APPENDICES

Appendix A. Techno-Economic Model Assumptions

A.1 Energy Conversion

1. To convert megawatt to gigajoule per hour (MW to GJ/h) and back. Power: GJ/h=3.6×MW. MW=0.2777777778×GJ/h.

2. Combustible Recovery Formula: $\text{Comb Rec}\,(\%) = \dfrac{\%Yield \times (100 - Ash_{conc})}{(100 - Ash_{feed})}$

   Where Yield = Actual Yield (%), Ash_{conc} = ash content in concentrate (%) and Ash_{feed} = ash content in feed (%)

A.2 Techno-Economic Model CPI & PPI

	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031
RSA CPI	0.06	0.06	0.06	0.05	0.05	0.05	0.05	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06
RSA CPI Index	1.10	1.17	1.23	1.29	1.36	1.43	1.50	1.58	1.67	1.77	1.87	1.97	2.09	2.20	2.33	2.46	2.60	2.75	2.90	3.07
RSA PPI	0.07	0.06	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05
RSA PPI Index	1.14	1.21	1.27	1.33	1.40	1.47	1.54	1.61	1.69	1.78	1.86	1.96	2.05	2.15	2.26	2.37	2.48	2.61	2.73	2.87
Capital Esc.	0.07	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Capital Esc. Factors	1.14	1.23	1.32	1.42	1.53	1.64	1.77	1.90	2.05	2.20	2.37	2.55	2.74	2.95	3.18	3.42	3.68	3.96	4.26	4.58

A.3 Techno-Economic Model Parameters

Parameter	Assumption
Internal rate of return (after taxes)	10%
General plant depreciation period	5 years
Discount rate (for Greenfields project)	12%
Income tax rate	39%
Electricity cost	53 cents/kWh
Working capital	Based on industry data and Wood-Mackenzie report
Plant availability	6 000 hours per year
Exchange Rate Base	R8/US$

Appendix B. Detailed operating Costs

Note that all costs shown are given in R'Million and were calculated per annum

B.1 Witbank Coalfield No. 4 Seam (Export)

Combined **DMS Cyclones (All)**

	Yield %	C.V.	Ash	S	Energy Recovery Factor	Comb Recovery %	Price	Turn Over (FOR)	Mining	Preparation	Transport	Port	Overheads	EBITDA
	% (adb)	MJ/kg (adb)	% (adb)	% (adb)			US$/ton	(R'Million)						
6000	22.3	27.47	10.8	0.8	0.27	19.81	99.6	R 534	R 199	R 32	R 95	R 26	R 17	R 165
5900	27.3	27.04	11.8	0.8	0.32	24.48	97.94	R 642	R 244	R 39	R 116	R 32	R 21	R 191
5800	33.4	26.56	12.9	0.7	0.39	30.27	96.28	R 772	R 298	R 48	R 142	R 39	R 26	R 220
5700	39.2	26.12	14.0	0.7	0.44	35.76	94.62	R 890	R 349	R 56	R 166	R 46	R 30	R 242
5600	45.5	25.67	15.1	0.7	0.51	42.03	92.96	R 1 014	R 405	R 65	R 193	R 53	R 35	R 263
5500	52.3	25.20	16.2	0.7	0.57	48.91	91.3	R 1 146	R 466	R 75	R 222	R 61	R 40	R 282
5400	58.1	24.80	17.2	0.6	0.62	54.93	89.64	R 1 249	R 518	R 83	R 246	R 68	R 45	R 290
5300	64.8	24.34	18.4	0.6	0.68	62.05	87.98	R 1 368	R 578	R 93	R 275	R 76	R 50	R 298
5200	71.4	23.89	19.5	0.6	0.74	69.26	86.32	R 1 478	R 636	R 102	R 302	R 83	R 55	R 299
5100	78.1	23.43	20.7	0.6	0.79	76.82	84.66	R 1 587	R 696	R 112	R 331	R 91	R 60	R 297
5000	83.6	23.00	21.9	0.7	0.83	83.37	83	R 1 665	R 745	R 120	R 354	R 98	R 64	R 284

Combined **DMS BATH + DMS Cyclones (All)**

	Yield %	C.V.	Ash	S	Energy Recovery Factor	Comb Recovery %	Price US$/ton	Turn Over (FOR)	Mining	Preparation	Transport	Port	Overheads	EBITDA
								(R'Million)						

6000	24.0	27.45	10.9	0.8	0.29	19.81	99.6	R 575	R 214	R 32	R 102	R 28	R 19	R 179
5900	29.4	27.06	11.9	0.7	0.35	24.48	97.94	R 691	R 262	R 40	R 125	R 34	R 23	R 208
5800	36.0	26.59	13.0	0.7	0.42	30.27	96.28	R 832	R 321	R 49	R 152	R 42	R 28	R 240
5700	42.2	26.08	14.1	0.7	0.48	35.76	94.62	R 958	R 376	R 57	R 179	R 49	R 33	R 265
5600	49.0	25.71	15.0	0.8	0.55	42.03	92.96	R 1 092	R 436	R 66	R 207	R 57	R 38	R 287
5500	56.3	25.19	16.3	0.8	0.62	48.91	91.3	R 1 234	R 502	R 76	R 239	R 66	R 43	R 308
5400	62.5	24.85	17.1	0.8	0.67	54.93	89.64	R 1 345	R 557	R 84	R 265	R 73	R 48	R 317
5300	69.8	24.32	18.4	0.9	0.74	62.05	87.98	R 1 474	R 622	R 94	R 296	R 82	R 54	R 326
5200	76.8	23.91	19.5	0.9	0.80	69.26	86.32	R 1 592	R 685	R 104	R 326	R 90	R 59	R 329
5100	84.1	23.43	20.7	0.9	0.85	76.82	84.66	R 1 709	R 750	R 114	R 356	R 98	R 65	R 326
5000	81.7	23.01	21.8	0.8	0.82	83.37	83	R 1 628	R 728	R 110	R 346	R 95	R 63	R 284

Combined WATER JIGS + DMS Cyclones (All)

	Yield %	C.V.	Ash	S	Energy Recovery Factor	Comb Recovery %	Price US$/ton	Turn Over (FOR)	Mining	Preparation	Transport	Port	Overheads	EBITDA
								(R'Million)						
6000	17.6	27.46	10.8	0.8	0.21	19.81	99.6	R 421	R 157	R 10	R 75	R 21	R 14	R 145
5900	23.0	26.99	11.9	0.8	0.27	24.48	97.94	R 541	R 205	R 13	R 97	R 27	R 18	R 181
5800	29.1	26.52	13.0	0.7	0.33	30.27	96.28	R 672	R 259	R 16	R 123	R 34	R 22	R 217
5700	34.5	26.12	14.0	0.7	0.39	35.76	94.62	R 783	R 307	R 19	R 146	R 40	R 27	R 243
5600	41.4	25.64	15.2	0.7	0.46	42.03	92.96	R 924	R 369	R 23	R 175	R 48	R 32	R 276
5500	47.7	25.22	16.2	0.7	0.52	48.91	91.3	R 1 045	R 425	R 27	R 202	R 56	R 37	R 299
5400	55.1	24.76	17.3	0.7	0.59	54.93	89.64	R 1 185	R 491	R 31	R 233	R 64	R 42	R 323
5300	61.3	24.36	18.3	0.7	0.65	62.05	87.98	R 1 294	R 546	R 35	R 260	R 72	R 47	R 335
5200	68.5	23.89	19.5	0.6	0.71	69.26	86.32	R 1 420	R 611	R 39	R 290	R 80	R 53	R 347
5100	75.4	23.44	20.7	0.6	0.77	76.82	84.66	R 1 532	R 672	R 42	R 319	R 88	R 58	R 352
5000	81.9	22.99	21.9	0.6	0.82	83.37	83	R 1 632	R 730	R 46	R 347	R 96	R 63	R 350

Combined DRY FGX + DMS CYCLONES

	Yield %	C.V.	Ash	S	Energy Recovery Factor	Comb Recovery %	Price US$/ton	Turn Over (FOR)	Mining	Preparation	Transport	Port	Overheads	EBITDA
								(R'Million)						
6000	14.5	27.56	10.5	0.8	0.17	19.81	99.6	R 347	R 129	R 11	R 61	R 17	R 11	R 116
5900	17.2	27.11	11.6	0.8	0.20	24.48	97.94	R 404	R 153	R 13	R 73	R 20	R 13	R 131
5800	23.3	26.64	12.8	0.8	0.27	30.27	96.28	R 538	R 207	R 18	R 99	R 27	R 18	R 168
5700	29.6	26.24	13.8	0.8	0.34	35.76	94.62	R 672	R 264	R 23	R 125	R 35	R 23	R 202
5600	36.9	25.75	15.1	0.7	0.41	42.03	92.96	R 824	R 329	R 29	R 156	R 43	R 28	R 238
5500	43.4	25.31	16.2	0.7	0.48	48.91	91.3	R 952	R 387	R 34	R 184	R 51	R 33	R 262
5400	49.7	24.87	17.3	0.7	0.54	54.93	89.64	R 1 070	R 443	R 39	R 211	R 58	R 38	R 281
5300	55.5	24.44	18.4	0.7	0.59	62.05	87.98	R 1 171	R 494	R 43	R 235	R 65	R 43	R 291
5200	61.3	23.98	19.7	0.7	0.64	69.26	86.32	R 1 269	R 546	R 48	R 259	R 72	R 47	R 297
5100	66.3	23.54	20.8	0.7	0.68	76.82	84.66	R 1 347	R 591	R 52	R 281	R 77	R 51	R 295
5000	70.7	23.09	22.0	0.7	0.71	83.37	83	R 1 409	R 631	R 55	R 300	R 83	R 54	R 286

Combined DRY XRT SORTER + DMS CYCLONES

	Yield %	C.V.	Ash	S	Energy Recovery Factor	Comb Recovery %	Price US$/ton	Turn Over (FOR)	Mining	Preparation	Transport	Port	Overheads	EBITDA
								(R'Million)						
6000	14.5	27.56	10.8	0.9	0.17	19.81	99.6	R 347	R 129	R 11	R 61	R 17	R 11	R 117
5900	17.2	27.11	11.9	0.8	0.20	24.48	97.94	R 404	R 153	R 13	R 73	R 20	R 13	R 132
5800	20.1	26.64	13.0	0.8	0.23	30.27	96.28	R 465	R 179	R 15	R 85	R 24	R 16	R 146
5700	26.1	26.24	14.0	0.8	0.30	35.76	94.62	R 593	R 233	R 20	R 111	R 31	R 20	R 179

5600	33.3	25.75	15.2	0.8	0.37	42.03	92.96	R 744	R 297	R 25	R 141	R 39	R 26	R 216
5500	39.8	25.31	16.3	0.7	0.44	48.91	91.3	R 872	R 355	R 30	R 169	R 46	R 31	R 242
5400	46.0	24.87	17.4	0.7	0.50	54.93	89.64	R 990	R 410	R 35	R 195	R 54	R 35	R 261
5300	51.7	24.44	18.4	0.7	0.55	62.05	87.98	R 1 092	R 461	R 39	R 219	R 60	R 40	R 273
5200	57.5	23.98	19.6	0.7	0.60	69.26	86.32	R 1 191	R 512	R 43	R 243	R 67	R 44	R 280
5100	62.5	23.54	20.7	0.7	0.64	76.82	84.66	R 1 270	R 557	R 47	R 265	R 73	R 48	R 280
5000	67.0	23.09	21.9	0.7	0.67	83.37	83	R 1 334	R 597	R 50	R 284	R 78	R 52	R 273

B.2 Waterberg Upper Ecca

Combined DMS Cyclones (All)

	Yield %	C.V.	Ash	S	Energy Recovery Factor	Combustible Recovery %	Price	Turn Over (FOR)	Mining	Preparation	Transport	Port	Overheads	EBITDA
	% (adb)	MJ/kg (adb)	% (adb)	% (adb)			US$/ton	(R' Million)						
4000	73.2	18.70	36.7	1.3	0.87	19.81	24.46	R 430	R 109	R 17	R 592	R 65	R 22	-R 377
4200	66.7	19.57	34.3	1.3	0.83	24.48	31.68	R 507	R 109	R 17	R 540	R 60	R 20	-R 239
4400	59.2	20.40	32.1	1.4	0.76	30.27	38.9	R 553	R 109	R 17	R 479	R 53	R 18	-R 124
4600	47.3	21.32	29.5	1.4	0.64	35.76	46.12	R 523	R 109	R 17	R 383	R 42	R 14	-R 42
4800	36.0	22.30	26.8	1.2	0.51	42.03	53.34	R 461	R 109	R 17	R 291	R 32	R 11	R 0
5000	28.8	23.04	24.7	1.2	0.42	48.91	60.56	R 418	R 109	R 17	R 233	R 26	R 9	R 25
5200	21.5	23.93	22.0	1.1	0.33	54.93	67.78	R 349	R 109	R 17	R 174	R 19	R 6	R 24
5400	14.8	24.89	19.2	1.1	0.23	62.05	75	R 267	R 109	R 17	R 120	R 13	R 4	R 3
5600	10.2	25.78	16.9	1.0	0.17	69.26	82.22	R 200	R 109	R 17	R 82	R 9	R 3	-R 20
5800	6.7	26.56	14.8	1.0	0.11	76.82	89.44	R 144	R 109	R 17	R 54	R 6	R 2	-R 44
6000	4.6	27.12	13.1	1.0	0.08	83.37	96.66	R 107	R 109	R 17	R 37	R 4	R 1	-R 62

Combined DMS BATH + DMS Cyclones (All)

	Yield %	C.V.	Ash	S	Energy Recovery Factor	Combustible Recovery %	Price	Turn Over (FOR)	Mining	Preparation	Transport	Port	Overheads	EBITDA
	% (adb)	MJ/kg (adb)	% (adb)	% (adb)			US$/ton	(R'Million)						
4000	73.3	18.64	36.8	1.3	0.86	19.81	24.46	R 430	R 109	R 12	R 593	R 66	R 22	-R 372
4200	65.1	19.62	34.2	1.3	0.81	24.48	31.68	R 495	R 109	R 12	R 527	R 58	R 20	-R 232
4400	57.0	20.41	32.0	1.4	0.74	30.27	38.9	R 532	R 109	R 12	R 461	R 51	R 17	-R 119
4600	45.2	21.37	29.4	1.4	0.61	35.76	46.12	R 501	R 109	R 12	R 366	R 40	R 14	-R 41
4800	36.7	22.17	27.2	1.3	0.51	42.03	53.34	R 469	R 109	R 12	R 297	R 33	R 11	R 7
5000	27.6	23.08	24.5	1.2	0.40	48.91	60.56	R 402	R 109	R 12	R 224	R 25	R 8	R 23
5200	20.3	23.99	21.8	1.1	0.31	54.93	67.78	R 331	R 109	R 12	R 165	R 18	R 6	R 20
5400	15.0	24.80	19.5	1.1	0.24	62.05	75	R 271	R 109	R 12	R 122	R 13	R 5	R 9
5600	10.3	25.71	17.1	1.0	0.17	69.26	82.22	R 203	R 109	R 12	R 83	R 9	R 3	-R 14
5800	6.2	26.71	14.3	1.0	0.10	76.82	89.44	R 133	R 109	R 12	R 50	R 6	R 2	-R 46
6000	5.0	26.93	13.7	1.0	0.09	83.37	96.66	R 116	R 109	R 12	R 41	R 4	R 2	-R 52

Combined WATER JIGS + DMS Cyclones (All)

	Yield %	C.V.	Ash	S	Energy Recovery Factor	Combustible Recovery %	Price	Turn Over (FOR)	Mining	Preparation	Transport	Port	Overheads	EBITDA
	% (adb)	MJ/kg (adb)	% (adb)	% (adb)			US$/ton	(R'Million)						
4000	68.8	18.65	36.8	1.3	0.81	19.81	24.46	R 404	R 109	R 5	R 557	R 62	R 21	-R 350
4200	59.4	19.55	34.4	1.3	0.74	24.48	31.68	R 452	R 109	R 5	R 481	R 53	R 18	-R 215
4400	48.4	20.44	31.9	1.3	0.63	30.27	38.9	R 452	R 109	R 5	R 392	R 43	R 15	-R 112
4600	38.7	21.30	29.5	1.3	0.52	35.76	46.12	R 428	R 109	R 5	R 313	R 35	R 12	-R 46
4800	29.3	22.25	26.8	1.2	0.41	42.03	53.34	R 375	R 109	R 5	R 237	R 26	R 9	-R 12
5000	22.1	23.12	24.4	1.2	0.32	48.91	60.56	R 321	R 109	R 5	R 179	R 20	R 7	R 1

5200	16.2	23.99	21.9	1.1	0.25	54.93	67.78	R 263	R 109	R 5	R 131	R 14	R 5	-R 2
5400	11.2	24.90	19.4	1.1	0.18	62.05	75	R 202	R 109	R 5	R 91	R 10	R 3	-R 17
5600	7.9	25.65	17.3	1.0	0.13	69.26	82.22	R 156	R 109	R 5	R 64	R 7	R 2	-R 32
5800	6.8	25.91	16.6	1.0	0.11	76.82	89.44	R 146	R 109	R 5	R 55	R 6	R 2	-R 32
6000	5.6	26.13	15.9	1.0	0.09	83.37	96.66	R 129	R 109	R 5	R 45	R 5	R 2	-R 37

Combined DRY FGX + DMS CYCLONES

	Yield %	C.V.	Ash	S	Energy Recovery Factor	Combustible Recovery %	Price	Turn Over (FOR)	Mining	Preparation	Transport	Port	Overheads	EBITDA
	% (adb)	MJ/kg (adb)	% (adb)	% (adb)			US$/ton	(R'Million)						
4000	63.6	18.63	37.3	1.2	0.75	19.81	24.46	R 373	R 109	R 9	R 515	R 57	R 19	-R 336
4200	56.4	19.53	34.5	1.2	0.70	24.48	31.68	R 429	R 109	R 9	R 457	R 50	R 17	-R 214
4400	49.6	20.38	31.8	1.2	0.64	30.27	38.9	R 463	R 109	R 9	R 402	R 44	R 15	-R 116
4600	43.1	21.25	29.1	1.2	0.58	35.76	46.12	R 477	R 109	R 9	R 349	R 39	R 13	-R 42
4800	36.1	22.14	26.3	1.2	0.51	42.03	53.34	R 463	R 109	R 9	R 293	R 32	R 11	R 8
5000	28.9	23.02	23.6	1.2	0.42	48.91	60.56	R 420	R 109	R 9	R 234	R 26	R 9	R 33
5200	22.1	23.89	20.8	1.2	0.33	54.93	67.78	R 359	R 109	R 9	R 179	R 20	R 7	R 36
5400	15.4	24.77	18.1	1.2	0.24	62.05	75	R 278	R 109	R 9	R 125	R 14	R 5	R 16
5600	9.3	25.66	15.3	1.2	0.15	69.26	82.22	R 184	R 109	R 9	R 75	R 8	R 3	-R 21
5800	3.8	26.53	12.5	1.2	0.06	76.82	89.44	R 82	R 109	R 9	R 31	R 3	R 1	-R 72
6000	2.6	27.36	9.8	1.1	0.05	83.37	96.66	R 61	R 109	R 9	R 21	R 2	R 1	-R 82

Combined DRY XRT SORTER + DMS CYCLONES

	Yield %	C.V.	Ash	S	Energy Recovery Factor	Combustible Recovery %	Price	Turn Over (FOR)	Mining	Preparation	Transport	Port	Overheads	EBITDA
	% (adb)	MJ/kg (adb)	% (adb)	% (adb)			US$/ton	(R'Million)						

4000	56.5	19.04	37.0	1.1	0.66	19.81	24.46	R 332	R 109	R 9	R 457	R 51	R 17	-R 311
4200	49.2	19.94	34.4	1.1	0.61	24.48	31.68	R 374	R 109	R 9	R 398	R 44	R 15	-R 201
4400	42.4	20.55	32.0	1.1	0.55	30.27	38.9	R 396	R 109	R 9	R 343	R 38	R 13	-R 116
4600	36.2	21.70	29.6	1.2	0.49	35.76	46.12	R 400	R 109	R 9	R 293	R 32	R 11	-R 54
4800	29.8	22.27	27.1	1.2	0.43	42.03	53.34	R 381	R 109	R 9	R 241	R 27	R 9	-R 14
5000	17.6	23.45	22.2	1.2	0.28	48.91	60.56	R 255	R 109	R 9	R 142	R 16	R 5	-R 26
5200	23.3	24.09	24.7	1.2	0.36	54.93	67.78	R 380	R 109	R 9	R 189	R 21	R 7	R 45
5400	12.2	25.07	19.7	1.2	0.21	62.05	75	R 219	R 109	R 9	R 99	R 11	R 4	-R 12
5600	7.6	25.84	17.2	1.2	0.14	69.26	82.22	R 149	R 109	R 9	R 61	R 7	R 2	-R 39
5800	2.6	26.86	12.3	1.2	0.06	76.82	89.44	R 56	R 109	R 9	R 21	R 2	R 1	-R 86
6000	3.8	27.46	14.7	1.2	0.08	83.37	96.66	R 89	R 109	R 9	R 31	R 3	R 1	-R 65

B.3 Free State (Vereeniging)

Combined **DMS Cyclones (All)**

	Yield %	C.V.	Ash	Energy Recovery Factor	Comb Recovery %	Price	Turn Over (FOR)	Mining	Preparation	Transport	Overheads	EBITDA
	% (adb)	MJ/kg (adb)	% (adb)			R/ton	(R'Million)					
4000	70.6	18.72	23.4	0.5	88.6	187.23	R 397	R 233	R 19	R 64	R 15	R 67
4200	63.3	19.56	23.9	0.5	82.9	195.59	R 371	R 208	R 17	R 57	R 13	R 76
4400	52.7	20.41	24.5	0.5	72.1	204.09	R 323	R 174	R 14	R 47	R 11	R 77
4600	38.9	21.40	25.3	0.6	55.8	214.00	R 250	R 128	R 10	R 35	R 8	R 68

