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STUART COAL (PTY) LTD

SOUTH BLOCK COLLIERY

Hydrocensus report

November 2018

CLEAN STREAM
ENVIRONMENTAL CONSULTANTS (PTY) LTD

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TABLE OF CONTENTS

HYDROCENSUS REPORT – STUART SOUTH BLOCK COLLIERY

A INTRODUCTION

Stuart Coal (Pty) Ltd.[1] is a coal mining company with active operations close to Delmas in the Mpumalanga Province. Stuart Coal has three collieries in close vicinity to each other; these are the Weltevreden Colliery, the East Colliery and the South Block Colliery. Stuart Coal recently obtained all necessary approvals associated with the initial mine plan for several listed mining activities and Water Uses to take place the South Block Colliery. However, since the approval of the EIR[2], EMPr[3], and WUL[4] several changes have been made to the approved mine plan which necessitated an update on several specialist studies including the Hydrocensus Report. CSEC[5] was therefore appointed by Stuart Coal to undertake a hydrocensus study around the South Block Colleiry as part of the EIR, EMPr, and WUL amendment.

A(I) SITE LOCALITY

The mine boundary of the South Block Colliery is situated on portions 7, 9, 14, 15 and 24 of the farm Moabsvelden 248 IR, portion 0 (Re) of the farm Vogelfontein 222 IR, and portions 0 (Re) and 2 of the farm Vanggatfontein 250 IR which falls within the jurisdiction of Delmas Magisterial District, and the Victor Khanye Local Municipality in Mpumalanga. Further, the South Block Colliery lies within the upper reaches of the Bronkhorstspruit and unnamed tributaries of the Bronkhorstspruit. The South Block Colliery area is therefore part of the Olifants River drainage region which falls within the B20A and B20E quaternary catchment (refer to the South Block Colliery Infrastructure and quaternary catchment map in Figure 1 below).

