6	6	5	4	6	4	2	-	1	-	-	-	-	-	1	-	-	-	-
787	White-bellied (breasted) Sunbird		594	47	38	35	36	33	51	48	56	60	53	55	50	43	9	1	-	-	-	-	-	1	-	2	1	1	3
789	Grey (Mouse-coloured) Sunbird		202	16	12	13	12	11	20	23	20	16	20	16	14	13	5	-	1	-	-	-	-	-	1	2	1	-	-
790	Olive Sunbird		483	38	35	42	33	30	35	46	34	46	46	46	32	37	5	-	-	-	-	-	-	-	-	2	1	1	1
791	Scarlet-chested Sunbird		33	3	2	3	3	4	4	3	5	3	-	2	2	1	0	-	-	-	-	-	-	-	-	-	-	-	-
792	Amethyst (Black) Sunbird		658	52	51	62	45	47	53	63	52	61	50	48	51	42	17	2	1	-	1	-	-	-	4	1	3	2	3
793	Collared Sunbird		440	35	30	27	31	34	43	43	38	35	40	38	25	27	8	1	-	-	-	-	-	-	1	1	2	2	1
796	Cape White-eye (pre-split)		1012	80	79	80	77	73	78	81	82	84	83	86	81	82	16	2	2	-	1	2	-	1	1	1	4	1	1
801	House Sparrow		665	53	51	48	53	51	55	44	49	53	45	60	65	63	45	4	1	1	2	3	-	5	4	5	8	5	7
803	Cape Sparrow		14	1	2	1	1	-	2	1	2	-	2	-	2	-	0	-	-	-	-	-	-	-	-	-	-	-	-
804	Greyheaded Sparrow (pre-split)		38	3	4	-	4	2	3	3	4	4	2	3	6	1	0	-	-	-	-	-	-	-	-	-	-	-	-
805	Yellow-throated Petronia (Sparrow)		16	1	-	-	-	-	1	1	2	3	1	3	1	3	0	-	-	-	-	-	-	-	-	-	-	-	-
807	Thick-billed (Grosbeak) Weaver		531	42	52	37	39	36	42	47	40	41	32	53	44	44	32	7	3	1	-	-	-	1	3	1	7	3	6
808	Dark-backed (Forest) Weaver		178	14	10	11	10	8	18	21	15	15	15	16	15	13	11	-	-	-	-	-	-	-	-	1	7	3	-
810	Spectacled Weaver		718	57	53	52	52	55	62	61	56	60	60	63	56	52	40	4	-	-	-	1	-	1	5	7	14	3	5
811	Village (Spotted-backed) Weaver		688	55	68	45	46	39	44	41	57	63	58	66	70	61	112	13	8	3	1	4	2	9	13	15	22	12	10
813	Cape Weaver		110	9	12	7	4	2	4	7	9	10	9	10	17	17	13	-	-	-	-	-	-	-	3	2	3	3	2
814	Southern Masked-Weaver		49	4	7	7	2	2	2	4	5	3	4	2	7	4	14	2	2	-	1	-	-	1	1	2	1	2	2

Spp	English	Cons	Occurrence														Breeding												
Code		Status	n	%	J	F	M	A	M	J	J	A	S	O	N	D	n	J	F	M	A	M	J	J	A	S	O	N	D
816	Golden-Weaver		13	1	-	-	-	1	1	3	-	1	1	2	1	2	0	-	-	-	-	-	-	-	-	-	-	-	-
817	Yellow (African Golden) Weaver		234	19	31	24	14	11	7	5	6	20	24	32	32	29	26	2	2	-	-	-	-	1	3	7	7	2	2
818	Southern Brown-throated Weaver		18	1	3	-	-	1	-	-	-	3	-	3	5	3	1	-	-	-	-	-	-	-	-	-	1	-	-
821	Red-billed Quelea		2	0	-	-	1	-	-	-	-	-	-	-	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
822	Red-headed Quelea		2	0	-	-	1	1	-	-	-	-	-	-	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
824	Southern Red (Red) Bishop		274	22	41	32	23	18	14	9	9	10	10	27	43	39	12	4	1	-	-	-	-	-	-	-	1	3	3
828	Fan-tailed (Red-shouldered) Widowbird		368	29	46	38	21	20	19	20	21	24	29	36	40	47	3	2	1	-	-	-	-	-	-	-	-	-	-
829	White-winged Widowbird		2	0	-	-	-	-	-	-	-	-	-	2	-	-	0	-	-	-	-	-	-	-	-	-	-	-	-
831	Red-collared Widowbird		122	10	18	18	11	4	4	2	2	2	7	21	17	23	3	-	1	2	-	-	-	-	-	-	-	-	-
832	Long-tailed Widowbird		4	0	1	-	-	-	-	-	-	1	-	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
835	Green Twinspot		26	2	2	-	1	1	2	3	4	4	4	-	1	1	0	-	-	-	-	-	-	-	-	-	-	-	-
840	African (Blue-billed) Firefinch		236	19	21	17	23	15	24	28	17	14	15	21	11	16	1	-	-	-	-	-	-	-	-	-	-	1	-
844	Blue Waxbill		12	1	3	1	1	1	3	-	-	1	-	1	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
846	Common Waxbill		358	28	38	37	30	31	29	23	17	22	21	29	33	41	0	-	-	-	-	-	-	-	-	-	-	-	-
848	Grey (Black-tailed) Waxbill		72	6	4	4	3	4	5	13	9	8	3	7	5	2	2	1	-	-	-	-	-	-	-	-	-	-	1
850	Swee (Black-faced) Waxbill (Swee)		39	3	3	6	1	3	4	4	1	3	4	4	5	2	0	-	-	-	-	-	-	-	-	-	-	-	-
854	Orange-breasted (Zebra) Waxbill		18	1	2	-	1	3	1	2	2	-	-	2	3	1	0	-	-	-	-	-	-	-	-	-	-	-	-
857	Bronze Mannikin		912	72	62	73	74	75	82	79	74	74	63	72	73	66	41	5	3	3	5	2	2	3	3	4	5	2	4
858	Red-backed Mannikin		110	9	7	10	9	11	8	9	9	8	11	7	10	6	2	1	-	-	-	-	-	-	-	-	-	1	-
860	Pin-tailed Whydah		279	22	37	34	28	14	8	11	6	14	25	34	30	42	15	1	1	2	1	-	-	-	-	2	-	5	3
864	Dusky Indigobird		34	3	9	3	7	3	-	-	-	1	-	-	6	6	1	-	-	1	-	-	-	-	-	-	-	-	-
867	Village Indigobird		1	0	-	-	-	-	1	-	-	-	-	-	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-
869	Yellow-fronted (eyed) Canary		869	69	77	73	69	65	65	63	65	64	64	77	74	77	6	-	-	-	1	-	-	1	-	-	1	2	1
872	Cape (Yellow-crowned) Canary		86	7	1	-	1	-	4	12	13	14	14	10	5	3	0	-	-	-	-	-	-	-	-	-	-	-	-
873	Forest Canary		14	1	2	-	-	2	1	-	2	2	1	2	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
877	Brimstone (Bully) Canary		223	18	20	14	14	17	13	17	22	22	26	20	13	12	0	-	-	-	-	-	-	-	-	-	-	-	-
881	Streaky-headed Seedeater (Canary)		210	17	13	14	14	14	15	16	17	20	20	22	18	18	0	-	-	-	-	-	-	-	-	-	-	-	-
884	Golden-breasted Bunting		27	2	1	-	-	3	6	4	2	3	1	2	-	1	0	-	-	-	-	-	-	-	-	-	-	-	-
888	Yellow-billed Kite		402	32	54	65	37	5	-	-	6	51	53	51	44	47	14	1	-	1	-	-	-	-	2	4	4	1	1
889	Black Kite		22	2	3	4	2	-	-	-	-	-	-	6	2	6	0	-	-	-	-	-	-	-	-	-	-	-	-

APPENDIX 13:

ASSESSMENT AND MAPPING OF HERITAGE RESOURCES ON THE SHONGWENI ESTATE FOR TONGAAT HULETT PROPERTIES (ARCHAIC CONSULTING)

Assessment and Mapping of Heritage Resources on the Shongweni Estate for Tongaat Hulett Properties

Prepared for: Tongaat Hulett Developments (Pty) Ltd
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May 2012

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Assessment and Mapping of Heritage Resources on the Shongweni Estate for Tongaat Hulett Properties

Contents of Report:

A Overall heritage Statement

A1. Introduction

Dr. Debbie Whelan of Archaic Consulting was approached by Mr. Rory Wilkinson of Tongaat Hulett Properties to carry out a full heritage assessment of the current landholdings of the Shongweni Estate, Hillcrest District, Thekweni Municipality Outer West. The heritage assessment is carried out in terms of the KwaZulu-Natal Provincial Heritage Act, no 4 of 2008 and the National Heritage Resources Act no 25 of 1999. It aims to identify archaeological sites, as well as structures and elements of the built environment that are either of significance, or over the age of 60 years.

These landholdings include the Remainder of Erf 79 Assagay, Remainder of Portion 2 of the farm Botha's Half-Way House 921, The farm Shongweni 15346, Remainder of Portion 24 of the farm Summerveld 14226 and the Remainder of the farm Kirkfalls, 14227.

Whilst Archaic Consulting is able to research the built and cultural environment and historic landscapes, it is unable to carry out surveys and comment on heritage of an archaeological nature. Thus, eThembeni Cultural Heritage worked in association. The two reports are presented discretely, with the Executive Summaries of both combined in section A2.

A2. Combined Heritage Executive Summary Statement

Architectural and historical landscape heritage

Of all of the architectural sites and historic structures which comprise the Shongweni Estates, little is of profound heritage status. However, the following must be noted:

- ***The historical landscape is inevitably tied with the production of mono-crops, and its associated labour compounds, and central homestead. Its primary association is with a single family, the McIntoshes, who started the Durban County Wattle Syndicate, and in whose name it remained until the 1960s.***
- ***The house at Waterfall Farm (S29°48'06.66" E30°44'51.40") and the associated outbuildings have minimal architectural, technical and scientific value. The farmhouse has medium historical and social value, given its association with both James McIntosh and the Durban County Wattle Syndicate.***
- ***However, even though the house has lost much of its architectural appeal, there is little left in the Hillcrest area which fully represents buildings of this period. There is thus an opportunity for reuse of the farmhouse. This would be better served removing the accretions, namely the enclosed portico to the south west, the extended veranda and the addition to the south, in order to arrive at a more compact, architecturally pleasing structure. More research needs to be carried out on the house in this regard. Furthermore, given the topophiliac quality of the garden, it is recommended that this be retained in any new development. It is recommended that the outbuildings associated directly with the farmhouse be demolished should this route be pursued.***
- ***For the two main groups of labourers compounds, (S29°48'33.45" E30°45'13.23" and S29°48'35.35" E30°44'33.81") it is suggested that even though these structures do not fall within the ambit of the KwaZulu-Natal Provincial Heritage Act no 4 of 2008, there is opportunity for reuse of what are, at face value, solid and well designed buildings.***
- ***For two of the Estate Management Cottages (S29°48'30.57" E30°44'44.11") and S29°48'06.62" E30°44'33.74"), it is recommended that the established gardens be retained where possible, as they add to the footprint of history.***
- ***For the site of the ruin by the Umhlatuzana River (S29°47'55.18" E30°45'00.30"), it is recommended that during any bush clearing and excavation, an archaeologist is present in a monitoring capacity.***

Archaeological heritage

- ***There is little remnant on the property of any archaeological value, given the extent and period over which the land has been disturbed. There is, however, concrete evidence of Middle Stone Age occupation at the Mhlatuzana Shelter, close to the site.***
- ***There are 3 known graves on the site at GPS co-ordinates S29° 48.166'; E30° 43.930'. All graves have high heritage significance and are protected in terms of legislation. In the process of ongoing development of the property it is possible that further human remains may be exposed, and these must be addressed appropriately according to age.***

B Report on the buildings, structures, and historical landscape at Shongweni Estates

---

B1. Introduction:

Debbie Whelan of Archaic Consulting is the lead investigator in this assessment, assisted by Len van Schalkwyk and Elizabeth Wahl from eThembeni Cultural Heritage.

This section of the document deals primarily with the built and historical environment, and the archaeology section will follow in the second part.

B2. Methodology:

Prior to visiting the site, an aerial survey was conducted using both Google Earth and the 1937 aerial photograph of the area in order to pinpoint sites of interest. The aerial photograph (see Fig 3) shows extensive planting of timber. This was supported by the Land Registers which show the Durban and County Wattle Company purchasing up large tracts of land on these farms from the turn of the 20th century. This established that there was little in the way of built structure apart from the main Waterfall farmhouse, which existed at that point in time.

On the 10th April 2012, Debbie Whelan from Archaic Consulting conducted a site inspection of the Shongweni Estate lands, in agreement with the Estates Manager, Mr. Ryan Holmes. This was carried out in the form of inspecting pre-identified areas from Google Earth and the 1937 aerial photograph, as well as identifying any modifications or structures *in situ*. Areas consisting of clumps of established trees were checked for ruins.

The information garnered in the land registers offered search terms for archival research and this was carried out at the Provincial Archives Repository in Pietermaritzburg, there being little of import on the database for the Durban Archives Repository. Given the dearth of publications in this district on the early history, the two known works 'Pioneer's Progress' (O'Keefe 1988) and Lest We Forget' (Camp 1999) were consulted. In addition, the books associated with the railroad, particularly 'Twentieth Century Impressions of Natal' (Lloyds, 1906) were also consulted.

This report covers the inspection of all aspects of the built environment, and assesses them in terms of their heritage value. It is to be noted that Archaic Consulting also inspected the site of Delville Wood Station, in order to establish any value in the associated railway tunnels, despite the fact that this is not situated on Tongaat Hulett Shongweni Estate Property.

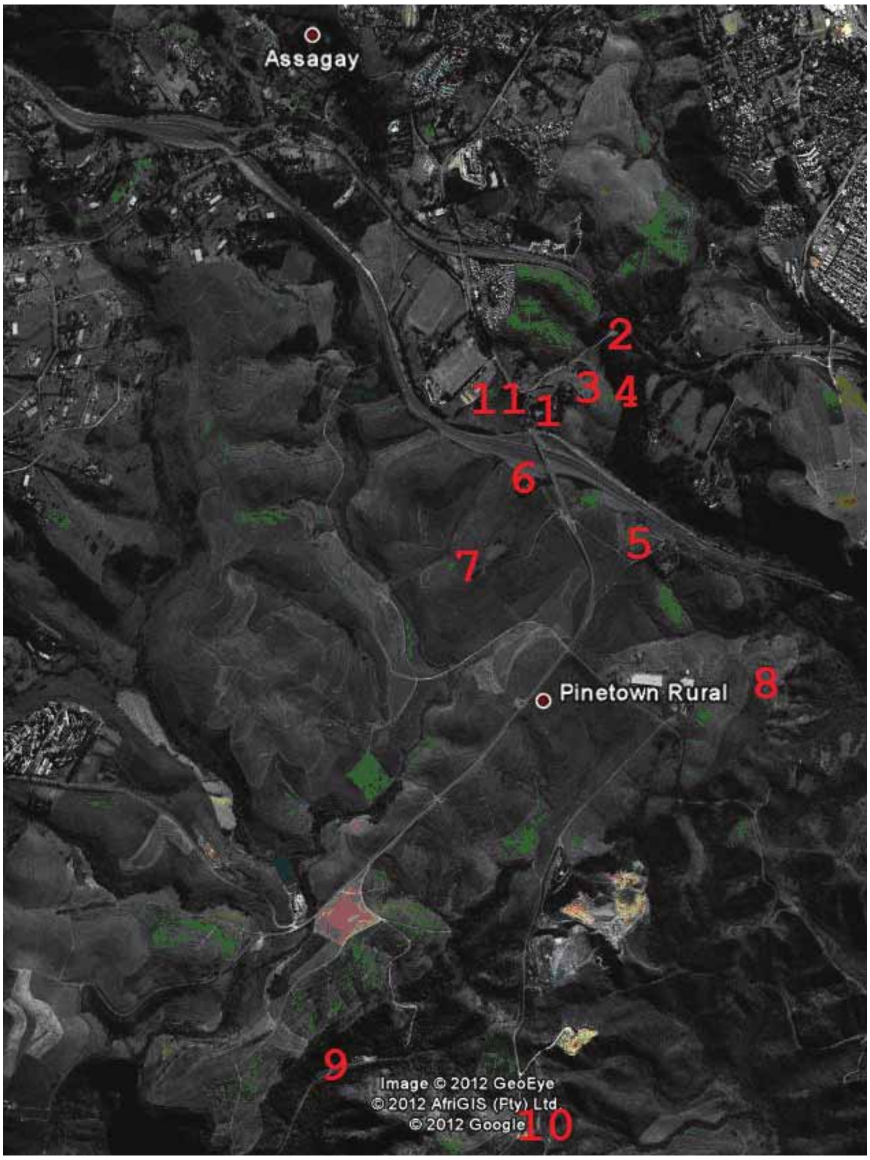

Fig 1: Sites identified for discussion

1: Waterfall Farmhouse- currently Tongaat Hulett Headquarters
2: Site of ruin by Umhlatuzana River
3: Estate Management House 1
4: 2 Labour Cottages
5: Full time labour cottages
6: Estate Management House 2
7: Seasonal Labour compound
8: Fire Lookout tower
9: Delville Wood Station
10: Signal Tower
11: Estate Management House 3

B3. Executive Summary

Of all of the architectural sites and historic structures which comprise the Shongweni Estates, little is of profound heritage status. However, the following must be noted:

- ***The historical landscape is inevitably tied with the production of mono-crops, and its associated labour compounds, and central homestead. Its primary association is with a single family, the McIntoshes, who started the Durban County Wattle Syndicate, and in whose name it remained until the 1960s.***
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- ***However, even though the house has lost much of its architectural appeal, there is little left in the Hillcrest area which fully represents buildings of this period. There is thus an opportunity for reuse of the farmhouse. This would be better served removing the accretions, namely the enclosed portico to the south west, the extended veranda and the addition to the south, in order to arrive at a more compact, architecturally pleasing structure. More research needs to be carried out on the house in this regard. Furthermore, given the topophiliac quality of the garden, it is recommended that this be retained in any new development. It is recommended that the outbuildings associated directly with the farmhouse be demolished should this route be pursued.***
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- ***For two of the Estate Management Cottages (S29°48'30.57" E30°44'44.11") and S29°48'06.62" E30°44'33.74"), it is recommended that the established gardens be retained where possible, as they add to the footprint of history.***
- ***For the site of the ruin by the Umhlatuzana River (S29°47'55.18" E30°45'00.30"), it is recommended that during any bush clearing and excavation, an archaeologist is present in a monitoring capacity.***

B4. Background to the properties:

4.1 History

The parent farms which make up the contemporary landholdings of the Tongaat Hulett Shongweni Estate consist of the large properties Waterfall and Kirkman, as well as portions of Albinia. Most of the landholdings are part of those originally purchased/ created by Joseph McIntosh, Byrne Settler, who had business interests in the Durban County Wattle Syndicate. James McIntosh had arrived from Scotland in 1869 and first purchased Kirkman. Camp (1999:27) notes that it was a well-known farm in the early 20th century, and was renamed 'Waterfall' due to the two 'magnificent' falls on the Umhlatuzana River within its boundaries.

Kirkman 915 was a 2273 acre farm granted to Joseph Kirkman in 1850. He sold this to Clement John Hill in 1874 who created a subdivision of 1815 acres, Sub A which was sold to James McIntosh in 1880. This forms part of the Kirkfalls property. Waterfall 948 was a 3388 acre grant to Francis Collison in 1851. He sold this to James McIntosh in 1880, and in 1907 it was registered in the name of the Durban County Wattle Syndicate, of which McIntosh was a major shareholder. Of this, in 1919 the Subdivision Delville Wood Station of 10 acres was created and sold to Durban Corporation. Other subdivisions were excised, for the rail and road access, and in 1958, the Remainder of Waterfall was transferred to Durban County Wattle Syndicate Ltd, and consolidated into Kirkfalls.