Combined **DMS BATH**

	Yield %	C.V.	Ash	Energy Recovery Factor	Comb Recovery %	Price	Turn Over (FOR)	Mining	Preparation	Transport	Overheads	EBITDA

	% (adb)	MJ/kg (adb)	% (adb)			R/ton	(R'Million)					
4000	70.9	18.64	23.4	0.5	88.6	186.38	R 397	R 234	R 19	R 64	R 15	R 66
4200	61.6	19.55	23.9	0.5	80.7	195.54	R 361	R 203	R 16	R 55	R 13	R 74
4400	50.9	20.41	24.5	0.5	69.7	204.10	R 312	R 168	R 14	R 46	R 11	R 74
4600	32.8	21.29	25.2	0.6	46.8	212.86	R 209	R 108	R 9	R 30	R 7	R 56

Combined WATER JIGS

	Yield %	C.V.	Ash	Energy Recovery Factor	Comb Recovery %	Price	Turn Over (FOR)	Mining	Preparation	Transport	Overheads	EBITDA
	% (adb)	MJ/kg (adb)	% (adb)			R/ton	(R'Million)					
4000	64.7	18.64	0.5	0.8	50.5	186.38	R 362	R 213	R 17	R 58	R 13	R 60
4200	52.0	19.57	0.5	0.7	52.3	195.65	R 305	R 171	R 14	R 47	R 11	R 63
4400	35.6	20.40	0.5	0.5	53.9	204.03	R 218	R 117	R 9	R 32	R 7	R 52

Combined DRY FGX

	Yield %	C.V.	Ash	Energy Recovery Factor	Comb Recovery %	Price	Turn Over (FOR)	Mining	Preparation	Transport	Overheads	EBITDA
	% (adb)	MJ/kg (adb)	% (adb)			R/ton	(R'Million)					
4000	37.1	18.61	0.5	0.3	25.9	186.07	R 207	R 122	R 10	R 33	R 8	R 34
4200	31.6	19.49	0.5	0.2	24.7	194.87	R 184	R 104	R 8	R 28	R 7	R 37
4400	26.0	20.37	0.5	0.2	22.2	203.67	R 159	R 86	R 7	R 23	R 5	R 38

Combined DRY XRT SORTER

	Yield %	C.V.	Ash	Energy Recovery Factor	Comb Recovery %	Price	Turn Over (FOR)	Mining	Preparation	Transport	Overheads	EBITDA

	% (adb)	MJ/kg (adb)	% (adb)			R/ton	(R'Million)					
4000	28.9	18.61	0.5	0.3	25.9	187.23	R 162	R 95	R 8	R 26	R 6	R 27
4200	24.3	19.49	0.5	0.2	24.7	195.59	R 142	R 80	R 6	R 22	R 5	R 29
4400	19.6	20.37	0.5	0.2	22.2	204.09	R 120	R 65	R 5	R 18	R 4	R 29

DMS Cyclones + Dry Screening

	Yield %	C.V.	Ash	Energy Recovery Factor	Comb Recovery %	Price	Turn Over (FOR)	Mining	Preparation	Transport	Overheads	EBITDA
	% (adb)	MJ/kg (adb)	% (adb)			R/ton	(R'Million)					
4000	70.6	18.72	23.4	0.5	88.6	187.23	R 397	R 233	R 19	R 64	R 15	R 67
4200	63.3	19.56	23.9	0.5	82.9	195.59	R 371	R 208	R 17	R 57	R 13	R 76
4400	52.7	20.41	24.5	0.5	72.1	204.09	R 323	R 174	R 14	R 47	R 11	R 77
4600	38.9	21.40	25.3	0.6	55.8	214.00	R 250	R 128	R 10	R 35	R 8	R 68

DMS BATH + Dry Screen

	Yield %	C.V.	Ash	Energy Recovery Factor	Comb Recovery %	Price	Turn Over (FOR)	Mining	Preparation	Transport	Overheads	EBITDA
	% (adb)	MJ/kg (adb)	% (adb)			R/ton	(R'Million)					
4000	70.6	18.72	23.4	0.5	88.6	187.23	R 397	R 233	R 19	R 64	R 15	R 67
4200	63.3	19.56	23.9	0.5	82.9	195.59	R 371	R 208	R 17	R 57	R 13	R 76
4400	52.7	20.41	24.5	0.5	72.1	204.09	R 323	R 174	R 14	R 47	R 11	R 77
4600	38.9	21.40	25.3	0.6	55.8	214.00	R 250	R 128	R 10	R 35	R 8	R 68

WATER JIGS

	Yield %	C.V.	Ash	Energy Recovery Factor	Comb Recovery %	Price	Turn Over (FOR)	Mining	Preparation	Transport	Overheads	EBITDA
	% (adb)	MJ/kg (adb)	% (adb)			R/ton	(R'Million)					
4000	70.6	18.72	23.4	0.5	88.6	187.23	R 397	R 233	R 19	R 64	R 15	R 67
4200	63.3	19.56	23.9	0.5	82.9	195.59	R 371	R 208	R 17	R 57	R 13	R 76
4400	52.7	20.41	24.5	0.5	72.1	204.09	R 323	R 174	R 14	R 47	R 11	R 77
4600	38.9	21.40	25.3	0.6	55.8	214.00	R 250	R 128	R 10	R 35	R 8	R 68

DRY FGX + DRY SCREENING

	Yield %	C.V.	Ash	Energy Recovery Factor	Comb Recovery %	Price	Turn Over (FOR)	Mining	Preparation	Transport	Overheads	EBITDA
	% (adb)	MJ/kg (adb)	% (adb)			R/ton	(R'Million)					
4000	37.1	18.61	0.5	0.5	88.6	186.07	R 207	R 122	R 10	R 33	R 8	R 34
4200	31.6	19.49	0.5	0.5	82.9	194.87	R 184	R 104	R 8	R 28	R 7	R 37
4400	26.0	20.37	0.5	0.5	72.1	203.67	R 159	R 86	R 7	R 23	R 5	R 38

DRY XRT SORTER + DRY SCREENING

	Yield %	C.V.	Ash	Energy Recovery Factor	Comb Recovery %	Price	Turn Over (FOR)	Mining	Preparation	Transport	Overheads	EBITDA
	% (adb)	MJ/kg (adb)	% (adb)			R/ton	(R'Million)					
4000	28.9	18.61	0.5	0.5	88.6	186.07	R 161	R 95	R 8	R 26	R 6	R 26
4200	24.3	19.49	0.5	0.5	82.9	194.87	R 142	R 80	R 6	R 22	R 5	R 29
4400	19.6	20.37	0.5	0.5	72.1	203.67	R 120	R 65	R 5	R 18	R 4	R 28
4600	14.9	21.25	0.5	0.5	72.1	212.47	R 95	R 49	R 4	R 13	R 3	R 25

Appendix C. Detailed Equipment Lists & CAPEX

Note that the costs displayed in this table serves to depict the generic plant costs. Not all the detailed costs used in the evaluation are displayed.

C.1 Major Equipment & Installation Cost (R'000)

All Costs (R'000), 10% Installation

Description	Power-e.a.	Total	Installed Equipment	Sub-	Total	Equipment	Installation Cost (R'000)	
	Energy (kW)	Energy (kW)	Cost	Contract	Cost	Unit Cost-Supply (R'000)	Each	Total
filter press, pate and frane, semi-automatic	10.00	10.00	44309.21	44.39	44353.60	443.92	44.39	44.39
decanter	75.00	150.00	5312.27	26.56	5338.83	531.23	26.56	53.12
screens (horizontal) vibrating pu	22.00	88.00	16843.80	42.11	16885.90	1684.38	42.11	168.44
screens (horizontal) vibrating pu	22.00	154.00	31710.71	45.30	31756.02	3171.07	45.30	317.11
screens (horizontal) vibrating pu	22.00	264.00	52650.44	43.88	52694.31	5265.04	43.88	526.50
screens (horizontal) vibrating pu	22.00	22.00	1864.14	18.64	1882.78	186.41	18.64	18.64
screens (horizontal) vibrating pu	22.00	22.00	1864.14	18.64	1882.78	186.41	18.64	18.64
screens (horizontal) vibrating pu	22.00	176.00	35100.29	43.88	35144.17	3510.03	43.88	351.00
screens (horizontal) vibrating pu	22.00	264.00	52650.44	43.88	52694.31	5265.04	43.88	526.50
static screen	0.00	0.00	9940.11	8.28	9948.39	994.01	8.28	99.40
static screen	0.00	0.00	13551.50	16.94	13568.44	1355.15	16.94	135.51
Classifier Hydrocyclone, 20 deg Cone, rubber lined	0.00	0.00	457.28	4.57	461.85	45.73	4.57	4.57
Classifier Hydrocyclone, 20 deg Cone, rubber lined	0.00	0.00	671.73	3.36	675.09	67.17	3.36	6.72
Classifier Hydrocyclone, 20 deg Cone, rubber lined	0.00	0.00	671.73	3.36	675.09	67.17	3.36	6.72
Processing Equipment	0.00	0.00	30000.00	75.00	30075.00	3000.00	75.00	300.00
36 x 60 RB 135 SECONDARY SHUMAR CRUSHER	74.00	74.00	9186.20	91.86	9278.06	918.62	91.86	91.86
Thickener - free standing tank, mild steel	0.00	0.00	55296.47	552.96	55849.44	5529.65	552.96	552.96
Flocculant Plant	20.00	20.00	4375.00	43.75	4418.75	437.50	43.75	43.75
Magnetic Separa tor,wet drum, 1220 mm diam.	15.00	60.00	1161.82	2.90	1164.72	116.18	2.90	11.62
C200 Pipe Densifier, 200 mm	0.00	0.00	357.98	0.89	358.88	35.80	0.89	3.58

Pumps, vacuum, 60 Torr.,8kPa, Cast Iron, Liquid Iron	127.00	254.00	1024.67	5.12	1029.79	102.47	5.12	10.25
Pumps(slurry duties-rubber lined)	19.00	38.00	535.37	2.68	538.05	53.54	2.68	5.35
Pumps, vacuum, 60 Torr.,8kPa, Cast Iron, Liquid Iron	70.00	140.00	864.32	4.32	868.64	86.43	4.32	8.64
Pumps(slurry duties-rubber lined)	7.00	14.00	89.00	0.44	89.44	8.90	0.44	0.89
Pumps, vacuum, 60 Torr.,8kPa, Cast Iron, Liquid Iron	30.00	60.00	152.95	0.76	153.72	15.30	0.76	1.53
Pumps(Clearwater)	7.00	14.00	143.97	0.72	144.69	14.40	0.72	1.44
Pumps(slurry duties-rubber lined)	63.00	126.00	1069.49	5.35	1074.84	106.95	5.35	10.69
Pumps(Clearwater)	30.00	60.00	286.89	1.43	288.33	28.69	1.43	2.87
Pumps(Clearwater)	50.00	200.00	285.76	0.71	286.48	28.58	0.71	2.86
Pumps(Clearwater)	50.00	200.00	286.50	0.72	287.22	28.65	0.72	2.87
Pumps(Clearwater)	19.00	38.00	214.31	1.07	215.38	21.43	1.07	2.14
Tank(mild steel 60 deg cone) Natural rubber	0.00	0.00	9705.58	24.26	9729.84	970.56	24.26	97.06
Tank(mild steel 60 deg cone) Natural rubber	0.00	0.00	3763.31	37.63	3800.94	376.33	37.63	37.63
Tank(mild steel 60 deg cone) Natural rubber	0.00	0.00	2179.34	10.90	2190.24	217.93	10.90	21.79
Tank(mild steel 60 deg cone) Natural rubber	0.00	0.00	313.48	3.13	316.61	31.35	3.13	3.13
Tank(mild steel 60 deg cone) Natural rubber	0.00	0.00	636.83	6.37	643.20	63.68	6.37	6.37
Tank(mild steel 60 deg cone) Natural rubber	0.00	0.00	636.83	6.37	643.20	63.68	6.37	6.37
Tank(mild steel 60 deg cone) Natural rubber	0.00	0.00	3069.42	5.12	3074.53	306.94	5.12	30.69
Tank(mild steel 60 deg cone) Natural rubber	0.00	0.00	2934.84	14.67	2949.51	293.48	14.67	29.35
Tank(mild steel 60 deg cone) Natural rubber	0.00	0.00	4128.59	41.29	4169.87	412.86	41.29	41.29
Tank(mild steel 60 deg cone) Natural rubber	0.00	0.00	4128.82	20.64	4149.46	412.88	20.64	41.29
	0.00	0.00	4166.52	10.42	4176.94	416.65	10.42	41.67
Electric, squirrel cage,380V,1420/1440 to 1490 rpm,3 phase	50.00	100.00	489.33	2.45	491.78	48.93	2.45	4.89
Motors, electric, DC, 380 V. variable speed. Range 10:1	50.00	100.00	363.77	1.82	365.59	36.38	1.82	3.64
Electric, squirrel cage,380V,1420/1440 to 1490 rpm,3 phase	150.00	300.00	298.73	1.49	300.22	29.87	1.49	2.99
Motors, electric, DC, 380 V. variable speed. Range 10:1	75.00	150.00	233.63	1.17	234.80	23.36	1.17	2.34
Electric, squirrel cage,380V,1420/1440 to 1490 rpm,3 phase	188.58	377.16	132.26	0.66	132.92	13.23	0.66	1.32
Motors, electric, DC, 380 V. variable speed. Range 10:1	1263.53	2527.05	233.63	1.17	234.80	23.36	1.17	2.34
Electric, squirrel cage,380V,1420/1440 to 1490 rpm,3 phase	0.00	0.00	271.55	1.36	272.90	27.15	1.36	2.72
Electric, squirrel cage,380V,1420/1440 to 1490 rpm,3 phase	0.00	0.00	132.26	0.66	132.92	13.23	0.66	1.32
Electric, squirrel cage,380V,1420/1440 to 1490 rpm,3 phase	0.00	0.00	218.87	1.09	219.96	21.89	1.09	2.19
Motors, electric, DC, 380 V. variable speed. Range 10:1	0.00	0.00	489.82	2.45	492.27	48.98	2.45	4.90
Motors, electric, DC, 380 V. variable speed. Range 10:2	0.00	0.00	363.77	1.82	365.59	36.38	1.82	3.64
valves, pinch type, cast iron, complete installed	0.00	0.00	11.49	0.01	11.50	1.15	0.01	0.11

Conveyor, belt, 12 Deg inclined, belt width 1050 mm		0.00	9014.85	90.15	9105.00	901.48	90.15	90.15
Conveyors horizontal 600mm	180.00	180.00	2223.19	22.23	2245.42	222.32	22.23	22.23
Conveyors horizontal 600mm	180.00	180.00	2223.19	22.23	2245.42	222.32	22.23	22.23
Conveyors horizontal 600mm	180.00	180.00	2223.19	22.23	2245.42	222.32	22.23	22.23
Conveyors horizontal 600mm	180.00	180.00	2223.19	22.23	2245.42	222.32	22.23	22.23
Conveyors horizontal 600mm	180.00	180.00	2223.19	22.23	2245.42	222.32	22.23	22.23
Conveyor, belt, 12 Deg inclined, belt width 600 mm	200.00	200.00	10832.04	108.32	10940.36	1083.20	108.32	108.32
Conveyors horizontal 600mm	180.00	180.00	3116.77	31.17	3147.94	311.68	31.17	31.17
Conveyors horizontal 600mm	180.00	180.00	2223.19	22.23	2245.42	222.32	22.23	22.23
Conveyors horizontal 600mm	180.00	180.00	2223.19	22.23	2245.42	222.32	22.23	22.23
Conveyors horizontal 600mm	180.00	180.00	1795.49	17.95	1813.45	179.55	17.95	17.95
Conveyors horizontal 600mm	180.00	180.00	1795.49	17.95	1813.45	179.55	17.95	17.95
Conveyor, belt, 12 Deg inclined, belt width 600 mm	200.00	200.00	10832.04	108.32	10940.36	1083.20	108.32	108.32
Conveyors horizontal 600mm	180.00	180.00	2223.19	22.23	2245.42	222.32	22.23	22.23
Bins, Mild Steel	0.00	0.00	3181.61	3.18	3184.79	318.16	3.18	31.82
Silo's, concrete, (storage of ore)	0.00	0.00	7906.57	39.53	7946.10	790.66	39.53	79.07

C.2 Capital Estimate for 500 tph (tons per hour) Dense Medium Plant

ROM HANDLING AND CRUSHING		**DENSE MEDIUM CIRCUIT**		**FINES CIRCUIT**		**FROTH FLOTATION CIRCUIT**	
	TOTAL COST		TOTAL COST		TOTAL COST		TOTAL COST
CAPITAL EQUIPMENT	(R'000)	CAPITAL EQUIPMENT	(R'000)	CAPITAL EQUIPMENT	(R'000)	CAPITAL EQUIPMENT	(R'000)
ROM Chain Feeder	R 9 140	Desliming Screen	R 1 640	Fine Raw Coal Pump	R 447	Flotation Feed Pump	R 83
Primary Mineral Sizer	R 14 451	Intermediate DM Cyclone Feed Pump	R 652	Raw Coal Classifying Cyclones	R 1 144	Primary Flotation Unit	R 8 559
Raw Coal Conveyor	R 1 522	Intermediate Dense Medium Cyclone	R 391	Reflux Classifier	R 2 176	Secondary Flotation Unit	R 5 706
Belt Magnet	R 431	Intermediate Correct Medium Pump	R 560	Reflux Classifier	R 2 176	Flotation Overflow Thickener	R 2 254
Weightometer	R 200	High Density DM Cyclone Feed Pump	R 567	Spirals Feed Pump	R 120	Product Thickener Underflow Pump	R 114
Secondary Mineral Sizer	R 7 056	High Density Dense Medium Cyclone*	R 360	Spirals	R 1 168	Product Water Pump	R 124
Raw Coal Sizing Screen	R 1 440	High Density Correct Medium Pump	R 449	Clean Coal Classifying Cyclones Feed Pump	R 291	Filter Press Feed Tank Agitator	R 133

Tertiary Mineral Sizer	R 6 187	Combined Dilute Medium Pump	R 404	Clean Coal Classifying Cyclones	R 806	Filter Press	R 46 570
Raw Coal Conveyor	R 1 577	Intermediate Floats D&R Screen	R 2 140	Spiral Middlings Cyclones Feed Pump	R 139	Filter Presses Collection Feeder	R 5 124
Plant Feed Vibrating Feeder	R 315	High Density Floats D&R Screen	R 1 390	Spiral Middlings Classifying Cyclones	R 365		
Plant Feed Sampler	R 3 060	Intermediate Sinks D&R Screen	R 2 140	Fines Product Dewatering Screen	R 640	**TAILINGS DEWATERING**	
Plant Feed Weightometer	R 200	High Density Sinks D&R Screen	R 1 390	Spiral Middlings Dewatering Screen	R 490		TOTAL COST
Plant Feed Conveyor	R 1 319	Middlings Centrifuges	R 2 210	Spiral Discard Dewatering Screen	R 490	CAPITAL EQUIPMENT	(R'000)
		Primary Product Centrifuge	R 1 105	Screen Bowl Product Centrifuge	R 3 944	Filter Press	R 8 575
THICKENER AND WATER RETICULATION		Secondary Product Centrifuge	R 1 105	Screen Bowl Middlings Centrifuge	R 2 862	Belt Press Spray Water Pump	R 110
	TOTAL COST	Tertiary Product Centrifuge	R 1 105	Non-Magnetics Spillage Pump	R 72	Belt Presses Collection Conveyor	R 219
CAPITAL EQUIPMENT	(R'000)	Magnetic Separator	R 276	Reflux Collection Conveyor	R 984		
Thickener	R 6 041	Magnetic Separator	R 276	Spiral Middlings Collection Conveyor	R 900		
Thickener Underflow Pump (VSD)	R 124	Magnetics Spillage Pump	R 72				
Clarified Water Pump	R 908						
Thickener Spillage Pump	R 72						

C.3 Auxiliary Construction & Installation Capital Costs

	Factor
Equipment	1.00
Erection of items	0.15
Structural and Buildings	0.26
Civils	0.22

Piping and ducting	0.25
Electrical	0.26
Instruments	0.17
Installed plant	2.31
Contingency	3.3

Appendix D. Discounted Cash Flow Scenario's & Sensitivity Analysis

D.1 Witbank Coalfield No. 4 Seam

DMS Cyclones (All)

		Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)
6000	22.3	775.20	638
5900	27.3	746.29	774
5800	33.4	717.38	897
5700	39.2	688.46	915
5600	45.5	659.55	869
5500	52.3	630.64	750
5400	58.1	600.00	480
5300	64.8	571.12	166
5200	71.4	542.24	-248
5100	78.1	513.36	-757
5000	83.6	484.48	-1356

DMS BATH + DMS Cyclones

		Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)
6000	24.0	775.20	847
5900	29.4	746.29	998
5800	36.0	717.38	1136
5700	42.2	688.46	1161
5600	49.0	659.55	1118
5500	56.3	630.64	995
5400	62.5	600.00	710
5300	69.8	571.12	378
5200	76.8	542.24	-62
5100	84.1	513.36	-603
5000	81.7	484.48	-1201

WATER JIGS + DMS Cyclones

		Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)
6000	17.6	775.20	913
5900	23.0	746.29	1158
5800	29.1	717.38	1366
5700	34.5	688.46	1449
5600	41.4	659.55	1526
5500	47.7	630.64	1477

5400	55.1	600.00	1347
5300	61.3	571.12	1104
5200	68.5	542.24	788
5100	75.4	513.36	364
5000	81.9	484.48	-162