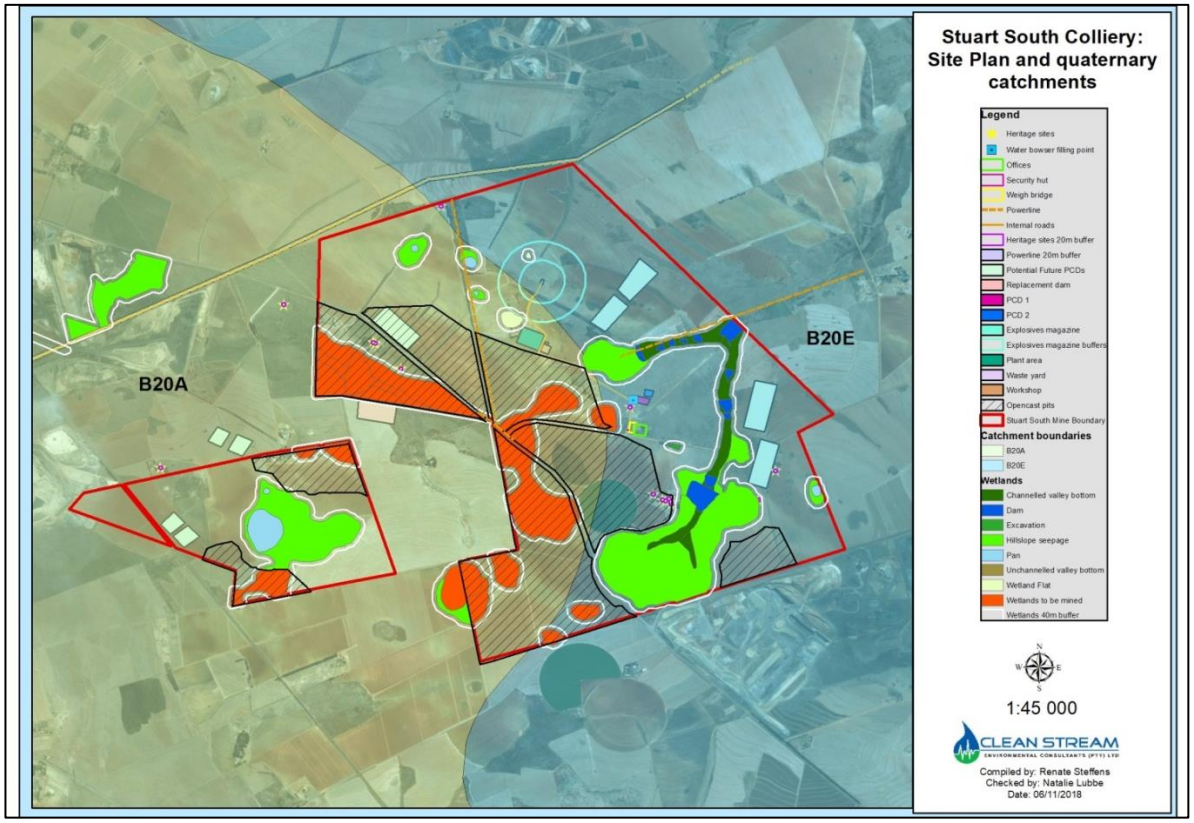

Figure 1: Existing and proposed new infrastructure associated with the South Block Colliery relative to the B20A and B20E quaternary catchments.

[1] Stuart Coal: Stuart Coal (Pty) Ltd.
2 EIR: Environmental Impact Assessment Report.
3 EMPr: Environmental Management Programme report.
[4] WUL: Water Use Licence
[5] CSEC: Clean Stream Environmental Consultants (Pty) Ltd.

B METHODOLOGY

The data considered in this hydrocensus report consisted of:

1. Existing monitored data from boreholes within the mine boundary as obtained from Aquatico (who is currently appointed to run the monthly sampling and analysis of water samples within and around the Stuart Collieries, as per Stuart Coal Monitoring Programme in place).
2. *In situ* samples taken by CSEC representatives during the filed investigation.
3. Chemical analyses (undertaken by Intertek) of additional samples obtained by CSEC representatives during the site investigation.

B(I) EXISTING MONITORED DATA

Stuart Coal has an existing water quality monitoring programme which includes the Weltevreden Colliery, the East Block Colliery as well as the South Block Colliery. Aquatico is currently the appointed specialists responsible for monthly and quarterly water quality monitoring at the various surface- and groundwater monitoring points which forms part of the existing monitoring programme. This hydrocensus report will however focus only on the groundwater monitoring locations, and the details of these locations are presented in **Table 1** below. **Figure 2** depicts the locations of all boreholes considered in this hydrocensus report.

Table1: Details of boreholes as part of the Stuart Coal existing monitoring programme.

Site Name	Y-coordinate	X- coordinate	Description
SB01	-26,1435367	28,8092783	South Block borehole
SB02	-26,1509383	28,8177317	South Block borehole
SB03	-26,1617817	28,8281567	South Block Borehole
SB04	-26,1528133	28,8316750	South Block Borehole
SB05	-26,1456550	28,8342467	South Block Borehole
SB06	-26,1735633	28,8259183	South Block Borehole
SB07	-26,1658733	28,7907533	South Block Borehole
SB08	-26,1546350	28,7979750	South Block Borehole
SB09	-26,1427517	28,8013283	South Block Borehole
SB10	-26,1590500	28,8433050	South Block Borehole
SCG01	-26,1438900	28,7589533	North of opencast workings next to Open Void
SCG06	-26,1470950	28,7620233	Weltevreden Colliery: Borehole WGM-1 East of Explosives Magazine
SCG08	-26,1549017	28,7502300	Weltevreden Colliery: Borehole WGM-3 Southwest of Weltevreden Block
SCGW01	-26,1312883	28,7901200	North Eastern Corner of Stuart East Block
SCGW02D	-26,1424167	28,7783733	Demolished - Southern perimeter of the Stuart East Block - Deep aquifer
SCGW02S	-26,1424100	28,7783767	Demolished - Southern perimeter of the Stuart East Block - Shallow aquifer
SCGW03D	-26,1463517	28,7693650	South Western perimeter of the Stuart East Block - Deep aquifer
SCGW03S	-26,1463733	28,7693617	South Western perimeter of the Stuart East Block - Shallow aquifer
SCGW04	-26,1358850	28,7904350	Eastern perimeter of the Stuart East Block
SCGW05	-26,1363150	28,7743783	Demolished - Western perimeter of the Staurt East Block
SCGW06	-26,1273817	28,7810783	Northern perimeter of the Stuart East Block