Subdivision A of Albinia, to the north was also an early allotment. It was part of a much larger farm originally granted to James Harrison in 1867. This was sold to William Gillitt in 1879, and remained reasonably intact for some time, until the railway came through at the turn of the 20th century and Subdivisions NGR and NGR2 were created in 1901 and 1906 respectively. Notably, the Subdivision 'Hillcrest' forming the core of the current day town was allotted to a number of members of the Gillitt family, and Subdivision A was transferred into the name of Albert Edward Gillitt. William Gillitt had died in 1899 and it took some time before his Estate was wound up.[1] Subdivision A of Albinia appears to have remained relatively undeveloped, as the 1937 aerial photograph in Fig 3 shows. However, the Land Registers show many land transactions and ultimately, the contemporary description, 491 of 3 of Albinia consisting of 267 acres was transferred into his Deceased Estate in the early 1960s.

Other points of interest are the purchase of lands around Summerveld by the Berlin Missionaries in 1894, who sold it to the Durban County Wattle Syndicate in 1930. Other land transactions show increasing use for equine sports and training, establishing the Jockey Academy and the Polo Grounds. In 1969 land was transferred for the Polo Pony Hotel.

1958 appears as a landmark year with consolidation of lands forming Kirkfalls and Summerveld by the Durban County Wattle Syndicate. It is known that at this point, wattle was becoming increasingly unprofitable due to the increase in the manufacture and sophistication of plastics post- World War II. It is suspected that large tracts of the original wattle plantations were put under cane from this time onwards.

A small sliver of land falls adjacent to Subdivision A of Albinia. Although little of significance is found towards the Kirkman farm area, this farm known as Botha's Half Way House was a grant of 310 acres to Cornelius Botha. O'Keefe describes Cornelius Botha as a runaway serving on British merchant ships. He captained the Eleanor, which was eventually wrecked off Durban Bay in 1839. A recipient of land grants by the Dutch Volksraad, he was also an appointed assistant magistrate, and turned his hand to many other pursuits. He took over the accommodation rooms known as Elliot's Albany Hotel at the foot of Botha's Hill in 1847, running it sporadically until it was let to JF Smith (O'Keefe 1988:91). In 1876 this property was transferred to Elizabeth Cato, and to John Coote Field in the same year. In 1886 it was purchased by William Gillitt, and Subdivision A was registered in the name of Albert Gillitt. The Land Register notes that in 1912 the Durban (Natal) Wattle Company Ltd purchased the Remainder from William Gillitt.

[1] MSCE 0 45/18

4.2 Historical Landscape

The land in this area being well watered and reasonably sheltered resulted in it being favourable for settlement from early on. These aspects are discussed in the accompanying Archaeological Report by eThembeni Cultural Heritage in section C.

For the European settlers, it is evident that it was similarly desirable land: in this instance it was close to the port at Durban and therefore any markets, but also close to the Durban-Pietermaritzburg wagon road which tracked up Botha's Hill. From a farming/agricultural perspective there is not much evidence of its use in farming early on, particularly borne out by the fact that McIntosh was a transport rider, and a successful one at that. Many early settlers turned their hands to such pursuits as the land, climate and soils were unfamiliar and difficult to make productive. This is possibly why McIntosh moved so intensively into wattle at the turn of the 20th century, making it one of the largest wattle plantations in the district. The move to sugar was inevitable, and occurred consistently across the province from the end of the 1950s onwards, once the wattle and general timber price had slumped in the face of more practical and enduring plastic goods.

For the homestead, it is most likely that the core of the building was constructed around 1880 when James McIntosh purchased Subdivision A. Its access was not along the current Shongweni Road, but rather dipped down from the centre of Hillcrest beyond where the present day Heritage Centre is situated (See fig 2).

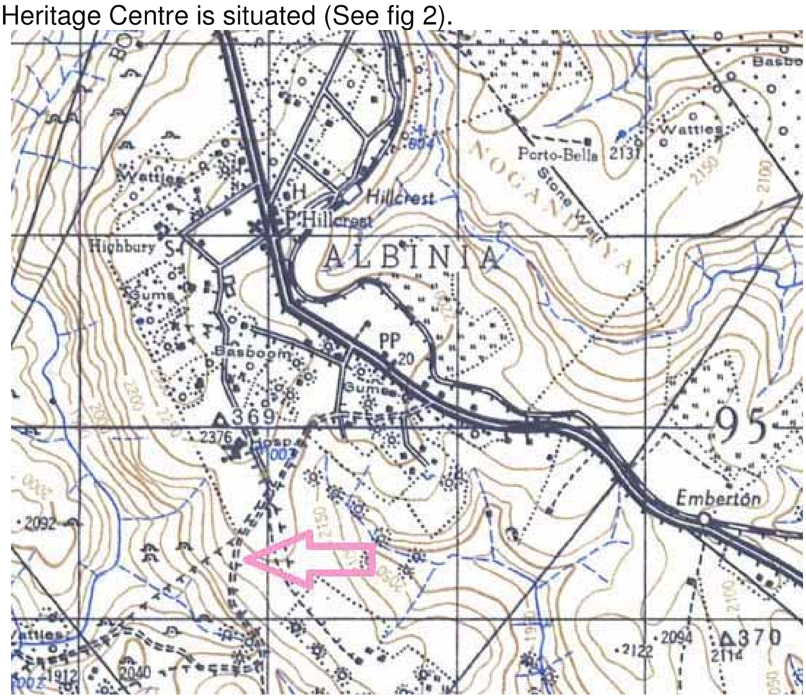

Fig 2: 1940 Topocadastral map 2930DD2931CC showing dotted tracks off towards Waterfall farm.

> *'The hospitality of Waterfall Farm was widely known, and over weekends between twenty and forty guests would arrive by carriage, and later by cars. The bowling green was the only one between Durban and Maritzburg, and amongst the well-known Natal tennis players who used the court, were Colin Robbins and Billy Tapscott. Mrs. McIntosh and friends played croquet, and there were picnics and walks through the beautiful fern-filled bush to the waterfalls. The huge garden was planted with palms and shrubs, the lovely Italian-tiled courtyard was the perfect place for roller-skating and parties.* (Camp 1999:29)

Summary: The historical landscape is inevitably tied with the production of mono-crops, and its associated labour compounds, and central homestead. Its primary association is with a single family, the McIntoshes, who started the Durban County Wattle Syndicate, and in whose name it remained until the 1960s.

B5. Architectural and historical assessment of sites

5.1: Waterfall Farmhouse- currently Tongaat Hulett Headquarters (S29°48'06.66" E30°44'51.40")

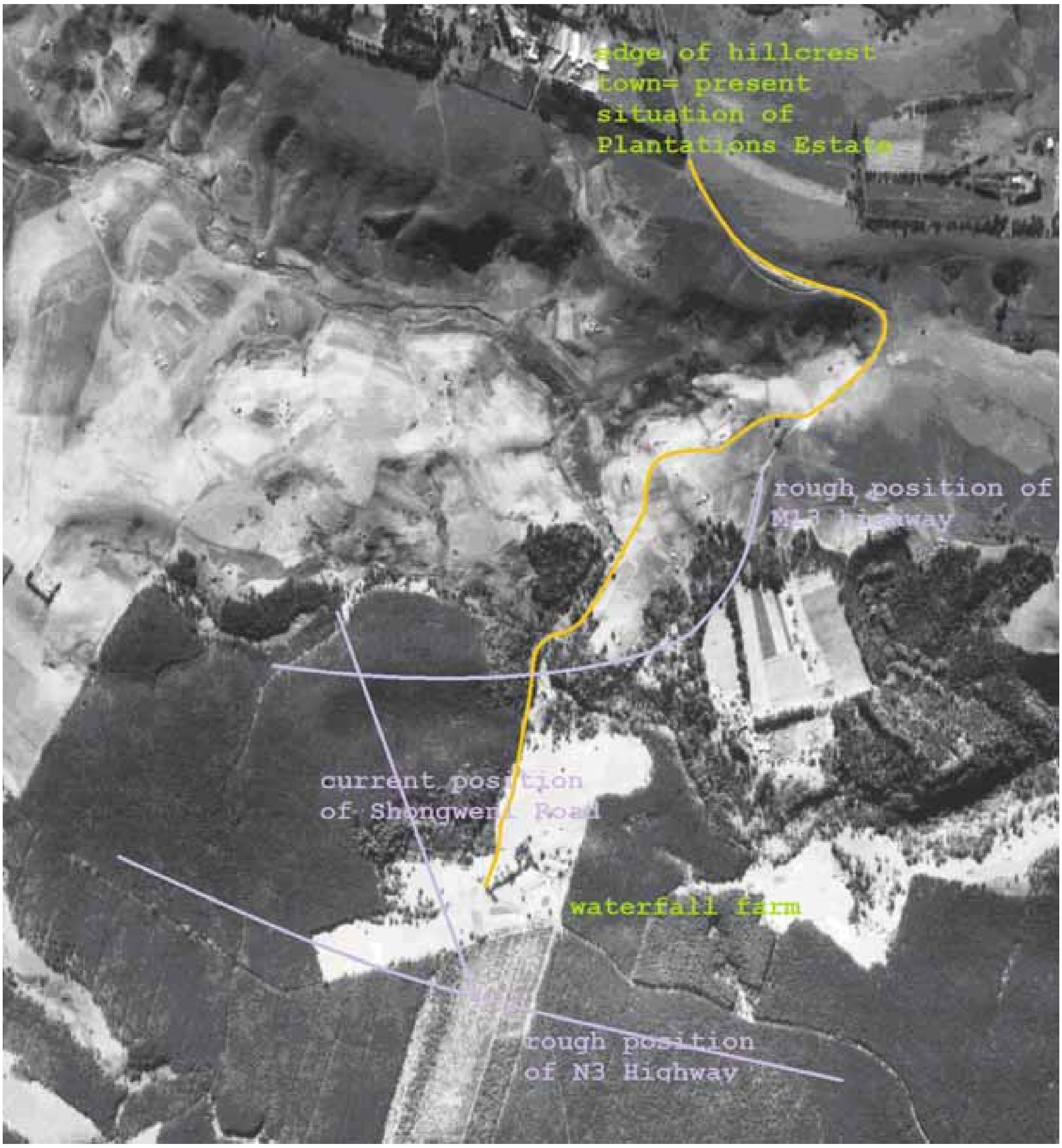

Fig 3: 1937 aerial photograph showing context of Waterfall farmhouse against its old access road (orange) and contemporary landmarks. Note intense afforestation.

Waterfall farmhouse[2] is currently situated between the M13 highway and the N3. It is located on a knoll overlooking the Mhlatuzana River to the east. The north-east facing homestead consists of a large, sprawling and much altered farmhouse, and sundry farm buildings, all enclosed by a fence. It is currently the home of the Estate Manager employed by Tongaat Hulett. After an inspection of the many structures on site, it was established that the only buildings of interest in this complex on this site is the old farmhouse house and the stock pen, and for expedience sake, these shall be discussed.

[2] Note that on the 1968 and 1989 topocadastral maps the farmhouse is known as 'Kirkfalls'.

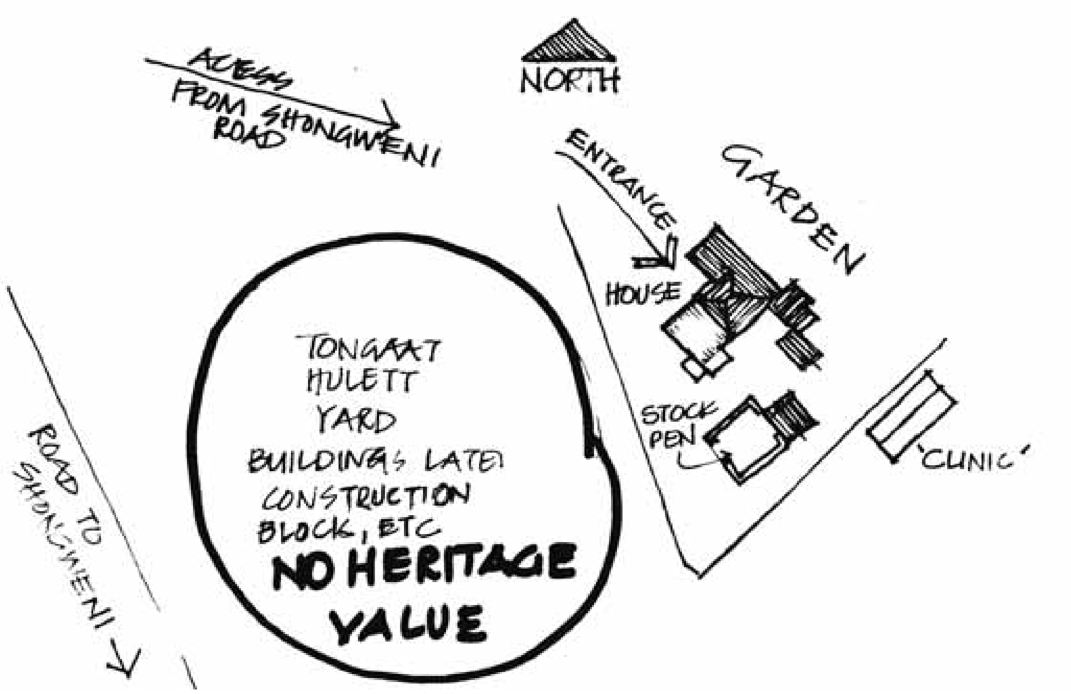

Fig 4: Schematic layout of site.

The house has little evidence of its age remaining. The core section of the house was most probably started in around 1880, but there are very few diagnostic features that support this. It is constructed most likely of brick and mortar, and has currently got a reasonably low pitched Holley Harvey tiled roof. Windows vary in age, style and material.

Fig 5: Entrance aspect to Waterfall Farmhouse

From the driveway the entrance is nondescript, possibly given the realignment of the Hillcrest Shongweni Road, removing the approach from the old road directly to the house. One is greeted with plastered walls containing meranti cottage pane windows.

The north-east façade has a long veranda facing onto the garden, with a section consisting of four Tuscan columns on top of two low slung brick walls that flank an entrance onto the veranda- oddly aligned with a window rather than a door. The veranda has been further extended, and enclosed with *louvres*, distorting the proportions and the integrity of the façade (See Fig 6).

Fig 6: North East Facade of Waterfall Farmhouse

Fig 7: South East Elevation showing accretions: A, B and C.

The South East façade is equally discombobulated. The addition marked A is in raked pointing and bagwashed with meranti windows. Addition B is a double pitched accretion onto the edge of the veranda and C is a little portico with stone columns which has been enclosed (See Fig 8).

Fig 8: Enclosed portico on double pitched addition to veranda.

Internally, the core of the house retains some of the elegance which it must have had. Panelled doors with fanlights, timber floors (under carpet) and timber ceilings exist in those parts of the house that have not been added to or modernized (see figs 9, 10 and 11).

Fig 9. Room currently used as a dining room

Fig 10: Lounge made up of two rooms

Fig 11: Passage through house from back to front. Fig 12: 'Stock pen'

Fig 13: Stock pen looking towards the house

The 'stock pen' is of random rubble and roughly cemented at a fall close to the house (see Fig 13). It is adjacent to a bagwashed structure of block (see fig 12). It is not certain exactly what function this structure played, given its proximity to the house. Certainly the family is known to have kept ponies, and, one would assume fowls and the like (Camp 1999:29).

Fig 14&15: Garden from the driveway

Fig 16: Garden from the driveway

Fig 17: Garden from the house

An important aspect of this property is not so much the house, but the quality of the garden, which, certainly was lauded in the past as seen in the earlier quote from Camp's book. The garden has been well maintained, and provides a strong sense of place around the home.

Waterfall farmhouse **Age: parts over 60 years**	**Local**	**Regional**	**National**	**International**
Architectural	low	low	low	low
Historical	medium	low	low	low
Social	medium	low	low	low
Technical	low	low	low	low
Scientific	low	low	low	low

Summary: The house at Waterfall Farm and the associated outbuildings have minimal architectural, technical and scientific value. The farmhouse has medium historical and social value, given its association with both James McIntosh and the Durban County Wattle Syndicate.

Even though the house has lost much of its architectural appeal, there is little left in the Hillcrest area which fully represents buildings of this period. There is thus an opportunity for reuse of the farmhouse. This would be better served removing the accretions, namely the enclosed portico to the south west, the extended veranda and the addition to the south, in order to arrive at a more compact, architecturally pleasing structure. More research needs to be carried out on the house in this regard. Furthermore, given the topophiliac quality of the garden, it is recommended that this be retained in any new development. It is recommended that the outbuildings associated directly with the farmhouse be demolished should this route be pursued.

Mitigation: Reuse House, Retain garden, demolish outbuildings

5.2: Site of ruin by Umhlatuzana River (S29°47'55.18" E30°45'00.30")

Identified by large and established *Bouganvilla sp.* the building that stood in its place was allegedly demolished about 15 years ago (Stroud pers.comm). Given that this was positioned on the old road to Hillcrest, this could have had some value. Nothing further is known about it at this point. It is recommended that during any bush clearing and excavation, an archaeologist is present in a monitoring capacity.

Fig 18: Site of demolished building

Demolished building **Age: unknown**	**Local**	**Regional**	**National**	**International**
Architectural	low	low	low	low
Historical	low	low	low	low
Social	low	low	low	low
Technical	low	low	low	low
Scientific	low	low	low	low

Mitigation: It is recommended that during any bush clearing and excavation, an archaeologist is present in a monitoring capacity.

5.3: Estate Management House 1 (S29°48'03.47" E30°44'52.30")

This property was securely fenced and inaccessible. However, it could be seen from its access road, and similar to the property in section 5.6, was difficult to photograph given its position deep onto the site and heavy vegetation. Thus, a photograph is not included.

This is a ranch style suburban building of conventional construction and materials. It is of recent construction, possibly late 1960's to early 1970's. It has no architectural merit and is of similar ilk to the house described in section 5.6.

Estate Management House 1 **Age: circa 1960s/1970s**	**Local**	**Regional**	**National**	**International**
Architectural	low	low	low	low
Historical	medium	low	low	low
Social	medium	low	low	low
Technical	low	low	low	low
Scientific	low	low	low	low

Mitigation: None

5.4: Pair of Labour Cottages (S29°48'04.73" E30°44'56.08")

These two cottages are located close to the main farmhouse beyond the Estate Management House number 1. They are in a similar architectural mould as the Full-time labour cottages in section 5.5, and are situated on an upper and a lower terrace. They have Marseilles tiled roofs, are bagged and painted, and have standard steel section windows. Half-moon awnings have been positioned over the entrance ways.

The buildings are modest and well considered, well maintained, and are good examples of a labour village idiom. It is suspected that they were constructed in the 1960s, after the consolidation of Kirkfalls.


Fig 19 and 20: Labour cottages

Pair of labour cottages **Age: circa 1960s**	**Local**	**Regional**	**National**	**International**
Architectural	low	low	low	low
Historical	low	low	low	low
Social	low	low	low	low
Technical	low	low	low	low
Scientific	low	low	low	low

Mitigation: None

5.5: Full time labour cottages (S29°48'33.45" E30°45'13.23")

This is a large complex of cottages used to house the full-time labour, constructed possibly in the 1960s and then in the 1970s. It consists of two sections on terraces.

The upper section has slightly larger accommodation and is constructed in much the same manner as the pair of cottages in 5.4 above, indeed they are most likely contemporaneous. The buildings consist of a couple of large flats in a single structure constructed of brick and painted bagwash. The roof is Marseilles tiled and the windows and doors are all standard stock items. As with the two units in 5.4, the entrances have a half-moon canvas awning above them, are similar modest but well- proportioned and considered buildings.

The structures on the lower terraces are smaller flatlets, most likely constructed at a later date. They are of face brick, with end gables under Marseilles tiles. There is a small patio at the entrance to each complex unit with a decorative low *stoep* wall defining space. As before, these structures are well designed and very good examples of a labour village.

Labour villages are an important part of the history of KwaZulu-Natal and it is important that there is some record as to their contribution in the labour history of the province. It is suggested that even though these structures do not fall within the ambit of the KwaZulu-Natal Provincial Heritage Act No 4 of 2008, there is opportunity for reuse of what are, at face value, solid and well designed buildings.