DRY FGX + DMS CYCLONES

		Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)
6000	14.5	775.20	620
5900	17.2	746.29	693
5800	23.3	717.38	930
5700	29.6	688.46	1090
5600	36.9	659.55	1205
5500	43.4	630.64	1183
5400	49.7	600.00	1037
5300	55.5	571.12	806
5200	61.3	542.24	493
5100	66.3	513.36	90
5000	70.7	484.48	-386

DRY XRT SORTER + DMS CYCLONES

		Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)
6000	14.5	775.20	598

5900	17.2	746.29	672
5800	20.1	717.38	723
5700	26.1	688.46	892
5600	33.3	659.55	1029
5500	39.8	630.64	1032
5400	46.0	600.00	915
5300	51.7	571.12	712
5200	57.5	542.24	428
5100	62.5	513.36	55
5000	67.0	484.48	-393

DMS Cyclones + Dry Screening

		Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)
5400	76.2	600.00	2021
5300	80.2	571.12	1556
5200	83.6	542.24	1023
5100	87.7	513.36	445
5000	90.9	484.48	-191

DMS BATH + Dry Screen

		Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)
5400	78.2	600.00	1469
5300	82.6	571.12	998

5200	86.2	542.24	453
5100	90.6	513.36	-139
5000	94.0	484.48	-795

WATER JIGS + DMS Cyclones (All)

		Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)
5400	73.2	600.00	1951
5300	76.7	571.12	1513
5200	80.8	542.24	1033
5100	85.0	513.36	497
5000	89.2	484.48	-101

DRY FGX + DRY SCREENING

		Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)
5400	67.9	600.00	2015
5300	70.9	571.12	1598
5200	73.5	542.24	1131
5100	75.9	513.36	623
5000	78.0	484.48	79

DRY XRT SORTER + DRY SCREENING

		Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)
5400	64.2	600.00	1907
5300	67.1	571.12	1516
5200	69.7	542.24	1076
5100	72.1	513.36	596
5000	74.2	484.48	80

Combined **Three Product Cyclone - export only**

		Weighted Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)
5500	65.6	629.83	2035
5100	72.6	607.27	1893
5000	76.6	587.40	1642
4900	81.0	566.63	1341
4800	84.7	546.19	990
4700	87.5	526.45	604
4600	89.7	327.42	-3850
4500	91.9	322.81	-4040

Combined **Three Product Cyclone - Eskom**

		Weighted Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)
5500	65.6	549.83	718
5100	72.6	527.27	434
5000	76.6	507.40	103
4900	81.0	486.63	-286

4800	84.7	466.19	-712
4700	87.5	446.45	-1153
4600	89.7	247.42	-5651
4500	91.9	242.81	-5885

D.2 Waterberg Upper Ecca

DMS Cyclones (All)

		Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)
6000	4.6	773.28	-520
5800	6.7	715.52	-462
5600	10.2	657.76	-407
5400	14.8	600.00	-414
5200	21.5	542.24	-526
5000	28.8	484.48	-830
4800	36.0	426.72	-1345
4600	47.3	368.96	-2183
4400	59.2	311.20	-3376
4200	66.7	253.44	-4662
4000	73.2	195.68	-6092

Combined **DMS BATH + DMS Cyclones (All)**

		Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)

6000	5.0	773.28	-244
5800	6.2	715.52	-245
5600	10.3	657.76	-151
5400	15.0	600.00	-156
5200	20.3	542.24	-289
5000	27.6	484.48	-574
4800	36.7	426.72	-1092
4600	45.2	368.96	-1859
4400	57.0	311.20	-3010
4200	65.1	253.44	-4295
4000	73.3	195.68	-5819

Combined **WATER JIGS + DMS Cyclones (All)**

		Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)
6000	5.6	773.28	-13
5800	6.8	715.52	-22
5600	7.9	657.76	-68
5400	11.2	600.00	-80
5200	16.2	542.24	-159
5000	22.1	484.48	-381
4800	29.3	426.72	-790
4600	38.7	368.96	-1465
4400	48.4	311.20	-2429
4200	59.4	253.44	-3745
4000	68.8	195.68	-5263

Combined **DRY FGX + DMS CYCLONES**

		Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)
6000	2.6	773.28	-257
5800	3.8	715.52	-223
5600	9.3	657.76	-30
5400	15.4	600.00	23
5200	22.1	542.24	-92
5000	28.9	484.48	-400
4800	36.1	426.72	-911
4600	43.1	368.96	-1623
4400	49.6	311.20	-2521
4200	56.4	253.44	-3624
4000	63.6	195.68	-4949

Combined **DRY XRT SORTER + DMS CYCLONES**

		Price	NPV (20 YRS)
	Yield %	R/ton	(R'Million)
6000	2.6	773.28	-284
5800	3.8	715.52	-250
5600	7.6	657.76	-137
5400	12.2	600.00	-104
5200	17.6	542.24	-192
5000	23.3	484.48	-436
4800	29.8	426.72	-856
4600	36.2	368.96	-1462
4400	42.4	311.20	-2247
4200	49.2	253.44	-3240

4000	56.5	195.68	-4472

D.3 Free State (Vereeniging)

DMS Cyclones (All)

			Price	NPV (20 YRS)
	Yield %	C.V.	R/ton	(R'Million)
4000	70.6	18.72	187.23	460
4200	63.3	19.56	195.59	456
4400	52.7	20.41	204.09	349
4600	38.9	21.40	214.00	129

Combined DMS BATH

			Price	NPV (20 YRS)
	Yield %	C.V.	R/ton	(R'Million)
4000	70.9	18.64	186.38	691
4200	61.6	19.55	195.54	661
4400	50.9	20.41	204.10	549
4600	32.8	21.29	212.86	207

Combined WATER JIGS

			Price	NPV (20

				YRS)
	Yield %	C.V.	R/ton	(R'Million)
4000	64.7	18.64	186.38	849
4200	52.0	19.57	195.65	718
4400	35.6	20.40	204.03	432

Combined	DRY FGX

			Price	NPV (20 YRS)
	Yield %	C.V.	R/ton	(R'Million)
4000	37.1	18.61	186.07	266
4200	31.6	19.49	194.87	229
4400	26.0	20.37	203.67	167

Appendix E. Data Analysis Tables

Table I: No. 4 Seam QEM SEM flotation test work Witbank Coalfield No.4 Seam

Mineral	Ideal Composition	S4-Feed	S4-Calc. Fd.	S4-Product	S4-Tailings	%Recovery
Sulphates/Gibbsite	Ca- and Al-bearing sulphates	0.1	0.1	0.0	0.1	42.3
Pyrite	FeS2	2.3	2.5	2.2	2.7	46.8
Siderite	FeCO3	0.7	0.8	0.5	1.1	31.0
Calcite	CaCO3	0.9	0.6	0.5	0.8	39.3
Dolomite	CaMg(CO3)2	2.0	1.9	1.6	2.2	43.8

Apatite	Ca5(PO4)3(OH,F,Cl)	0.2	0.3	0.3	0.4	44.2
Kaolinite	Al2Si2O5(OH)4 (clay)	13.1	14.8	9.4	20.6	33.1
Quartz	SiO2 (sand)	6.7	6.1	5.1	7.3	43.0
Illite/Muscovite	K2Al6Si6O20(OH)4/ KAl5Si7O20(OH)4	0.9	1.5	0.7	2.4	23.4
Microcline	(K,Na)AlSi3O8	1.4	2.2	0.8	3.7	18.1
Rutile	TiO2	0.2	0.2	0.2	0.2	49.7
Coal-organic S bearing	C,H,O,N,S	16.7	15.7	17.7	13.5	58.8
Coal	C,H,O,N	54.4	53.0	60.8	44.4	59.7
Other	Unidentified Phases	0.4	0.4	0.3	0.6	32.9
Total		100.0	100.0	100.0	100.0	
Mineral Matter/Ash reconciliation						
Total Mineral Matter	100-Total("Coal")	28.9	31.4	21.5	42.1	35.6
Mineral-derived volatiles	Calculated	4.8	5.0	3.7	6.4	38.7
Calculated Ash-%	MM-MV	24.1	26.4	17.7	35.7	35.0
Measured ash-%	Proximate	28.5	25.5	13.7	38.2	28.0

Table II: No. 4 seam batch flotation test work proximate results – 1 Witbank Coalfield No.4 Seam

				TEF1D	TEF1F	TEF1P	Ash yield%
Proximate Analysis	Moisture as analysed (Inherent Moisture)	IM	%	2.4	2.5	2.6	57.4%
	Volatile Matter	VOL	%	21.4	22.5	22.8	
	Ash content	ASH	%	35.9	26.2	19	
	Fixed Carbon	FC	%	40.3	48.9	55.7	
							CV Yield

							to product
Other	Calorific Value	CV	MJ/kg	18.89	22.71	25.46	58.1%
	Sulphur	S	%	0.74	0.88	0.82	

Table III: No. 4 seam batch flotation release analysis test work proximate results – Witbank Coalfield No.4 Seam

FLOTATION TEST SAMPLES			**ASH YIELD%**	57.8%	**%RECOVERY**	54.3%	
FEED	**MASS IN GRAMS**	**ASH 1**	**ASH 2**	**CV**	**VOLS**	**%IM**	**FC %**
	400.00	26.78	26.90	23.33	24.3	1.2	47.7
PRODUCT	**MASS**	**ASH 1**	**ASH 2**	**CV**	**VOLS**	**%IM**	**FC %**
	234.80	18.61	18.22	26.56	25.1	1.0	55.5
TAIL	**MASS**	**ASH 1**	**ASH 2**	**CV**	**VOLS**	**%IM**	**FC %**
	198.00	37.95	37.64	18.36	23.9	2.3	36.0

			Frac	Cum			Cum	Cum
Time (sec)	**Sample number**	**Mass (g) recovered**	**Mass (%) recovered**	**Mass (%) recovered**	**Ash (%)**	**CV (MJ/kg)**	**Ash**	**CV**
2#								
20	FA4 - 1	34.6	37.77	37.77	12.7	28.57	12.7	28.57
40	FA4 - 2	12.0	13.10	50.87	18.8	28.38	18.85923	28.52159
60	FA4 - 3	5.4	5.90	56.77	16.1	27.83	21.2529	28.44925
120	FA4 - 4	2.9	3.17	59.93	16.8	26.91	22.2207	28.36778

Table IV: XRD results mass distribution per density fraction Witbank Coalfield No.4 Seam

RD	Calcite %	Dolomite %	Graphite %	Hydroxyapatite %	Kaolinite %	Pyrite %	Quartz %	Siderite %
1.3	0.11	0.61	87.38	0.160	8.59	1.38	1.72	0.04
1.35	0.17	1.33	82.13	0.410	11.93	1.17	2.7	0.15
1.45	0.11	1.56	75.69	0.330	15.51	0.75	5.85	0.21
1.55	0.12	2.15	65.19	0.000	20.8	0.6	10.34	0.8
1.65	0.59	6.81	53.99	0.000	24.77	0.9	11.92	1.02
1.75	0.49	3.04	46.6	0.000	28.52	1.15	15.2	5.03
+1.8	2.32	5.46	28.1	0.000	30.2	7.33	20.96	5.56

RD	Calcite %	Dolomite %	Graphite %	Muscovite %	Kaolinite %	Pyrite %	Quartz %	Siderite %	Rutile %
1.3	0	0	94.16		4.83	0.34	0.62	0.05	
1.35	0	0.76	83.87		12.53	0.64	1.93	0.27	
1.45	0.24	2.62	76.78		16.06	0.43	3.53	0.33	
1.55	0.33	2.19	67.85		22.2	0.33	6.58	0.52	
1.65	0.52	2.58	60.07	1.690	25.29	0.29	8.26	1.31	
1.75	0.31	2.82	52.6		31.33	0.69	10.29	1.69	0.29
+1.8	3.04	7.15	17.7	7.020	39.1	6.22	11.23	7.58	0.95

Table V: XRD results mass distribution per density fraction Waterberg Upper Ecca

	Calcite	Dolomite	Graphite	Kaolinite	Muscovite	Pyrite	Quartz	Rutile	Siderite
F @ 1,35	1.75	2.3	65.61	15.89	2.59	1	8.84	0.03	2
1,35 - 1,40	0.85	0.95	74.26	13.67	1.83	0.69	7.14	0	0.6
1,40 - 1,50	1.82	2.06	67.42	14.59	3.08	0.7	8.55	0.14	1.63

F @ 1,50 HQ	3.31	3.06	54.63	19.04	4.24	0.92	11.65	0.2	2.95
1,50 - 1,70	2.84	3.38	39.2	25.23	5.02	1.13	19.42	0.48	3.27
1,50 - 1,70 HQ	3.31	3.06	54.63	19.04	4.24	0.92	11.65	0.2	2.95
1,70 - 1,90	2	3.31	50.69	20.01	3.81	1.04	15.82	0.27	3.05
1,70 - 1,90 HQ	1.55	2.7	42.3	26.54	4.72	0.44	16.2	0.4	5.17
1,90 - 2,00	2.84	2.24	32.5	28.79	5.88	1.66	22.25	0.61	3.25
1,90 - 2,00 HQ	0.98	1.39	37.5	29.46	5.6	0.41	18.62	0.49	5.53
S @ 2,00	1.85	1.38	16.7	35.8	8.16	3.18	31.3	0.77	0.93
S @ 2,00 - HQ	0.68	0.35	20	38.3	8.07	0.52	27.76	0.78	3.55
0,500 - FINE	2.64	4.48	41.8	27.31	4.06	1.33	16.32	0.34	1.75

Table VI: QEMSEM mineral composition % mass distribution per Feed and 1.3., 1.6 density fractions Witbank Coalfield No.4 Seam

Mineral	**Ideal Composition**	**S4-Feed**	**F1.3**	**F1.6**
Sulphates/Gibbsite	Ca- and Al-bearing sulphates	0.1	0.0	0.1
Pyrite	FeS_2	1.1	1.2	1.1
Siderite	$FeCO_3$	0.4	0.1	0.3
Calcite	$CaCO_3$	0.4	0.1	0.5
Dolomite	$CaMg(CO_3)_2$	1.6	0.3	7.4
Apatite	$Ca_5(PO_4)_3(OH,F,Cl)$	0.9	0.4	0.8
Kaolinite	$Al_2Si_2O_5(OH)_4$ (clay)	10.0	2.3	14.3
Quartz	SiO_2 (sand)	4.0	0.5	7.5
Illite/Hydro-Muscovite	$K_2Al_6Si_6O_{20}(OH)_4$/ $KAl_5Si_7O_{20}(OH)_4$	1.0	0.1	0.2
Microcline	$(K,Na)AlSi_3O_8$	0.6	0.1	0.4
Rutile	TiO_2	0.2	0.0	0.2

Coal-organic S bearing	C,H,O,N,S	21.1	58.0	8.7
Coal	C,H,O,N	58.4	36.8	58.2
Other	Unidentified Phases	0.2	0.1	0.3
Total		100.0	100.0	100.0
Mineral Matter/Ash Reconciliation				
Total Mineral Matter	100-Total("Coal")	20.48	5.21	33.11
Mineral-derived volatiles	Calculated	3.19	1.18	6.51
Calculated Ash-%	MM-MV	17.29	4.03	26.60
Measured ash-%	Proximate	28.28	5.12	16.70
Mineral	**Classification Specifications**	**S4-Feed**	**F1.3**	**F1.6**
Pyrite/Siderite Cleat	Pyrite/Siderite>60 Area%	0.76	0.11	0.59
Carbonate Cleat	Calcite+Dolomite>60 Area%	0.78	0.08	2.75
Sandstone	Quartz+Microcline>60 Area%	1.12	0.03	0.47
Mudstone	Kaolinite+Illite/Hydro-Muscovite>60 Area%	3.42	0.56	2.73
Siltstone	Kaolinite+Quartz>60 Area%	0.25	0.01	3.57
Middling	Mineral Matter 30-60 Area-%	20.22	2.84	48.55
Included	Mineral Matter 0.1-30 Area-%	60.30	68.04	35.30
Free Coal	No included mineral matter	13.14	28.33	6.03
Total		100.00	100.00	100.00

Table VI: QEMSEM mineral composition % mass distribution per Feed and 1.3., 1.5. 1.7 density fractions Waterberg Upper Ecca

Mineral	Composite	RD 1.35 - 1.40	RD 1.50 - 1.70	RD 1.9 - 2.00
Sulphates/Gibbsite	0.0	0.0	0.2	0.1
Pyrite	1.2	0.4	1.0	1.2
Magnetite/Siderite	1.3	0.7	2.5	3.7
Calcite	1.9	0.3	3.6	2.2

Dolomite	2.0	0.4	2.1	1.5
Kaolinite	24.4	2.3	12.0	33.3
Quartz	10.0	5.0	8.7	13.4
Illite/Muscovite	1.4	0.4	1.0	2.0
Microcline	3.4	1.0	1.6	3.2
Vitrinite	28.7	69.4	35.9	17.2
Inertinite	25.0	19.5	29.9	21.3
Other	0.7	0.6	1.5	0.9
Total	100.0	100.0	100.0	100.0

Table VII: Trace element analysis of flotation samples (Feed, product and tailings) Witbank Coalfield No.4 Seam

Certificate of analysi 748

Note: all results in parts per million (ppm) unless specified otherwise

Sample Origin	Sample ID	Ag	As	B	Ba	Be	Bi	Cd	Ce	Co	Cr	Cs	Cu	Ga	Ge	Hg
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
53589	53589	0.03	5.77	51.6	325	1.84	0.92	0.26	43.7	14.4	90.3	0.92	27.4	13.8	2.70	0.28
53590	53590	0.05	7.46	63.4	517	1.64	0.96	0.22	51.5	16.9	74.2	1.36	29.6	19.5	2.68	0.28
53591	53591	0.03	5.90	51.0	481	1.44	0.87	0.22	49.5	15.0	64.2	1.55	26.2	17.2	2.31	0.16

Sample Origin	Sample ID	La	Li	Mn	Mo	Nb	Nd	Ni	Pb	Rb	Sb	Sc	Se	Sn	Sr	Th
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
53589	53589	68.3	37.0	117	2.35	10.9	7.21	39.2	18.7	4.20	0.64	12.7	0.60	3.94	664	5.88
53590	53590	82.7	55.9	247	2.30	13.0	8.33	43.3	18.3	6.13	1.18	17.9	0.77	4.89	716	6.11
53591	53591	99.1	50.2	191	2.11	11.4	8.12	37.2	18.5	9.84	0.76	14.5	0.69	4.17	656	6.42

Comments / additional information: Please note that where no results are filled in, the Minimum as in the row below the element will apply

	Chemical elements:	Ag, As, B, Ba, Be, Bi, Cd, Ce, Co, Cr, Cs, Cu, Ga, Ge, Hg, La, Li, Mn, Mo, Nb, Nd, Ni, Pb, Rb, Sb, Sc, Se, Sn, Sr, Th, F
Identification of test methods:	Instrument:	ICP-MS
	Documentation:	

Table VIII: Trace element analysis of washability samples at seven relative density fractions – first sample set Witbank Coalfield No.4 Seam

Sample set 1:

Certificate of analysis: 429

Sample Origin	Sample ID	Ag	As	B	Ba	Be	Bi	Cd	Ce	Co	Cr	Cs	Cu	Ga	Ge	Hf	Hg	Ho	In	Ir	La	Li	Mn	Mo	Nb
	Note: all results in parts per million (ppm) unless specified otherwise																								
		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	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l	mg/l
	Det Limit	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
F130 – 2804275	429 - 31678	0.06	2.55	19.3	299	1.33	1.28	0.31	28.8	19.5	25.6	0.16	16.6	12.3	6.47	2.57	0.21	0.28	0.04	0.17	17.2	11.2	65.2	3.28	8.58
F140 – 2804276	429 - 31679	0.03	1.77	14.2	383	2.04	1.13	0.23	49.9	30.7	23.3	0.34	22.1	10.9	3.86	2.01	0.16	0.34	0.04	0.17	33.0	15.6	78.6	2.25	6.24
F150 – 2804277	429 - 31680	0.03	1.05	9.66	360	2.50	1.25	0.22	56.3	9.26	24.0	0.33	16.6	7.44	1.54	1.62	0.13	0.35	0.03	0.12	41.4	15.7	101	0.91	4.93
F160 – 2804278	429 - 31681	0.03	1.42	8.01	335	2.24	1.08	0.31	45.9	5.59	22.5	0.49	19.3	6.76	1.31	1.89	0.13	0.27	0.05	0.09	14.5	17.3	117	0.91	5.35
F170 – 2804279	429 - 31682	0.04	2.96	9.20	321	2.51	1.26	0.30	53.1	5.97	28.3	0.94	13.8	7.98	0.95	2.11	0.18	0.48	0.04	0.15	33.6	25.1	206	1.08	7.00
F180 – 2804280	429 - 31683	0.03	1.69	13.9	318	1.84	1.23	0.15	33.4	5.56	29.0	1.24	17.2	9.88	1.26	2.44	0.22	0.38	0.04	0.14	17.8	36.6	290	1.58	8.80
S180 – 2804281	429 - 31684	0.06	18.4	22.9	445	3.38	0.981	0.54	34.0	14.6	112	2.15	25.3	19.0	1.60	4.33	0.76	0.31	0.05	0.18	27.4	82.4	364	6.78	18.1