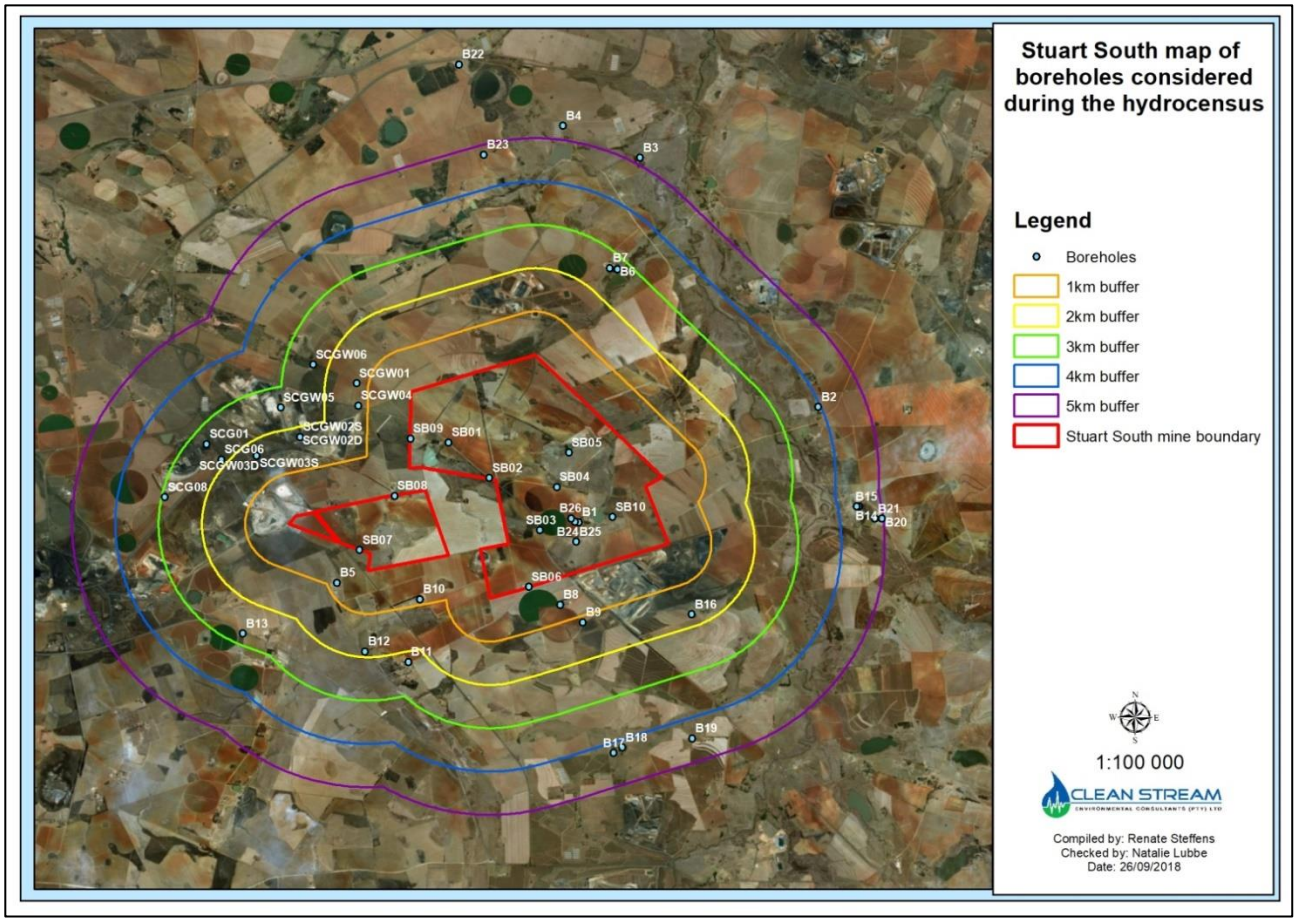

Figure 2: Boreholes investigated as part of the Hydrocensus.

B(II) IN SITU SAMPLES

CSEC representatives undertook a field investigation on the 16th and 17th of August 2018 to identify and document as many as possible groundwater users within a 5km radius of the South Block Colliery mine boundary. A total of 26 boreholes were identified and sampled within the 5km radius. **Table 2** in **Part C** presents the details of each borehole identified and sampled by CSEC representatives.

Landowners of the properties where boreholes identified in **Table 2** are located, were consulted in order to obtain information regarding the use and volume of each borehole. Boreholes were also inspected and described in terms of the following characteristics:

- Colour of water.
- Smell of water.
- Presence of oil or other film
- Other notes.

In addition, water samples were obtained from boreholes as per the borehole sampling protocol (attached as **Appendix 1**), in order to obtain accurate *in situ* measurements of the following parameters:

- pH.
- EC[6].
- TDS[7].
- Temperature.