Fig 21 & 22: Labour cottages on upper terrace

Fig 23: Labour cottage on upper terrace

Fig 24: Labour cottage on lower terrace

Fig 25 &26: Cottages on lower terrace

Full time labour cottages **Age: 1960's-1970's**	**Local**	**Regional**	**National**	**International**
Architectural	medium	low	low	low
Historical	low	low	low	low
Social	medium	medium	low	low
Technical	low	low	low	low
Scientific	low	low	low	low

Mitigation: None – ***However, It is suggested that even though these structures do not fall within the ambit of the KwaZulu-Natal Provincial Heritage Act no 4 of 2008, there is opportunity for reuse of what are, at face value, solid and well designed buildings.***

5.6: Estate Management House 2 (S29°48'30.57" E30°44'44.11")

This property was securely fenced and inaccessible. However, it could be seen from its access road, and similar to the property in section 5.3, was difficult to photograph given its position deep onto the site and heavy vegetation. Thus, a photograph is not included.

This is a ranch style suburban building of conventional construction and materials. It is of recent construction, possibly late 1960's to early 1970's. It has no architectural merit and is of similar ilk to the house described in section 5.3. Note, however, that this house is situated in a well-established garden.

Fig 27: Estate management house 2

Estate management house 2 **Age: 1960's-1970's**	**Local**	**Regional**	**National**	**International**
Architectural	low	low	low	low
Historical	low	low	low	low
Social	low	low	low	low
Technical	low	low	low	low
Scientific	low	low	low	low

Mitigation: Possibility to retain garden

5.7: Seasonal Labour compound (S29°48'35.35" E30°44'33.81")

As with the Labour compound in 5.5 above, this compound is also well appointed and slightly elevated, and situated in the middle of the cane fields. It consists of a number of buildings, arranged around a series of courtyard spaces, with established trees in and around these courtyards. There is a football field to the north east of it.

Fig 28 &29: Courtyard in seasonal labour compound

The buildings themselves are utilitarian, constructed out of stretcher bond brickwork, bagged and rule jointed with steel section standard windows, and 'Big Six' asbestos sheeting. Flippant elements of Modernism such as *brise soliel* and screens add privacy. Rooms lead onto the courtyards which assist in constructing a strong sense of place. As with the Full-time labour compound, this complex provides an opportunity for reuse.

Fig 30: Edge from the access road

Fig 31: Courtyard

Seasonal labour compound **Age: 1960s?**	Local	Regional	National	International
Architectural	low	low	low	low
Historical	low	low	low	low
Social	medium	medium	low	low
Technical	low	low	low	low
Scientific	low	low	low	low

Mitigation: None - ***However, It is suggested that though these structures do not fall within the ambit of the KwaZulu-Natal Provincial Heritage Act no 4 of 2008, there is opportunity for reuse of what are, at face value, solid and well designed buildings.***

5.8: Fire Lookout tower (S29°49'00.78" E30°45'33.71")

This is a circular tower of mixed construction visible from the N3 and situated adjacent to the Ntabankulu trigonometric beacon on top of the hill. It is apparently an old structure, which has been much altered in the past (Stroud: pers.comm). It is suspected that given its inaccessible position, it is generally safe from development, thus retaining its landmark quality.

Fig 32: Fire Lookout tower

Fire Lookout tower **Age: unknown**	Local	Regional	National	International
Architectural	low	low	low	low
Historical	low	low	low	low
Social	medium	low	low	low
Technical	low	low	low	low
Scientific	low	low	low	low

Mitigation: None.

5.9: Delville Wood Station (S29°50'02.69" E30°44'09.74")

Although this property is not part of the Shongweni Estates, it was subjected to cursory inspection bearing in mind the railway line and it's associated tunneling.

The railway tracks came through this area in the early 1920s. Significantly the blasting and tunneling made an impression on local residents, as noted by Camp in her work on the area (Camp 1999:29). However, little of any import remains as the current tunnel is dated to 1974 and the station is reduced to an electrical substation. A single element of its history exists in the square concrete structure in Fig 34 below, possibly used as a reservoir in the past.

Fig 33: Tunnels dated to 1974

Fig 34: Possible reservoir

Delville station and surrounds Age: 1960's-1970's	**Local**	**Regional**	**National**	**International**
Architectural	low	low	low	low
Historical	low	low	low	low
Social	low	low	low	low
Technical	low	low	low	low
Scientific	low	low	low	low

Mitigation: None

5.10: Microwave Tower

This is a steel framed tower of recent construction and function in the middle of canelands on the descent to Shongweni. At its base is a small, nondescript and utilitarian plant room constructed of stretcher bond brickwork. This has no architectural nor heritage value.

Fig 35: Microwave tower

Microwave tower Age: 1980's?	Local	Regional	National	International
Architectural	low	low	low	low
Historical	low	low	low	low
Social	low	low	low	low
Technical	low	low	low	low
Scientific	low	low	low	low

Mitigation: None

5.11: Estate Management House 3 (S29°48'06.62" E30°44'33.74")

This is a ranch style suburban building of conventional construction and materials. It is of recent construction, possibly late 1960's to early 1970's. It has no architectural merit and is of similar ilk and period to the houses described in section 5.3 and 5.6. It is, however, set in a well- established and maintained garden.

Fig 36: House 3 from drive

Fig 37: House 3 from garden

Estate management house 3 Age: 1960's-1970's	Local	Regional	National	International
Architectural	low	low	low	low
Historical	low	low	low	low
Social	low	low	low	low
Technical	low	low	low	low
Scientific	low	low	low	low

Mitigation: Possibility to retain garden.

B6. References

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Personal Communications:

Mr DJ Tuttle, Kloof
Mr Bob Stroud, Tongaat Hulett
Mrs. Elizabeth Camp

Archival Information:

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PM 73 1908/644 J McIntosh , Waterfall Hill Crest . Deputation of Durban county voters wish to interview government regarding division of Durban County into electoral wards

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PVS 118 2753/1909 J McIntosh Waterfall, Hill Crest. Reporting an alleged outbreak of East Coast Fever on Berlin Mission Lands.

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II 1/127 I1219A/1904 HG Davidson, Waterfall Farm, Hillcrest: Concerning the Indian CV Chathu who went astray.

3/DBN 4/1/2/1209 457 Railway Sidings: No 249 Power-Station No 475 Greyville No 325 Camp Siding No 527 Berea Road No 405 General Stores Berea No 594 Umbilo Store Depot No 502 Delville Wood No 264 Northdene.

3/DBN 4/1/3/1679 457 Railway Sidings. No 249 Power Station No 325 Camp Siding No 405 General Stores-Berea Road No 394 Umbilo Stone Depot No 502 Delville Wood No 264 Northdene No 475 Greyville No 527 Berea Road.

MSCE 0 45/18 Gillitt, William. (S/SP Gillitt, Elizabeth Catrina Helena).

C Report on the Archaeological Resources at Shongweni Estates

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C1. Introduction and methodology:

eThembeni Cultural Heritage inspected the property on 08 and 09 May 2012 and subsequently assessed the study area by close Google Earth scrutiny.

C2. Executive Summary

- ***There is little remnant on the property of any archaeological value, given the extent and period over which the land has been disturbed. There is, however, concrete evidence of Middle Stone Age occupation at the Mhlatuzana Shelter, close to the site.***
- ***There are 3 known graves on the site at GPS co-ordinates S29° 48.166'; E30° 43.930'. All graves have high heritage significance and are protected in terms of legislation. In the process of ongoing development of the property it is possible that further human remains may be exposed, and these must be addressed appropriately according to age.***

C3: General Archaeological Remains

The study area has been subjected to over a century of agricultural activity, primarily wattle production and latterly sugar cane. These activities have largely taken place on land with medium to gentle slopes. Some steeper valley sides were contoured and planted to wattle. Many of these are currently covered with feral eucalyptus stands.

The consequence of these historically more recent agricultural activities has been the complete removal of any Late Iron Age archaeological footprint. Random pot shard fragments observed during the field inspection attest to a Late Iron Age presence. However, such settlements would have been located on the medium and gentler slopes above the incised valleys of the Mhlathuzana and Mlazi drainage basins. It is these same areas that have been subjected to successive episodes of land clearance and ploughing with the consequent removal of any discrete Iron Age archaeological remains.

Archeological remnant	Local	Regional	National	International
Archaeological remains	low	low	low	low
Historical	low	low	low	low
Social	low	low	low	low
Technical	low	low	low	low
Scientific	low	low	low	low

Mitigation: None necessary

Mhlathuzana Shelter (29°48.505'S; 30°45.400'E) is located at the base of a sandstone cliff face within the Mhlathuzana River valley. The shelter contains a significant Middle Stone Age deposit that was excavated and described by Kaplan (1988). Whilst the site can be accessed off the Tongaat Hulett property it falls outside of the boundary and within the surveyed road reserve of the N3.

Summary: There is little remnant on the property of any archaeological value, given the extent and period over which the land has been disturbed. There is, however, concrete evidence of Middle Stone Age occupation at the Mhlatuzana Shelter, close to the site.

C4. Graves and their implications

A grave site with three burials is recorded on the property at S29° 48.166'; E30° 43.930'. The location of the graves was provided to eThembeni from the Tongaat Hulett Graves and Cemeteries Data Base. Field inspection places these on the edge a thicket of uncultivated land above the dam adjacent to the N3. The graves are those of Nkunzi Mgwaba (died 1959), Anelia Mgwaba (died 1971) and a child that died 1965.

Fig 1: Showing grave sites superimposed on Google Earth

All graves have high heritage significance and are protected in terms of legislation. In the process of ongoing development of the property it is possible that further human remains may be exposed. The following legal guidelines are appended (see Appendix CI).

Graves	**Local**	**Regional**	**National**	**International**
Archaeological	high	low	low	low
Historical	low	low	low	low
Social	high	low	low	low
Technical	low	low	low	low
Scientific	low	low	low	low

Mitigation: removal and reburial through appropriate consultative process – note graves younger than 60 years - protocol as per 'The Vermillion Accord on Human Remains' (see Appendix C2)

Summary: There are 3 known graves on the site at GPS co-ordinates S29° 48.166'; E30° 43.930'. All graves have high heritage significance and are protected in terms of legislation. In the process of ongoing development of the property it is possible that further human remains may be exposed, and these must be addressed appropriately according to age.

C5. Appendices

Appendix C1 Management of Graves and Burial Grounds

- **Graves younger than 60 years** are protected in terms of Section 2(1) of the Removal of Graves and Dead Bodies Ordinance 7 of 1925 as well as the Human Tissues Act 65 of 1983. Such graves 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 Member of the Executive Council for Local Government and Planning, or in some cases the MEC for Housing and Welfare.

  Authorisation for exhumation and reinterment 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. In order to handle and transport human remains the institution conducting the relocation should be authorised under Section 24 of the Human Tissues Act 65 of 1983.

- **Graves older than 60 years situated outside a formal cemetery administered by a local authority** are protected in terms of Section 36 of the NHRA as well as the Human Tissues Act of 1983. Accordingly, such graves are the jurisdiction of SAHRA. The procedure for Consultation Regarding Burial Grounds and Graves (Section 36(5) of NHRA) is applicable to graves older than 60 years that are situated outside a formal cemetery administrated by a local authority. Graves in the category located inside a formal cemetery administrated by a local authority will also require the same authorisation as set out for graves younger than 60 years over and above 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.

The **protocol for the management of graves older than 60 years situated outside a formal cemetery administered by a local authority** is detailed in Section 36 of the NHRA:
(3) *(a)* No person may, without a permit issued by SAHRA or a provincial heritage resources authority—
(a) destroy, damage, alter, exhume or remove from its original position or otherwise disturb the grave of a victim of conflict, or any burial ground or part thereof which contains such graves;
(b) destroy, damage, alter, exhume, remove from its original position or otherwise disturb any grave or burial ground older than 60 years which is situated outside a formal cemetery administered by a local authority; or
(c) bring onto or use at a burial ground or grave referred to in paragraph *(a)* or *(b)* any excavation equipment, or any equipment which assists in the detection or recovery of metals.
(4) SAHRA or a provincial heritage resources authority may not issue a permit for the destruction or damage of any burial ground or grave referred to in subsection (3)*(a)* unless it is satisfied that the applicant has made satisfactory arrangements for the exhumation and re-interment of the contents of such graves, at the cost of the applicant and in accordance with any regulations made by the responsible heritage resources authority.
(5) SAHRA or a provincial heritage resources authority may not issue a permit for any activity under subsection (3)*(b)* unless it is satisfied that the applicant has, in accordance with regulations made by the responsible heritage resources authority—
(a) made a concerted effort to contact and consult communities and individuals who by tradition have an interest in such grave or burial ground; and
(b) reached agreements with such communities and individuals regarding the future of such grave or burial ground.
(6) Subject to the provision of any other law, any person who in the course of development or any other activity discovers the location of a grave, the existence of which was previously unknown, must immediately cease such activity and report the discovery to the responsible

heritage resources authority which must, in co-operation with the South African Police Service and in accordance with regulations of the responsible heritage resources authority—
(a) carry out an investigation for the purpose of obtaining information on whether or not such grave is protected in terms of this Act or is of significance to any community; and
(b) if such grave is protected or is of significance, assist any person who or community which is a direct descendant to make arrangements for the exhumation and re-interment of the contents of such grave or, in the absence of such person or community, make any such arrangements as it deems fit.

Appendix C2. The Vermillion Accord on Human Remains[3] (as adopted in 1989 at WAC Inter-Congress, South Dakota, USA)

1. Respect for the mortal remains of the dead shall be accorded to all, irrespective of origin, race, religion, nationality, custom and tradition.
2. Respect for the wishes of the dead concerning disposition shall be accorded whenever possible, reasonable and lawful, when they are known or can be reasonably inferred.
3. Respect for the wishes of the local community and of relatives or guardians of the dead shall be accorded whenever possible, reasonable and lawful.
4. Respect for the scientific research value of skeletal, mummified and other human remains (including fossil hominids) shall be accorded when such value is demonstrated to exist.
5. Agreement on the disposition of fossil, skeletal, mummified and other remains shall be reached by negotiation on the basis of mutual respect for the legitimate concerns of communities for the proper disposition of their ancestors, as well as the legitimate concerns of science and education.
6. The express recognition that the concerns of various ethnic groups, as well as those of science are legitimate and to be respected, will permit acceptable agreements to be reached and honoured.

Appendix C3. Statutory Requirements

General

The Constitution of the Republic of South Africa Act 108 of 1996 is the source of all legislation. Within the Constitution the Bill of Rights is fundamental, with the principle that the environment should be protected for present and future generations by preventing pollution, promoting conservation and practising ecologically sustainable development. With regard to spatial planning and related legislation at national and provincial levels the following legislation may be relevant:

- Physical Planning Act 125 of 1991
- Municipal Structures Act 117 of 1998
- Municipal Systems Act 32 of 2000
- Development Facilitation Act 67 of 1995 (DFA)
- KwaZulu-Natal Planning and Development Act 6 of 2008.

The identification, evaluation and management of heritage resources in South Africa is required and governed by the following legislation:

- National Environmental Management Act 107 of 1998 (NEMA)
- KwaZulu-Natal Heritage Act 4 of 2008 (KZNHA)
- National Heritage Resources Act 25 of 1999 (NHRA)
- Minerals and Petroleum Resources Development Act 28 of 2002 (MPRDA)

KwaZulu-Natal Heritage Act 4 of 2008 (KZNHA)

This Act is implemented by Amafa aKwaZulu-Natali/Heritage KwaZulu-Natal, the provincial heritage resources authority charged to provide for the conservation, protection and administration of both the physical and the living or intangible heritage resources of the province; along with a statutory Council to administer heritage conservation in the Province.

[3] http://www.worldarchaeologicalcongress.org/

National Heritage Resources Act 25 of 1999 (NHRA)

The NHRA established the South African Heritage Resources Agency (SAHRA) together with its Council to fulfill the following functions:

- co-ordinate and promote the management of heritage resources at national level;
- set norms and maintain essential national standards for the management of heritage resources in the Republic and to protect heritage resources of national significance;
- control the export of nationally significant heritage objects and the import into the Republic of cultural property illegally exported from foreign countries;
- enable the provinces to establish heritage authorities which must adopt powers to protect and manage certain categories of heritage resources; and
- provide for the protection and management of conservation-worthy places and areas by local authorities.

Heritage Impact Assessments

Section 38(1) of the NHRA may require a Heritage Impact Assessment in case of:
- the construction of a road, wall, power line, pipeline, canal or other similar form of linear development or barrier exceeding 300m in length;
- the construction of a bridge or similar structure exceeding 50m in length;
- any development or other activity which will change the character of a site—
  (i) exceeding 5 000m² in extent; or
  (ii) involving three or more existing erven or subdivisions thereof; or
  (iii) involving three or more erven or divisions thereof which have been consolidated within the past five years; or
  (iv) the costs of which will exceed a sum set in terms of regulations by SAHRA or a provincial heritage resources authority;
- the re-zoning of a site exceeding 10 000m² in extent; or
- any other category of development provided for in regulations by SAHRA or a provincial heritage resources authority.

Reports in fulfilment of NHRA Section 38(3) must include the following information:

- the identification and mapping of all heritage resources in the area affected;
- an assessment of the significance of such resources in terms of the heritage assessment criteria set out in regulations;
- an assessment of the impact of the development on such heritage resources;
- an evaluation of the impact of the development on heritage resources relative to the sustainable social and economic benefits to be derived from the development;
- the results of consultation with communities affected by the proposed development and other interested parties regarding the impact of the development on heritage resources;
- if heritage resources will be adversely affected by the proposed development, the consideration of alternatives; and
- plans for mitigation of any adverse effects during and after completion of the proposed development.

It is incumbent upon the developer or Environmental Practitioner to approach the South African Heritage Resources Agency (SAHRA) or Amafa to ascertain whether an HIA is required for a project; what categories of heritage resource must be assessed; and request a detailed motivation for such a study in terms of both the nature of the development and the nature of the environment. In this regard we draw your attention to Section 38(**2) of the NHRA which states specifically that 'The responsible heritage resources authority must … if there is reason to believe that heritage resources will be affected by such development, notify the person who intends to undertake the development to submit an impact assessment report'. In other words, the heritage authority must be able to justify a request for an Archaeological, Palaeontological or Heritage Impact Assessment.** The Environmental Practitioner may also submit information to **the heritage**

authority in substantiation of exemption from a specific assessment due to existing environmental disturbance, for example.

Definitions of heritage resources

The Act defines a heritage resource as any place or object of cultural significance i.e. of aesthetic, architectural, historical, scientific, social, spiritual, linguistic or technological value or significance. This includes, but is not limited to, the following wide range of places and objects:

- living heritage as defined in the National Heritage Council Act 11 of 1999 (cultural tradition; oral history; performance; ritual; popular memory; skills and techniques; indigenous knowledge systems; and the holistic approach to nature, society and social relationships);
- ecofacts (non-artefactual organic or environmental remains that may reveal aspects of past human activity; definition used in KwaZulu-Natal Heritage Act 2008);
- places, buildings, structures and equipment;
- places to which oral traditions are attached or which are associated with living heritage;
- historical settlements and townscapes;
- landscapes and natural features;
- geological sites of scientific or cultural importance;
- archaeological and palaeontological sites;
- graves and burial grounds;
- public monuments and memorials;
- sites of significance relating to the history of slavery in South Africa;
- movable objects, but excluding any object made by a living person; and
- battlefields.

Furthermore, a place or object is to be considered part of the national estate if it has cultural significance or other special value because of—

- its importance in 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; and
- its strong or special association with the life or work of a person, group or organisation of importance in the history of South Africa.

Archaeological means –

- material remains resulting from human activity which are in a state of disuse and are in or on land and are older than 100 years, including artefacts, human and hominid remains and artificial features and structures;
- rock art, being any form of painting, engraving or other graphic representation on a fixed rock surface or loose rock or stone, which was executed by human agency and is older than 100 years including any area within 10m of such representation;
- wrecks, being any vessel or aircraft, or any part thereof, which was wrecked in South Africa, whether on land, in the internal waters, the territorial waters or in the culture zone of the Republic, as defined respectively in sections 3, 4 and 6 of the Maritime Zones Act 15 of 1994, and any cargo, debris or artefacts found or associated therewith, which is older than 60 years or which SAHRA considers to be worthy of conservation;

– features, structures and artefacts associated with military history which are older than 75 years and the sites on which they are found.