		F	S (tot)	S (Pyretic	S (SO_4^{2-})	(Organic	Nd	Ni	Pb	Rb	Sb	Sc	Se	Sn	Sr	Te	Th	Tl	U	V	W	Y	Zn	Zr
		ppm	%	%	%	%	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	mg/l	mg/l
							<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.001	<0.0001	<0.001	<0.001	<0.001	<0.001	<0.001
F130 – 2804275	429 - 31678	370	0.85	0.214	<0.01	0.63																		
F140 – 2804276	429 - 31679	310	0.85	0.249	<0.01	0.60	5.24	28.3	12.0	2.17	0.73	1.75	0.98	3.35	267	0.68	1.98	0.23	3.12	58.1	2.24	14.0	51	167
F150 – 2804277	429 - 31680	307	0.72	0.211	<0.01	0.51	9.55	26.7	8.53	3.65	0.91	1.53	0.50	2.90	409	0.75	4.33	0.27	2.71	38.0	1.86	17.1	72	122
F160 – 2804278	429 - 31681	168	0.57	0.127	<0.01	0.44	11.6	21.0	8.35	4.82	0.25	2.79	0.94	3.66	443	0.99	5.64	0.15	2.02	27.1	1.37	19.0	200	82.7
F170 – 2804279	429 - 31682	309	0.73	0.333	<0.01	0.40	6.10	17.4	9.50	3.56	0.30	3.43	0.94	3.38	387	1.00	4.17	0.07	2.27	23.5	1.16	13.6	106	96.9
F180 – 2804280	429 - 31683	361	0.86	0.449	<0.01	0.42	11.9	18.2	16.0	5.85	0.18	4.67	0.87	4.35	326	0.70	8.93	0.14	2.53	26.2	1.90	24.7	140	104
S180 – 2804281	429 - 31684	430	6.21	4.12	0.010	2.07	8.30	18.7	15.6	1.75	0.26	5.70	0.63	6.32	360	0.63	6.95	0.26	2.75	28.5	2.28	16.3	192	120
							11.3	70.3	29.3	11.8	0.87	9.55	1.39	8.14	262	0.59	8.15	2.28	3.61	58.6	4.04	12.0	213	199

Sample set 2:

Sample	Sample																						
Origin	ID	Note: all results in parts per million (ppm) unless specified otherwise																					
		As	B	Ba	Cd	Co	Cr	Cu	Hg	Mn	Ni	Pb	Sb	V	Zn	S(total)	S(pyritic)	S(sulphate)	P (Coal)	P (Ash)	Y	Cl
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg				%	%	mg/kg	mg/l
792 - 5507	88198/TEV	5.08	47.3	327	0.24	30.3	51.8	18.6	0.27	5.28	41.1	14.2	0.74	79.4	602	0.71	0.16	0.04	0.06	1.55	76.4	600
792 - 5507	88198/TEV	4.88	47.2	336	0.14	19.1	37.9	18.9	0.20	25.1	28.7	10.6	0.43	60.8	488	0.67	0.21	0.03	0.12	1.56	79.9	471
792 - 5507	88198/TEV	2.20	37.9	298	0.18	10.7	38.3	15.7	0.22	53.6	21.4	10.4	0.20	37.2	557	0.50	0.11	0.02	0.15	1.14	87.4	563
792 - 5507	88198/TEV	1.38	44.5	166	0.13	3.93	28.8	10.1	0.14	64.8	14.4	9.80	0.27	27.4	644	0.45	0.10	0.03	0.16	0.749	16.1	671
792 - 5507	88198/TEV	0.95	69.4	158	0.16	2.58	29.1	8.95	0.14	57.0	12.9	10.8	0.19	27.2	595	0.43	0.10	0.04	0.12	0.42	1.84	566
792 - 5507	88198/TEV	2.55	34.8	176	0.23	3.98	36.5	11.0	0.19	88.8	13.5	15.1	0.30	39.1	1137	0.70	0.33	0.04	0.18	0.513	1.71	1265
792 - 5507	88198/TEV	18.8	62.7	291	0.36	14.4	60.5	16.7	0.80	527	37.9	36.4	1.12	67.3	1661	5.65	4.06	0.01	0.15	0.236	8.11	565
		Ag	Be	Bi	Ce	Cs	Ga	Ge	Hf	In	Ir	La	Li	Mo	Nb	Nd	Rb	Sc	Se	Sn	V	
		mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	
792 - 5507	TEVL2/28	0.02	1.22	0.70	39.8	0.33	20.7	6.69	3.39	0.07	0.17	40.7	3.02	3.24	12.42	5.71	3.27	5.03	0.87	3.47	2.49	
792 - 5507	TEVL2/28	0.01	0.87	0.64	58.7	0.35	11.75	3.47	2.51	0.05	0.06	64.4	3.88	1.83	7.23	8.29	5.74	5.14	0.72	2.56	1.36	
792 - 5507	TEVL2/28	0.03	1.84	0.59	71.1	0.49	7.95	1.65	2.12	0.05	0.05	80.7	20.9	1.75	5.21	10.4	5.65	8.36	0.78	2.09	2.69	
792 - 5507	TEVL2/28	0.04	1.39	0.57	9.85	0.38	4.57	1.00	2.07	0.05	0.11	5.45	29.1	0.61	5.51	1.15	1.55	9.88	0.41	2.23	1.09	
792 - 5507	TEVL2/28	0.04	0.86	0.62	8.99	0.54	5.35	0.88	2.50	0.04	0.08	0.87	29.4	0.56	7.08	0.20	2.69	10.21	0.42	2.76	1.43	
792 - 5507	TEVL2/28	0.03	1.87	0.60	7.63	0.54	7.83	1.17	2.80	0.04	0.16	1.07	26.2	0.97	8.66	0.19	3.03	13.60	0.55	4.20	1.76	
792 - 5507	TEVL2/28	0.02	1.76	0.49	10.1	1.84	20.3	1.63	3.43	0.06	0.14	3.65	80.9	5.92	14.0	0.70	7.75	26.35	1.37	5.11	3.31	

Table IX: Trace element analysis of washability samples at seven relative density fractions – second sample set Waterberg Upper Ecca

	Trace Elements		Ag	As	B	Ba	Be	Bi	Cd	Ce	Co	Cr	Cs	Cu	Ga	Ge	Hg	La	Li	Mn	Mo	Nb
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
FINE/0.500	4061 - 251750		0.06	8.72	38.1	499	4.08	0.64	0.24	6.08	25.0	9.8	60	1.4	19.9	3.49	0.19	8.30	62.8	176	3.23	18.6
F@1.3500	4061 - 251759		0.06	3.91	49.4	358	3.51	0.39	0.21	8.22	18.4	9.9	47	29.3	22.6	6.53	0.15	6.00	54.5	90	5.39	20.3
1.3500-1.400	4061 - 251751		0.05	5.11	44.4	568	3.71	0.42	0.22	11.0	13.6	13.2	41	12.4	21.1	5.42	0.13	7.64	54.0	64	4.61	14.0
1.400-1.500	4061 - 251752		0.05	5.05	34.8	517	3.53	0.52	0.22	18.6	17.8	14.6	60.2	18.7	20.8	4.86	0.15	25.2	20.5	139.1	3.74	12.2
F@1.500/H-Q	4061 - 251760		0.08	5.88	39.7	538	3.95	0.41	0.34	23.5	20.0	20.1	215	28.5	30.4	7.56	0.48	18.11	57.2	135	8.46	15.6
1.500-1.700	4061 - 251753		0.05	6.50	32.4	540	4.22	0.57	0.29	20.2	19.8	12.5	59.8	8.8	19.3	3.36	0.16	41.8	29.8	249	2.87	12.3
1.500-1.700/H-Q	4061 - 251754		0.06	7.15	35.6	1162	5.24	0.58	0.29	97.4	27.2	18.0	109	17.2	26.8	5.49	0.59	190	35.6	272	5.78	14.6
1.700-1.900	4061 - 251755		0.05	8.74	30.5	448	4.27	0.59	0.27	7.13	22.0	10.0	55	249	18.5	2.58	0.18	9.54	65.6	249	2.71	13.4
1.700-1.900/H-Q	4061 - 251756		0.05	5.50	53.7	459	5.77	0.60	0.30	8.59	24.2	10.4	73	253	20.7	2.74	0.22	11.05	65.5	357	3.71	16.2
1.900-2.00	4061 - 251757		0.05	10.7	32.5	454	4.35	0.68	0.24	4.96	24.4	9.0	56	247	20.4	1.89	0.18	6.34	84.3	331	2.49	15.0
1.900-2.00/H-Q	4061 - 251758		0.05	6.88	35.0	295	5.83	0.74	0.27	2.36	27.6	9.1	83	239	23.0	1.86	0.47	4.46	96.1	282	2.72	18.4
S@2.00	4061 - 251761		0.04	18.17	31.4	408	3.69	0.81	0.20	3.22	26.0	6.5	58	146	28.5	1.43	0.44	3.28	99.6	69	2.77	24.1
S@2.00/H-Q	4061 - 251762		0.06	4.52	61.1	269	3.62	0.98	0.24	1.32	34.6	5.4	64	131	23.0	1.81	0.25	1.29	148	118	2.89	32.7

	Trace Elements		Nd	Ni	Pb	Rb	Sb	Sc	Se	Sn	Sr	Te	Th	Tl	U	V	W	Y	Zn	Zr	F	Cl
			mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
FINE/0.500	4061 - 251750		2.10	21.1	33.9	24.1	1.08	15.5	1.02	6.04	155	0.09	4.65	0.53	4.18	98.8	3.04	13.77	43.9	285.0	310	126
F@1.3500	4061 - 251759		1.38	16.6	18.1	20.4	1.66	5.73	0.58	2.74	237	0.04	2.31	0.24	3.30	126	4.36	10.4	196	256	169	894
1.3500-1.400	4061 - 251751		1.80	15.5	19.7	18.65	1.32	5.61	0.85	2.40	645	0.04	2.29	0.33	3.25	99.4	2.94	13.13	235	223	216	782
1.400-1.500	4061 - 251752		5.50	21.4	25.8	20.44	0.97	6.69	0.89	2.95	382	0.08	3.91	0.35	3.57	95.7	2.30	33.84	311	202	234	935
F@1.500/H-Q	4061 - 251760		4.80	25.7	44.4	21.8	1.71	5.76	1.51	3.40	245	0.12	8.60	0.64	4.72	266	2.79	20.8	275	330	191	813
1.500-1.700	4061 - 251753		9.34	36.8	29.6	14.32	0.86	9.98	1.11	3.32	329	0.09	9.01	0.38	3.98	81.4	2.20	52.98	421	202	275	1314
1.500-1.700/H-Q	4061 - 251754		42.7	22.8	56.1	15.9	1.64	12.1	2.43	4.24	816	0.20	17.73	0.44	5.77	146	2.56	120.6	305	263	275	983
1.700-1.900	4061 - 251755		2.44	25.6	36.6	92.0	1.02	15.6	1.00	4.05	184	0.08	4.04	0.65	3.96	80.8	2.45	12.98	357	219	337	1020
1.700-1.900/H-Q	4061 - 251756		2.57	21.2	36.7	69.9	1.06	15.0	1.70	4.49	156	0.15	3.81	0.36	4.82	98.7	2.95	12.41	199	235	275	708
1.900-2.00	4061 - 251757		1.67	24.6	40.6	89.1	0.75	21.0	0.98	4.66	164	0.09	5.29	0.89	4.29	76.0	2.83	7.73	341	208	351	1067
1.900-2.00/H-Q	4061 - 251758		1.11	23.8	36.3	71.0	0.70	20.0	1.19	5.26	47	0.13	3.60	0.63	4.73	90.0	3.39	6.67	239	226	337	663
S@2.00	4061 - 251761		0.65	26.4	38.5	76.8	0.68	29.5	0.73	6.20	60	0.13	3.62	1.11	5.15	76.3	5.21	3.03	286	209	456	592
S@2.00/H-Q	4061 - 251762		0.27	21.1	36.8	47.0	0.58	30.8	0.89	7.71	33	0.17	1.20	0.56	4.76	88.4	5.59	1.33	199	303	446	488

Table X: Proximate, phosphorous and calorific value analysis of washability samples at seven relative density fractions – Witbank Coalfield No.4 Seam

Report on Completed Samples														
	Kg	%	%	%	%	%	%	%	%	%	%	MJ/kg	MJ/kg	%
			Cum		**Cum**		**Cum**		**Cum**		**Cum**		**Cum**	
Density	**Mass**	**Yield**	**Yield**	**IM**	**IM**	**VOL**	**VOL**	**ASH**	**ASH**	**FC**	**FC**	**CV**	**CV**	**P**
F @-1.30	3.31	0.962	0.962	2.3	2.3	36.2	36.2	5	5	56.5	56.5	32	32	0.079
1.30-1.40	39.796	11.561	12.522	2.2	2.2	32.1	32.4	7.8	7.6	57.9	57.8	30.13	30.27	0.117
1.40-1.50	117.812	34.224	46.746	2.3	2.3	24.1	26.4	13.6	12	59.9	59.4	28.26	28.8	0.128
1.50-1.60	61.012	17.724	64.47	2.1	2.3	21.2	24.9	20.6	14.4	56.1	58.4	25.35	27.85	0.133
1.60-1.70	34.86	10.127	74.597	2	2.2	21.6	24.5	27.9	16.2	48.4	57.1	21.85	27.04	0.127
1.70-1.80	16.2	4.706	79.303	2	2.2	19.6	24.2	35.7	17.4	42.7	56.2	19.25	26.58	0.306
S @-1.80	71.246	20.697	100	0.9	1.9	16.9	22.7	70	28.2	12.2	47.1	6.14	22.35	0.313

			Date: 29/01/2009											
Report on Completed Samples			Time: 13:44:35											
	Kg	%	%	%	%	%	%	%	%	%	%	MJ/kg	MJ/kg	%
			Cum		Cum		Cum		Cum		Cum		Cum	
Density	**Mass**	**Yield**	**Yield**	**IM**	**IM**	**VOL**	**VOL**	**ASH**	**ASH**	**FC**	**FC**	**CV**	**CV**	**P**
F @-1.30	0.926	0.668	0.668	2.9	2.9	36.6	36.6	3.9	3.9	56.5	56.5	32.17	32.17	1.55
1.30-1.40	25.136	18.137	18.805	3.1	3.1	29.9	30.2	8.1	7.9	58.9	58.8	30.4	30.47	1.56
1.40-1.50	54.228	39.128	57.933	2.9	3	24.8	26.5	12.9	11.3	59.4	59.2	28.16	28.91	1.14
1.50-1.60	21.276	15.352	73.284	3	3	20.1	25.2	21.7	13.5	55.1	58.4	24.61	28.01	0.749
1.60-1.70	14.054	10.141	83.425	2.6	2.9	18.5	24.4	28.6	15.3	50.3	57.4	21.75	27.25	0.42
1.70-1.80	7.042	5.081	88.506	2.5	2.9	18.3	24	34.7	16.4	44.5	56.6	19.69	26.81	0.513
S @-1.80	15.93	11.494	100	1.5	2.8	18.8	23.4	62.2	21.7	17.5	52.1	8.5	24.71	0.236

Table XI: Proximate, phosphorous and calorific value analysis of washability samples at seven relative density fractions – Waterberg Upper Ecca

Screening Yields																					
Bottle	**Screening**	%	%	%	%	%	%	%	%	%	%	MJ/kg	MJ/kg	%	%						

			Cum		Cum		Cum		Cum		Cum		Cum		Cum						
Number		Yield	Yield	IM	IM	VOL	VOL	ASH	ASH	FC	FC	CV	CV	S	S						
2759481	PLUS-50	0.082	0.082																		
2759482	50-32	35.467	35.55																		
2759495	32-25	11.992	47.54																		
2759508	25-16	20.842	68.38																		
2759521	16-12.5	5.932	74.31																		
2759534	12.5-6	11.133	85.45																		
2759547	6-3	6.992	92.44																		
2759560	3-1	6.165	98.6																		
2759573	1-.500	0.661	99.27	2.1	2.1	23.5	23.5	45.8	45.8	28.6	28.6	15.81	15.81	1	0.97						
2759574	.500-.250	0.402	99.67	2.1	2.1	24	23.7	45.5	45.7	28.4	28.5	15.8	15.81	1	0.98						
2759575	.250-FINE	0.333	100	2	2.1	23.4	23.6	47.7	46.2	26.9	28.1	14.86	15.58	1.3	1.05						
		1.396			2.1		23.6		45.9		28		15.8		1.0						
Screening At: 50-32																					
Bottle		%	%	°C	°C	°C	°C	%	%	%	%	%	%	%	%	MJ/kg	MJ/kg		%	%	%
			Cum						**Cum**		**Cum**		**Cum**		**Cum**		**Cum**			**Cum**	
Number	**Density**	**Yield**	**Yield**	**DEF**	**SOFT**	**HEM**	**FLOW**	**IM**	**IM**	**VOL**	**VOL**	**ASH**	**ASH**	**FC**	**FC**	**CV**	**CV**	**FSI**	**S**	**S**	**P**
2759483	F @-1.35	0.149	0.149	1240	1250	1260	1270	4	4	35	35	8	8	53	53	28.77	28.77	3.5	0.8	0.83	0.03
2759484	1.35-1.40	0.432	0.581	1270	1290	1310	1320	3.4	3.5	34.2	34.4	14.4	12.7	48	49.3	26.75	27.27	2	1.2	1.1	0.03
2759485	1.40-1.45	0.73	1.31	1250	1260	1270	1280	3.2	3.4	33.7	34	17.9	15.6	45	47	25.4	26.23	3	0.9	1	0.01
2759486	1.45-1.50	1.635	2.945	1230	1250	1260	1280	3.3	3.3	33.3	33.6	21	18.6	42	44.4	23.86	24.92		1.4	1.2	
2759487	1.50-1.60	2.599	5.544	1170	1190	1210	1220	3	3.2	31.4	32.6	26.6	22.4	39	41.9	22.33	23.7		1.3	1.25	
2759488	1.60-1.70	3.691	9.235	1290	1320	1350	1370	2.6	3	28	30.7	34.1	27	35	39.3	20.49	22.42		1	1.15	
2759489	1.70-1.80	10.362	19.6	1180	1200	1220	1240	2.6	2.8	27.3	28.9	34.1	30.8	36	37.6	19.75	21.01		3.4	2.33	
2759490	1.80-1.90	11.689	31.29	1390	1420	1440	1450	2.7	2.7	26	27.8	38.1	33.5	33	35.9	18.6	20.11		1.3	1.95	

2759491	1.90-2.00	5.815	37.1	1440	1460	1480	1490	2.1	2.6	21.5	26.8	51	36.3	26	34.3	13.25	19.03		1.1	1.81	
2759492	2.00-2.10	5.523	42.62	1540	1550	1550	1550	2	2.5	19.7	25.9	57.2	39	21	32.6	10.97	17.99		0.5	1.64	
2759493	2.10-2.20	9.119	51.74	1550	1550	1550	1550	1.7	2.4	17.2	24.4	66.2	43.8	15	29.5	7.67	16.17		0.4	1.42	
2759494	S @-2.20	48.257	100	1550	1550	1550	1550	1.3	1.8	9.7	17.3	83.1	62.7	5.9	18.1	2.29	9.47		0.2	0.84	
									1.9		17.3		62.7		18.1		9.5			0.8	
Screening At: 32-25																					
Bottle		%	%	°C	°C	°C	°C	%	%	%	%	%	%	%	%	MJ/kg	MJ/kg		%	%	%
			Cum						**Cum**		**Cum**		**Cum**		**Cum**		**Cum**			**Cum**	
Number	**Density**	**Yield**	**Yield**	**DEF**	**SOFT**	**HEM**	**FLOW**	**IM**	**IM**	**VOL**	**VOL**	**ASH**	**ASH**	**FC**	**FC**	**CV**	**CV**	**FSI**	**S**	**S**	**P**
2759496	F @-1.35	0.153	0.153	1410	1430	1450	1470	4.1	4.1	36.4	36.4	7.4	7.4	52	52.2	28.91	28.91	3	0.8	0.81	0.02
2759497	1.35-1.40	1.279	1.432	1270	1290	1300	1320	3.6	3.6	35.4	35.5	13.4	12.8	48	48.1	27	27.2	3	0.9	0.93	0.02
2759498	1.40-1.45	1.458	2.89	1210	1230	1240	1260	3.6	3.6	34.7	35.1	18	15.4	44	45.9	25.84	26.52	2	0.9	0.93	0.01
2759499	1.45-1.50	1.202	4.093	1230	1240	1250	1280	3.3	3.5	33.1	34.5	22.6	17.5	41	44.4	23.61	25.66		1.1	0.98	
2759500	1.50-1.60	2.328	6.42	1230	1250	1270	1280	3	3.3	31.3	33.3	27.6	21.2	38	42.1	22.02	24.34		1.2	1.06	
2759501	1.60-1.70	3.76	10.18	1190	1210	1230	1250	3.1	3.3	31	32.5	28.7	24	37	40.3	21.48	23.29		1.1	1.06	
2759502	1.70-1.80	10.257	20.44	1240	1260	1280	1300	2.7	3	30.5	31.5	30.2	27.1	37	38.4	21.22	22.25		0.9	1	
2759503	1.80-1.90	10.948	31.39	1190	1210	1230	1250	2.8	2.9	30.4	31.1	31.1	28.5	36	37.5	20.55	21.65		1.6	1.2	
2759504	1.90-2.00	3.776	35.16	1360	1400	1430	1440	2.2	2.8	20.7	30	53	31.1	24	36	13.1	20.74		1.5	1.22	
2759505	2.00-2.10	4.011	39.17	1380	1420	1440	1460	1.9	2.8	18.6	28.8	58.6	33.9	21	34.5	10.3	19.67		1.5	1.26	
2759506	2.10-2.20	5.576	44.75	1550	1550	1550	1550	1.8	2.6	15.4	27.2	65.9	37.9	17	32.3	8.24	18.24		2	1.34	
2759507	S @-2.20	55.251	100	1550	1550	1550	1550	1.3	1.9	9.7	17.5	83	62.8	6	17.7	2.43	9.5		0.6	0.92	
									1.9		17.5		62.8		17.8		9.5			0.9	
Screening At: 25-16																					
Bottle	**Density**	%	%	°C	°C	°C	°C	%	%	%	%	%	%	%	%	MJ/kg	MJ/kg	**FSI**	%	%	%