[6] EC: Electrical Conductivity
[7] TDS: Total Dissolved Solids

The results of the data gathered in-situ are summarised in **Table 3** in Part C of this report.

B(III) CHEMICAL ANALYSIS

Water samples were also taken at 22 of the boreholes assessed and submitted to Intertek[8] for chemical analysis in which the concentrations of the following constituents were determined; Ca[9], Mg[10], K[11], Na[12], Fe[13], Mn[14], Cu[15], Zn[16], B[17], Mo[18], SO^{2-}_4[19], H_2PO_4[20], NO^-_3[21], NH^+_4[22], CO^{2-}_3[23], HCO^-_3[24], pH, EC, TSS[25], Cl^-[26], SAR[27], TPC[28], Coliforms, *E Coli*. These constituents were compared against the SANS 241 (2015) and DWA Drinking water standards and presented in **Table 4** in Part C of the report.

[8] A laboratory accredited by the South African National Accreditation System
[9] Ca: Calcium
[10] Mg: Magnesium
[11] K: Potassium
[12] Na: sodium
[13] Fe: Iron
[14] Mn: Manganese
[15] Cu: Copper
[16] Zn: Zink
[17] B: Boron
[18] Mo: Molybdenum
[19] So^{2-}_4: Sulphate
[20] H_2PO_4: Dihydrogen Phosphate
[21] NO^-_3: Nitrate
[22] NH^+_4: Ammonium
[23] CO^{2-}_3: Carbonate
[24] HCO^-_3: Bicarbonate
[25] TSS: Total suspended solids
[26] CL^-: Chlorine
[27] SAR: Sodium Adsorption Ratio
[28] TPC: Total Plate Count

C RESULTS AND DISCUSSION

The results of the borehole data gathered in-situ and sent for chemical analysis are summarised in **Table 3** and **Table 4** respectively.

Table 3: Summary of borehole data gathered in-situ.

Sample					Characteristics				Parameters			
Ref on maps	Description on data sheet	Location of sample	South (Y)	East (X)	Colour	Smell	Oil	Other	pH	EC	TDS	Temperature
B1	2	Pipe from bh Closed	-26,1601111	28,8362778	Clear	None	no	no	7,2	230,0	110,0	25,7
B2	Kraal	House	-26,1361944	28,8859722	Clear	None	no	no	7,4	70,0	30,0	20,5
B3	House	Tank tap Closed	-26,0844722	28,8489722	Clear	None	no	no	7,5	240,0	110,0	20,2
B4	Chickens	Pipe Closed	-26,0778333	28,8329722	Clear	None	no	no	7,0	190,0	90,0	21,5
B5	field	Tank. Closed	-26,1726944	28,7860833	clear	None	no	no	8,2	190,0	90,0	23,3
B6	House	from pipe into dam. closed	-26,1075556	28,84425	Clear	Sweet	no	no	6,5	350,0	170,0	14,4
B7	Workshop	Via tank Closed	-26,1073611	28,8426944	Clear	None	no	no	7,8	310,0	140,0	18,7
B8	House	corrugated iron dam pipe. Closed	-26,17725	28,8324444	Clear	no	no	no	8,2	400,0	190,0	19,8
B9	Field	pipe close to borehole. Closed	-26,1808889	28,8370833	Clear	no	no	no	7,2	490,0	240,0	18,6
B10	House	tap, closed	-26,1761111	28,8033333	clear	no	no	no	7,2	310,0	150,0	19,0
B11	Skaapkraal		-26,1891667	28,8008611	clear	no	no	no	7,9	450,0	220,0	21,7
B12	Landery	tap, about 400m from hole. closed	-26,1869722	28,7918611	clear	no	no	no	7,8	520,0	250,0	19,3
B13	Next to R50		-26,1832778	28,7665556								
B14	house	tap from tank. Closed	-26,1568333	28,8943889	a bit murky	no	no	no	6,7	70,0	30,0	21,4
B15	outside	Tap . Closed	-26,1568889	28,8940278	Clear	no	no	no	7,2	180,0	80,0	22,1
B16	workshop	tap. Closed	-26,1792778	28,8597222	Clear	oily	no	no	7,0	560,0	270,0	18,4
B17	field	borehole. Closed	-26,2080278	28,8434722	Clear	no	no	no	7,5	490,0	240,0	29,4
B18	cattle kraal	tap. Closed	-26,2069167	28,8453056	Clear	no	no	no	7,7	400,0	190,0	17,2
B19	field unequipped		-26,205	28,8598056								
B20	Skaapkraal	borehole. Closed	-26,1593611	28,8992222	Clear	no	no	no	6,3	420,0	200,0	20,4
B21	veld	borehole. Closed	-26,1593889	28,89775	Clear	no	no	no	6,3	180,0	80,0	19,9
B22	community borehole	open container from tap	-26,0650833	28,8113611	Clear	no	no	no	6,9	80,0	30,0	21,9
B23	huis	tap at tank. Closed	-26,0838333	28,8165	Clear	no	no	no	7,2	100,0	40,0	24,1
B24	1	tap near borehole. Closed	-26,1600833	28,8355278	Clear	no	no	no	7,9	240,0	110,0	25,7
B25	3	irrigation pipe. Closed	-26,1641667	28,83575	Clear	no	no	no	8,0	240,0	110,0	22,2
B26	house	tap. Closed	-26,1593333	28,8346944	Clear	no	no	Iron content is high	6,9	190,0	90,0	19,2