Palaeontological means any fossilised remains or fossil trace of animals or plants which lived in the geological past, other than fossil fuels or fossiliferous rock intended for industrial use, and any site which contains such fossilised remains or trace.

A **place** is defined as:
– a site, area or region;
– a building or other structure which may include equipment, furniture, fittings and articles associated with or connected with such building or other structure;
– a group of buildings or other structures which may include equipment, furniture, fittings and articles associated with or connected with such group of buildings or other structures;
– an open space, including a public square, street or park; and
– in relation to the management of a place, includes the immediate surroundings of a place.

Public monuments and memorials means all monuments and memorials:
– erected on land belonging to any branch of central, provincial or local government, or on land belonging to any organisation funded by or established in terms of the legislation of such a branch of government; or
– which were paid for by public subscription, government funds, or a public-spirited or military organisation, and are on land belonging to any private individual.

Structures means any building, works, device or other facility made by people and which is fixed to land, and includes any fixtures, fittings and equipment associated therewith.

Management of Graves and Burial Grounds

– **Definitions**

Grave
The NHRA defines a grave as a place of interment and includes the contents, headstone or other marker of such a place, and any other structure on or associated with such a place. The KwaZulu-Natal Cemeteries and Crematoria Act 12 of 1996 defines a grave as an excavation in which human remains have been intentionally placed for the purposes of burial, but excludes any such excavation where all human remains have been removed.

Burial ground
The term 'burial ground' does not appear to have a legal definition. In common usage the term is used for management purposes to describe two or more graves that are grouped closely enough to be managed as a single entity.

Cemetery
The KwaZulu-Natal Cemeteries and Crematoria Act 1996 defines a cemetery as any place
(a) where human remains are buried in an orderly, systematic and pre-planned manner in identifiable burial plots;
(b) which is intended to be permanently set aside for and used only for the purposes of the burial of human remains.

– **Protection of graves and cemeteries**

No person may damage, alter, exhume, or remove from its original position any grave, as defined above, without permission from the relevant authority, as detailed in the following table.

Grave type	Relevant legislation	Administrative authority – disinterment	Administrative authority – reburial
Graves located within a formal cemetery administered by a local	KwaZulu-Natal Cemeteries and Crematoria Act 12 of 1996	National and / or Provincial Departments of Health	If relocated to formal cemetery – relevant local authority.

authority	Human Tissue Act 65 of 1983		
Graves younger than 100 years located outside a formal cemetery administered by a local authority and the graves of victims of conflict	KwaZulu-Natal Heritage Act 4 of 2008 Human Tissue Act 65 of 1983	Amafa aKwaZulu-Natali, the provincial heritage resources authority	If relocated to private or communal property – Amafa. If relocated to formal cemetery – Amafa and relevant local authority.

– **Procedures required for permission to disinter and rebury graves**

The procedure for consultation regarding burial grounds and graves (Section 36 of the NHRA) is applicable to all graves located outside a formal cemetery administrated by a local authority. The following extract from this legislation is applicable to this policy document:

SAHRA or Amafa may not issue a permit for any alteration to or disinterment or reburial of a grave unless it is satisfied that the applicant has, in accordance with regulations made by the responsible heritage resources authority—

> *(a)* made a concerted effort to contact and consult communities and individuals who by tradition have an interest in such grave or burial ground; and
> *(b)* reached agreements with such communities and individuals regarding the future of such grave or burial ground.

Any person who in the course of development or any other activity discovers the location of a grave, the existence of which was previously unknown, must immediately cease such activity and report the discovery to the responsible heritage resources authority which must, in co-operation with the South African Police Services and in accordance with regulations of the responsible heritage resources authority—

> *(a)* carry out an investigation for the purpose of obtaining information on whether or not such grave is protected in terms of this Act or is of significance to any community; and
> *(b)* if such grave is protected or is of significance, assist any person who or community which is a direct descendant to make arrangements for the exhumation and re-interment of the contents of such grave or, in the absence of such person or community, make any such arrangements as it deems fit.

C6. References:

Kaplan, J. 1990. The Umhlatuzana Rock Shelter sequence: 100000 years of Stone Age history. *Natal Museum Journal of Humanities* **2**: 1-94.

Websites:

http://www.worldarchaeologicalcongress.org/

APPENDIX 14:

ENVIRONMENTAL MANAGEMENT PROGRAMME

DRAFT ENVIRONMENTAL MANAGEMENT PROGRAMME

FOR THE CONSTRUCTION OF THE SHONGWENI RETIAL / MIXED-USE DEVELOPMENT WITIN THE ETHEKWINI LOCAL MUNICIPALITY (EIA no. DM/0003/2012)

NOVEMBER 2013

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Certifications: Certified by the Environmental Assessment Practitioners of South Africa (EAPSA)
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Certified GCX Carbon Footprint Analyst (Level 1)

Tertiary Education: University of Natal, Durban
BSc (Hons) - Estuarine Ecology (Major), Urban Biogeography (Ecology) (Major) *MSc awarded cum laude*
Environmental Management and Open Space Planning Thesis *"Developing an Open Space System for the Queensburgh Municipal Area"*

Work Experience: 1993-1994 Queensburgh Municipality - Unofficial Environmental Advisor for duration of MSc
1994-1995 IDEAS- Partner in Environmental Consultancy
1995-1998 Environment Branch, North and South Central Local Council- Professional Environmental Officer
1999 - present; Director Kerry Seppings Environmental Management Specialists cc.

Stephanie Williams BSc (Hons) MPhil **Lead Environmental Scientist**

Tertiary Education: University of Cape Town, Cape Town
BSc (Hons) - Botany (Major), Zoology and Ecology.
MPhil Marine and Environmental Law

Work Experience: 2012 Environmental Control Officer on the Transnet multi-purpose pipeline.
2012 – 2013; Environmental Consultant for Kerry Seppings Environmental Management Specialists cc
2013 - present: Lead Environmental Scientist for Kerry Seppings Environmental Management Specialists cc

Compiled by: Swilliams
Stephanie Williams

Reviewed by:
Kerry Seppings

CONTENTS

Acronyms

BID	BACKGROUND INFORMATION DOCUMENT
DAEA	DEPARTMENT OF AGRICULTURE AND ENVIRONMENTAL AFFAIRS
D'MOSS	DURBAN METROPOLITAN OPEN SPACE SYSTEM
DSW	DURBAN SOLID WASTE
DWA	DEPARTMENT OF WATER AFFAIRS
EAP	ENVIRONMENTAL ASSESSMENT PRACTITIONER
ECO	ENVIRONMENTAL CONTROL OFFICER
EIA	ENVIRONMENTAL IMPACT ASSESSMENT
EIR	ENVIRONMENTAL IMPACT REPORT
EMPR	ENVIRONMENTAL MANAGEMENT PROGRAMME
EPCPD	ENVIRONMENTAL PLANNING AND CLIMATE PROTECTION DEPARTMENT
ESR	ENGINEERING SERVICES REPORT
EWS	ETHEKWINI WATER SERVICES
HGM	HYDROGEOMORPHIC
I & AP	INTERESTED AND AFFECTED PARTY
IEM	INTEGRATED ENVIRONMENTAL MANAGEMENT
LAP	LOCAL AREA PLAN
NEMA	NATIONAL ENVIRONMENTAL MANAGEMENT ACT 107 OF 1998 AS AMENDED
NFEPA	NATIONAL FRESHWATER ECOSYSTEM PRIORITY AREAS
PCA	POST CONSTRUCTION AUDIT
RE	RESIDENT ENGINEER
SANRAL	SOUTH AFRICAN NATIONAL ROAD AGENCY LIMITED
SDP	SPATIAL DEVELOPMENT PLAN
SRA	SPECIAL RATING AREA
SUDS	SUSTAINABLE URBAN DRAINAGE SYSTEM
SWMP	STORMWATER MANAGEMENT PLAN
TIA	TRAFFIC IMPACT ASSESSMENT
THD	TONGAAT HULETT DEVELOPMENTS
URBAN-ECON	URBAN-ECON KZN (PTY) LTD

1. INTRODUCTION

1.1 BACKGROUND

Tongaat Hulett Developments (THD) propose facilitating the construction of a new Regional Retail Centre and other, associated, appropriate and compatible uses in the form of logistics, business park and service and light industry. The proposed site is located in Shongweni, eThekwini Municipality. The proposed development will be comprised of a variety of land uses which will be anchored by retail and supported by residential and office space, should the demand be sufficient to support such activities. The provision of green open space has also been incorporated into the various layout options. The proposed development aims to provide a new regional retail town centre in line with eThekwini Municipality's Strategic Development Plan (SDP) for the Outer West District and the Shongweni Local Area Plan (LAP). The activity also considers the environmental sustainability principles outlined in the Shongweni LAP by incorporating rehabilitated areas.

Three potential sites were identified within THD's extensive landholdings in the Ntshongweni area, south-west of Hillcrest. Site 2, located south of the N3 Highway and was identified as the preferred site environmental alternative (Figure 1). This Environmental Management Programme (EMPr) is therefore specific to site 2. The site is currently under sugarcane cultivation and therefore requires provisions for bulk service delivery. The effluent generated from the proposed development (approximately 0.4Ml/day to 1.4Ml/day) will be directed to the uMhlatuzana Sewage Treatment Works and bulk water (approximately 1.72Ml/day) will be supplied by a newly proposed water pipeline and associated reservoir located approximately 2.1km north-west of the site. In terms of electricity demands, a new 132/11kV, 60MVA major substation will be required to ultimately supply the site with 29.6MVA. This substation will be located directly south of the site (Figure 3 shows the service layout proposal).

The freshwater ecosystems located in site 2 drain into the Wekeweke Stream, a river identified as a National Freshwater Ecosystem Priority Areas (NFEPA). Green Open Space has been incorporated into the proposed layout aiming to minimise the impact on the water resources. It is a priority to control stormwater quality and quantity to protect the freshwater ecosystems and associated species further downstream of the proposed sites.

This EMPr includes the construction of a 5.6km bulk water pipeline originating from the Western Aquaduct (29°46'40.58"S; 30°45'08.40"E) and terminating at a proposed reservoir location (29°47'42.09"S; 30°43'33.63"E) as indicated in Figure 2 below. There are however 9 areas where the pipeline route will transect or boarder delineated watercourses. The 500mm diameter steel pipeline will travel within the Applicants property apart from where is crosses underneath three major roads, namely the N3 Highway, Kassier Road and the M13.

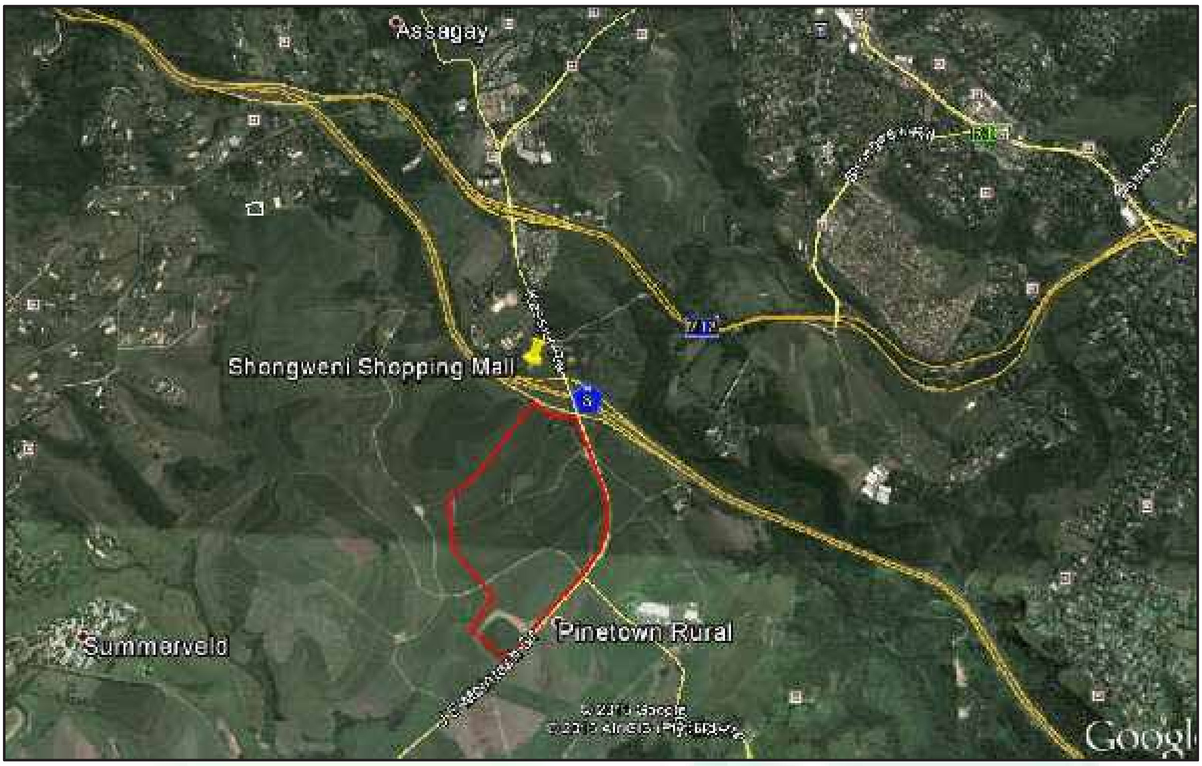


Figure 1: Aerial Photography of the proposed site, outlined in red, for the Shongweni Retail / Mixed Use Centre (source: Google Earth, 2013).

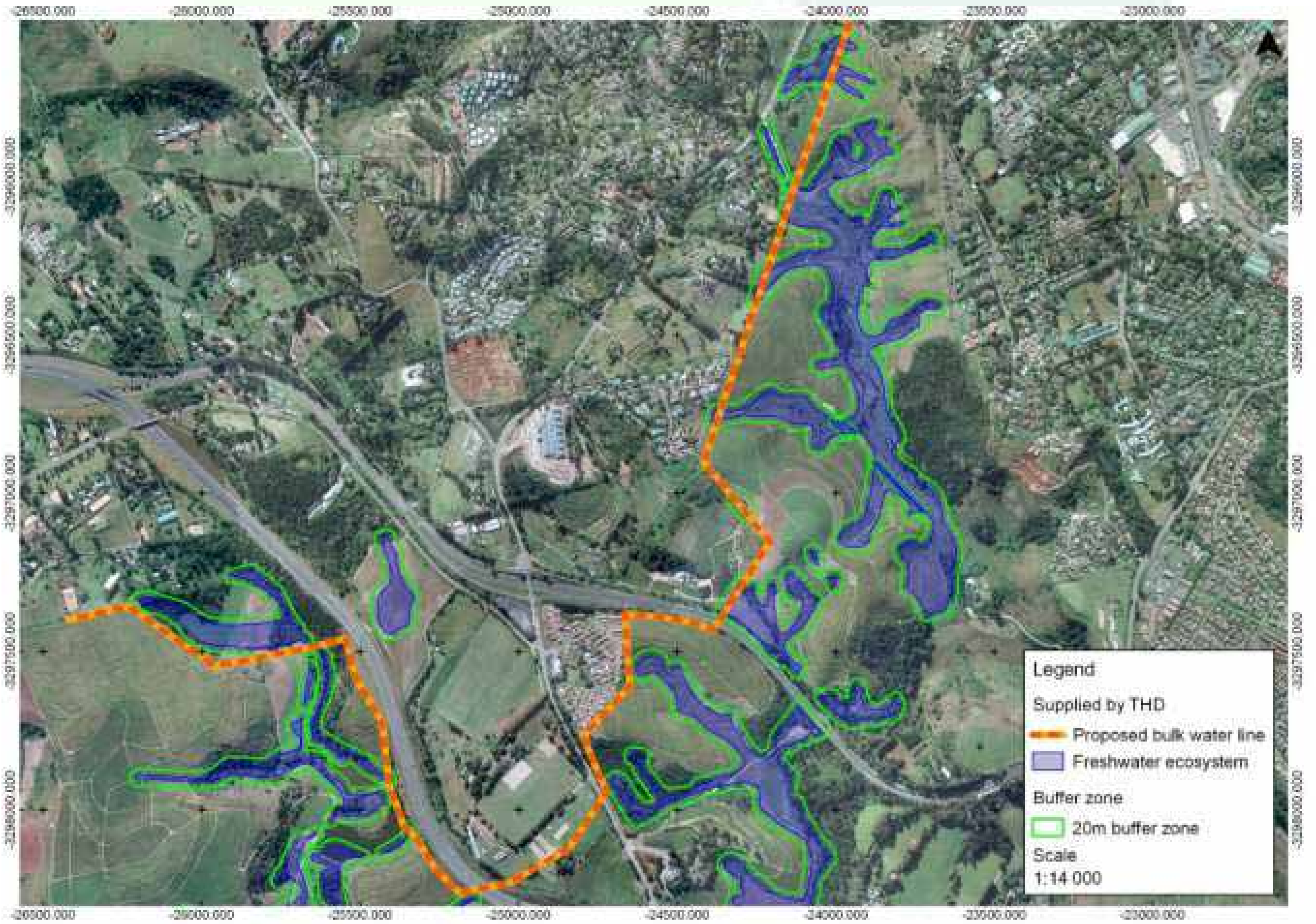
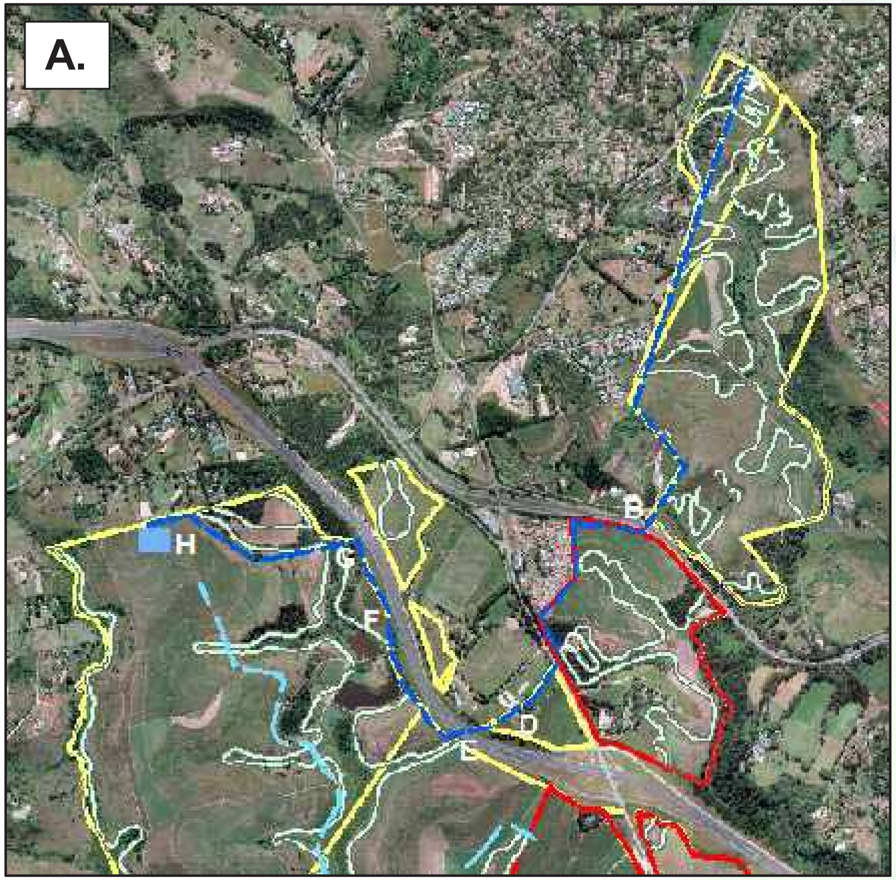


Figure 2: Aerial Photography of the proposed water pipeline route indicating the water crossings. The uMhlatuzana River crossing is circled in red (source: GroundTruth, October 2013).