			Cum						Cum		Cum		Cum		Cum		Cum			Cum	
Number		**Yield**	**Yield**	**DEF**	**SOFT**	**HEM**	**FLOW**	**IM**	**IM**	**VOL**	**VOL**	**ASH**	**ASH**	**FC**	**FC**	**CV**	**CV**		**S**	**S**	**P**
2759509	F @-1.35	0.388	0.388	1210	1230	1250	1280	4.2	4.2	35.5	35.5	5.8	5.8	54	54.4	29.54	29.54	3	0.9	0.86	0.01
2759510	1.35-1.40	2.094	2.482	1200	1220	1240	1260	3.6	3.7	36.4	36.2	12	11	48	49	27.45	27.78	2	1	0.93	0.01
2759511	1.40-1.45	4.171	6.653	1210	1230	1250	1270	3.4	3.5	34.5	35.1	18.3	15.6	44	45.8	25.22	26.17	1	1.1	1.02	0.01
2759512	1.45-1.50	4.292	10.95	1200	1210	1220	1240	3.3	3.4	34	34.7	21.8	18	41	43.9	23.78	25.23		1.2	1.09	
2759513	1.50-1.60	7.736	18.68	1190	1210	1220	1230	3	3.2	32.5	33.8	25.4	21.1	39	41.9	22.74	24.2		1.1	1.09	
2759514	1.60-1.70	8.528	27.21	1260	1280	1300	1320	2.8	3.1	29.2	32.3	31.5	24.3	37	40.2	20.66	23.09		1.1	1.1	
2759515	1.70-1.80	4.486	31.7	1260	1280	1300	1320	2.6	3	25.8	31.4	41.1	26.7	31	38.9	17.03	22.23		2	1.24	
2759516	1.80-1.90	2.328	34.02	1390	1410	1420	1430	2.5	3	22.8	30.8	47.6	28.1	27	38.1	14.71	21.72		0.8	1.2	
2759517	1.90-2.00	2.538	36.56	1550	1550	1550	1550	2.4	2.9	18.4	30	56.3	30.1	23	37	11.62	21.02		0.7	1.17	
2759518	2.00-2.10	3.314	39.88	1550	1550	1550	1550	2.1	2.9	16.4	28.8	63.4	32.9	18	35.4	9.25	20.04		0.5	1.12	
2759519	2.10-2.20	6.588	46.47	1550	1550	1550	1550	2	2.7	14.9	26.9	66.6	37.6	17	32.8	8.02	18.33		1	1.1	
2759520	S @-2.20	53.535	100	1550	1550	1550	1550	1.4	2	9.6	17.6	82.8	61.8	6.2	18.5	2.59	9.9		0.6	0.83	
									2.03		18		61.8		19		9.91			0.84	
Screening At: 16-12.5																					
Bottle		%	%	°C	°C	°C	°C	%	%	%	%	%	%	%	%	MJ/kg	MJ/kg		%	%	%
			Cum						**Cum**		**Cum**		**Cum**		**Cum**		**Cum**			**Cum**	
Number	**Density**	**Yield**	**Yield**	**DEF**	**SOFT**	**HEM**	**FLOW**	**IM**	**IM**	**VOL**	**VOL**	**ASH**	**ASH**	**FC**	**FC**	**CV**	**CV**	**FSI**	**S**	**S**	**P**
2759522	F @-1.35	0.255	0.255	1170	1190	1200	1220	4.4	4.4	35.5	35.5	7.5	7.5	53	52.7	29.09	29.09	3.5	0.8	0.84	0
2759523	1.35-1.40	0.369	0.624	1190	1200	1220	1240	3.8	4	35.6	35.5	12	10.2	49	50.3	27.68	28.25	3	0.9	0.88	0.01
2759524	1.40-1.45	0.94	1.564	1160	1180	1200	1230	3.5	3.7	34.5	34.9	16.6	14	45	47.3	25.76	26.75	2.5	1	0.96	0.01
2759525	1.45-1.50	0.798	2.361	1150	1170	1190	1210	3.4	3.6	33.5	34.4	20.3	16.2	43	45.8	24.9	26.13		1	0.96	
2759526	1.50-1.60	1.185	3.546	1130	1170	1200	1220	3.2	3.5	31.5	33.4	25.8	19.4	40	43.7	22.63	24.96		1	0.96	
2759527	1.60-1.70	2.798	6.344	1180	1210	1230	1240	3.1	3.3	30.8	32.3	27.2	22.8	39	41.6	22.19	23.74		1.1	1	
2759528	1.70-1.80	7.816	14.16	1220	1240	1260	1280	3.2	3.2	30.6	31.3	27.4	25.4	39	40	22.41	23.01		1	0.98	

2759529	1.80-1.90	12.794	26.95	1120	1150	1170	1190	3.1	3.2	28.5	30	31.4	28.2	37	38.6	20.51	21.82		1	0.96	
2759530	1.90-2.00	4.717	31.67	1360	1370	1400	1430	2.7	3.1	21.8	28.8	48.3	31.2	27	36.9	14.37	20.71		1.2	1	
2759531	2.00-2.10	3.453	35.12	1280	1320	1340	1360	2.5	3	19.5	27.9	56.1	33.7	22	35.4	11.68	19.82		0.8	0.98	
2759532	2.10-2.20	6.336	41.46	1550	1550	1550	1550	2.2	2.9	16.8	26.2	62	38	19	32.9	9.7	18.28		0.5	0.9	
2759533	S @-2.20	58.541	100	1550	1550	1550	1550	1.6	2.1	10.4	16.9	80.9	63.1	7.2	17.8	3.12	9.4		0.4	0.62	
									2.15		16.9		63.1		17.9		9.4			0.63	
Screening At: 12.5-6																					
Bottle		%	%	°C	°C	°C	°C	%	%	%	%	%	%	%	%	MJ/kg	MJ/kg		%	%	%
			Cum						**Cum**		**Cum**		**Cum**		**Cum**		**Cum**			**Cum**	
Number	**Density**	**Yield**	**Yield**	**DEF**	**SOFT**	**HEM**	**FLOW**	**IM**	**IM**	**VOL**	**VOL**	**ASH**	**ASH**	**FC**	**FC**	**CV**	**CV**	**FSI**	**S**	**S**	**P**
2759535	F @-1.35	0.812	0.812	1380	1400	1410	1420	3.7	3.7	32.4	32.4	14.2	14.2	50	49.7	26.78	26.78	3.5	0.8	0.83	0.01
2759536	1.35-1.40	1.846	2.658	1210	1230	1250	1260	3.4	3.5	35.6	34.7	12.1	12.8	49	49.1	27.8	27.49	3	0.9	0.88	0.01
2759537	1.40-1.45	1.915	4.574	1160	1180	1210	1220	3.1	3.3	33.5	34.2	18.3	15.1	45	47.4	25.54	26.67	2	1.1	0.97	0.01
2759538	1.45-1.50	1.652	6.225	1190	1200	1220	1240	3.1	3.3	32.4	33.7	22.8	17.1	42	45.9	23.63	25.86		1	0.97	
2759539	1.50-1.60	1.901	8.127	1250	1270	1280	1290	2.9	3.2	31	33.1	26.9	19.4	39	44.4	22.4	25.05		1	0.99	
2759540	1.60-1.70	7.429	15.56	1220	1240	1260	1270	3	3.1	32	32.6	24.3	21.7	41	42.6	23.18	24.16		1	1.01	
2759541	1.70-1.80	8.341	23.9	1250	1270	1280	1290	2.8	3	29.8	31.6	29.5	24.5	38	41	21.41	23.2		1.2	1.07	
2759542	1.80-1.90	12.155	36.05	1260	1300	1320	1340	3.2	3	27.7	30.3	32.3	27.1	37	39.6	20.18	22.18		0.9	1.01	
2759543	1.90-2.00	5.671	41.72	1380	1410	1430	1450	2.6	3	22.4	29.2	46.4	29.7	29	38.1	15.12	21.22		0.9	0.99	
2759544	2.00-2.10	4.387	46.11	1550	1550	1550	1550	2.3	2.9	20.2	28.3	54	32	24	36.7	12.21	20.36		0.7	0.96	
2759545	2.10-2.20	7.604	53.71	1480	1500	1520	1530	2.2	2.8	18.1	26.9	58.7	35.8	21	34.5	10.39	18.95		1.1	0.99	
2759546	S @-2.20	46.288	100	1550	1550	1550	1550	1.3	2.1	9.9	19	82.8	57.5	6.1	21.3	1.47	10.86		1	1.01	
Screening At: 6-3																					
Bottle	**Density**	%	%	°C	°C	°C	°C	%	%	%	%	%	%	%	%	MJ/kg	MJ/kg	**FSI**	%	%	%

			Cum						Cum		Cum		Cum		Cum		Cum			Cum	
Number		Yield	Yield	DEF	SOFT	HEM	FLOW	IM	IM	VOL	VOL	ASH	ASH	FC	FC	CV	CV		S	S	P
2759548	F @-1.35	0.757	0.757	1200	1220	1230	1240	3.8	3.8	36	36	5.9	5.9	54	54.3	29.64	29.64	3	1	0.99	0.01
2759549	1.35-1.40	1.99	2.747	1210	1220	1240	1260	3.9	3.9	34.8	35.1	8.8	8	53	53.1	28.67	28.94	2	1	1.02	0.01
2759550	1.40-1.45	2.499	5.246	1210	1230	1240	1250	3.4	3.6	34.3	34.7	14.3	11	48	50.7	26.75	27.89	2	1.1	1.05	0.01
2759551	1.45-1.50	1.333	6.579	1220	1230	1250	1270	3.1	3.5	33	34.3	19.6	12.8	44	49.4	24.96	27.3		1.1	1.06	
2759552	1.50-1.60	5.499	12.08	1200	1220	1240	1260	3.3	3.4	33.5	34	18	15.2	45	47.5	25.43	26.45		1.1	1.07	
2759553	1.60-1.70	14.293	26.37	1220	1240	1260	1270	3	3.2	32.6	33.2	22.2	19	42	44.6	23.99	25.12		1.1	1.1	
2759554	1.70-1.80	9.973	36.35	1270	1300	1310	1320	2.9	3.1	29.7	32.3	28.3	21.5	39	43.1	21.77	24.2		1	1.07	
2759555	1.80-1.90	4.933	41.28	1410	1450	1480	1490	2.9	3.1	23.1	31.2	44.7	24.3	29	41.5	15.61	23.17		0.9	1.04	
2759556	1.90-2.00	2.994	44.27	1490	1530	1540	1550	2.2	3	19	30.3	56.6	26.5	22	40.2	11.19	22.36		0.7	1.02	
2759557	2.00-2.10	3.2	47.47	1540	1550	1550	1550	1.9	2.9	17.4	29.5	60.8	28.8	20	38.8	9.53	21.5		0.6	0.99	
2759558	2.10-2.20	5.756	53.23	1550	1550	1550	1550	2.1	2.8	15.4	27.9	65.3	32.8	17	36.5	7.41	19.97		0.5	0.94	
2759559	S @-2.20	46.772	100	1550	1550	1550	1550	1.5	2.2	10.9	20	80.3	55	7.2	22.8	2.12	11.62		1.1	1	
									2.22		20		55		23		11.6			0.998	
Screening At: 3-1																					
Bottle		%	%	°C	°C	°C	°C	%	%	%	%	%	%	%	%	MJ/kg	MJ/kg		%	%	%
			Cum						**Cum**		**Cum**		**Cum**		**Cum**		**Cum**			**Cum**	
Number	**Density**	**Yield**	**Yield**	**DEF**	**SOFT**	**HEM**	**FLOW**	**IM**	**IM**	**VOL**	**VOL**	**ASH**	**ASH**	**FC**	**FC**	**CV**	**CV**	**FSI**	**S**	**S**	**P**
2759561	F @-1.35	8.943	8.943	1260	1290	1310	1330	4.1	4.1	35.4	35.4	4.9	4.9	56	55.6	29.68	29.68	3	0.9	0.86	0
2759562	1.35-1.40	5.972	14.92	1260	1280	1300	1330	3.7	3.9	34.6	35.1	9.3	6.7	52	54.3	28.41	29.17	2	1.1	0.96	0.01
2759563	1.40-1.45	7.034	21.95	1240	1260	1270	1280	3.8	3.9	32.7	34.3	11.1	8.1	52	53.7	27.85	28.75	2	1.1	1	0.01
2759564	1.45-1.50	5.295	27.24	1270	1290	1320	1340	3.5	3.8	28	33.1	17.4	9.9	51	53.2	25.67	28.15		0.7	0.95	
2759565	1.50-1.60	9.037	36.28	1240	1260	1280	1290	3.4	3.7	28.3	31.9	20.6	12.6	48	51.8	24.21	27.17		0.9	0.93	
2759566	1.60-1.70	6.396	42.68	1210	1240	1260	1280	3	3.6	27	31.2	28.2	14.9	42	50.3	21.71	26.35		1	0.94	
2759567	1.70-1.80	3.94	46.62	1300	1340	1350	1360	2.7	3.5	22.5	30.4	37.8	16.8	37	49.2	17.94	25.64		0.9	0.94	
2759568	1.80-1.90	5.766	52.38	1350	1380	1390	1400	3.9	3.6	21.4	29.4	45.8	20	29	47	14.56	24.42		0.7	0.92	

2759569	1.90-2.00	3.146	55.53	1440	1470	1490	1500	3.6	3.6	19.5	28.9	51	21.8	26	45.8	12.63	23.75		0.7	0.9	
2759570	2.00-2.10	3.005	58.54	1550	1550	1550	1550	3.5	3.6	18.5	28.4	54.6	23.5	23	44.6	11.58	23.13		0.7	0.89	
2759571	2.10-2.20	5.758	64.29	1490	1520	1530	1540	2.9	3.5	18.1	27.4	57	26.5	22	42.6	10.67	22.01		0.5	0.86	
2759572	S @-2.20	35.706	100	1480	1510	1520	1530	1.8	2.9	12.3	22	78.2	44.9	7.6	30.1	3.32	15.34		1.1	0.93	

Table XII: Correlation between mineral and maceral species - Witbank Coalfield No.4 Seam.

	Ag	As	B	Ba	Be	Bi	Cd	Ce	Co	Cr	Cs	Cu	Ga	Ge	Hf	Hg
Correlation Coefficient Pyrite	0.692019	0.993849	0.785524	0.804397	0.706908	-0.71691	0.859433	-0.4368	0.140673	0.994238	0.83255	0.74884	0.928048	-0.09689	0.960585	0.995068
Correlation Coefficient Kaolinite	-0.01571	0.536763	0.072082	0.331981	0.636263	-0.42025	0.31363	-0.14163	-0.6087	0.575069	0.883533	0.192026	0.26998	-0.7907	0.510638	0.552189
Correlation Coefficient Dolomite	0.143003	0.519637	0.025607	0.271861	0.671037	-0.2217	0.4485	0.109866	-0.43326	0.51157	0.729749	-0.01579	0.240308	-0.62593	0.436968	0.487823
Correlation Coefficient Quartz	0.165257	0.703536	0.252854	0.463701	0.707784	-0.54942	0.498311	-0.25687	-0.51979	0.736731	0.949219	0.347997	0.451304	-0.69347	0.675647	0.716851
Correlation Coefficient Siderite	0.289568	0.675802	0.503348	0.437161	0.46762	-0.46726	0.350522	-0.53226	-0.2927	0.721485	0.920857	0.440906	0.607915	-0.43479	0.749524	0.738938
Correlation Coefficient Calcite	0.588613	0.977548	0.661341	0.755415	0.784021	-0.6737	0.814574	-0.35389	-0.03711	0.982563	0.935028	0.634176	0.842454	-0.29887	0.932985	0.976482
Correlation Coefficient Hydroxyappetite	-0.18339	-0.35524	-0.06914	0.134557	-0.2411	0.210454	-0.36771	0.425053	0.705756	-0.35838	-0.60632	0.089082	-0.14522	0.438126	-0.43262	-0.37358
Correlation Coefficient Carbon	-0.19686	-0.72298	-0.28584	-0.48387	-0.71696	0.528611	-0.50198	0.248115	0.468806	-0.75337	-0.9678	-0.34876	-0.48648	0.673801	-0.6967	-0.73698
Correlation Coefficient %Ash	0.375262	0.678927	0.736196	0.463402	0.811515	-0.66681	-0.69611	-0.30171	-0.09033	0.045266	0.871145	0.496098	0.731192	0.234954	0.015108	0.977472
	Ho	In	Ir	La	Li	Mn	Mo	Nb	Nd	Ni	Pb	Rb	Sb	Sc	Se	Sn
Correlation Coefficient Pyrite	-0.20306	0.509376	0.531388	0.017502	0.936013	0.717423	0.948738	0.96788	0.316832	0.986922	0.911849	0.875688	0.567595	0.824509	0.741254	0.814052
Correlation Coefficient Kaolinite	0.359159	0.718388	-0.09085	-0.10574	0.764437	0.931107	0.265849	0.550903	0.411328	0.355378	0.726575	0.523084	-0.2951	0.894753	0.328146	0.837847
Correlation Coefficient Dolomite	0.659504	0.423178	0.157086	0.206856	0.611158	0.729826	0.248503	0.469512	0.625146	0.332934	0.69759	0.647012	-0.22819	0.72485	0.366157	0.600374
Correlation Coefficient Quartz	0.19832	0.764008	0.007081	-0.13736	0.878409	0.960951	0.461414	0.708473	0.376528	0.546032	0.839781	0.65357	-0.12803	0.967639	0.502968	0.912465
Correlation Coefficient Siderite	0.063711	0.719989	0.23148	-0.24887	0.876275	0.953932	0.572416	0.780123	0.218838	0.588351	0.820139	0.477969	0.083559	0.903656	0.344005	0.96374
Correlation Coefficient Calcite	0.015779	0.578553	0.464959	0.052241	0.981156	0.84911	0.856935	0.95182	0.441786	0.915277	0.970649	0.90192	0.386137	0.926375	0.704362	0.89227
Correlation Coefficient Hydroxyappetite	-0.12148	-0.78956	0.201079	0.571813	-0.48665	-0.66234	-0.1831	-0.42459	0.128252	-0.16926	-0.58761	-0.24625	0.360904	-0.66066	-0.43339	-0.58377
Correlation Coefficient Carbon	-0.26108	-0.73403	-0.09042	0.083412	-0.89458	-0.97702	-0.48771	-0.73186	-0.43196	-0.56832	-0.86612	-0.67722	0.090037	-0.97406	-0.48105	-0.92494
Correlation Coefficient %Ash	-0.16094	-0.21963	-0.08524	0.195572	-0.01852	0.911661	0.551842	0.946341	0.213991	0.277768	0.84569	0.807012	0.329197	0.059906	0.625334	0.536817
	Sr	Te	Th	Tl	U	V	W	Y	Zn	Zr	F					
Correlation Coefficient Pyrite	-0.61522	-0.53925	0.398396	0.998678	0.809922	0.691147	0.936229	-0.49984	0.457257	0.822051	0.655187					
Correlation Coefficient Kaolinite	-0.24466	-0.35419	0.846382	0.519444	0.253914	-0.15671	0.49471	0.008888	0.755966	0.15248	0.212235					
Correlation Coefficient Dolomite	-0.39002	-0.42726	0.913152	0.445147	0.263753	-0.07043	0.456764	0.407017	0.501009	0.156486	0.244025					
Correlation Coefficient Quartz	-0.37277	-0.39844	0.783986	0.688482	0.40984	0.041909	0.64059	-0.16484	0.75312	0.3373	0.312219					
Correlation Coefficient Siderite	-0.41693	-0.6052	0.599667	0.705161	0.58512	0.241325	0.758569	-0.35112	0.694145	0.507623	0.55911					
Correlation Coefficient Calcite	-0.60084	-0.57761	0.61327	0.967613	0.746083	0.531619	0.920165	-0.32373	0.574921	0.720494	0.624479					
Correlation Coefficient Hydroxyappetite	0.561321	0.314055	-0.46584	-0.2879	-0.29687	0.024393	-0.33662	0.114713	-0.31051	-0.2396	-0.0258					
Correlation Coefficient Carbon	0.396875	0.465885	-0.82164	-0.70717	-0.44803	-0.07188	-0.67959	0.114882	-0.74833	-0.36492	-0.3742					
Correlation Coefficient %Ash	-0.51976	0.740521	-0.34543	0.418455	0.786334	0.882405	0.758286	-0.41431	0.059274	-0.00048	0.745442					

	Ag	As	B	Ba	Be	Bi	Cd	Ce	Co	Cr	Cs	Cu	Ga	Ge	Hf	Hg
Correlation Coefficient Pyrite	-0.44314	0.970872	0.4376	0.239665	0.378724	-0.77568	0.852541	-0.30508	0.098671	0.758414	0.985071	0.272624	0.593164	-0.15708	0.594277	0.978968
Correlation Coefficient Kaolinite	0.141286	0.496018	0.320696	-0.48833	0.468651	-0.85588	0.526373	-0.69723	-0.62481	0.131333	0.751243	-0.46214	-0.09678	-0.74767	0.154354	0.539129
Correlation Coefficient Dolomite	-0.04489	0.748359	0.396771	-0.13624	0.537019	-0.93655	0.703733	-0.44702	-0.34792	0.440121	0.93858	-0.13338	0.191982	-0.56893	0.284243	0.804486
Correlation Coefficient Quartz	0.271216	0.369729	0.314817	-0.62444	0.434044	-0.76014	0.470726	-0.79274	-0.6859	0.033394	0.649719	-0.59413	-0.17486	-0.75022	0.139246	0.419992
Correlation Coefficient Siderite	-0.31141	0.909359	0.48889	0.049851	0.396787	-0.81175	0.849999	-0.46009	-0.06819	0.660379	0.991701	0.083515	0.47732	-0.29319	0.568792	0.930434
Correlation Coefficient Calcite	-0.276	0.909676	0.530571	0.072473	0.371764	-0.83399	0.814992	-0.41795	-0.05585	0.655481	0.99393	0.094608	0.47144	-0.29167	0.517705	0.936621
Correlation Coefficient Muscovite	-1	1	-1	1	1	-1	1	1	1	1	1	1	1	1	1	1
Correlation Coefficient Carbon	0.017673	-0.68757	-0.42274	0.299746	-0.4604	0.88768	-0.68208	0.636166	0.435535	-0.35057	-0.89126	0.27244	-0.12736	0.606714	-0.32267	-0.72732
Correlation Coefficient %Ash	-0.02292	-0.60733	0.399458	-0.11922	-0.0342	-0.51812	-0.46697	-0.31176	0.503887	0.669256	0.692847	0.147713	0.775984	0.694528	0.530881	0.688933