The main uses of the borehole water included:

- Domestic Use.
- Use in gardens.
- Use for watering livestock.
- Irrigation (few)

It is noted from **Table 3** above that the overall characteristics of the water quality at the surveyed boreholes are good. The colour of all samples presented in **Table 3** was clear and only one sample presented an abnormal, oily smell. This specific sample was taken from a tap within a workshop and the oily smell of the water could have originated from oil products used and stored in the workshop environment.

Table 4: Quality of water samples compared against the SANS 241:1 and DWA Drinking Water Standards.

Sample	Ca	Mg	K	Na	Fe	Mn	Cu	Zn	B	Mo	SO^{2-}_4	$H_2PO^-_4$	NO^-_3	NH^+_4	CO^{2-}_3	HCO^-_3	pH	EC	TSS	Cl^-	SAR	TPC	Coli-forms	E Coli
	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		micro S/cm	mg/l	mg/l		cfu/ 100 ml	cfu/ 100ml	cfu/100 ml
DWA SAWQTV Drinking water standards	<32	<30	<100	<50	<0.1	<0.05	<1	<3	NS	NS	<200	NS	<26.5	NS	NS	NS	6-9	<70	NS	<100	NS	0-5 COUNTS /100		0
SANS 241:1 (2015)	NS	NS	<200	NS	0	2.4	0.4	2	5	2.4	<500	NS	48.6	NS	NS	NS	5-9.7	<170		<300	NS			
CSEC 1	2,91	1,65	3,90	6,22	<0.01	<0.01	<0.01	<0.01	<0.01	0,05	1,32	0,42	2,25	<0.01	<0.01	30,51	7,71	65,2	46	4,25	0,72	29	2	<10
CSEC 3	21,90	9,65	3,61	14,50	<0.01	0,01	-0,02	<0.01	0,03	<0.01	11,04	0,18	1,15	<0.01	<0.01	122,03	7,96	262	242	9,93	0,65	2170	>30000	<10
CSEC 4	26,15	18,12	1,94	14,79	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	7,47	0,00	70,65	<0.01	<0.01	61,02	7,38	349	356	35,45	0,54	>10	>30000	<10
CSEC 5	18,51	8,96	2,30	8,87	<0.01	-0,01	<0.01	<0.01	<0.01	<0.01	1,48	0,00	22,32	<0.01	<0.01	91,52	8,19	211	288	14,89	0,42	6400	>30000	<10
CSEC 7	19,53	14,53	2,56	13,92	<0.01	0,00	<0.01	<0.01	0,02	<0.01	4,54	0,00	11,57	<0.01	<0.01	122,03	8,42	283	208	24,82	0,58	22400	>30000	<10
CSEC 2	12,36	5,54	3,94	76,84	<0.01	<0.01	<0.01	<0.01	0,10	0,03	17,68	0,08	23,05	6,71	<0.01	213,56	8,49	489	340	17,02	4,57	5	2	<10
CSEC 6	11,45	6,56	3,71	40,63	<0.01	<0.01	<0.01	<0.01	0,12	0,02	4,94	0,15	<0.01	<0.01	<0.01	137,29	8,44	297	396	17,73	2,37	1900	>30000	<10
CSEC 9	23,70	15,03	7,12	11,88	<0.01	<0.01	<0.01	<0.01	<0.01	0,02	5,83	0,16	74,27	17,39	<0.01	137,29	7,98	407	254	17,02	0,47	> 3000	500	<10