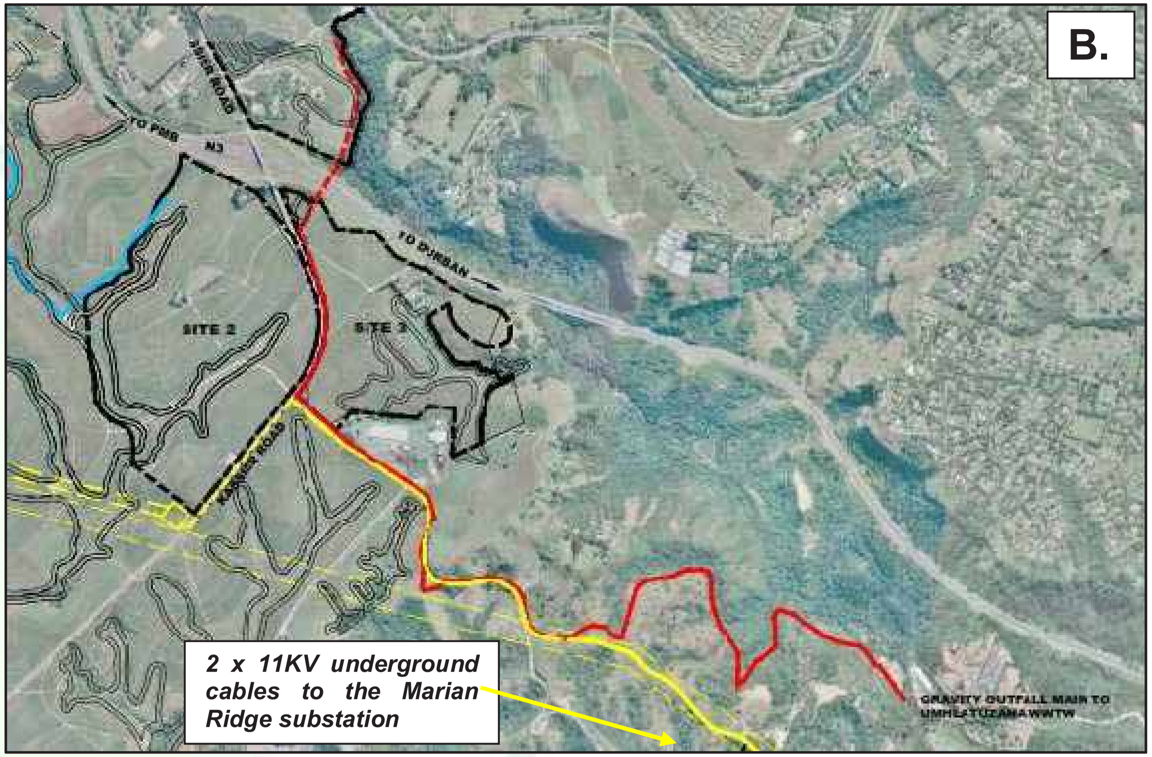


Figure 3: Proposed bulk service provisions

3A – Proposed bulk water connection shown in blue. From the western aquaduct (purple) a 500mm diameter steel pipe will connect to the proposed 3.5Ml reservoir (dark blue). A 300mm diameter pipeline will connect the reservoir to the development site, shown in light blue (source: Bosch Stemele, ESR 2013).
3B – Proposed bulk sewer supply shown in red and electrical supply in yellow. The bulk sewer will link into the newly authorized uMhlatuzana outfall main. Initially, electricity will be supplied by the Marian Ridge major substation (source: Bosch Stemele, ESR 2013).

1.2 OBJECTIVES OF THE ENVIRONMENTAL MANAGEMENT PROGRAMME (EMPR)

The objective of the EMPr is to provide measures to mitigate and manage construction, operation and decommissioning activities in order to minimize potential negative impacts on the surrounding environment. This is achieved by:

- Assigning environmental impact mitigation responsibilities to key personnel,
- Developing specific action plans designed to ensure mitigation,
- Managing and auditing the specified action plans, and
- Managing stakeholder involvement.

Integrated Environmental Management Principles (IEM) have been used as a foundation for the development of this EMPr and must be strictly applied during its implementation. The EMPr serves as a standalone document to be disseminated to and used by the contractors and other stakeholders involved in the construction phase.

1.3 ASSIGNED RESPONSIBILITY

In order for the EMPr to be effectively implemented the following professional inputs will be required:

- **Applicant – THD is responsible for the following:**
  - Ensuring that the engineer and contractors comply with the approved EMPr.
  - Ensuring compliance with the provisions for duty of care and remediation of damage in accordance with section 28 of the National Environmental Management Act (NEMA), (No. 107 of 1998) and its obligations regarding the control of emergency incidents in terms of Section 30 of NEMA.
  - Notifying the DEA of any incident as defined in subsection 30(1)(a) of NEMA.
- **Project Manager – Engineer is responsible for the following:**
  - Appointing the appropriately qualified contractor to co-ordinate, supervise and expedite different action plans.
  - Ensuring adherence to the DAEA conditions of authorization and any other laws and standards relevant to the construction.
  - Ensuring all elements of the work undertaken are properly and competently directed, guided and executed at appointed stages of the project.
  - Ensuring the adherence to statutory safety, health and environment (SHE) standards and ensuring the construction activities comply with the EMPr.
  - Monitoring the site on a daily basis to ensure compliance.
  - Overall responsibility and accountability for the site during the construction phase.
  - Avoiding and / or mitigating adverse impacts on the environment by the appropriate design and construction.
  - Ensuring transparency in their operation and environmental management of the site.
  - Managing the contractors compliance and ensure documentation management.
  - Ensuring that the contractor has a copy of the EMPr and all agreed Method Statements.
- **Contractors - Responsible for the following:**
  - Managing and operating their activities with due care and diligence.
  - Complying with all elements of the EMPr.
  - Ensuring that stakeholder interest is reported to the ECO.

- Maintaining relevant documentation for review by the ECO.

- **ECO - (Environmental Control Officer) is responsible for the following:**
  - Determining the conformance of the site with the EMPr criteria and compliance with the conditions of the EMPr.
  - Liaising with the DAEA and I&APs, if required.
  - Identification of possible areas of improvement during construction.
  - Undertaking on-going monitoring of the construction site through regular site visits and record key findings. This includes photographic monitoring of the construction site.
  - Advising the Project Manager and the contractors on environmental matters during the construction phase of the development.
  - Monitoring implementation of the EMPr by the contractor.
  - Advising the project manager on environmental impacts and provide appropriate recommendations to address and rectify these matters.
  - Ensuring that the conditions stipulated in the EA and any other laws and standards relevant to the construction are being complied with.

- **NAMES AND TELEPHONE NUMBERS OF CONTACT PERSONS**

The following list of contacts must be completed, printed and made clearly visible on the site:

NAME	DESIGNATION	ORGANIZATION	CONTACT NUMBER
Rory Wilkinson	**Applicant**	THD	031 560 1900
Kerry Stanton / Stephanie Willimams	**Independent Environmental Practitioner**	Kerry Seppings Environmental Management Specialists cc	031 769 1578
	Environmental Control Officer		
Lithewe Mabanga	**DAEA Official**	DAEA (Provincial)	031 302 2874
Diane van Rensburg	**Local Municipality**	eThekwini Local Municipality	031 311 1111
Neo Leburu	**DWA Official**	DWA	031 336 2741
	Project Engineer		
	Fire Department	eThekwini Municipality	031 361 0000
	Emergency Response	eThekwini Municipality	10177
	Police	SAPS	10111 - General
	Emergency Spill Response	Abzorbit (24 Hour response)	083 269 8790 083 2536618
	Solid Waste	DSW General Waste Site	Bulbul Drive - 031 460 4600 Marianhill - 031 700 8929/46
EnviroServe	**Solid Waste**	Hazardous Waste Site	Shongweni – 031 769 1134

1.4 COMPLIANCE

A copy of the EMPr must be available on site at all times. Compliance with all elements of the EMPr must be reviewed on a daily basis by the site engineer and all responsible parties must sign the acceptance letter in Appendix 1. In addition it must be noted as per the Environment Conservation Act and the National Environmental Management Act No 107 of 1998 (Section 28) offending parties will be held financially accountable for any pollution or environmental damage.

1.5 MONITORING

The key to a successful EMPr is appropriate monitoring and review to ensure effective functioning of the EMPr and to identify and implement corrective measures in a timely manner. Monitoring for non-compliance must be done on a daily basis (using attached appendices) by the contractors under the guidance of the Project Manager / Environmental Officer / Engineer. An appropriately timed audit report should be compiled by the independent ECO. Paramount to the reporting of non-conformance and incidents is that appropriate corrective and preventative action plans are developed and adhered to. Photographic records of all incidents and non-conformances must be retained.

1.6 APPLICABLE LEGISLATION

The following environmental legislation must be adhered to:

- Constitution of South Africa (Act No. 108 of 1996)
- National Environmental Management Act (Act No 107 of 1998) – NEMA
- National Environmental Management: Biodiversity Act (Act No. 10 of 2004)
- National Heritage Resources Act (Act No 25 of 1999)
- Hazardous Substances Act (Act No. 15 of 1973)
- National Environmental Management: Waste Act (Act No. 59 of 2008)
- Environment Conservation Act (Act No 73 of 1989)
- Occupational Health and Safety Act (Act No 85 of 1993)
- National Environmental Management: Air Quality Act (Act No. 39 of 2004)
- National Water Act (Act No 36 of 1998)
- Protected species – provincial ordinances
- eThekwini municipality by-laws (General by-laws)

1.7 LAYOUT OF THE EMPR

This EMPr is site and impact specific. Sections 1 and 2 are introductory sections whilst section 3 forms the bulk of the report. Section 3 has been designed so that each element is investigated for the different phases of development (i.e. construction, operation and decommissioning). Where possible a photographic illustration has been included to assist with implementation of the EMPr. The layout of this EMPr allows for the users to quickly and efficiently locate and use relevant sections as the need arises, e.g. In the event of a diesel spill on site the contractor can quickly locate and apply Section 3.6 of the EMPr.

Individual sections under section 3.0 have been included for the environmentally sensitive areas on the site such as the management of the wetland system on the site (section 3.14). A site specific Wetland Rehabilitation Plan was compiled by GroundTruth in July 2013. The Rehabilitation Plan was compiled to achieve desired levels of functioning and integrity within the wetland habitat and specific maintenance and management requirements included. Alien invasive plant clearing techniques have been recommended to include in the follow-up operation of these areas. The Rehabilitation Plan is to be attached to the EMPr as Appendix 9. Section 3.14 of the EMPr provides mitigation measures for the proposed pipeline route.

2. PROPOSAL

Tongaat Hulett is proposing to facilitate the construction of a town centre for retail/mixed use in Shongweni. The proposed property where the development will occur is currently owned by Tongaat Hulett with the vast majority of the land being used for sugar cane farming. The development of the town centre will be in line with the guidelines outlined in the Shongweni LAP for the Central-Eastern Precinct (Town Centre Precinct) thereby including a variety of land uses including an intensive development core and a supporting frame incorporating an open space corridor. Developers, investors and tenants will purchase freehold stands within the precincts upon which they could develop retail facilities, offices or warehousing etc. for their various business activities or to lease buildings/portions of buildings that could be constructed by the developer.

The development of the site will include construction of bulk water services, sewer pipelines and associated pump station and electrical supply. The details of each of these service upgrades are outlined in more detail below. The proposed development footprint is indicated in Figure 1 with the proposed preferred layout in Figure 4 below.

Figure 4: Proposed development layout for the Shongweni Retail / Mixed Use Centre (source: GAPP Architects/Urban Designers, 2013).

2.1 SITE DESCRIPTION

- ***Directions to the site***: From Durban, head west on the N3. After the Marianhill Toll Plaza take exit 32 towards Hillcrest/ Assagay/ Shongweni. Turn left into Kassier Road and the proposed site will be on the right. The water pipeline ties into the Western Aquaduct (29°46'40.58"S; 30°45'08.40"E) and terminates at a proposed reservoir location (29°47'42.09"S; 30°43'33.63"E).

- ***Fauna & Flora***: Due to the current land use, the site is covered in sugarcane. SiVest has stated that the only remaining natural vegetation occurs within the wetland/drainage line, which runs in a north east – south west orientation. Within the soccer field and labour housing areas only four individual indigenous species were growing. No conservation worthy vegetation communities were identified however an important wetland unit was identified within the vicinity of the western site boundary. Only a few conservation significant bird species would be likely to utilise the site however there may be red data frog species associated with the freshwater systems on the site.

  The pipeline mainly falls within transformed cultivated land however it passes adjacent to a remnant of Sandstone Sourveld. There are also two provincially protected species, *Eulophia streptopetala* and *Scadoxus puniceus* (both illustrated in Figures 6 and 7 below).

- ***Gradient:*** The site has a gentle gradient and is dominated by two north east, south westerly trending spurs separated with a drainage line trending to the south-west.

- ***Surrounding Land use***: The site lies directly south of the N3 Highway and west of J.B. McIntosh Drive (an extension of Kassier Road). Sugarcane fields lie to the south and east of the site.

- ***Geographic Co-ordinates (centre of site):*** 29°48'40.01"S; 30°44'39.32"E

2.2 SUMMARY OF IMPACTS

The following specialist studies were carried out during the EIA:

- Engineering Services Report including a Stormwater Management Plan, Electrical Report and Traffic Impact Assessment.
- Geotechnical Investigation
- Agricultural Potential Report
- Heritage Impact Assessment
- Market Demand and Socio-Economic Impact Assessments Reports
- Wetland and Riparian Assessments for the proposed sites.
- Wetland Assessment for the proposed pipeline route.
- Wetland Rehabilitation Plan
- Vegetation and Faunal Assessments (for the site and pipeline route)
- Planning Report

All specialist studies have been fully summarized in the EIR and identified impacts included in the impacts table below. Recommendations prescribed by the variety of specialists have been incorporated into the main body of the EMPr in section 3. It is evident that the freshwater ecosystems on the site and their associated fauna and flora links are the most important environmental component to consider. The drainage lines are associated with significant conservation habitats further downstream of the proposed site. The drainage lines within site 2, provide water to an important freshwater ecosystem, the Wekeweke Stream which ultimately drains into Shongweni Dam. This stream has been identified as a NFEPA.

Due to the current land use, the site has been heavily disturbed in terms of indigenous vegetation with the small patches of woodlot being infested with alien invasive plants. Due to the poor quality of vegetation, the site has a low faunal conservation value. Although the proposed development will result in the loss of open green space currently provided by the sugarcane fields, the fauna and flora specialist has stated that it is likely to add value to the land and provide much needed funding for the improvement of the conservation significance of the sites. Green Open Space has been incorporated into the layout and has been positioned to take into account the location of the drainage lines and freshwater ecosystems of the sites (Figure 5). The Green Open Space as well as the proposed 32m buffer, are the main mitigatory measures that are in place to reduce the impact of the proposed development on the freshwater ecosystems. The 32m buffer is from the boundary of the riparian habitat of the Wekeweke Stream adjacent to the site and hydrogeomorphic units shown in green below.

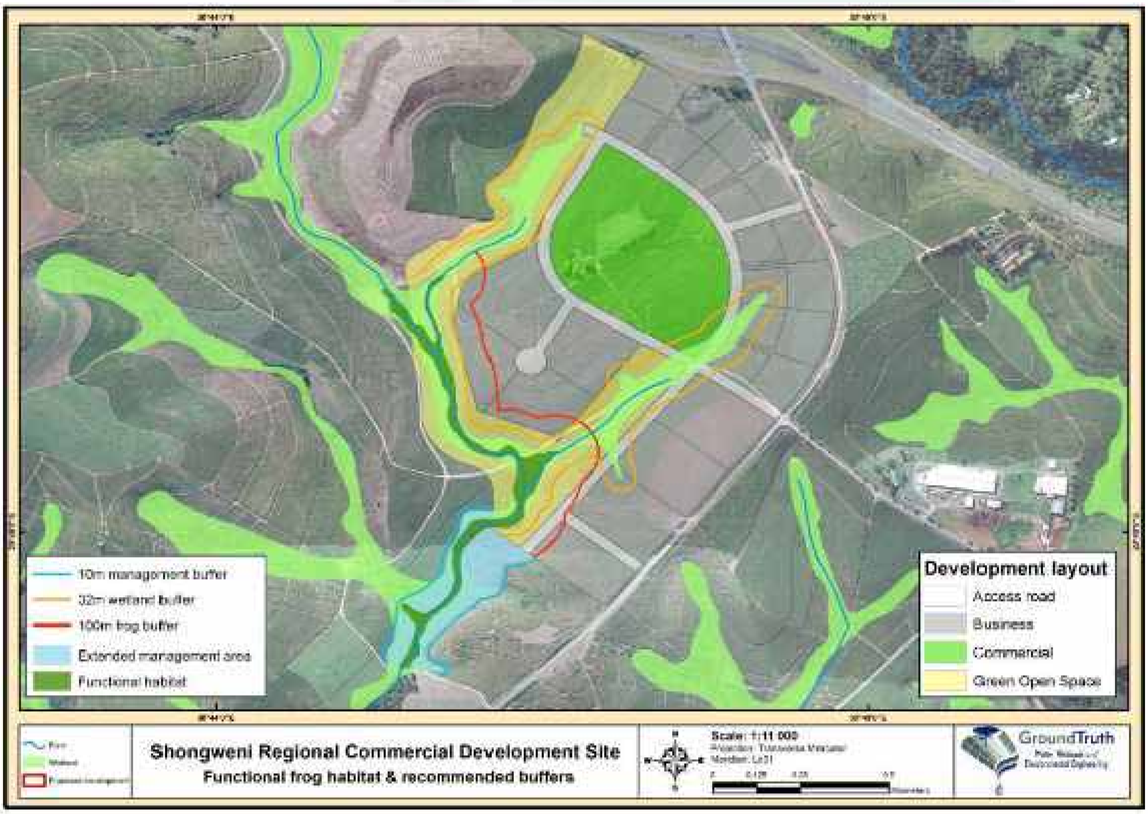


Figure 5: Map showing the drainage lines within and adjacent to the site including the proposed 32m buffer in dark yellow. The functional habitat requiring careful avoidance is indicated in dark green (source: GroundTruth, Riparian Assessment, 2013).

According to the findings of the wetland specialist, the proposed development of the site will result in the loss of 1.4 hectares of wetland. THD commissioned GroundTruth to carry out an extensive Wetland Rehabilitation Plan for the site which aims to achieve “no-net-loss” through detailed rehabilitation planning and interventions (summarised in the EIR and to be attached to the EMPr during construction).

Provided that the Rehabilitation Plan, SWMP and EMPr measures are strictly followed during site establishment, construction and operation, it is likely that all identified impacts as listed below, can be effectively mitigated against and managed. On-going maintenance and monitoring of the stormwater infrastructure, Green Open Space and extended management area (illustrated in blue in Figure 5) are vital for achieving a sustainable environmental development.

The proposed pipeline route is to avoid the two provincially protected plants and remnant of Sandstone Sourveld. No faunal species will be impacted on during operation however the contractor and workers are to be aware of the Black-headed Dwarf Chameleon. The chameleon and both plant species are illustrated in the EMPr and should be included in initial toolbox talks. The wetland specialist has stated that although freshwater ecosystems are crossed, there is an opportunity for rehabilitation of currently modified wetland habitats. Provided that method statements are submitted to the Engineer and ECO prior to construction activities taking place, the watercourses should not be significantly impacted on by the proposed pipeline route.

The major positive impacts that require noting are the provision of opportunities for employment during construction and operation of the Shongweni retail/ mixed use development as well as the alignment with local, regional and national strategic plans for the Outer West area.

2.3 IMPACTS AND MITIGATION MEASURES IDENTIFIED IN THE EIR, INCLUDING A TIME SCHEDULE OF ACTIONS TO BE UNDERTAKEN TO IMPLEMENT MITIGATORY MEASURES FOR THE PREVENTION, MANAGEMENT AND REMEDIATION OF EACH ENVIRONMENTAL IMPACTS, SOCIO-ECONOMIC CONDITION AND HISTORICAL AND CULTURAL ASPECTS FOR EACH PHASE OF THE CONSTRUCTION OF THE SHONGWENI RETAIL/MIXED USE DEVELOPMENT

Compliance against the EMPr must be monitored on a monthly basis by an independent ECO. An EMPr checklist/audit template must be utilised on site to conduct weekly compliance monitoring by a contractor representative. A complaints register (Appendix 2) and a non-conformance record (Appendix 3) must be utilised to record any complaints and non-conformances which will assist in monitoring compliance.

Time Frames

Phase 1: Pre-construction activities (i.e. site camp establishment, removal of vegetation within the developable area, identification of sensitive areas, neighbour notification, etc.)