	Ho	In	Ir	La	Li	Mn	Mo	Nb	Nd	Ni	Pb	Rb	Sb	Sc	Se	Sn
Correlation Coefficient Pyrite	-0.19651	0.272893	0.290083	-0.30788	0.894026	0.989181	0.872009	0.70078	-0.30993	0.503989	0.980002	0.729701	0.835997	0.915287	0.850296	0.771424
Correlation Coefficient Kaolinite	0.261166	-0.46721	0.226313	-0.69646	0.877724	0.762605	0.25856	0.229971	-0.716	-0.26715	0.65848	0.243896	0.248062	0.899275	0.236593	0.620787
Correlation Coefficient Dolomite	0.070752	-0.13989	0.144446	-0.44701	0.982521	0.938435	0.585522	0.395147	-0.45924	0.074689	0.845695	0.557489	0.507082	0.973133	0.584828	0.640118
Correlation Coefficient Quartz	0.328855	-0.52899	0.303096	-0.79262	0.809456	0.658854	0.138518	0.196608	-0.811	-0.36632	0.565316	0.068394	0.154931	0.833639	0.098127	0.598208
Correlation Coefficient Siderite	-0.04469	0.114653	0.333637	-0.46442	0.947062	0.990822	0.777125	0.666092	-0.47088	0.349739	0.968537	0.627384	0.752319	0.971097	0.744808	0.81162
Correlation Coefficient Calcite	-0.08636	0.145031	0.263719	-0.42125	0.95968	0.993395	0.790425	0.630728	-0.42429	0.369949	0.953617	0.633395	0.751856	0.953675	0.756646	0.732527
Correlation Coefficient Muscovite	-1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1
Correlation Coefficient Carbon	-0.15423	0.253545	-0.27068	0.637508	-0.95905	-0.89692	-0.48366	-0.41355	0.652196	0.031593	-0.81699	-0.40901	-0.46321	-0.97578	-0.45528	-0.7175
Correlation Coefficient %Ash	-0.27217	-0.63096	0.387938	-0.58278	-0.54564	0.949072	0.804914	0.857791	-0.28151	0.31748	0.546941	0.667485	0.609916	0.618256	0.61696	0.658133

	Sr	Te	Th	Tl	U	V	W	Y	Zn	Zr	F
Correlation Coefficient Pyrite	-0.10674	0.466633	-0.31702	0.998183	0.083163	0.412655	0.686963	-0.33181	0.884165	0.332083	0.52778
Correlation Coefficient Kaolinite	-0.60397	-0.18076	-0.66334	0.647198	-0.57057	-0.29215	0.204713	-0.82982	0.831657	-0.22324	0.943918
Correlation Coefficient Dolomite	-0.29582	0.255476	-0.43065	0.861697	-0.34559	-0.03835	0.55364	-0.56596	0.873926	-0.06496	0.7927
Correlation Coefficient Quartz	-0.73739	-0.28128	-0.76933	0.532179	-0.59421	-0.37118	0.11154	-0.90891	0.777231	-0.22974	0.910217
Correlation Coefficient Siderite	-0.29166	0.328461	-0.47714	0.972163	-0.04883	0.27285	0.620399	-0.50769	0.931104	0.258168	0.640223
Correlation Coefficient Calcite	-0.23248	0.440264	-0.42229	0.971448	-0.0541	0.254794	0.63928	-0.46184	0.880212	0.223817	0.598524
Correlation Coefficient Muscovite	1	1	1	1	1	1	1	1	1	1	1
Correlation Coefficient Carbon	0.507035	-0.03902	0.620809	-0.81281	0.393199	0.087902	-0.39191	0.741321	-0.90739	0.046761	-0.86277
Correlation Coefficient %Ash	-0.43906	0.463569	0.289492	-0.31764	0.13558	0.921613	0.564523	0.18122	-0.57663	0.283694	-0.4617

Table XIII: Correlation between mineral trace element species – Waterberg Upper Ecca

Correlation Coefficient	Ag	As	B	Ba	Be	Bi	Cd	Ce	Co	Cr	Cs	Cu	Ga	Ge	Hg	La	Li	Mn	Mo	Nb
Calcite	-0.07	0.39	-0.79	0.94	0.88	0.63	0.92	0.92	0.76	0.89	0.91	0.11	0.31	-0.46	0.80	0.94	-0.38	0.89	-0.20	-0.80
Dolomite	-0.16	0.25	-0.74	0.76	0.82	0.51	0.95	0.72	0.60	0.75	0.74	0.26	-0.10	-0.48	0.56	0.75	-0.37	0.92	-0.34	-0.89
Graphite	0.67	-0.92	0.83	-0.44	-0.64	-0.94	-0.61	-0.34	-0.73	-0.15	-0.51	-0.63	-0.28	0.95	-0.60	-0.39	-0.38	-0.64	0.79	0.37

Kaolinite	-0.68	0.92	-0.76	0.35	0.56	0.91	0.52	0.26	0.68	0.05	0.43	0.61	0.29	-0.92	0.55	0.30	0.45	0.55	-0.79	-0.26
Muscovite	-0.62	0.95	-0.84	0.50	0.66	0.96	0.60	0.41	0.77	0.21	0.57	0.60	0.39	-0.92	0.67	0.45	0.38	0.64	-0.73	-0.35
Pyrite	-0.48	0.81	-0.32	-0.05	0.10	0.61	-0.05	-0.12	0.38	-0.40	0.04	0.50	0.46	-0.62	0.29	-0.09	0.75	0.00	-0.51	0.33
Quartz	-0.72	0.93	-0.78	0.33	0.54	0.91	0.51	0.22	0.66	0.02	0.40	0.64	0.24	-0.94	0.52	0.27	0.46	0.55	-0.83	-0.28
Rutile	-0.75	0.89	-0.85	0.42	0.60	0.92	0.61	0.31	0.67	0.16	0.48	0.57	0.20	-0.95	0.55	0.36	0.30	0.64	-0.84	-0.42
Siderite	-0.22	0.40	-0.76	0.75	0.89	0.63	0.97	0.70	0.70	0.67	0.76	0.44	-0.03	-0.61	0.62	0.73	-0.19	0.96	-0.42	-0.83
Correlation Coefficient	Nd	Ni	Pb	Rb	Sb	Sc	Se	Sn	Sr	Te	Th	Tl	U	V	W	Y	Zn	Zr	F	Cl
Calcite	0.93	0.72	0.85	0.08	-0.25	0.42	0.93	0.54	0.90	0.88	0.98	0.38	0.83	0.05	-0.85	0.97	0.80	-0.11	0.56	0.59
Dolomite	0.75	0.73	0.72	0.19	-0.30	0.32	0.79	0.40	0.71	0.70	0.82	0.28	0.65	-0.11	-0.92	0.80	0.83	-0.20	0.48	0.73
Graphite	-0.39	-0.78	-0.68	-0.66	0.82	-0.91	-0.53	-0.88	-0.17	-0.68	-0.50	-0.90	-0.72	0.65	0.44	-0.39	-0.73	0.60	-0.94	-0.09
Kaolinite	0.30	0.73	0.61	0.66	-0.82	0.90	0.45	0.86	0.08	0.62	0.42	0.90	0.66	-0.67	-0.33	0.29	0.66	-0.60	0.91	0.01
Muscovite	0.45	0.74	0.73	0.65	-0.78	0.93	0.58	0.91	0.24	0.74	0.55	0.92	0.78	-0.58	-0.43	0.44	0.71	-0.55	0.95	0.03
Pyrite	-0.09	0.24	0.23	0.59	-0.56	0.75	0.01	0.67	-0.30	0.24	-0.04	0.77	0.33	-0.52	0.26	-0.15	0.12	-0.36	0.65	-0.48
Quartz	0.27	0.74	0.60	0.69	-0.85	0.91	0.42	0.86	0.05	0.59	0.39	0.90	0.64	-0.72	-0.34	0.27	0.67	-0.64	0.92	0.02
Rutile	0.36	0.83	0.65	0.61	-0.88	0.87	0.50	0.84	0.16	0.65	0.49	0.87	0.68	-0.71	-0.48	0.38	0.78	-0.69	0.91	0.16
Siderite	0.73	0.72	0.79	0.37	-0.37	0.48	0.82	0.54	0.65	0.76	0.80	0.43	0.73	-0.19	-0.87	0.76	0.81	-0.23	0.61	0.57

Witbank No. 4 Seam Correlation Matrix

	ash	Kaolinite	Dolomite	Quartz	Siderite	Calcite	Pyrite	Ag	As	B	Ba	Be	Bi	Cd	Ce	Co	Cr	Cs	Cu	Ga	Ge	Hf	Hg	Ho	In	Ir	La	Li	Mn	Mo	Nb	Nd	Ni	Pb	Rb	Sb	Sc	Se	Sn	Sr	Te	Th	Tl	U	V	W	Y	Zn	Zr	F
ash	1.00																																																	
Kaolinite	0.96	1.00																																																
Dolomite	0.95	0.89	1.00																																															
Quartz	0.92	0.98	0.81	1.00																																														
Siderite	0.93	0.80	0.94	0.71	1.00																																													
Calcite	0.90	0.76	0.94	0.66	0.99	1.00																																												
Pyrite	0.84	0.67	0.88	0.56	0.98	0.98	1.00																																											
Ag	-0.02	0.14	-0.04	0.27	-0.31	-0.28	-0.44	1.00																																										
As	0.70	0.50	0.75	0.37	0.91	0.91	0.97	-0.61	1.00																																									
B	0.44	0.32	0.40	0.31	0.49	0.53	0.44	-0.15	0.40	1.00																																								
Ba	-0.30	-0.49	-0.14	-0.62	0.05	0.07	0.24	-0.79	0.43	-0.12	1.00																																							
Be	0.45	0.47	0.54	0.43	0.40	0.37	0.38	0.23	0.29	-0.49	-0.03	1.00																																						
Bi	-0.86	-0.86	-0.94	-0.76	-0.81	-0.83	-0.78	-0.05	-0.62	-0.26	0.21	-0.52	1.00																																					
Cd	0.71	0.53	0.70	0.47	0.85	0.81	0.85	-0.38	0.87	0.26	0.27	0.51	-0.47	1.00																																				
Ce	-0.67	-0.70	-0.45	-0.79	-0.46	-0.42	-0.31	-0.35	-0.18	-0.40	0.75	-0.07	0.39	-0.31	1.00																																			
Co	-0.40	-0.62	-0.35	-0.69	-0.07	-0.06	0.10	-0.70	0.33	-0.05	0.87	-0.20	0.48	0.28	0.50	1.00																																		
Cr	0.38	0.13	0.44	0.03	0.66	0.66	0.76	-0.64	0.87	0.18	0.66	0.32	-0.23	0.88	0.06	0.67	1.00																																	
Cs	0.89	0.75	0.94	0.65	0.99	0.99	0.99	-0.32	0.92	0.49	0.13	0.41	-0.82	0.85	-0.36	-0.02	0.69	1.00																																
Cu	-0.27	-0.46	-0.13	-0.59	0.08	0.09	0.27	-0.84	0.47	-0.13	0.99	-0.03	0.21	0.32	0.67	0.90	0.70	0.15	1.00																															
Ga	0.17	-0.10	0.19	-0.17	0.48	0.47	0.59	-0.72	0.76	0.20	0.72	0.08	0.02	0.76	0.12	0.83	0.96	0.50	0.78	1.00																														
Ge	-0.56	-0.75	-0.57	-0.75	-0.29	-0.29	-0.16	-0.52	0.08	-0.12	0.70	-0.31	0.70	0.12	0.43	0.95	0.48	-0.27	0.73	0.69	1.00																													
Hf	0.38	0.15	0.28	0.14	0.57	0.52	0.59	-0.56	0.71	0.31	0.39	0.10	0.00	0.85	-0.25	0.60	0.86	0.55	0.46	0.89	0.53	1.00																												
Hg	0.74	0.54	0.80	0.42	0.93	0.94	0.98	-0.51	0.99	0.39	0.38	0.39	-0.66	0.90	-0.19	0.27	0.87	0.95	0.42	0.73	0.02	0.69	1.00																											
Ho	0.14	0.26	0.07	0.33	-0.04	-0.09	-0.20	0.24	-0.31	0.40	-0.43	-0.25	0.05	-0.18	-0.15	-0.52	-0.43	-0.06	-0.49	-0.46	-0.45	-0.20	-0.27	1.00																										
In	-0.22	-0.47	-0.14	-0.53	0.11	0.15	0.27	-0.57	0.47	-0.01	0.80	0.00	0.28	0.47	0.36	0.95	0.80	0.17	0.83	0.90	0.87	0.68	0.45	-0.63	1.00																									
Ir	0.34	0.23	0.14	0.30	0.33	0.26	0.29	-0.04	0.34	-0.03	-0.11	0.30	0.04	0.64	-0.58	0.25	0.50	0.26	-0.01	0.52	0.33	0.76	0.34	-0.33	0.39	1.00																								
La	-0.67	-0.70	-0.45	-0.79	-0.46	-0.42	-0.31	-0.34	-0.18	-0.42	0.74	-0.05	0.38	-0.32	1.00	0.50	0.05	-0.37	0.67	0.11	0.42	-0.26	-0.19	-0.18	0.36	-0.58	1.00																							
Li	0.96	0.88	0.98	0.81	0.95	0.96	0.89	-0.02	0.77	0.48	-0.18	0.46	-0.92	0.71	-0.55	-0.32	0.45	0.94	-0.16	0.23	-0.52	0.33	0.82	0.00	-0.09	0.23	-0.55	1.00																						
Mn	0.90	0.76	0.94	0.66	0.99	0.99	0.99	-0.32	0.93	0.44	0.11	0.43	-0.84	0.83	-0.39	-0.04	0.68	0.99	0.14	0.49	-0.28	0.53	0.95	-0.14	0.16	0.29	-0.39	0.95	1.00																					
Mo	0.50	0.26	0.59	0.14	0.78	0.79	0.87	-0.63	0.95	0.32	0.61	0.29	-0.42	0.88	0.00	0.55	0.97	0.81	0.64	0.89	0.32	0.78	0.95	-0.40	0.70	0.38	0.00	0.61	0.80	1.00																				
Nb	0.47	0.23	0.40	0.20	0.67	0.63	0.70	-0.55	0.80	0.35	0.39	0.15	-0.14	0.89	-0.28	0.57	0.90	0.65	0.46	0.91	0.47	0.99	0.78	-0.29	0.68	0.74	-0.29	0.45	0.64	0.86	1.00																			
Nd	-0.69	-0.72	-0.46	-0.81	-0.47	-0.42	-0.31	-0.34	-0.18	-0.43	0.75	-0.06	0.39	-0.32	1.00	0.52	0.07	-0.37	0.68	0.13	0.45	-0.25	-0.19	-0.21	0.39	-0.56	1.00	-0.55	-0.40	0.01	-0.28	1.00																		
Ni	0.00	-0.27	0.07	-0.37	0.35	0.37	0.50	-0.75	0.69	0.16	0.84	-0.02	0.08	0.60	0.30	0.91	0.90	0.40	0.88	0.97	0.76	0.76	0.65	-0.54	0.95	0.34	0.30	0.11	0.39	0.85	0.78	0.32	1.00																	
Pb	0.83	0.66	0.85	0.57	0.97	0.95	0.98	-0.43	0.97	0.40	0.23	0.42	-0.69	0.94	-0.36	0.16	0.82	0.97	0.27	0.67	-0.06	0.72	0.98	-0.20	0.34	0.46	-0.37	0.86	0.97	0.89	0.81	-0.37	0.55	1.00																
Rb	0.38	0.24	0.56	0.07	0.63	0.63	0.73	-0.71	0.77	0.17	0.69	0.27	-0.47	0.57	0.38	0.34	0.69	0.69	0.67	0.57	0.05	0.37	0.77	-0.09	0.37	-0.19	0.38	0.47	0.66	0.76	0.43	0.36	0.59	0.67	1.00															
Sb	0.50	0.25	0.51	0.15	0.75	0.75	0.84	-0.64	0.93	0.35	0.52	0.18	-0.34	0.86	-0.16	0.58	0.95	0.76	0.58	0.92	0.39	0.86	0.91	-0.46	0.72	0.54	-0.16	0.56	0.77	0.96	0.93	-0.15	0.85	0.88	0.61	1.00														
Sc	0.98	0.90	0.97	0.83	0.97	0.95	0.92	-0.11	0.80	0.38	-0.14	0.53	-0.88	0.80	-0.56	-0.26	0.53	0.95	-0.10	0.31	-0.46	0.45	0.85	-0.01	-0.05	0.35	-0.56	0.98	0.96	0.65	0.55	-0.57	0.16	0.91	0.50	0.62	1.00													
Se	0.46	0.24	0.58	0.10	0.74	0.76	0.85	-0.66	0.93	0.22	0.68	0.36	-0.43	0.84	0.14	0.54	0.95	0.79	0.70	0.86	0.29	0.71	0.93	-0.37	0.67	0.26	0.14	0.57	0.78	0.98	0.78	0.14	0.83	0.86	0.86	0.90	0.62	1.00												
Sn	0.76	0.62	0.64	0.60	0.81	0.73	0.77	-0.38	0.77	0.24	0.07	0.41	-0.41	0.93	-0.51	0.15	0.73	0.76	0.16	0.64	0.04	0.85	0.78	-0.08	0.28	0.75	-0.52	0.65	0.76	0.71	0.87	-0.53	0.44	0.87	0.41	0.77	0.78	0.66	1.00											
Sr	-0.54	-0.60	-0.30	-0.74	-0.29	-0.23	-0.11	-0.44	0.02	-0.36	0.82	-0.01	0.20	-0.21	0.96	0.54	0.19	-0.19	0.76	0.22	0.40	-0.21	0.00	-0.36	0.44	-0.56	0.96	-0.38	-0.20	0.17	-0.20	0.96	0.42	-0.19	0.51	0.02	-0.40	0.30	-0.44	1.00										
Te	0.05	-0.18	0.26	-0.28	0.33	0.44	0.47	-0.24	0.55	0.25	0.59	0.13	-0.21	0.41	0.31	0.55	0.65	0.42	0.56	0.62	0.38	0.32	0.58	-0.52	0.72	0.00	0.31	0.31	0.42	0.70	0.42	0.34	0.72	0.44	0.48	0.61	0.22	0.69	0.08	0.46	1.00									
Th	-0.67	-0.66	-0.43	-0.77	-0.48	-0.42	-0.32	-0.30	-0.21	-0.43	0.68	-0.08	0.30	-0.42	0.97	0.40	-0.05	-0.38	0.61	0.00	0.32	-0.40	-0.23	-0.22	0.27	-0.68	0.98	-0.52	-0.39	-0.07	-0.41	0.98	0.21	-0.41	0.34	-0.22	-0.56	0.07	-0.61	0.97	0.29	1.00								
Tl	0.82	0.65	0.86	0.53	0.97	0.97	1.00	-0.47	0.98	0.45	0.27	0.36	-0.74	0.87	-0.29	0.15	0.79	0.98	0.30	0.63	-0.11	0.64	0.99	-0.19	0.31	0.32	-0.30	0.87	0.98	0.89	0.74	-0.30	0.54	0.99	0.74	0.86	0.90	0.87	0.79	-0.10	0.48	-0.32	1.00							
U	-0.35	-0.57	-0.35	-0.59	-0.05	-0.05	0.08	-0.62	0.31	-0.02	0.75	-0.18	0.53	0.36	0.35	0.97	0.68	-0.02	0.79	0.85	0.97	0.71	0.26	-0.45	0.94	0.43	0.34	-0.30	-0.04	0.54	0.66	0.36	0.88	0.18	0.23	0.59	-0.22	0.50	0.27	0.35	0.47	0.22	0.14	1.00						
V	-0.05	-0.29	-0.04	-0.37	0.27	0.25	0.41	-0.82	0.62	0.06	0.82	-0.06	0.22	0.58	0.27	0.92	0.86	0.29	0.87	0.96	0.82	0.81	0.55	-0.49	0.91	0.44	0.26	-0.01	0.29	0.77	0.80	0.28	0.96	0.48	0.51	0.81	0.09	0.74	0.50	0.35	0.50	0.16	0.46	0.92	1.00					
W	0.40	0.20	0.55	0.11	0.62	0.64	0.69	-0.33	0.73	0.10	0.55	0.57	-0.35	0.83	0.18	0.43	0.87	0.69	0.53	0.73	0.22	0.62	0.80	-0.22	0.61	0.27	0.18	0.52	0.65	0.85	0.67	0.18	0.67	0.73	0.72	0.71	0.55	0.89	0.58	0.26	0.70	0.07	0.70	0.43	0.56	1.00				
Y	-0.76	-0.83	-0.57	-0.91	-0.51	-0.46	-0.33	-0.40	-0.16	-0.40	0.81	-0.15	0.53	-0.27	0.96	0.69	0.15	-0.42	0.76	0.27	0.64	-0.11	-0.19	-0.33	0.56	-0.40	0.96	-0.62	-0.44	0.07	-0.15	0.97	0.46	-0.36	0.28	-0.04	-0.63	0.17	-0.47	0.93	0.40	0.92	-0.31	0.55	0.43	0.18	1.00			
Zn	0.92	0.83	0.87	0.78	0.93	0.88	0.88	-0.22	0.81	0.22	-0.05	0.60	-0.74	0.88	-0.55	-0.11	0.63	0.90	0.01	0.44	-0.28	0.60	0.84	-0.11	0.08	0.55	-0.55	0.87	0.91	0.69	0.68	-0.55	0.26	0.93	0.48	0.69	0.95	0.66	0.91	-0.41	0.14	-0.58	0.88	-0.05	0.25	0.58	-0.58	1.00		
Zr	0.01	-0.22	-0.06	-0.23	0.26	0.22	0.33	-0.61	0.51	0.19	0.55	-0.10	0.32	0.63	-0.01	0.83	0.79	0.25	0.62	0.92	0.81	0.93	0.47	-0.33	0.84	0.68	-0.03	0.00	0.23	0.67	0.89	-0.01	0.85	0.46	0.25	0.77	0.10	0.59	0.60	0.01	0.38	-0.16	0.38	0.91	0.92	0.50	0.19	0.28	1.00	
F	0.83	0.94	0.79	0.91	0.64	0.60	0.53	0.19	0.34	0.12	-0.52	0.48	-0.86	0.29	-0.58	-0.74	-0.08	0.59	-0.50	-0.31	-0.86	-0.11	0.36	0.22	-0.63	0.03	-0.57	0.75	0.62	0.07	-0.03	-0.59	-0.44	0.47	0.20	0.04	0.77	0.08	0.41	-0.47	-0.32	-0.49	0.49	-0.73	-0.45	0.01	-0.74	0.69	-0.46	1.00