CSEC 10	16,03	9,15	5,53	33,53	<0.01	<0.01	<0.01	<0.01	0,05	0,02	2,25	0,05	3,85	1,12	<0.01	167,79	8,08	324	272	11,34	1,66	570	200	<10
CSEC 21	8,34	6,18	2,54	101,00	<0.01	<0.01	<0.01	<0.01	0,26	<0.01	1,16	0,12	0,50	0,14	<0.01	122,03	8,40	535	514	69,49	6,46	5000,0	80,0	<10
CSEC 22	1,45	1,73	3,68	5,43	0,04	<0.01	<0.01	<0.01	<0.01	<0.01	0,15	<0.01	18,49	5,38	<0.01	15,25	7,11	85	304	7,09	0,72	140,0	17,0	<10
CSEC 24	3,56	3,03	6,02	25,49	0,38	<0.01	<0.01	<0.01	0,07	<0.01	3,79	0,12	1,69	0,49	<0.01	76,27	7,88	172	274	14,89	2,40	370,0	74,0	<10
CSEC 8	4,61	3,66	8,01	9,9	<0.01	<0.01	0,12	0,08	<0.01	0,03	7,77	0,31	8,64	<0.01	<0.01	45,76	6,54	117	104	4,25	0,84	37	11	<10
CSEC 11	2,53	1,86	2,98	3,87	<0.01	<0.01	0,02	<0.01	<0.01	0,04	0,75	0,19	3,87	<0.01	<0.01	30,51	6,43	52,3	36	5,67	0,45	450	8	<10
CSEC 12	46,06	22,99	4,49	11,43	<0.01	<0.01	<0.01	0,02	<0.01	0,03	5,34	0,06	93,43	<0.01	<0.01	122,03	7,15	483	442	43,96	0,34	3400	23	<10
CSEC 14	32,32	17,48	4,51	34,96	<0.01	<0.01	<0.01	<0.01	0,02	0,04	13,74	0,25	7,27	<0.01	<0.01	91,52	7,73	466	336	14,18	1,23	4900	3	<10
CSEC 15	21,06	10,15	2,63	12,58	<0.01	<0.01	<0.01	<0.01	0,04	0,04	11,61	0,03	0,61	<0.01	<0.01	137,29	8,19	251	224	6,38	0,56	670	7	<10
CSEC 16	6,92	3,71	4,23	8,25	<0.01	<0.01	<0.01	<0.01	0,01	0,02	1,05	0,16	6,51	<0.01	<0.01	61,02	7,31	112,2	104	4,25	0,63	280	<10	<10
CSEC 17	13,23	7,63	3,55	12,63	<0.01	<0.01	<0.01	<0.01	0,01	0,01	15,90	<0.01	38,97	<0.01	<0.01	76,27	6,81	193,7	148	17,02	0,68	78	20	<10
CSEC 18	4,61	2,51	2,98	5,03	<0.01	<0.01	<0.01	<0.01	<0.01	0,01	0,81	<0.01	18,61	<0.01	<0.01	15,25	6,3	73,3	50	7,80	0,47	1350	340	<10
CSEC 23	19,35	9,09	3,63	14,30	1,78	<0.01	<0.01	<0.01	0,05	0,03	19,68	0,19	<0.01	<0.01	<0.01	137,3	7,8	243	242	6,38	0,67	101	400	<10
CSEC 25	32,36	18,03	5,55	37,50	<0.01	<0.01	<0.01	<0.01	0,02	0,02	14,91	0,66	9,76	<0.01	<0.01	244,1	7,4	485	310	13,5	1,3	2140	220	<10

The results of the chemical analysis from ongoing site monitoring of boreholes at the South Block Colliery are summarised (minimum, maximum, average and number of samples taken between 2010 and 2018) in **Table 5** below.

Table 5: Summary of borehole monitoring data.