Phase 2: Construction activities (i.e. construction of the retail/mixed use centre)

Phase 3: Post Construction (i.e. removal of waste disposal facilities, removal of site camp, site is devoid of any hazardous waste utilized during construction, ensure no unauthorised public access is possible, etc.)

Phase 4: Rehabilitation (removal of alien vegetation, implementation of indigenous species to disturbed landscapes etc.)

Phase 5: Operational phase

The following impacts and mitigation measures were identified during the EIR.

PROPOSED DEVELOPMENT IMPACTS				
Nature of impact (potential)	**Mitigation measure**	**Time frame for mitigation measure to be undertaken**	**Person responsible for monitoring**	**Monitoring frequency**
Erosion of stockpiled material (stone, sand and gravel).	Material must be stocked in such a way that they cannot fall or cause injury or damage to properties or the natural environment. Stockpiles must not exceed 6m in height (as per the SWMP) and must be covered if exposed to heavy wind or rain. Alternatively, low walls or berms must be constructed around the stockpiles.	Phase 1 and 2	Contractor / ECO	The contractor / must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Risk of contamination to soil during concrete mixing. Mixing	Cement mixing will need to take place on a hard surface or cement mixing trays will need to be used. Cement mixing will not be permitted to occur where run off can enter stormwater drains. Construction will be monitored by an Environmental Control Officer (ECO) who will ensure compliance with the construction EMPr.	Phase 3	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
The onsite erosion of exposed soil before rehabilitation is completed.	As a general principle, contractors must limit vegetation clearing to the platform site only. The contractor must stabilise cleared areas to prevent and control erosion and/or sedimentation. Only vegetation that's needs to be removed to accommodate the development, should be removed in a phased and controlled manner.	Phase 1, 2 and 3	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Loss of agricultural land impacting food security.	Mottram and Associates cc carried out the Agricultural Potential Report for the Shongweni Estate, where it was found to have "limited agricultural potential". Tongaat Hulett have a strategy to increase agricultural production in South Africa and food security has been incorporated into the applicant's strategies and action plans. Sugarcane production has in fact increased over the last three years and this is expected to increase even more in the future.	Phase 5	Applicant	n/a
Loss of agricultural land	The portion of land zoned for agriculture will be lost with the development of the site. These portions of land, currently zoned as agriculture, are however not in line with the Shongweni LAP which makes provisions for urban development and a regional centre.	Phase 5	Applicant	n/a
Potentially slope failures resulting in unstable slopes during construction and operation. These slopes are also more vulnerable to erosion and sediment deposition into the adjacent drainage lines. Steeper slopes in the south-west corner have been identified.	The Geotechnical specialist concluded that the site is stable in its existing conditions with the majority of the site being capable of development provided that work is carried out according to prescribed recommendations. During the earthworks phase, the geotechnical engineer recommended a number of slope gradients for the cut and fill embankments depending on the underlying material / location of the proposed embankment on the site. Pressure recommendations for carrying out shallow and deep founding were prescribed. The specialist recommends that the overall natural drainage system should remain intact in terms of subsoil drainage as the wetland system on site is part of a wider, complex drainage system connecting to the KZN coast line.	Phase 2, 3 and 5	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Potential for erosion to occur on cut embankments.	As per the geotechnical specialist's recommendations, all cut embankments are to be vegetated immediately after construction. This will	Phase 2, 3 and 5	Contractor / Designated Representative	The contractor / designated representative must monitor the site on a

PROPOSED DEVELOPMENT IMPACTS				
Nature of impact (potential)	**Mitigation measure**	**Time frame for mitigation measure to be undertaken**	**Person responsible for monitoring**	**Monitoring frequency**
	aid in reducing run-off. The geotechnical specialists has stated that slopes should be less than a gradient of 1:2. Stormwater management control measures are to be implemented to prevent high run-off rates.		(i.e. Resident Engineer) and ECO	daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Poor stormwater management during construction leading to erosion on and offsite. Site 2: south-west portion particularly vulnerable to erosion.	The SWMP states that measures will be required to minimise the run-off especially for large storm events. Even with the bulk of overland run-off being redirected via kerbing, a certain level of erosion can be expected from precipitation on the embankments. It is recommended that these embankments be stabilised as soon as possible during the construction phase. Stormwater management is included under section 3B of the EMPr. The specialist stated that slopes are to have a gradient of less than 1:2 to prevent erosion and minimise run-off from the embankments, especially during large storm events.	Phase 2	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Potentially polluted stormwater run-off entering the onsite and adjacent wetland systems impacting on water quality and habitats associated with the freshwater systems.	Measures to be applied to reduce pollutants include bio-attenuation swales and infiltration measures (permeable paving). These measures will be applied at the point source (individual sites and road reserves) as far as possible.	Phase 2 and 5	Contractor / ECO	The contractor must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Risk of flooding downstream of the sites with the increase in hard surfaces resulting in increased water quantity.	One of the philosophies of the SWMP is to reduce stormwater flow to within a 10% variance of the pre-development flows using attenuating devices such as attenuation dams/structures or infiltration devices. Infiltration is to be maximised across the site with the SWMP being followed during design, construction and operational phases. On completion of works, a site inspection will be carried out to check compliance with the stormwater management requirements prior to the Certificate of Occupation being issued.	Phase 5	Contractor / Designated Representative (i.e. Resident Engineer).	The contractor / designated representative should monitor the site on a monthly basis.
Stormwater features accumulating litter/excess vegetation resulting in blockages or directing debris into the wetland/ drainage areas.	The SWMP states that no dumping of construction rubble or spoil is to occur in completed stormwater drains, pipes, channels or natural drainage lines (existing wetland, stream and riparian zone). Weekly checks are to be carried out on the site's drainage system to ensure that the water flow is unobstructed. These are to be repaired or cleared of silt if required (included in section 3B of the EMPr). During operation, it will be the responsibility of the constituted Home Owners Association (or designated maintenance body) to maintain the stormwater system in a safe and responsible manner. As good practice, certain months of the year before the onset of the summer rains should be reserved to carry out routine maintenance work on the stormwater system. Routine inspections are to be carried out every three months by a competent personnel, as per specialist recommendation.	Phase 5	Applicant / designated representative	The designated representative must monitor the site on a weekly basis as per the SWMP.

PROPOSED DEVELOPMENT IMPACTS				
Nature of impact (potential)	**Mitigation measure**	**Time frame for mitigation measure to be undertaken**	**Person responsible for monitoring**	**Monitoring frequency**
Accumulated material on hardened surfaces transported via stormwater directly into the adjacent freshwater ecosystems resulting in a build-up of sediment /material in the wetland.	As above, the SWMP has catered for attenuation swales and infiltration measures. Revegetation along the proposed buffer zones and Green Open Space areas will assist in reducing the transportation of sediment into the wetlands. Landscaping and re-vegetation of areas not occupied by buildings/paving shall be implemented immediately after building works are complete. Stabilisation and erosion control measures should be implemented immediately if any embankments are constructed. All mitigation measures and recommendations made in the SWMP have been included in the EMPr requirements below.	Phase 2 and 5	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Change in Wekeweke Stream input from diffuse to point source water input from stormwater infrastructure potentially increasing the risk of erosion and high volumes of water flooding the system during high rainfall events.	The SWMP recommends that energy dissipating structures be utilised where erosion is a possibility, on the outlets from underground conduits or the run-off from the embankments. Bio-attenuation swales and infiltration measures (such as permeable paving) will be applied at the point source (individual sites and road reserves) as far as possible to reduce flow velocity draining into the different freshwater systems.	Phase 2 and 5	Contractor and ECO	The contractor must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Loss of wetland area associated with each alternative as well as portions of wetland and riparian habitat associated with construction of the water pipeline.	To ensure that the removal of wetland area is not significant, the impacts on the wetland systems and downstream riparian habitat would have to be appropriately managed to ensure the integrity of the wetland and riparian habitats are not impaired. The development of the site, could be appropriately managed to ensure the impacts on the Wekeweke stream are negligible and there are no adverse effects downstream of the development site. The specific Wetland Rehabilitation Plan for site 2 compiled by GroundTruth should be carefully adhered to which aims to ensure no-net-loss of functioning wetland area. Principles of the Rehabilitation Plan have been included in the EMPr. An extended management area is to be included into the proposal to account for the loss of wetland habitat (see Figure 5 above). This management area is located south of the proposed site. Pipeline crossing are required to be immediately rehabilitated once construction is complete. This will in fact upgrade the riparian habitat, as vegetation units are currently invaded with alien species.	Phase 1, 2, 3, 4 and 5	Applicant / Contractor / Designated , Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a weekly basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Increase in hardened surfaces reducing water infiltration and hence wetland recharge.	Currently, subsurface drainage through the perched water table recharges the wetland. The SWMP therefore recommends bio-attenuation swales and infiltration measures (e.g. permeable paving) which are to be applied at the point source to promote infiltration, reduce flow velocity and reduce pollutants from entering the wetlands decreasing functionality. The Wetland Rehabilitation Plan for site 2 includes a	Phase 5	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.

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Nature of impact (potential)	**Mitigation measure**	**Time frame for mitigation measure to be undertaken**	**Person responsible for monitoring**	**Monitoring frequency**
	list of interventions such as the construction of gabion cut-off walls which is likely to reduce flow, promoting further infiltration.			
Potential increase in pollutants and sediments entering the Shongweni Dam, downstream from the Wekeweke Stream.	As above, the SWMP states that there will be a variety of measures applied to reduce pollutants being carried in the stormwater (bio-attenuation swales and infiltration measures). The wetland specialist has stated that a prerequisite for developing the site would be the adoption and rehabilitation of a minimum 32m buffer from the boundary of the riparian habitat of the Wekeweke Stream adjacent to the site. Rehabilitation of the riparian habitat adjacent and downstream of the site, as discussed in the GroundTruth Riparian Assessment, is to commence with the implementation, rehabilitation and management of the variable buffer zones adjacent to the wetland habitat. The GroundTruth Rehabilitation Plan for site 2 is to be followed when rehabilitating the remaining wetland areas within and directly adjacent to site 2.	Phase 2 and 5	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Construction of the proposed sewer pump station south of site impacting on the drainage line.	Although the footprint of the pump station (26m x 26m) is negligible, GroundTruth recommends that appropriate mitigation measures are in place in case of power / operational failures: - The pump station must be constructed on contour, - A designated bund area must be constructed below or directly adjacent to the sewer pump station to capture accidental spills/leaks, - The pump station should include a backup generator and - Emergency procedures should be in place to manage pump station failures and spills/leaks with immediate effect.	Phase 2 and 5	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Poor waste management potentially resulting in leachate formation infiltrating into the soil and groundwater.	The waste management area should be located on an impermeable surface to prevent leachate from coming into direct contact with the soil. Waste Management is outlined in section 3F of the EMPr.	Phase 2	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Spillages of hazardous material, leaking storage facilities and fittings and poor sewerage facilities potentially contaminating water resources.	“Hazardous materials” in this impact refers to materials that could potentially be on site during construction. For example oils and herbicides are classified as “hazardous”. As described above, efficient and effective waste management is included in the EMPr however a designated hazardous store will be set up which must be located within a bunded area on a hardened surface and under cover. Toilets on site are to be monitored regularly to ensure that no leaks or overflow is permitted. Safe-disposal slips are to be retained on site for auditing purposes in the site environmental file.	Phase 2	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Degradation of the proposed Green Open Space areas and/or drainage lines	It is recommended that the areas designated as Green Open Space in the layouts be avoided where possible. No stockpiling or dumping of construction material should occur within or directly adjacent to	Phase 2	Contractor / Designated Representative (i.e. Resident	The contractor / designated representative must monitor the site on a daily basis and conduct

PROPOSED DEVELOPMENT IMPACTS				
Nature of impact (potential)	**Mitigation measure**	**Time frame for mitigation measure to be undertaken**	**Person responsible for monitoring**	**Monitoring frequency**
from deposition of construction sediment and rubble.	the Green Open Space or drainage lines. If this is unavoidable, the area disturbed must be rehabilitated as soon as possible and all materials removed from the area, No dumping of construction rubble or spoil is to occur in completed stormwater drains, pipes, channels or natural drainage lines. Weekly checks are to be carried out during construction. These are to be repaired or cleared of silt if required.		Engineer) and ECO	weekly checklists. Monthly audits must be conducted by an ECO.
During construction of the pipeline, there is potential for sedimentation and foreign materials to enter the freshwater ecosystem such as fuel, cement and other building materials reducing the water quality.	A Method Statement is to be submitted to the Engineer and ECO detailing the construction method including stockpiling and waste management of workers constructing the pipeline route. Cement mixing is not to take place within the watercourse itself or directly adjacent to it. This is to be tightly monitored by the ECO. Alternatively, if a spill occurs or cement mixing does take place, the affected area is to be rehabilitated immediately to the satisfaction of the ECO. Soil excavated from the trench is to be placed on the upslope side of the trench, minimizing the risk of excess sediment entering the downstream areas of the freshwater ecosystems.	Phase 2	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Compaction of the wetland soils by heavy vehicles accesses areas requiring excavation during the pipeline construction building materials.	Vehicles are to use existing roads where possible. The working servitude across the systems must be as narrow as practically possible. i.e. machinery must utilise the same route through the systems at all times so as to avoid unnecessary disturbance.	Phase 2	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Potential modification of wetlands, river banks and beds from the trenching process building materials.	The pipeline is to be located beyond a 20m buffer where possible, however if this cannot be achieved, the pipeline is to be aligned adjacent to existing services such as roads within the freshwater ecosystem. Where infrastructure cannot be aligned adjacent to existing services, the crossings should be planned at a narrow section and be perpendicular to the flow direction, minimising the amount of disturbance to the freshwater ecosystem and the risks of headward erosion.	Phase 2	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Trench erosion and the diversion of subsurface flow as a result of preferential flow paths having been created.	In order to prevent sub-surface channel flow and erosion, the wetland specialist recommends that: - "Trench-breakers", which are in-trench barriers, should be installed along the length of the trench within the wetland to deactivate the flow of water along the trench; - These barriers to be placed at head-to-toe intervals, where the top of downstream barrier "floods" to the base of next barrier upstream. The intervals of barriers are therefore determined by the slope of the wetland down the length of the trench; - Since work will be within the wetland, it is recommended that the barriers be constructed using 20% bentonite and in situ soil mix or impermeable geotextile liners; and	Phases 2 and 3	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.

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Nature of impact (potential)	**Mitigation measure**	**Time frame for mitigation measure to be undertaken**	**Person responsible for monitoring**	**Monitoring frequency**
	- Small-scale diversion berms should be constructed on the surface of the trench, directly downstream of the "trench-breaker" to reduce the risk of the trench becoming a preferred surface flow path. Additionally, infrastructure is to be positioned on the downstream side of a road crossing/ dam to reduce headward erosion and sub-surface impoundment of flow.			
Risk of erosion forming upstream of the trench if infilling is not adequately compacted or the longitudinal slope of the wetland system is not maintained.	The risk of erosion will be greatly reduced with effective rehabilitation measures. The watercourse crossings are to be rehabilitated to ensure that no barriers exist within the stream so that the in-stream habitat is similar to the natural situation. This should be done as soon as possible after the pipeline construction activities have ceased, to the ECO's satisfaction.	Phases 2 and 3	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Potential impoundment of flow upstream of the trenches and desiccation of the systems downstream of the trenching.	Infrastructure is to be positioned on the downstream side of a road crossing/ dam to reduce headward erosion and sub-surface impoundment of flow. Effective rehabilitation is to take place along the disturbed area. This is done by eradicating alien invasive plant species, actively re-vegetating the disturbed area with appropriate wetland species and removing excess vegetative material within the wetland at regular intervals promoting new growth.	Phase 2	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Difficulty associated with trenching in the uMhlatuzana River during pipeline excavation.	The Contractor is to submit a detailed method statement to the Engineer and ECO prior to trenching in the uMhlatuzana River. The Method Statement is to ensure that trenching across this system occurs rapidly to reduce any potential impacts.	Phase 2	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Risk of alien vegetation invasive with the proposed disturbance resulting in displacement of indigenous species.	The wetland specialist has recommended that the rehabilitation of the buffer zones between site development and the drainage lines is to include the removal of alien invasive vegetation species and active replanting of indigenous plants, to ensure a DENSE, undisturbed vegetative community. This will reduce the likelihood of alien vegetation invasion however a maintenance plan is also included in the Rehabilitation Plan for site 2. This involves the intermittent removal of excess plant material and control of alien species (to continue during operational phase). It is also a recommendation within the Riparian Assessment, that a comprehensive alien weed control programme be implemented be developed.	Phase 4 and 5	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Excess removal of vegetation resulting in a potential increase in sediments entering the existing wetland system.	The SWMP states that the stripping of vegetation to allow commencement of construction of the earthworks platform shall only be undertaken immediately prior to that element of construction commencing with topsoiling and re-vegetation of exposed surfaces to commence immediately after the completion of all construction activity. Precautionary measures are to be incorporated into the stormwater infrastructure to attenuate the water	Phase 1, 2, 3 and 4	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.

PROPOSED DEVELOPMENT IMPACTS				
Nature of impact (potential)	**Mitigation measure**	**Time frame for mitigation measure to be undertaken**	**Person responsible for monitoring**	**Monitoring frequency**
	allowing sediments to settle and encourage infiltration. The incorporation of the buffer area surrounding the drainage lines will assist in preventing high amounts of sediments being washed into the wetlands.			
Potential erosion of the D'MOSS wetland system on the western boundary.	The vegetation specialist stated that the potential for erosion of the wetland system can be mitigated against provided that the "hydrology of the wetland systems onsite be maintained post-development by incorporating storm water infiltration and attenuation into the design of the development". The SWMP for site 2, recommends these attenuation and infiltration measures ensuring post-development flows are less than 110% of pre-development flows. Erosion is to be monitored and prevented throughout the site as per the requirements in section 3K of the EMPr.	Phase 1, 2, 3 and 4	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Change in hydrology potentially impacting on the population of *Gladiolus cruentus* (critically endangered) occurring downstream of the site.	The species depends on spray mist from the waterfall downstream. It is therefore important that normal flow volumes from the upstream catchment be maintained. It is anticipated that there will be an increase in flow volume which could improve habitat availability.	Phase 4 and 5	Applicant Contractor / Designated Representative and ECO	A maintenance schedule must be drawn up by the applicant and monitored accordingly.
Disturbance of vegetation and the encroachment of alien invasive or ruderal/pioneer wetland plant species during construction of the proposed pipeline.	Alien clearing must be undertaken within the entire development corridor and an alien management plan put in place to ensure that the construction area and pipeline servitude are maintained free of alien plant species.	Phases 2, 4 and 5	Applicant Contractor / Designated Representative and ECO	A maintenance schedule must be drawn up by the applicant and monitored accordingly.
Potential impact on *Bradypodion melanocephalum* (Black-headed Dwarf Chameleon) found within alien infested woody vegetation along the pipeline route.	While no Chameleons were found during the site survey, the specialist recommends that should a specimen be found during construction, the specie needs to be removed carefully before construction continues. The specie needs to be relocated to an identified release site. The release site should be identified in consultation with Ezemvelo KZN Wildlife and eThekwini Environmental Management Division.	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Potential disturbance to the remnant of sandstone sourveld grassland located in the western section of the pipeline route	The remnant of sandstone sourveld is indicated in yellow on Figure 16 above. The pipeline is to be placed within the sugarcane cordon and not impact the limited natural vegetation which is restricted to the steeper slopes. Workers are to be trained and educated on the location of these species prior to work commencing. No stockpiling is to occurring in this remnant. The contractor is to be aware that *Eulophia streptopetala* occurs in this area and must not be disturbed.	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Potential disturbance / removal of indigenous species in	The Contractor is to avoid the removal of tree species in this area.	Phase 2	Contractor / Designated	The contractor / designated representative must monitor the site on a

PROPOSED DEVELOPMENT IMPACTS				
Nature of impact (potential)	**Mitigation measure**	**Time frame for mitigation measure to be undertaken**	**Person responsible for monitoring**	**Monitoring frequency**
the vicinity of the storm water culvert which passes underneath the N3.			Representative and ECO	daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Overall loss of indigenous species which fall within the pipeline route.	The loss of individual tree species will be minimal based on the current alignment however the vegetation specialist has stated that a large amount of alien vegetation will be removed during the construction process which will mitigate the loss of the limited number of indigenous tree species (page 7 of the Rapid Vegetation Assessment).	Phase 5	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Potential damage/ removal of the provincially protected *Scadoxus puniceus* and *Eulophia streptopetala species* located within/adjacent to the proposed pipeline route.	The vegetation specialist has stated that the species appear to fall **outside** of the proposed pipeline route and therefore the Contractors are to avoid these species. Pictures have been provided in the EMPr and the personnel working on the pipeline are to be educated on the location of these species.	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Loss of the individual *C. sphaerocephala,* a large old indigenous tree located on the western end of the pipeline.	The specialist recommends that the pipeline be aligned on the upper slope above the cane road to alleviate the loss of the *C. sphaerocephala.*	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Proposed pipeline route impacting on vegetation within adjacent properties.	Where possible, the contractor is to ensure that the pipeline and associated working servitude are maintained within the current property(s) to reduce any impact on the vegetation on the other side of the fence lines.	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Removal of soils in steeper areas along the pipeline route resulting in erosion.	The areas which are disturbed should be rehabilitated with a standard NPA mix of grass species. In steep areas where all the vegetation has been removed berms and swales are to be incorporated into the layout to prevent riff and gulley erosion from occurring. The vegetation specialist recommends that a combination of geofabric and regrassing is to occur immediately after construction has ceased to reduce the potential for erosion to occur and the resultant silting up of wetlands, dams and streams that are in close proximity to the construction area.	Phase 2, 3, 4 and 5	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Positive impact with the removal of existing alien invasive vegetation.	The Rehabilitation Plan as well as the recommendations in the Riparian Assessment state that there be intermittent removal of excess plant material and control of alien species (to continue during operational phase) and that a comprehensive alien weed control programme be implemented before development Alien vegetation will also be removed locally from the pipeline route and disturbed area. An alien management plan is to be put in place to ensure the construction area and pipeline servitude are maintained free of alien species. The areas which are disturbed should be rehabilitated with a standard NPA mix of grass species as the area will either be retained as a road or will abut the commercial sugarcane farming activities, therefore the merits of trying to re-establish any form of indigenous and diverse vegetation would prove fruitless.			