Waterberg Upper Ecca Correlation Matrix

	Calcite	*Dolomite*	*Graphite*	*Kaolinite*	*Muscovite*	*Pyrite*	*Quartz*	*Rutile*	*Siderite*	*Ag*	*As*	*B*	*Ba*	*Be*	*Bi*	*Cd*	*Ce*	*Co*	*Cr*	*Cs*	*Cu*	*Ga*	*Ge*	*Hg*	*La*	*Li*	*Mn*	*Mo*	*Nb*	*Nd*	*Ni*	*Pb*	*Rb*	*Sb*	*Sc*	*Se*	*Sn*	*Sr*	*Te*	*Th*	*Tl*	*U*	*V*	*W*	*Y*	*Zn*	*Zr*	*F*	*Cl*
Calcite	1.00
Dolomite	0.87	1.00
Graphite	-0.52	-0.43	1.00
Kaolinite	0.43	0.33	-0.99	1.00
Muscovite	0.55	0.39	-0.99	0.98	1.00
Pyrite	-0.06	-0.26	-0.73	0.80	0.75	1.00
Quartz	0.41	0.33	-0.99	1.00	0.98	0.80	1.00
Rutile	0.52	0.43	-0.99	0.98	0.98	0.70	0.98	1.00
Siderite	0.82	0.96	-0.55	0.46	0.51	-0.13	0.45	0.54	1.00
Ag	-0.07	-0.16	0.67	-0.68	-0.62	-0.48	-0.72	-0.75	-0.22	1.00
As	0.39	0.25	-0.92	0.92	0.95	0.81	0.93	0.89	0.40	-0.52	1.00
B	-0.79	-0.74	0.83	-0.76	-0.84	-0.32	-0.78	-0.85	-0.76	0.58	-0.75	1.00
Ba	0.94	0.76	-0.44	0.35	0.50	-0.05	0.33	0.42	0.75	0.12	0.44	-0.72	1.00
Be	0.88	0.82	-0.64	0.56	0.66	0.10	0.54	0.60	0.89	-0.09	0.62	-0.82	0.93	1.00
Bi	0.63	0.51	-0.94	0.91	0.96	0.61	0.91	0.92	0.63	-0.54	0.95	-0.91	0.64	0.80	1.00
Cd	0.92	0.95	-0.61	0.52	0.60	-0.05	0.51	0.61	0.97	-0.24	0.48	-0.87	0.86	0.94	0.72	1.00
Ce	0.92	0.72	-0.34	0.26	0.41	-0.12	0.22	0.31	0.70	0.23	0.35	-0.64	0.99	0.89	0.55	0.81	1.00
Co	0.76	0.60	-0.73	0.68	0.77	0.38	0.66	0.67	0.70	-0.09	0.80	-0.79	0.86	0.94	0.88	0.78	0.81	1.00
Cr	0.89	0.75	-0.15	0.05	0.21	-0.40	0.02	0.16	0.67	0.18	0.08	-0.57	0.91	0.75	0.35	0.78	0.92	0.58	1.00
Cs	0.91	0.74	-0.51	0.43	0.57	0.04	0.40	0.48	0.76	0.07	0.53	-0.76	0.99	0.96	0.71	0.86	0.98	0.91	0.86	1.00
Cu	0.11	0.26	-0.63	0.61	0.60	0.50	0.64	0.57	0.44	-0.36	0.77	-0.53	0.24	0.53	0.71	0.40	0.15	0.64	-0.10	0.33	1.00
Ga	0.31	-0.10	-0.28	0.29	0.39	0.46	0.24	0.20	-0.03	0.39	0.49	-0.15	0.52	0.41	0.40	0.10	0.55	0.63	0.27	0.55	0.18	1.00
Ge	-0.46	-0.48	0.95	-0.92	-0.92	-0.62	-0.94	-0.95	-0.61	0.75	-0.90	0.87	-0.41	-0.65	-0.94	-0.65	-0.29	-0.70	-0.14	-0.48	-0.77	-0.10	1.00
Hg	0.80	0.56	-0.60	0.55	0.67	0.29	0.52	0.55	0.62	0.07	0.69	-0.71	0.92	0.91	0.78	0.74	0.90	0.97	0.69	0.95	0.45	0.74	-0.54	1.00
La	0.94	0.75	-0.39	0.30	0.45	-0.09	0.27	0.36	0.73	0.18	0.38	-0.67	1.00	0.91	0.58	0.84	1.00	0.83	0.92	0.98	0.17	0.53	-0.34	0.91	1.00
Li	-0.38	-0.37	-0.38	0.45	0.38	0.75	0.46	0.30	-0.19	-0.11	0.60	0.02	-0.22	0.00	0.35	-0.23	-0.27	0.28	-0.60	-0.13	0.72	0.38	-0.38	0.15	-0.26	1.00
Mn	0.89	0.92	-0.64	0.55	0.64	0.00	0.55	0.64	0.96	-0.26	0.55	-0.89	0.86	0.96	0.77	0.99	0.81	0.83	0.75	0.88	0.49	0.15	-0.70	0.77	0.83	-0.14	1.00
Mo	-0.20	-0.34	0.79	-0.79	-0.73	-0.51	-0.83	-0.84	-0.42	0.96	-0.66	0.71	-0.04	-0.30	-0.69	-0.43	0.08	-0.30	0.10	-0.11	-0.57	0.31	0.89	-0.11	0.03	-0.23	-0.45	1.00
Nb	-0.80	-0.89	0.37	-0.26	-0.35	0.33	-0.28	-0.42	-0.83	0.36	-0.18	0.78	-0.68	-0.69	-0.48	-0.87	-0.63	-0.45	-0.79	-0.65	-0.13	0.24	0.47	-0.43	-0.66	0.57	-0.85	0.44	1.00
Nd	0.93	0.75	-0.39	0.30	0.45	-0.09	0.27	0.36	0.73	0.18	0.38	-0.67	1.00	0.91	0.58	0.84	1.00	0.83	0.92	0.98	0.18	0.53	-0.34	0.91	1.00	-0.26	0.83	0.03	-0.66	1.00
Ni	0.72	0.73	-0.78	0.73	0.74	0.24	0.74	0.83	0.72	-0.71	0.53	-0.86	0.50	0.60	0.71	0.78	0.41	0.49	0.44	0.50	0.23	-0.15	-0.76	0.40	0.46	-0.23	0.75	-0.77	-0.77	0.46	1.00
Pb	0.85	0.72	-0.68	0.61	0.73	0.23	0.60	0.65	0.79	-0.11	0.72	-0.85	0.93	0.98	0.86	0.88	0.88	0.98	0.72	0.96	0.56	0.53	-0.68	0.96	0.90	0.09	0.91	-0.31	-0.62	0.90	0.57	1.00
Rb	0.08	0.19	-0.66	0.66	0.65	0.59	0.69	0.61	0.37	-0.41	0.82	-0.53	0.21	0.49	0.74	0.35	0.11	0.63	-0.15	0.30	0.99	0.22	-0.79	0.45	0.14	0.77	0.44	-0.60	-0.07	0.14	0.23	0.54	1.00
Sb	-0.25	-0.30	0.82	-0.82	-0.78	-0.56	-0.85	-0.88	-0.37	0.97	-0.68	0.74	-0.10	-0.31	-0.73	-0.42	0.02	-0.33	0.03	-0.16	-0.48	0.21	0.88	-0.16	-0.03	-0.17	-0.44	0.98	0.45	-0.03	-0.80	-0.34	-0.52	1.00
Sc	0.42	0.32	-0.91	0.90	0.93	0.75	0.91	0.87	0.48	-0.47	0.99	-0.76	0.49	0.69	0.96	0.54	0.40	0.85	0.12	0.58	0.83	0.48	-0.91	0.72	0.43	0.61	0.61	-0.64	-0.22	0.43	0.52	0.76	0.86	-0.65	1.00
Se	0.93	0.79	-0.53	0.45	0.58	0.01	0.42	0.50	0.82	0.03	0.53	-0.78	0.99	0.98	0.72	0.91	0.96	0.91	0.86	1.00	0.37	0.48	-0.52	0.93	0.97	-0.13	0.92	-0.16	-0.70	0.97	0.55	0.97	0.33	-0.19	0.58	1.00
Sn	0.54	0.40	-0.88	0.86	0.91	0.67	0.86	0.84	0.54	-0.37	0.97	-0.79	0.62	0.78	0.97	0.62	0.54	0.92	0.27	0.70	0.79	0.56	-0.87	0.83	0.57	0.52	0.69	-0.55	-0.29	0.57	0.52	0.85	0.81	-0.57	0.99	0.70	1.00
Sr	0.90	0.71	-0.17	0.08	0.24	-0.30	0.05	0.16	0.65	0.30	0.15	-0.54	0.95	0.79	0.38	0.75	0.97	0.66	0.98	0.91	-0.04	0.44	-0.13	0.79	0.97	-0.47	0.74	0.19	-0.67	0.97	0.36	0.77	-0.09	0.12	0.19	0.90	0.35	1.00
Te	0.88	0.70	-0.68	0.62	0.74	0.24	0.59	0.65	0.76	-0.10	0.70	-0.83	0.95	0.97	0.85	0.86	0.90	0.97	0.74	0.97	0.48	0.57	-0.65	0.97	0.92	0.04	0.89	-0.28	-0.61	0.92	0.58	0.99	0.46	-0.33	0.74	0.97	0.84	0.80	1.00
Th	0.98	0.82	-0.50	0.42	0.55	-0.04	0.39	0.49	0.80	0.03	0.44	-0.77	0.99	0.93	0.66	0.90	0.97	0.83	0.91	0.97	0.20	0.44	-0.45	0.89	0.98	-0.28	0.89	-0.13	-0.74	0.98	0.61	0.91	0.16	-0.18	0.48	0.98	0.61	0.93	0.93	1.00
Tl	0.38	0.28	-0.90	0.90	0.92	0.77	0.90	0.87	0.43	-0.51	0.99	-0.76	0.45	0.64	0.95	0.50	0.35	0.81	0.09	0.54	0.83	0.45	-0.91	0.69	0.38	0.62	0.58	-0.67	-0.21	0.39	0.51	0.73	0.87	-0.68	1.00	0.54	0.97	0.15	0.71	0.44	1.00
U	0.83	0.65	-0.72	0.66	0.78	0.33	0.64	0.68	0.73	-0.11	0.76	-0.83	0.91	0.96	0.88	0.83	0.87	0.99	0.67	0.95	0.54	0.61	-0.69	0.98	0.88	0.15	0.86	-0.30	-0.54	0.88	0.56	0.99	0.53	-0.34	0.80	0.95	0.89	0.74	0.99	0.90	0.77	1.00
V	0.05	-0.11	0.65	-0.67	-0.58	-0.52	-0.72	-0.71	-0.19	0.98	-0.51	0.49	0.23	-0.02	-0.50	-0.17	0.34	-0.05	0.33	0.17	-0.45	0.44	0.74	0.15	0.30	-0.25	-0.19	0.96	0.25	0.30	-0.63	-0.04	-0.49	0.94	-0.48	0.12	-0.35	0.43	-0.01	0.14	-0.51	-0.04	1.00
W	-0.85	-0.92	0.44	-0.33	-0.43	0.26	-0.34	-0.48	-0.87	0.34	-0.27	0.82	-0.75	-0.77	-0.56	-0.92	-0.70	-0.56	-0.81	-0.73	-0.20	0.14	0.53	-0.53	-0.73	0.50	-0.90	0.44	0.99	-0.73	-0.78	-0.71	-0.15	0.45	-0.32	-0.78	-0.39	-0.72	-0.70	-0.80	-0.30	-0.64	0.23	1.00
Y	0.97	0.80	-0.39	0.29	0.44	-0.15	0.27	0.38	0.76	0.10	0.32	-0.70	0.98	0.88	0.56	0.87	0.98	0.76	0.96	0.95	0.08	0.41	-0.34	0.84	0.98	-0.40	0.85	-0.03	-0.75	0.98	0.56	0.86	0.04	-0.09	0.36	0.95	0.50	0.97	0.88	0.99	0.32	0.83	0.23	-0.80	1.00
Zn	0.80	0.83	-0.73	0.66	0.71	0.12	0.67	0.78	0.81	-0.62	0.53	-0.93	0.64	0.72	0.74	0.88	0.55	0.59	0.60	0.64	0.30	-0.11	-0.76	0.52	0.60	-0.28	0.86	-0.71	-0.88	0.60	0.97	0.70	0.29	-0.74	0.54	0.68	0.56	0.51	0.69	0.73	0.53	0.66	-0.53	-0.90	0.68	1.00
Zr	-0.11	-0.20	0.60	-0.60	-0.55	-0.36	-0.64	-0.69	-0.23	0.99	-0.41	0.57	0.10	-0.06	-0.47	-0.26	0.20	-0.03	0.10	0.07	-0.22	0.46	0.68	0.12	0.16	0.06	-0.26	0.92	0.44	0.16	-0.74	-0.08	-0.26	0.94	-0.36	0.03	-0.27	0.24	-0.07	0.00	-0.40	-0.07	0.94	0.40	0.05	-0.66	1.00
F	0.56	0.48	-0.94	0.91	0.95	0.65	0.92	0.91	0.61	-0.55	0.97	-0.88	0.58	0.77	0.99	0.68	0.48	0.87	0.27	0.65	0.79	0.37	-0.96	0.74	0.52	0.44	0.74	-0.72	-0.42	0.52	0.67	0.83	0.81	-0.73	0.98	0.67	0.97	0.30	0.80	0.59	0.97	0.84	-0.53	-0.51	0.48	0.70	-0.47	1.00
Cl	0.59	0.73	-0.09	0.01	0.03	-0.48	0.02	0.16	0.57	-0.25	-0.24	-0.39	0.32	0.27	0.03	0.57	0.31	-0.02	0.56	0.25	-0.36	-0.51	-0.09	-0.01	0.34	-0.79	0.48	-0.24	-0.78	0.33	0.68	0.16	-0.40	-0.24	-0.23	0.30	-0.19	0.43	0.17	0.44	-0.24	0.09	-0.17	-0.73	0.49	0.68	-0.38	-0.03	1

Table XIV: Proximate Analysis Waterberg Upper Ecca

%	%	%	%	%	%	%	%	%	MJ/kg	MJ/kg	%	%	MJ/kg
Yield	Cum		Cum		Cum		Cum			Cum		Cum	
	Yield	IM	IM	VOL	VOL	ASH	ASH	FC	CV	CV	S	S	CVScorr
2.3	2.3	4.6	4.6	32.6	32.6	13.2	13.2	49.63	26.85	26.85	0.85	0.85	26.77
1.4	3.7	4.6	4.6	30.5	31.8	15.6	14.1	49.53	25.71	26.41	0.70	0.79	25.64
6.0	9.7	4.4	4.4	28.8	29.9	22.1	19.0	44.93	23.34	24.52	0.70	0.74	23.27
21.8	31.5	4.1	4.2	25.5	26.8	26.4	24.1	44.18	21.51	22.44	0.55	0.61	21.45
22.7	54.2	3.6	3.9	20.5	24.2	42.6	31.9	33.60	16.08	19.78	0.42	0.53	16.04
8.9	63.0	2.9	3.8	17.0	23.2	55.2	35.1	25.18	11.57	18.62	0.33	0.50	11.53
37.0	100.0	2.2	3.2	14.5	20.0	68.7	47.6	14.95	6.20	14.03	2.29	1.16	5.98
100.0													

Table XV: Waterberg Borehole Analysis

BH	Seam	Yield%	RD	Ash%	CV (MJ/kg)	S	IM	Vol	FC
		% (adb)		% (adb)	% (adb)	% (adb)		% (adb)	
WBG0532	PUE								
WBG0532	PUE	12.71	1.71	9.06	27.57	0.83	5.4	35.18	50.35
WBG0532	PUE	32.71	1.71	12.46	26.78	0.91	4.83	35.71	47

WBG0532	PUE	53.29	1.71	15.5	25.77	1.02	4.58	35.41	44.52
WBG0532	PUE	63.76	1.71	17.3	24.89	1.06	4.48	34.83	43.39
WBG0532	PUE	66.66	1.71	18.14	24.47	1.05	4.44	34.69	42.73
WBG0532	PUE	69.4	1.71	19.3	24	1.16	4.37	34.46	41.86
WBG0532	PUE	100	1.71	36.99	17.57	2.79	3.58	27.82	31.61
WBG0532	PUP								
WBG0532	PUP	100	2.32	88.04	1.27	0.06	2.04	9.49	0.43
WBG0532	PUD								
WBG0532	PUD	7.16	1.89	5.81	29.04	0.97	4.8	36.61	52.79
WBG0532	PUD	19.61	1.89	11.29	27.33	1	4.37	35.51	48.85
WBG0532	PUD	26.54	1.89	14.46	26.3	1.01	4.2	34.63	46.72
WBG0532	PUD	40.22	1.89	21.29	23.91	1.04	4.03	32.13	42.56
WBG0532	PUD	40.8	1.89	21.64	23.8	1.04	4.01	31.99	42.36
WBG0532	PUD	42.27	1.89	22.8	23.4	1.05	3.95	31.55	41.7
WBG0532	PUD	100	1.89	51.06	13.43	1.09	2.77	20.89	25.27
WBG0532	PUC								
WBG0532	PUC	3.8	1.75	6.26	29.25	0.83	4.78	35.98	52.99
WBG0532	PUC	14.23	1.75	8.94	28.54	0.83	4.61	35.83	50.63
WBG0532	PUC	31.69	1.75	12.99	27.11	0.85	4.38	34.63	48
WBG0532	PUC	60.26	1.75	22.88	23.67	0.83	3.89	31.35	41.89
WBG0532	PUC	76.71	1.75	29.53	21.26	0.86	3.56	28.97	37.95
WBG0532	PUC	80.71	1.75	31.05	20.7	0.88	3.49	28.43	37.03
WBG0532	PUC	99.99	1.75	39.89	17.4	1.25	3.13	25.21	31.78
WBG0532	PUB								
WBG0532	PUB	6.71	1.94	5.53	29.34	0.82	4.94	35.61	53.92
WBG0532	PUB	14.19	1.94	8.94	28.5	0.9	4.55	35.55	50.96
WBG0532	PUB	26.39	1.94	13.96	26.71	1.03	4.22	34.55	47.27
WBG0532	PUB	36.37	1.94	18.85	25.07	1.15	3.97	33.05	44.13
WBG0532	PUB	38.87	1.94	20.4	24.54	1.18	3.9	32.52	43.18

WBG0532	PUB	42.47	1.94	22.7	23.72	1.24	3.79	31.78	41.74
WBG0532	PUB	99.99	1.94	55.64	12.46	1.67	2.48	19.51	22.37
WBG0532	PUP								
WBG0532	PUP	100	2.28	85.03	2.1	0.18	2.05	8.69	4.23
WBG0532	PUA								
WBG0532	PUA	5.27	1.84	6.67	28.66	0.71	5.86	34.99	52.48
WBG0532	PUA	15.33	1.84	9.88	27.74	0.85	5.37	34.92	49.83
WBG0532	PUA	35.99	1.84	15.59	26	0.99	4.94	34.11	45.37
WBG0532	PUA	48	1.84	19.23	24.69	1.14	4.72	33.21	42.84
WBG0532	PUA	52.06	1.84	20.47	24.3	1.19	4.6	32.83	42.1
WBG0532	PUA	54.87	1.84	21.88	23.82	1.24	4.49	32.38	41.25
WBG0532	PUA	99.99	1.84	47.39	14.75	2.02	3.07	22.89	26.66
WBG0532	PMP								
WBG0532	PMP	100	2.3	86.52	1.38	0.35	2.25	10.5	0.73
WBG0532	PMD								
WBG0532	PMD	7.17	2.01	6.89	28.96	0.91	5.21	36.02	51.88
WBG0532	PMD	11.94	2.01	10.09	28.02	0.95	4.85	35.67	49.4
WBG0532	PMD	18.49	2.01	14.09	26.69	0.97	4.51	34.89	46.51
WBG0532	PMD	26.82	2.01	20.58	24.36	1	4.21	32.79	42.42
WBG0532	PMD	27.82	2.01	21.29	24.15	1.01	4.18	32.55	41.97
WBG0532	PMD	30.63	2.01	23.83	23.23	1.06	4.06	31.88	40.23
WBG0532	PMD	100.01	2.01	61.26	9.97	0.65	2.57	18.14	18.04
WBG0532	PMC								
WBG0532	PMC	0.7	2.02	9	28.2	0.64	5.09	34.18	51.73
WBG0532	PMC	2.75	2.02	10.01	27.8	0.65	4.87	33.9	51.22
WBG0532	PMC	9.34	2.02	15.52	25.95	0.66	4.15	34.04	46.29
WBG0532	PMC	18.02	2.02	21.28	23.99	0.63	3.72	32.61	42.4
WBG0532	PMC	18.71	2.02	21.93	23.76	0.63	3.69	32.39	41.99
WBG0532	PMC	19.43	2.02	22.68	23.48	0.64	3.66	32.13	41.54