Sample		Ca	Mg	K	Na	Fe	Mn	SO^{2-}_4	NO^{-}_3	NH^{+}_4	pH	EC	TDS	Cl^{-}
		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		micro S/cm	mg/l	mg/l
DWA SAWQTV Drinking water standards		<32	<30	<100	<50	<0.1	<0.05	<200	<26.5	NS	6-9	<70	1000	<100
SANS 241:1 (2015)		NS	NS	<200	NS	0	2.4	<500	48.6	NS	5-9.7	<170	1200	<300
SB01	Min	2.05	2.26	0.38	0.58	0	0	0	0	0.04	6.85	5.72	0	0
	Ave	5.18	4.31	2.30	3.40	0.89	0.06	4.34	0.35	1.68	7.26	9.29	48	2.19
	Max	22.3	10.9	5.54	5.93	5.85	0.26	53.5	1.56	10.1	7.77	21.9	133	8.7
	No	18							17		18		17	18
SB02	Min	3.65	3.13	0.65	1.78	0	0	0	0	0.02	6.66	8.94	28	3.54
	Ave	4.75	4.26	2.83	4.60	0.73	0.06	0.65	0.91	2.52	7.18	12.52	49	6.13
	Max	8.2	5.14	3.36	7.29	7.31	0.25	3.84	2.81	6.36	8.00	20.1	84	11.6
	No	13											12	13
SB03	Min	9.75	6.08	1.73	2.99	0	0	0	0	0.02	6.98	11.6	0	0
	Ave	14.46	9.23	4.54	6.87	0.34	0.07	3.80	0.25	2.13	7.71	19.63	100	4.30
	Max	24.5	13.3	8.93	13	3.46	0.21	42.6	0.78	24.8	8.27	40.2	188	8.95
	No	23							22		23		22	23
SB04	Min	7.17	6.98	0.50	1.47	0	0	0	0	0.22	6.89	14.2	55	14.8
	Ave	9.22	9.01	1.81	12.23	0.37	0.03	3.32	0.32	1.28	7.68	19.01	97	19.54
	Max	11.3	12.4	2.37	16.80	5.38	0.20	16.1	0.55	5.09	8.39	23.70	129	21.8
	No	15							14			15		
SB05	Min	5.29	5.13	0.82	2.13	0	0	0	0	0	6.63	10.01	0	0
	Ave	7.68	8.45	1.15	2.85	0.02	0.04	6.13	2.31	0.29	7.15	12.03	48	1.95
	Max	14.3	10.9	1.58	3.59	0.12	0.08	27.9	4.06	1.37	7.70	13.80	85	5.95
	No	6												
SB06	Min	5.3	3.81	0.98	0.89	0	0	0	0	0.11	6.62	12.7	0	3.19
	Ave	12.88	7.06	3.33	12.70	1.19	0.25	1.17	0.28	4.30	7.49	21.67	108	10.46
	Max	22.4	10.9	6.08	17.7	8.14	0.84	4.7	0.94	16.4	8.37	34.8	197	20.2
	No	27							26			27		
SB07	Min	6.47	5.85	1.53	0.59	0	0.04	0	0	0.02	7.22	12.3	0	0
	Ave	28.87	17.53	2.52	4.12	0.05	0.65	0.50	0.52	0.82	7.68	28.3	126	0.83
	Max	36.8	25.7	5.78	8.57	0.30	1.44	2	2.73	1.52	8.53	47.1	212	4.86
	No	9											8	9
SB08	Min	9.07	5.65	2.34	4.51	0	0	0	0	0	6.68	11.7	53	0.63
	Ave	29.75	18.16	4.05	21.24	0.52	0.98	2.46	1.22	0.46	7.49	40.95	202	26.88
	Max	46.6	25.7	6.81	25.6	5.37	3.27	4.75	4.73	1.74	8.42	58.4	277	54.6
	No	11												

Sample		Ca	Mg	K	Na	Fe	Mn	SO^{2-}_4	NO^{-}_3	NH^{+}_4	pH	EC	TDS	Cl^{-}
		mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l		micro S/cm	mg/l	mg/l
DWA SAWQTV Drinking water standards		<32	<30	<100	<50	<0.1	<0.05	<200	<26.5	NS	6-9	<70	1000	<100
SANS 241:1 (2015)		NS	NS	<200	NS	0	2.4	<500	48.6	NS	5-9.7	<170	1200	<300
SB09	Min	8.68	3.96	0.51	0.54	0	0	0	0	0	7.03	9.34	0	0
	Ave	13.60	6.68	2.41	3.81	0.02	0.01	6.56	0.96	0.10	8.02	14.34	74	1.80
	Max	37.2	20.6	6.24	16.2	0.26	0.16	137	3.27	0.54	8.43	45.4	264	7.25
	No	30							29		30		29	30
SB10	Min	3.49	3.18	0.76	0	0	0	0	0	0	6.06	6.77	0	0
	Ave	8.74	5.90	1.74	2.97	0.93	0.46	1.42	1.37	2.06	6.91	13.37	64	3.80
	Max	22.6	13.90	3.55	4.71	12	0.35	5.93	4.11	11.6	7.72	28.2	165	8.68
	No	30							29		30		29	30