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Nature of impact (potential)	**Mitigation measure**	**Time frame for mitigation measure to be undertaken**	**Person responsible for monitoring**	**Monitoring frequency**
Poor planning may result in unnecessary loss of habitat supporting biodiversity (including frog species of conservation importance).	Although no red data species were identified on the site there is potential for a variety of near threatened and vulnerable. The Riparian Assessment concluded that a buffer 32m zone is required to be incorporated into the layout to preserve and protect the riparian areas of the Wekeweke River and associated wetland habitat. A 100m frog buffer was further proposed however the specialist notes that a portion of the development footprint falls within this 100m buffer (Figure 4). A variable buffer or "habitat corridor" is therefore recommended to provide sufficient protection of the potentially conservation important biota. The developments proposed Green Open Space was considered by the riparian specialist as an adequate offset to the loss of 3.9 hectares from the recommended 100m frog buffer. The Green Open Space furthermore provides additional terrestrial and aquatic habitat for frogs.	Phase 2 and 5	Applicant, Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Green Open Space being incorporated into the proposed development layout providing an improved, rehabilitated habitat refugia for flora and associated fauna.	The freshwater ecosystems on the sites are currently degraded and are not being maintained due to the current land use however it will be part of the proposed development plans to rehabilitate the ecosystems and remove the alien invasive vegetation. By removing the alien species, indigenous species will be encouraged to grown and it is likely that faunal species associated with this vegetation, will populate the proposed Green Open Space.			
Degradation of environmentally sensitive areas neighbouring the sites, namely the Wekeweke River situated to the south-west.	During construction, stormwater and waste management will be high priority (sections 3B and 3F in the attached EMPr). Workers on site are to be educated on the location and function of the Green Open Space areas as well as the neighbouring environmentally sensitive areas (depending on which site alternative is developed). These adjacent sites should be clearly demarcated to prevent workers from entering the area. During operation, stormwater is to be controlled and maintained according to the site specific SWMP. Litter should not be disposed of within or adjacent to the environmentally sensitive areas. The Rehabilitation Plan for site 2 has included a maintenance schedule for within the wetland and buffer zone. Should site alternatives 1 or 3 be developed, the Rehabilitation Plan is to include mitigation measures to ensure that the adjacent areas are not degraded.	Phase 2 and 3	Contractor / Designated Representative (i.e. Resident Engineer) and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Encroachment into the wetland buffer zone, thereby reducing protection of the drainage line and riparian habitat.	As stated above, the wetland buffer zone is to be demarcated prior to the commencement of construction activities and workers to be educated on the location and function of the buffer zones. Waste management and stockpile areas in particular are not to encroach into the wetland buffer zone. Any construction related impacts are to be rectified prior to the Contractor vacating the site (this could include rehabilitation measures).	Phase 1, 2, 4 and 5	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.

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Nature of impact (potential)	**Mitigation measure**	**Time frame for mitigation measure to be undertaken**	**Person responsible for monitoring**	**Monitoring frequency**
Potential for workers during the construction phase to interfere with the area within the layout designated as Green Open Space.	The area designated for Green Open Space is to be clearly demarcated so all workers on site are aware of these areas. Workers are to be informed on the conservational significance of the area (included in toolbox talks as per section 3L of the EMPr).	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Opportunity to rehabilitate and improve the condition of the wetland systems on the sites.	A Rehabilitation Plan has been prepared for the preferred site alternative which aims at achieving the objective of "no-net-loss" through detailed rehabilitation planning. The Rehabilitation Plan includes the remove of alien invasive vegetation, wetland interventions to enhance the functionality as well as monitoring for the long-term stability of the interventions.			
Improper storage of hazardous waste i.e. used oils from vehicles; old cement bags etc. resulting in possible contamination to the surrounding environment.	Hazardous waste must be stored on a hard surface within a bunded area and must not be allowed to enter stormwater drains and the surrounding environment. Waste must be disposed of regularly by a reputable contractor. Hazardous waste such as oils, contaminated rags etc. must be disposed of at a hazardous class landfill. Safe disposal certificates must be provided and retained in the site environmental file for audit purposes (waste management included in section 3F of the EMPr).	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Potential for improper storage and disposal of waste materials generated during construction resulting in possible contamination to the surrounding environment.	Waste must be stored in the bins within the waste collection area in the construction camp and must not be allowed to blow around the site or be placed in piles adjacent the skips / bins. Separate waste bins for each of the waste streams generated must be provided. The waste containers must be appropriate to the waste type contained therein and where necessary should be lined and covered. Waste must not be allowed to accumulate on site but should be disposed of regularly by a reputable contractor and must be disposed of at an appropriate landfill site.	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Littering around the site.	Littering will not be permitted on the site and general housekeeping will be enforced. Construction will be monitored by an ECO who will manage compliance with the EMPr.	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Litter and solid waste accumulating on site due to delay in servicing by Durban Solid Waste (DSW).	Solid waste will be stored on the site where it will be collected by a private operator or eThekwini Municipality. During construction, a waste management area is required to ensure that all waste types are contained and effectively managed. Safe disposal slips should be retained on site for audit purposes. Section 3F of the EMPr outlines waste management. Large amounts of solid general waste (>100m3) should not be allowed to accumulate on site.	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Improper disposal of rubble i.e. burying or neglecting building rubble resulting in direct mechanical damage to surrounding	All excess material and rubble **not being utilized on the site** must be removed and disposed of at an approved, designated landfill. A safe disposal certificate must be obtained and retained in the sites environmental file.	Phase 2 and 3	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.

PROPOSED DEVELOPMENT IMPACTS				
Nature of impact (potential)	**Mitigation measure**	**Time frame for mitigation measure to be undertaken**	**Person responsible for monitoring**	**Monitoring frequency**
vegetation and untidiness of the site.				
Potential for construction waste to be disposed of at incorrect landfill resulting in contamination at the landfill site.	Recycling should be undertaken where possible to limit waste added to the landfill site. Waste to be sent to registered landfills and safe disposal certificates must be retained for hazardous waste.	Phase 2 and 3	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Nominal increase in pressure on local landfill.	Solid waste will be collected by eThekwini Municipality for disposal or a private operator depending on the type and quantity of waste. The ESR states that the nearby DSW Bulbul Drive landfill site has adequate air-space (capacity) to accept waste generated from the development. The ESR also states that other waste collection models could be implemented, which could include 'contracted out' collection, facilities for waste separation for recycling etc.	Phase 2	Local Municipality	Local Municipality to ensure sufficient capacity prior to disposal at the landfill.
Bulk storage of dangerous fuels i.e. spillage of diesel during construction potentially contaminating groundwater and surrounding environment.	Cement mixing will need to take place on a hard surface or cement mixing trays will need to be used. If the creation of a permanent bunded area is not feasible, these materials must be stored on drip trays capable of holding at least 110% of the spilled volume. Any construction equipment that could leak oil must be placed on a drip tray. All equipment must be in good working order to reduce the likelihood of oil leaks occurring. Any re-fuelling of equipment must occur on a hardened surface, within a designated re-fuelling area where any spills can be contained. A designated hazardous store will be set up which must be located within a bunded area on a hardened surface and under cover. Construction will be monitored by an ECO who will manage compliance with the construction EMPr.	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Risk of spills from construction equipment (oils, fuels etc.) contaminating soil and stormwater.	As mentioned above, a designated re-fuelling area is required to contain spills, cement mixing is to take place on a hardened surface and a designated hazardous store will be set up within a bunded area capable of holding at least 110% of the spilled volume.	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Improper storage of hazardous waste i.e. used oils from vehicles, old cement bags, contaminated soil etc.	A separate bin dedicated to the storage of hazardous waste will be required. The bin should be clearly labelled as such and frequently emptied with the contents being disposed of at a registered hazardous landfill site. Safe disposal records are required to be kept on site for audit purposes. The hazardous storage area will be monitored according to the EMPr by an independent ECO.	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Potential for the reservoir to be noisy impacting on residential neighbours.	The majority of the water feed would be gravity and therefore there is no need for pumps.	Phase 5	n/a	n/a

PROPOSED DEVELOPMENT IMPACTS				
Nature of impact (potential)	**Mitigation measure**	**Time frame for mitigation measure to be undertaken**	**Person responsible for monitoring**	**Monitoring frequency**
Reservoir having a negative visual impact on the immediately adjacent neighbours.	The EAP has recommended that as part of the post construction phase, the area disturbed by the pipeline and reservoir be rehabilitated back to its current state. The reservoir is to be located as far underground as practically possible. Trees and shrubs are to be incorporated into the final design as far as practically possible.	Phase 2 and 4	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Reservoir having a negative visual impact on the immediately adjacent neighbours.	The only emissions that will be generated will be from construction vehicles which are expected to be minimal and are not expected to significantly affect the surrounding communities or the environment. Air emissions should be monitored daily by the onsite ECO and a complaints register available to surrounding communities.	Phase 2	Contractor / and ECO	The contractor / must monitor the site on a daily basis. Monthly audits must be conducted by an ECO.
Dust generated from construction vehicles and other on-site activities impacting workers on-site.	Dust control measures (the use of water cart/ truck) must be used to wet exposed soil thereby maintaining low dust levels. The dust levels must be kept below the required SANS Standards to ensure minimal impact on the surrounding community and environment. The ECO should monitor the dust levels daily. Drivers and workers on the site should be educated with regards to the air pollution on site. A complaints register is to be maintained recording any air quality/dust complaints.	Phase 2	Contractor / and ECO	The contractor / designated representative must monitor the site on a daily basis. Monthly audits must be conducted by an ECO.
Sourcing of raw materials i.e.: (gravel, stone, sand, cement and water) from unsustainable sources resulting in illegal sand winning and mining operations causing significant environmental damage.	Materials are to be sourced on site where possible and rubble from demolished infrastructure utilised as fill material. All sourced materials must be obtained from a registered and sustainable source and all delivery notes and slips must be made available to the ECO e.g. mined material such as stone must only be obtained from permitted quarries.	Phase 1 and 2	Contractor / Designated Representative and ECO	The contractor / designated representative must ensure all raw materials received are received from a sustainable source. Monthly audits must be conducted by an ECO.
Increase in traffic disruptions on surrounding access roads during construction.	Points man in attendance to control traffic where road disruption is most likely. Alert traffic department if road closure is required, conduct road closures during off peak hours and place notices of intent in advance. Construction vehicles to comply with the speed limits.	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Potential impact of increased traffic on pedestrian safety.	The traffic specialist recommended that the minimum width of the proposed new sidewalks be 3meters to safely accommodate pedestrians and cyclists. Initially, a sufficient road reserve is required to ensure the incorporation of public transport provisions at a later stage.	Phase 5	n/a	n/a
Increase in the volume of traffic on the roads during the operation of the proposed development resulting in congestion.	The Traffic Impact Assessment has identified intersections/ roads requiring upgrades and/or signalised. Once the upgrades are complete, the road network should cope with the calculated predicted traffic flows.	Phase 5	Applicant	n/a

PROPOSED DEVELOPMENT IMPACTS				
Nature of impact (potential)	**Mitigation measure**	**Time frame for mitigation measure to be undertaken**	**Person responsible for monitoring**	**Monitoring frequency**
Nuisance impact on surrounding residents with the upgrading of nearby roads.	Keep points man in attendance to control traffic where road disruption is most likely. Alert traffic department if road closure is required, conduct road closures during off peak hours and place notices of intent in advance.	Phase 2 and 3	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Positive impact with the incorporation of public transport and non-motorised transportation into the proposal.	The Traffic Impact Assessment has stated that there will be the construction of a public transport interchange within the site and laybys on Kassier Road. In the long term, the road upgrades will ensure that the public transport aligns with the IRPTN strategy and that sufficient road reserve is maintained to provide a BRT lane if required. There will be a minimum width of 3m for sidewalks, both internally and externally, to safely accommodate pedestrians and cyclists.			
Damage to existing services (electricity, water and sewer pipeline traversing site).	As a result of the existing long-term land use, there are not many services found in the proposed sites however, this impact can be fully mitigated against by identifying services prior to construction and avoiding damage to existing services. Alternatively, if service disruption is unavoidable, the parties affected must be notified in advance.	Phase 1 and 2	Applicant / Contractor	Services to be identified prior to construction.
Increased pressure on existing bulk water services in the Western area.	The bulk water supply for the proposed development will originate from the proposed and soon to be constructed Western Aquaduct. eThekwini Water and Sanitation have confirmed that a supply may be taken off the Western Aquaduct to serve the greater development.	Phase 5	eThekwini Water and Sanitation	eThekwini Water and Sanitation have confirmed capacity and are required to monitor the output.
Nominal pressure on the eThekwini Municipality's local substation (Marian Ridge Major substation to obtain developments initial load).	Bosch Stemele, as the electrical engineers are to be in correspondence with the Supply Authority, eThekwini Municipality, to ensure that there is sufficient capacity available. In the long term, the proposed development will require the construction of a new major substation.	Phase 5	eThekwini Municipality	eThekwini Municipality have confirmed capacity and are required to monitor the output.
Potential for the existing wastewater treatment works not having sufficient capacity to treat sewage from the upgrade.	The Tongaat Hulett Sewer Reticulation Project obtained environmental authorisation for the construction of bulk sewerage facilities in the area (EIA DM/0024/10). This assessment took into consideration existing and potential sewer generation for the proposed Shongweni retail/ mixed-use development. There is therefore sufficient capacity at the uMhlatuzana Sewage Treatment Works.	Phase 5	uMhlatuzana Sewage Treatment Works	uMhlatuzana Sewage Treatment Works have confirmed capacity and are required to monitor the input.
Over densification of the Shongweni area and change in sense of place currently associated with the existing land-use.	While there will be a loss of open space, the continuation of agricultural activities is not in line with the city's need for growth and development. GAPP Architects and Urban Designers, have stated the proposed development is aligned to the Urban Development Line, the Municipality's urban growth management tool. There will therefore be an unmitigated change in the sense of place currently associated with the site.	Phase 5	n/a	n/a
Positive impact for meeting housing and basic service needs, access to	Findings from interviews conducted in the local area, undertaken as part of the Marketing and Socio-Economic Impact Assessment identified the demand for affordable housing, the demand for safe, secure, upmarket office space and retail brand preferences (which are likely to be incorporated into the tenant considerations).			

PROPOSED DEVELOPMENT IMPACTS				
Nature of impact (potential)	**Mitigation measure**	**Time frame for mitigation measure to be undertaken**	**Person responsible for monitoring**	**Monitoring frequency**
employment opportunities				
Unauthorised access to property.	The applicants are the landowners and thereby will authorize access to the property. The entire site should however be fenced so ensure workers do not cross boundary lines particularly where the development footprint runs adjacent to residential communities.	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Potential for an associated increase in crime due to the influx of workers into the area.	As mentioned above, the entire site should be fenced to prevent workers from accessing adjacent properties. Security personnel on site should be strategically positioned at exit and entry points. The EAP further recommends that security personnel patrol the pipeline route where it runs adjacent to neighbouring properties during the construction phase.	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis. Monthly audits must be conducted by an ECO.
Potential temporary and permanent employment for skilled and unskilled members of the local community during the construction and operational phases.	3726 temporary employment opportunities will be created during the construction phase (2097 directly and 1629 indirectly) and 359 permanent jobs will be created during the operation phase (234 direct and 124 indirectly).			
Shongweni Regional Centre stimulating trade and investment along the intended freight highway (the N3; Planning Report, 2013).	The planning specialist states that the sites sit strategically within what is by far the most dominant freight and logistics corridor in Southern Africa. In anticipation of the proposed dug-out Port, a proposed freight highway along the N3 highway, is intended to pass directly through the THD landholdings in Shongweni.			
Potential unearthing and damage to items of cultural or historical significance.	A Heritage Impact Assessment was conducted. During the construction phase, should any culturally significance artifacts be discovered, construction is to cease immediately and the heritage authority contacted (AMAFA).	Phase 2	Contractor / and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Speeding construction vehicles resulting in safety issues for surrounding residents.	Speeding will be prohibited.	Phase 2	Contractor / and ECO	The contractor / designated representative must monitor the site on a daily basis. Monthly audits must be conducted by an ECO.
Lack of toilet facilities during construction resulting in unsanitary conditions.	Adequate toilet facilities will be provided for all staff members as standard construction practice. The provision of toilets is included in the EMPr requirements.	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct weekly checklists. Monthly audits must be conducted by an ECO.
Improper disposal of toilet waste from chemical toilets resulting in	The chemical toilets to be provided must be from a registered company and all sewage must be disposed of at an appropriate facility. Safe disposal	Phase 2	Contractor / Designated Representative and ECO	The contractor / designated representative must monitor the site on a daily basis and conduct

PROPOSED DEVELOPMENT IMPACTS				
Nature of impact (potential)	**Mitigation measure**	**Time frame for mitigation measure to be undertaken**	**Person responsible for monitoring**	**Monitoring frequency**
contamination of the surrounding environment.	certificates must be kept on record in the site environmental file.			weekly checklists. Monthly audits must be conducted by an ECO.

2.4 PROCEDURES FOR ENVIRONMENTAL RELATED EMERGENCIES AND REMEDIATION

The purpose of this section is to anticipate a potential impact resulting in an environmental crisis which may occur due to unforeseen circumstances. Such events cannot be predicted and as such a procedure has been prepared. This procedure must be followed in the event of such an incident to prevent degradation to the surrounding environment and to contribute to the safety of the workers and I & APs.

2.4.1 Potential environmental incidences / emergencies

The National Environmental Management Act 107 of 1998 as amended (NEMA) defines an 'incident' as an unexpected sudden occurrence, including a major emission, fire or explosion leading to serious danger to the public or potentially serious pollution of or detriment to the environment, whether immediate or delayed. The following hazards have the potential to occur within the proposed site:

- Hazardous chemical spillage
- Leakage of fuel or oil from equipment
- Slope instability
- Potential contamination of freshwater resources on the site effecting the important ecosystems downstream of the site.

2.4.2 Response to environmental emergencies

The emergency response plan (Appendix 4) must be used to update the onsite emergency response plans. A record of all incidents must be recorded as defined in NEMA and National Water Act 36 of 1998 (Appendix 5). Incidents should be reported and recorded the relevant authority as soon as reasonably practicable after knowledge of the incident.