Though, most of the constituents complied with both the SANS and DWA limits**, Table 4** shows that the constituents exceeding these limits include Calcium, Sodium, Iron and Nitrate concentrations a well as Electrical Conductivity and Microbiological counts (coliform). These results characterise the groundwater as a calcium-sodium-bicarbonate-chloride water type (Delta H, 2018).Boreholes at the South Block Colliery have also been continuously monitored as part of the South Block Colliery monitoring programme. These monitoring reports indicate an overall low mineralised groundwater facies during the monitoring period with seasonal fluctuations indicating groundwater responses to recharge and rainfall associated with a shallow aquifer system (Delta H, 2018). Detailed information on the groundwater quality is provided in the Geohydrology study undertaken by Delta H.

D CONCLUSION

Normally farming activities will result in higher nitrate levels in water, and sometimes also Phosphate and Potassium levels, as these are the three main constituents of commercial fertilisers. Coal mining influences many of the constituents in water, but the most notable ones are the pH, TDS, and Sulphate levels. The results from this study indicate that some of the boreholes might be affected to some degree by over fertilisation during farming practices. None of the boreholes present with water quality that has to date been affected by coal mining in the area. As mining has not yet commenced at the South Block Colliery at the time of compilation of this repost (though mining related activities have commenced), the information in this report remains a good baseline against which future water qualities assessed by the mine can be compared in order to determine the level of impacts of the mine in the future. The specific results of individual boreholes also provide a baseline for individual adjacent and nearby landowners against which future impacts of the South Block Colliery (and / or other activities) can be measured.

BOREHOLE SAMPLING PROTOCOL

1 EQUIPMENT CHECKLIST

Tools:

- Water tape in carry bag, with battery pack
- Ph/EC/TDS/Temperature Meter
- GPS

Consumables:

- 9V battery (x2)
- AA bettery (x2)
- Soft cloths (x2)
- Small towel (x1)

Calibration fluids:

- pH7
- pH10
- EC
- TDS
- Storage solution
- Cleaning solution
- Distilled water

Sampling equipment

- Permanent marker
- Sample bottles and lids
- Sample beakers
- Cooler bags
- Ice bricks

Paperwork

- Clipboard
- Pen (x2)
- Ruler
- Sample sheets
- Contact details of client
- Contact details of farmers
- Vehicle magnets

Tools

- Monkey wrench
- Various spanners
- Pliers

2 DAILY PROTOCOL

Start of the day

- Insert battery into Water Tape.
- Calibrate PH/EC/TDS/Temp meter (for all parameters).
- Turn on GPS

End of the day

- Remove battery from the Water Tape.
- Clean PH/EC/TDS/Temp meter with cleaning solution.
- Ensure that PH/EC/TDS/Temp meter cap is still FULL of storage fluid or bulb will damage
- Turn off GPS

3 BOREHOLE MEASUREMENT AND SAMPLING PROTOCOL

On Arrival

- Meat with landowner / occupier and introduce yourself.
- Obtain as much information from landowner / occupier as possible.
- Proceed to boreholes for measurements.

Depth measurement:

- Open borehole.
- Only sample borehole if safe to do so (note bees / other dangers)
- Preferably sample un-equipped boreholes, otherwise only sample boreholes when the depth of the pump is known – DO NOT LOWER PROBE BELOW PUMP DEPTH.
- Lower probe down borehole until noise.
- Adjust to confirm exact level at which noise commences.
- Read depth and note it on the information sheet. Also note casing height
- Note GPS location and save as waypoint
- Take a photograph of the location
- Close the borehole cover.

PH/EC/TDS/Temp measurement:

- Collect sample from pump station / tank / tap in beaker (as close to borehole as possible).
- Make note of smell and general appearance of water
- Turn on PH/EC/TDS/Temp meter.
- Remove probe cover.
- Insert probe and wait for measurement to settle.
- Toggle between screens and note measurements
- Turn off PH/EC/TDS/Temp meter.
- Clean with distilled water, or cleaning solution if needed.
- Replace cap (cap must still contain storage fluid or must be topped up)
- Note GPS location and save as waypoint
- Take a photograph of the location

Water sample collection

- Allow the water to run for 5-10 seconds (purge any loose particles from standing water)
- Fill the sample bottle ½ - thoroughly rinse the bottle and the cap with the water.
- Throw the water out
- Fill the bottle until overflowing and cap with as much water as possible
- Store bottle in cooler bag