An emergency incident report (Appendix 6) must be completed in terms of section 30(5) of the National Environmental Management Act (Act No. 107 of 1998).

"The responsible person or, where the incident occurred in the course of that person´s employment, his or her employer, must, within 14 days of the incident, report to the Director General, provincial head of department and municipality such information as is available to enable an initial evaluation of the incident, including:

(a) the nature of the incident;

(b) the substances involved and an estimation of the quantity released and their possible acute effect on persons and the environment and data needed to assess these effects;

(c) initial measures taken to minimise impacts;

(d) causes of the incident, whether direct or indirect, including equipment, technology, system, or management failure; and

(e) measures taken and to be taken to avoid a recurrence of such incident."

2.5 ENVIRONMENTAL AWARENESS PLAN

In accordance with NEMA EIA (2010) regulations, an environmental awareness plan is required. As part of the environmental awareness plan 'Toolbox Talks' posters have been developed and can be used for training purposes.

- **Objectives of the plan**

The objective of the environmental awareness plan is to inform employees and contractors of any environmental risks which may result from their work and the manner in which the identified possible risks must be dealt with in order to prevent degradation of the environment.

- **Content of the plan**

The environmental awareness plan should include:

- The definition of environment (people + air + soil + water +business);
- Reasons for conserving and protecting the environment;
- How the following activities can impact the environment: - Not using assigned ablutions, hazardous materials, uncleaned spills, mixing of cement or paint on soil or grass surfaces, waste management i.e. use of waste receptacles and waste separation for recycling, vehicle washing polluting soil & ground water; litter;
- What to do to prevent the above impacting the environment i.e. assign impermeable mixing areas, no vehicle washing on site, use of waste receptacles and separation of waste to allow for recycling, how to respond in an emergency and deal with a spill; and
- Consideration of neighbours.

The environmental awareness plan that should be presented to employees is attached in Appendix 7. A training record of all staff that has undergone environmental training must be kept on record (Appendix 8).

3. ENVIRONMENTAL MANAGEMENT PLAN

3.1 General Administration

Site Inception

- Prior to construction an Environmental Control Officer (ECO) must be appointed to carry out monthly audits monitoring compliance with the EMPr.
- An emergency response plan must be available on site as must a copy of the EMPr and the EA.
- The contractor, engineer and ECO must obtain a copy of the EMPr prior to coming on site. An initial site meeting must be held with all responsible parties to discuss the EMPr and ensure that all elements are understood in particular the functioning and management of the freshwater ecosystems on the site.
- It must also be agreed that no ad hoc changes will be made to the EMPr and that any requested changes must be submitted in writing to the ECO who will obtain clearance for the changes from either the DAEA compliance officer auditing the site and / or the environmental consultant or an authority body, depending on the changes requested and depending on the status of the project
- An environmental file must be kept on site. The environmental file should contain, amongst other things, a register of all environmental training, an incident record, a complaints register, safe disposal slips (waste and sewage) and any records proving the source of materials
- A record of audits conducted on operations, as well as findings must be kept by the Site Engineer, and findings from audits are to be communicated to the Foreman on site. Proof of communication of findings are to be kept on site in the Environmental File.
- The site must be sufficiently lit, enabling security and policing should work be required at night.
- The entire site should be fenced to restrict unauthorised access to the property.
- The following details are to be available at each site:
  - *Emergency contact numbers: Name, contact details*
  - *Environmental Control Officer: Name, contact details*
  - *A list of the sensitive areas identified for that site*
  - *Proof of communication of these details to the staff at that particular site.*
- Adequate spill kits and containers for spilled and contaminated material must be provided on site.
- Designated areas for stockpiling of raw materials must be identified on site. No stockpiling is to occur on or near slopes or the adjacent stream. All stockpiling areas must be approved by the Site Engineer and must not exceed 6m in height according to the initial specialist report.
- Haulage roads must be identified and demarcated at site set up. These should be located where existing/future roads will be built and must be clearly indicated. Turning areas must be identified and clearly demarcated.
- All staff are to be trained on their environmental responsibilities before commencing work. All new staff are to be trained before they start work on site. All staff must have basic environmental awareness training, which can be conducted with the required health, & safety training. Training should include:

  (1) the definition of environment (people + air + soil + water +business);

  (2) reasons for conserving and protecting the environment;

  (3) how the following activities can impact the environment: - Not using assigned ablutions, hazardous materials, uncleaned spills, mixing of cement or paint on soil or grass surfaces, waste management i.e. use of waste receptacles and waste separation for recycling, vehicle washing polluting soil & ground water; litter;

  (4) What to do to prevent the above impacting the environment i.e. assign impermeable mixing areas, no vehicle washing on site, use of waste receptacles and separation of waste to allow for recycling, how to respond in an emergency and deal with a spill;

  (5) Consideration of neighbours.
- All existing services must be identified prior to construction as standard practice.

- Any damage to existing infrastructure (i.e. water pipelines, electricity lines and residential property) must be repaired or replaced on completion of the upgrade. The cost of which must be borne by the applicant (or representative of the applicant).
- Evidence of items with historical or archaeological value must be reported to AMAFA and work in the affected area should be stopped immediately.
- Properties neighbouring the site must be notified before any phase of construction commences.

3.2 Site Camp Establishment

Site Inception

- The construction camp shall be located at the position agreed with by the ECO and the Contractor.
- The construction camp must be located in the proposed site and fenced.
- The size of the construction camp must be minimized.
- The 32m buffer area is to be well demarcated and signed to prevent worker accessing/disturbing the buffer zone.
- The contractor must attend to drainage of the construction camp to avoid standing water or sheet erosion.
- No contaminated runoff or grey water is allowed to be discharged from the construction camp.
- A suitable and sufficient waste management area is to be designated and demarcated within the construction camp.
- Storage of waste must be within a hard surfaced, bunded area located under cover and there must be a regular schedule for removal of waste.
- A materials storage area must be identified and designated within the construction camp.
- An area for fuel and hazardous chemical storage must be identified if required. This area should be bunded with an impermeable liner or a suitably sized container should be provided as storage space.
- Fuel bowsers must be maintained in good condition and be provided with a drip tray for use when dispensing/ refuelling equipment and must be placed under the pump and dispensing unit of the bowser during overnight storage. If possible an undercover area should be provided for overnight storage of the bowser/s.
- Storage areas/containers containing hazardous substances / materials must be clearly signed and fire extinguishers must be located in close proximity.
- Suitable spill kits must be available at the Site Camp.
- Only emergency (breakdown where equipment is no longer mobile) and minor maintenance (e.g. greasing) may be done on site. Any other planned or required maintenance must be done offsite at a suitable location.
- There is to be no encroachment into the wetland buffer zone reducing protection of the drainage line and riparian habitat

Construction

- The designated waste management area must be utilised at all times. Bins must be provided and emptied at regular intervals.
- Chemical toilets must be located on site and maintained regularly.
- Chemical toilets may not be located adjacent to the any of the freshwater drainage lines on the site as indicated in blue in Figure 5 below.
- Storm water control must be controlled and maintained as per the approved Stormwater Management Plan.
- Drip trays are to be cleaned out daily and material collected disposed of as hazardous waste.
- The striping of vegetation is to be carried out progressively and immediately prior to commencement of construction activities in a particular area.
- Alien vegetation re-growth must be controlled throughout the entire site during the construction period using mechanical and chemical removal.
- Herbicides may be used to control listed alien weeds and invaders only. The Material Safety Data Sheets (MSDSs) for the herbicides must be available to the ECO on request. Herbicides are to be stored in the hazardous materials storage area.
- All areas that have been stripped of vegetation, including all roads, must be dampened periodically to avoid excessive dust.

Post construction

- All building materials and waste must be removed from the site at the end of construction.
- Clearance from the ECO must be obtained to ensure the all of the requirements of the EMPr have been complied with (i.e. conduct a post construction audit).

- Ensure bins and / or skips have been removed from the construction site.
- Waybills must be produced showing the removal of waste / spoil / rubble to a registered waste site.
- Used oil must be collected by a registered used oil contractor and documentation to this effect has been provided.
- All undeveloped surfaces hardened due to construction activities are to be ripped, top soiled and vegetated as soon as possible.
- Alien vegetation growing in disturbed areas must be removed.
- The duration of exposed soil must be kept to a minimum and rehabilitation must be initiated as soon as construction is complete.

Operation

- *Not Applicable*

Key Issues

- **Prevention of runoff from site camp to the freshwater ecosystems.**
- **Establishment of the waste management area on an impermeable surface.**
- **Demarcate the 32m buffer zone adjacent to the drainage lines as indicated in Figure 6.**

Figure 6: Map showing the drainage lines within and adjacent to the site in blue. The waste management area, stockpiles and chemical toilets must not be placed within or adjacent to these areas (source: GroundTruth, Riparian Assessment, 2013).

3.3 Stormwater

Site Inception

- All existing drainage systems (streams, channels) are to be maintained by the main developer in accordance with normal agricultural soil conservation practices and local authority guidelines as far as possible (except where the town planning layout makes provision for the development of land over existing drainage systems).
- Prior to moving onto site, the Engineer and Contractor shall inspect the existing stormwater drainage measures along these access routes and repair or construct new drainage measures to limit point source run-off, prevent erosion and allow for the natural flow of water.
- There should be limited storage of sand and cement on the site as this could contaminate stormwater during construction.
- All potential stormwater contaminants (including herbicides) must be bunded in the site camp to prevent run-off into the surrounding environment.
- A drainage system must be established for the construction camp. The drainage system must be regularly checked to ensure an unobstructed water flow.
- Removal of vegetation cover should be carried out with care to decrease the likelihood of erosion resulting in excess sediments washing into the onsite and adjacent freshwater ecosystems.
- As there are no formal stormwater drainage facilities on site, the contractor must prepare a stormwater control plan prescribing methods to be used on the site complying with the requirements of the Stormwater Management Plan prior to construction.

Construction

- Stripping of vegetation to allow commencement of earthworks shall only be undertaken immediately prior to that element of construction commencing.
- Construction of the embankment to be done in segments up to full height, before moving on to the next area, clearing vegetation, and constructing embankment, etc.
- The construction of internal stormwater piped systems are to be programmed for construction immediately on completion of the bulk earthworks for the road works
- Any runoff from the construction site must not be allowed to cause excessive erosion or sediment input in to the adjacent stream.
- Temporary stormwater measures are required to control the runoff of stormwater until permanent structures have been constructed.
- Flow of stormwater must not be impeded during construction.
- Contamination of stormwater must be avoided at all times.
- A drainage system must be established for the construction camp. The drainage system must be regularly checked to ensure an unobstructed water flow.
- During construction unchannelled flow must be controlled to avoid soil erosion. Where large areas of soil are left exposed, rows of straw / hay or bundles of cut vegetation should be dug into the soil in contours to slow surface wash and capture eroded soil. The spacing between rows will be dependent on the slope.
- Any incidents involving stormwater contamination must be reported to the ECO for the purposes of maintaining the site's incident records.
- No temporary storage of rubble in natural waterways.
- Energy dissipating structures (gabions, reno-mattresses and/or concrete) are to be established at outlet structures where stormwater is being discharged reducing flow velocity and preventing scour/ soil erosion.
- The stormwater control plan must be adhered to at all times.
- There are to be multiple discharge points that are reasonably spread across the development adjoining the wetland habitat.
- Stormwater flow from the buffer zone should be via diffuse flow and concentrated flow should be avoided reducing the risk of erosion.

- Accompanying each discharge point should be suitable baffle structures (e.g. gabion mattresses) that will dissipate the energy of storm flow and encourage infiltration thus reducing the likelihood of erosion.
- Runoff entering the buffer zone should not exceed 1.5m/sec to reduce the pollutant removal performance of the buffer area.
- Stormwater may not be discharged directly into the Wekeweke Stream, but should be directed into the rehabilitated tributary wetlands
- Outflow points to trap excess suspended solids and other pollutants originating from the proposed development before entering the buffer zones. These will need to be regularly serviced and maintained to ensure adequate functioning and efficacy.
- Infiltration measures be constructed on the platformed sites to recharge groundwater (e.g. permeable paving).
- Kerbing upstream of embankment slopes to be constructed to divert flow away to an underground conduit or stabilised channel to the existing major stormwater system.

Post construction

- Post-development flows into stormwater systems are not to exceed pre-development flows as per the SWMP design.
- On completion of works, eThekwini Municipality, or their appointed professional person to inspect the site for compliance with the Stormwater Management Plan requirements before issuing a Certificate of Occupation.
- Topsoiling and re-vegetation of exposed surfaces is to commence immediately after the completion of all construction activity.

Operation

- Outflow points to be regularly serviced and maintained to ensure adequate functioning and efficacy.

Key Issues

- **Stormwater must be controlled before it is released into the drainage lines.**
- **Stormwater may not be directly discharged into the Wekeweke Stream but directed into the rehabilitated tributary wetlands.**

3.4 Construction Material (Sourcing and Stockpiling)

Site Inception

- Contractors must prepare a source statement indicating the sources of all materials (including topsoil, sands, indigenous gravels, crushed stone etc.).The source statement must be readily available in the environmental file for review by the ECO.
- Where possible, a signed document from the supplier of natural materials must be obtained confirming that they have been obtained in a sustainable manner and in compliance with relevant legislation.
- Any mined material must be from a licensed and permitted site. Suppliers must be able to provide permits for the quarry where material has been mined from.
- Stockpiles must be positioned and sloped to create the least visual impact.

Construction

- Ensure that all materials are sourced from those sites set out in the source statement and that any changes to sources of materials are updated and approved by the ECO.
- Make certain transportation of materials is such that no spillage occurs on route to the site.
- General building/other materials include non-hazardous materials and chemicals must be kept in a designated area.
- Materials must be stacked in a way that they cannot fall and cause injury or damage to property or the surrounding environment. Stockpiles must not exceed 6m in height and must be covered if exposed to heavy wind or rain. Alternatively, low walls or berms must be constructed around the stockpiles.
- Topsoil must be stockpiled separately to the sub-soils. Any soil or topsoil stockpiles created during site establishment are to be maintained as flat as possible, with no side slope greater than 1 in 4.
- Stockpiles must not be located within or adjacent to the drainage lines indicated in blue in Figure 5 above.

Post construction

- Ensure that areas where materials are sourced are rehabilitated to ensure no erosion or degradation of the surrounding area occurs.
- All residual stockpiles must be removed to spoil or spread on site as directed by the ECO.
- All leftover building materials must be removed from the site.
- No foreign material generated / deposited during construction must remain on site. Areas affected by stockpiling must be reinstated to the satisfaction of the RE and ECO.

Operation

- *Not Applicable.*

Key Issues

- **Review of source materials lists.**
- **Approve any changes in material sources with ECO first.**
- **Stockpiles must not be located within or adjacent to the delineated drainage lines on site.**

3.5 Water Use and Cement Batching

Site Inception

- Water used on site must be from an approved source. Should the quantity of water extracted from a natural source (river) exceed 50 000 litres per day a water use permit must be acquired from DWA.
- Concrete should be trucked in and discharge directly to areas where it may be needed.
- No topsoil may be removed from site but rather stockpiled and used to rehabilitate the site post construction.

Construction

- Water use on the site must be recorded and monitored.
- Concrete mixing directly on the ground must not be allowed and must take place on impermeable surfaces to the satisfaction of the ECO.
- Designated concrete mixing areas and storage areas for any hazardous materials must be assigned; cement mixing will not be permitted to where runoff can enter the Wekeweke Stream.
- During construction, waste reduction must be targeted and recycled building materials should be used where possible.

Post construction

- All excess concrete must be removed from site on completion of works and disposed of. Washing of the excess material into the ground or river is not allowed.
- All excess aggregate must also be removed from site.

Operation

- Not *Applicable*.

Key Issues

- **Water may only be used from an approved natural source or from a municipal source.**
- **Concrete mixing directly on the ground must not be allowed.**

3.6 Contamination & Waste Water Management

Site Inception

- A method statement must be completed by the Contractor and submitted to the ECO showing procedures for dealing with possible emergencies that can occur, such as fire, accidental leaks and spillages.
- The Contractor must be in possession of an emergency spill kit that is complete and available at all times on site. The internal EO must be aware of the location of the emergency spill kit and have access to it.
- The ECO must be aware of the spillage procedure with regard to spillages of hazardous or potentially hazardous substances.
- Adequate wastewater collection facilities must be provided
- The Contractor must submit a method statement to the ECO detailing how wastewater would be collected from all wastewater generating areas, as well as storage and disposal methods.
- No contaminated runoff or grey water may be discharged from the site camp.
- Portable toilets must not be located within or adjacent to the delineated drainage lines as indicated in blue in Figure 5.
- A maintenance plan for the servicing of these toilets must be drawn up and strictly adhered to, to prevent malfunctioning and neglect.

Construction

- Should any spills of hazardous materials occur on the site or in the storage area, the relevant clean-up specialists must be contacted immediately. Materials that absorb fuel & oil, such as Drizit or earth should be placed over the spill. This contaminated material must be uplifted, placed within impermeable container and disposed of at a recognized disposal site.
- An incident record must be completed for all spills.
- In the event of a spillage that cannot be contained and which poses a serious threat to the local environment, the following Departments must be informed of the incident in accordance with Section 30 of the National Environmental Management Act, Act 107 of 1998, within forty-eight (48) hours:
  - The Local Authority;
  - Department of Water Affairs;
  - The Department of Agriculture and Environmental Affairs
  - The Local Fire Department when relevant; and
  - Any other affected departments.
- The chemical toilets servicing the camp must be maintained in a good state, and any spills or overflows must be attended to immediately by a sanitation expert.
- No waste water must be allowed to runoff into the rivers or areas of indigenous vegetation.
- No vehicle equipment washing should be conducted on site.
- Toilet waste to be removed by an approved contractor and safe disposal certificates must be available on request.

Post construction

- No evidence of spills must be evident after construction.
- Ensure clean up and rehabilitation of areas where any waste water spillage has occurred.

Operation

- No

Key Issues

- **Correct procedures followed and records to be compiled.**
- **Protection of the indigenous/ riverine vegetation from contamination.**
- **Waste water must either be collected for removal or no washing should occur on site.**

3.7 Waste Management

Site Inception

- Waste must be disposed at the appropriate landfill site by an approved contractor.
- Safe disposal certificates will be obtained and kept on site.
- The waste management area must not be located within or directly adjacent to the "Green Open Space" component in the layout (i.e. preferably located in the centre or north of the site).
- The waste management area is to be located on an impermeable surface to prevent leachate from coming into direct contact with the soil.
- Burning of rubbish on site is not allowed.
- Recycling bins must be placed within the construction site to ensure all materials are properly sorted for recycling.

Construction

- The designated waste area must be utilized at all times.
- The construction rubble must be disposed in designated spoil dumps, demarcated by the Engineer.
- Refuse must be separated at source and disposed of in the appropriate bins, which must be emptied regularly.
- Littering is prohibited and the site must be cleaned daily.
- Separation of waste and recycling of paper, glass etc. must be encouraged throughout the construction period.
- All solid waste generated during the construction process (including packets, plastic, rubble, cut plant material, waste metals etc.) must be placed in the waste collection area in the construction camp and must not be allowed to blow around the site, be accessible by animals, or be placed in piles adjacent the skips / bins.
- Recycling should be undertaken where possible to limit waste added to the landfill site.
- Safe disposal certificates for all waste forms (i.e. general/construction/hazardous) must be obtained and kept on site within the site office.
- A separate receptacle must be available for storage of contaminated soil.

Post construction

- Any construction rubble not utilized as fill material will be disposed in designated spoil dumps, demarcated by the designated representative / Resident Engineer.
- No litter must be left on site
- All bins and other waste storage are removed from site.
- A final check must be done to ensure that no waste relating to the construction phase is left on site.
- Burying of rubble on site, or dumping in drainage lines/rivers is prohibited.
- The Contractor is to check that the stormwater channels and the drainage pipes are free from building rubble, spoil materials and waste materials.

Operation

- Maintenance personnel must undergo an induction programme to ensure compliance with operational phase requirements of the EMPr.

Key Issues

- **Recycling to be encouraged.**
- **Bins must be located at adequate intervals in the construction area.**
- **The waste management area is to be placed on a hard surface to prevent leachate from entering the soil.**