WBG0532	PMC	100	2.02	62.83	8.49	0.55	2.1	17.42	17.67
WBG0532	PMC								
WBG0532	PMC	1.36	1.91	6.94	28.74	0.84	5.43	34.84	52.78
WBG0532	PMC	5.92	1.91	8.45	28.26	0.84	5.05	35.2	51.3
WBG0532	PMC	16.93	1.91	14.67	26.13	0.85	4.48	34.48	46.38
WBG0532	PMC	34.24	1.91	22.22	23.45	0.81	4.2	31.85	41.73
WBG0532	PMC	44.24	1.91	28.45	21.27	0.78	3.88	29.52	38.15
WBG0532	PMC	51.02	1.91	31.78	20.12	0.76	3.71	28.16	36.36
WBG0532	PMC	100	1.91	52.55	12.53	0.77	2.79	20.2	24.47
WBG0532	PMB								
WBG0532	PMB	4.06	2.08	14.44	25.96	0.69	4.34	35.03	46.19
WBG0532	PMB	10.86	2.08	19.59	24.38	0.77	4.22	32.48	43.7
WBG0532	PMB	18.56	2.08	25.03	22.42	0.69	4.09	30.51	40.38
WBG0532	PMB	24.38	2.08	31.48	20.02	0.65	3.73	28.67	36.12
WBG0532	PMB	100	2.08	67.94	6.7	0.42	2.17	16.38	13.5
WBG0532	PMA								
WBG0532	PMA	1.87	2.07	8.39	28.36	0.78	4.7	34.66	52.26
WBG0532	PMA	3.56	2.07	10.61	27.64	0.78	4.5	34.78	50.12
WBG0532	PMA	7.76	2.07	15.7	26	0.76	4.2	34.1	46.01
WBG0532	PMA	14.15	2.07	20.46	24.28	0.71	3.91	32.39	43.24
WBG0532	PMA	19.11	2.07	23.03	23.32	0.69	3.79	31.74	41.45
WBG0532	PMA	20.82	2.07	24.6	22.76	0.68	3.71	31.15	40.53
WBG0532	PMA	100.01	2.07	67.3	7.53	0.32	1.87	15.68	15.15
WBG0532	PMA								
WBG0532	PMA	1.89	1.99	8.85	28.22	0.78	4.79	34.7	51.67
WBG0532	PMA	6.18	1.99	9.84	27.96	0.95	4.57	34.97	50.61
WBG0532	PMA	13.81	1.99	13.03	26.85	0.69	4.22	34.83	47.93
WBG0532	PMA	22.46	1.99	18.04	25	0.76	3.98	33.12	44.86
WBG0532	PMA	23.07	1.99	18.58	24.8	0.76	3.96	32.96	44.51

WBG0532	PMA	25.81	1.99	21.62	23.7	0.84	3.81	32.06	42.51
WBG0532	PMA	100	1.99	60.21	9.32	1.06	2.1	18.87	18.81
WBG0532	PLP								
WBG0532	PLP	100	2.18	76.47	3.45	0.18	2.07	13.89	7.57
WBG0532	PLC								
WBG0532	PLC	3.6	1.96	14.79	26.21	0.99	4.73	34.09	46.39
WBG0532	PLC	5.42	1.96	14.88	26.03	0.92	4.61	33.79	46.72
WBG0532	PLC	13.21	1.96	20.98	23.93	0.81	4.26	31.74	43.02
WBG0532	PLC	22.45	1.96	23.14	22.83	0.77	4.1	31.07	41.69
WBG0532	PLC	31.81	1.96	29.53	20.8	0.71	3.77	28.67	38.04
WBG0532	PLC	42.64	1.96	36.23	18.53	0.65	3.43	25.91	34.44
WBG0532	PLC	100	1.96	57.12	10.95	0.56	2.36	18.77	21.76
WBG0532	PLC								
WBG0532	PLC	5.76	1.89	11.55	27.76	1.12	3.63	35.25	49.57
WBG0532	PLC	10.17	1.89	12.91	27.18	0.97	3.63	34.25	49.21
WBG0532	PLC	15.74	1.89	17.09	25.64	0.87	3.46	32.42	47.03
WBG0532	PLC	20.48	1.89	19.28	24.73	0.83	3.38	31.71	45.63
WBG0532	PLC	25.81	1.89	23.33	23.17	0.78	3.22	29.92	43.53
WBG0532	PLC	34.39	1.89	29.23	21	0.72	3.03	27.34	40.4
WBG0532	PLC	100.01	1.89	51.84	12.28	0.57	2.22	19.43	26.51
WBG0532	PLB								
WBG0532	PLB	0	1.75	-	-	-	-	-	-
WBG0532	PLB	0.51	1.75	7.13	29.28	0.76	3.98	35.59	53.29
WBG0532	PLB	2.31	1.75	12.38	27.2	0.57	3.89	29.08	54.65
WBG0532	PLB	46.7	1.75	27.67	21.17	0.56	3.66	23.65	45.01
WBG0532	PLB	80.18	1.75	34.66	18.5	0.62	3.29	21.82	40.23
WBG0532	PLB	88.04	1.75	36.75	17.67	0.69	3.2	21.37	38.69
WBG0532	PLB	100	1.75	40.23	16.35	1.86	3	20.9	35.87
WBG0532	PLA								

WBG0532	PLA	1.27	1.72	12.41	27.18	1.89	3.48	34.44	49.67
WBG0532	PLA	2.87	1.72	13.12	26.83	1.85	3.47	33.58	49.83
WBG0532	PLA	5.46	1.72	18.12	24.82	1.63	3.5	30.38	48
WBG0532	PLA	51.01	1.72	26.7	21.34	1.52	3.3	27.47	42.54
WBG0532	PLA	78.19	1.72	30.75	19.78	1.32	3.24	25.54	40.48
WBG0532	PLA	82.79	1.72	31.99	19.32	1.31	3.18	25.15	39.68
WBG0532	PLA	100	1.72	37.89	17.08	2.93	2.86	23.67	35.58
WBG0532	PLA								
WBG0532	PLA	1.4	2	13.79	26.94	0.45	3.45	32.06	50.7
WBG0532	PLA	4.34	2	23.61	22.77	0.27	3.11	29.12	44.16
WBG0532	PLA	22.47	2	39.88	16.42	0.19	2.92	22.72	34.47
WBG0532	PLA	42.49	2	45.83	14.37	0.2	2.74	20.19	31.25
WBG0532	PLA	100	2	61.76	8.33	0.88	2.18	15.81	20.26
WBG0532	TRP								
WBG0532	TRP	100	2.22	79.83	2.83	0.13	2.11	13.58	4.49
WBG0532	TRB								
WBG0532	TRB	0	1.94	-	-	-	-	-	-
WBG0532	TRB	0.43	1.94	10.93	26.93	0.29	4.97	30.88	53.22
WBG0532	TRB	1.04	1.94	15.29	25.5	0.25	4.66	29.27	50.77
WBG0532	TRB	10.91	1.94	26.02	21.3	0.16	4.36	24.73	44.89
WBG0532	TRB	32.68	1.94	35.85	17.82	0.13	3.87	22.18	38.1
WBG0532	TRB	52.81	1.94	41.35	15.93	0.11	3.61	20.6	34.44
WBG0532	TRB	100	1.94	55.48	10.83	0.55	2.86	17.05	24.61
WBG0532	TRA								
WBG0532	TRA	0.67	1.74	10.27	27.77	0.86	4.62	32.87	52.24
WBG0532	TRA	1.85	1.74	13.17	26.65	0.77	4.73	30.55	51.54
WBG0532	TRA	5.32	1.74	16.86	25.13	0.87	4.61	29.64	48.89
WBG0532	TRA	34.82	1.74	25.27	22.17	0.48	4.23	23.85	46.66
WBG0532	TRA	77.1	1.74	33.25	18.96	0.35	3.88	21.6	41.28

WBG0532	TRA	83.76	1.74	34.8	18.39	0.34	3.81	21.23	40.16
WBG0532	TRA	100	1.74	39.39	16.64	1.51	3.55	20.42	36.64
WBG0532	ES3								
WBG0532	ES3	1.38	1.74	12.9	27.21	0.54	4.32	29.32	53.46
WBG0532	ES3	2.29	1.74	14.66	26.52	0.54	4.31	28.08	52.94
WBG0532	ES3	7.13	1.74	17.77	24.88	0.45	4.26	26.11	51.87
WBG0532	ES3	46.19	1.74	24.98	22.33	0.39	4.08	19.94	50.99
WBG0532	ES3	75.91	1.74	31.25	19.92	0.35	3.84	18.6	46.31
WBG0532	ES3	83.11	1.74	33.41	19.13	0.34	3.74	18.32	44.52
WBG0532	ES3	100.01	1.74	39.03	17	0.38	3.46	17.69	39.82
WBG0532	ES2								
WBG0532	ES2	0	2.01	-	-	-	-	-	-
WBG0532	ES2	0.95	2.01	16.21	26.22	0.88	4.39	32.54	46.85
WBG0532	ES2	2.2	2.01	18.01	25.62	0.75	4.17	31.15	46.67
WBG0532	ES2	7.42	2.01	26.04	22.34	0.5	3.89	25.12	44.95
WBG0532	ES2	28.06	2.01	39.4	17.01	0.3	3.58	19.83	37.18
WBG0532	ES2	41.26	2.01	44.21	15.16	0.27	3.39	18.66	33.74
WBG0532	ES2	100.02	2.01	61.07	7.8	0.27	2.6	15.87	20.46
WBG0532	ES2								
WBG0532	ES2	0	1.88	-	-	-	-	-	-
WBG0532	ES2	1.46	1.88	15.21	26.06	0.57	4.05	24.33	56.42
WBG0532	ES2	4.82	1.88	18.48	24.6	0.51	3.83	23.84	53.86
WBG0532	ES2	16.43	1.88	23.58	23	0.26	3.38	21.44	51.61
WBG0532	ES2	40.6	1.88	34.64	19.08	0.27	3.24	18.5	43.63
WBG0532	ES2	70.14	1.88	43.34	15.93	0.28	2.8	16.7	37.16
WBG0532	ES2	99.99	1.88	50.35	13.28	0.47	2.44	15.57	31.64
WBG0532	ES1								
WBG0532	ES1	2.16	1.81	7.57	29.19	0.59	4.01	31.42	57
WBG0532	ES1	5.48	1.81	9.05	28.7	0.59	3.85	30.28	56.82

WBG0532	ES1	18.75	1.81	13.72	26.76	0.55	3.72	27.54	55.01
WBG0532	ES1	37.36	1.81	18.75	24.86	0.55	3.51	26.66	51.08
WBG0532	ES1	54.78	1.81	27.03	21.67	0.53	3.19	24.77	45.01
WBG0532	ES1	66.84	1.81	32.5	19.58	0.49	2.99	23.34	41.17
WBG0532	ES1	100	1.81	43.96	14.73	1.2	2.43	22.48	31.14

Table XVI: Waterberg Forms of Sulphur at different density fractions

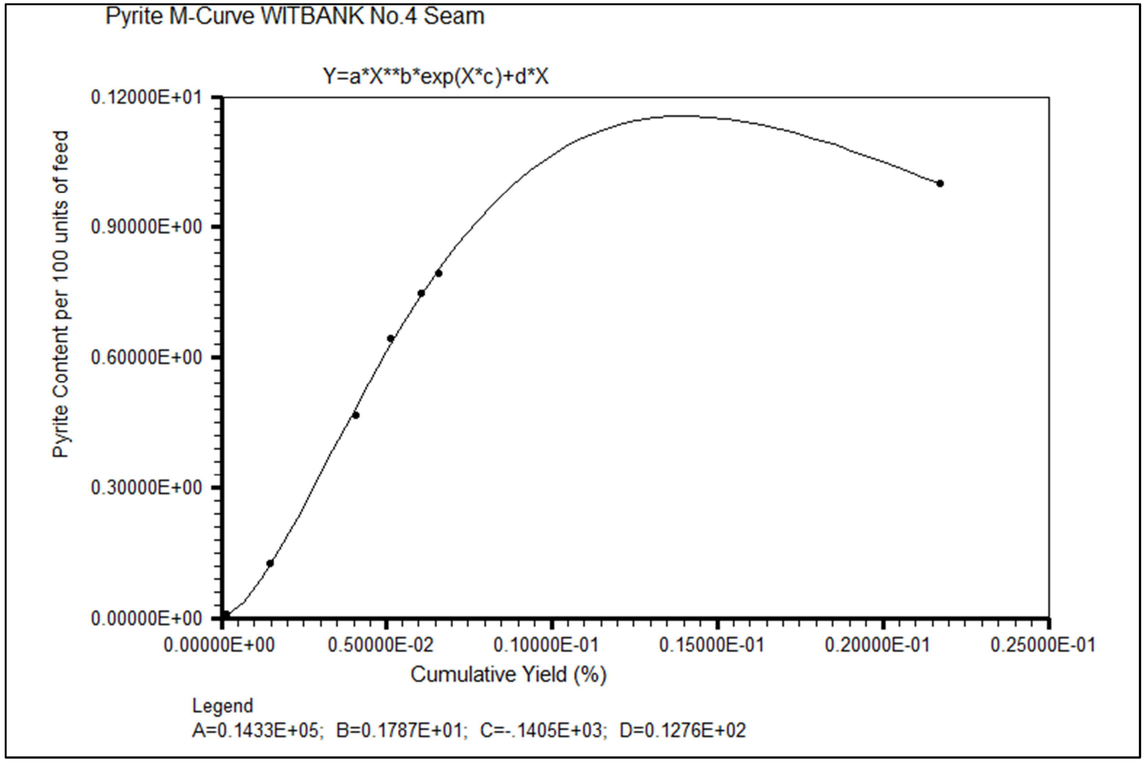
				Certificate of analysis: 4562		
Sample	**Sample**					
Origin	ID					
		S	**S (FeS2)**	**S (SO4)**	**S (org)**	
		%	%	%	%	
FINE/0.500	261439	1.00	0.66	0.03	0.31	
1.3500-1.400	261440	0.67	0.20	0.01	0.46	
1.400-1.500	261441	0.81	0.28	0.01	0.52	
1.500-1.700	261442	0.96	0.49	0.02	0.46	
1.500-1.700/H-Q	261443	0.72	0.23	0.01	0.48	
1.700-1.900	261444	0.93	0.59	0.02	0.32	
1.700-1.900/H-Q	261445	0.51	0.15	0.01	0.35	
1.900-2.00	261446	1.18	0.84	0.02	0.32	
1.900-2.00/H-Q	261447	0.47	0.20	0.01	0.26	

F@1.3500	261448	0.90	0.32	0.01	0.57	
F@1.500/H-Q	261449	1.01	0.36	0.01	0.65	
S@2.00	261450	2.65	2.40	0.01	0.24	
S@2.00/H-Q	261451	0.43	0.33	0.01	0.09	

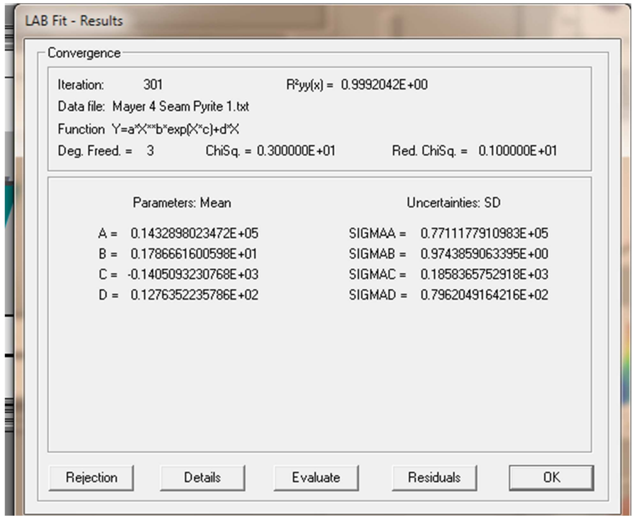
Table XVII: Curve Fitting Data – LabFit Regression Data for Minerals

Mineral Liberation of Witbank Coalfield No. 4 Seam

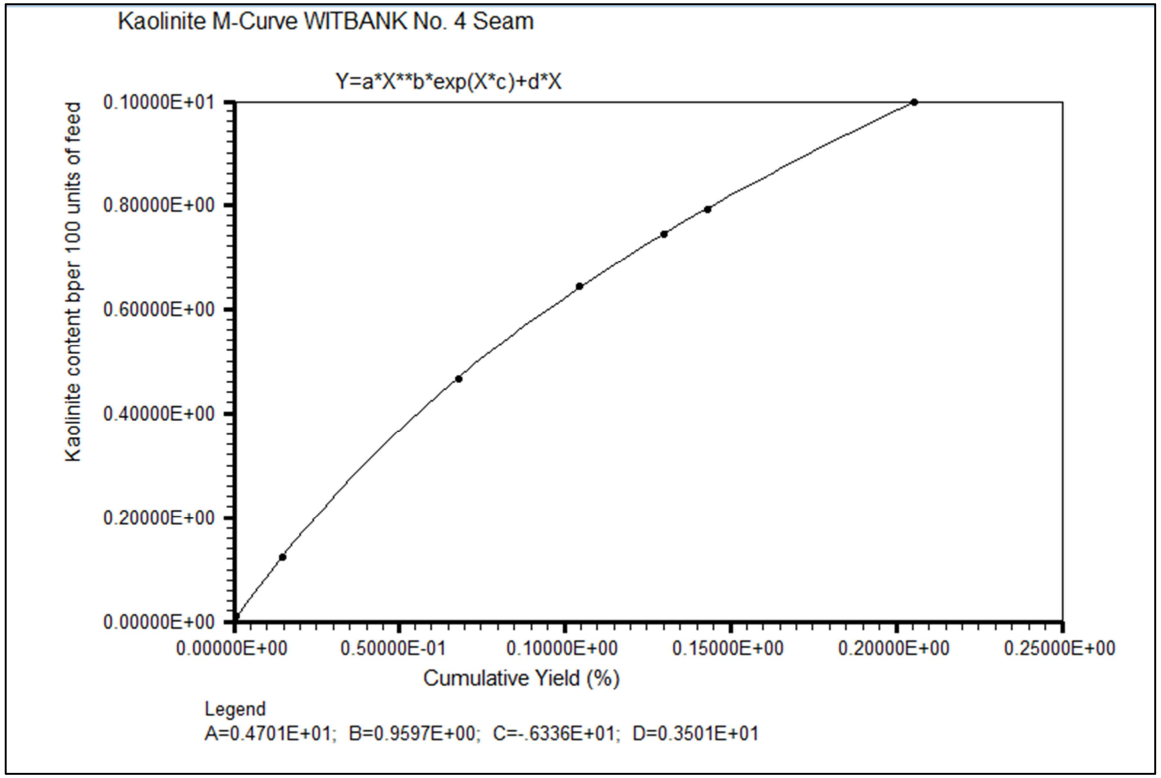
Pyrite



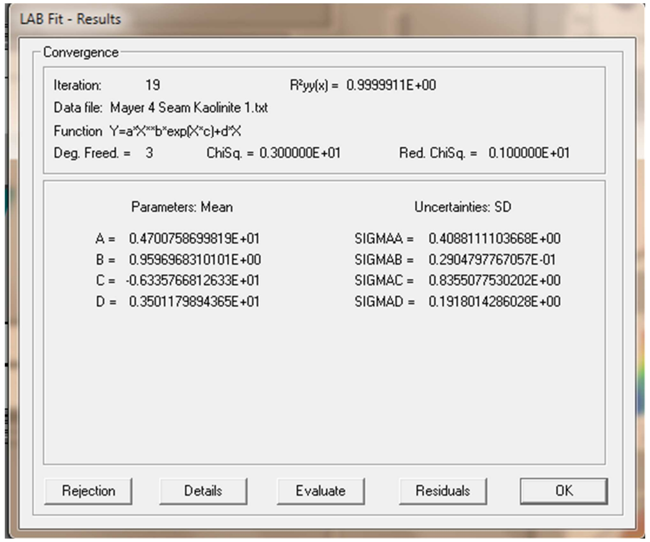
Pyrite M-Curve WITBANK No.4 Seam
Y=a*X**b*exp(X*c)+d*X
0.12000E+01
0.90000E+00
0.60000E+00
0.30000E+00
0.00000E+00
Pyrite Content per 100 units of feed
0.00000E+00
0.50000E-02
0.10000E-01
0.15000E-01
0.20000E-01
0.25000E-01
Cumulative Yield (%)
Legend
A=0.1433E+05; B=0.1787E+01; C=-.1405E+03; D=0.1276E+02


LAB Fit - Results
Convergence
Iteration: 301
R²yy(x) = 0.9992042E+00
Data file: Mayer 4 Seam Pyrite 1.txt
Function Y=a*X**b*exp(X*c)+d*X
Deg. Freed. = 3
ChiSq. = 0.300000E+01
Red. ChiSq. = 0.100000E+01
Parameters: Mean
Uncertainties: SD
A = 0.1432898023472E+05
SIGMAA = 0.7711177910983E+05
B = 0.1786661600598E+01
SIGMAB = 0.9743859063395E+00
C = -0.1405093230768E+03
SIGMAC = 0.1858365752918E+03
D = 0.1276352235786E+02
SIGMAD = 0.7962049164216E+02
Rejection
Details
Evaluate
Residuals
OK

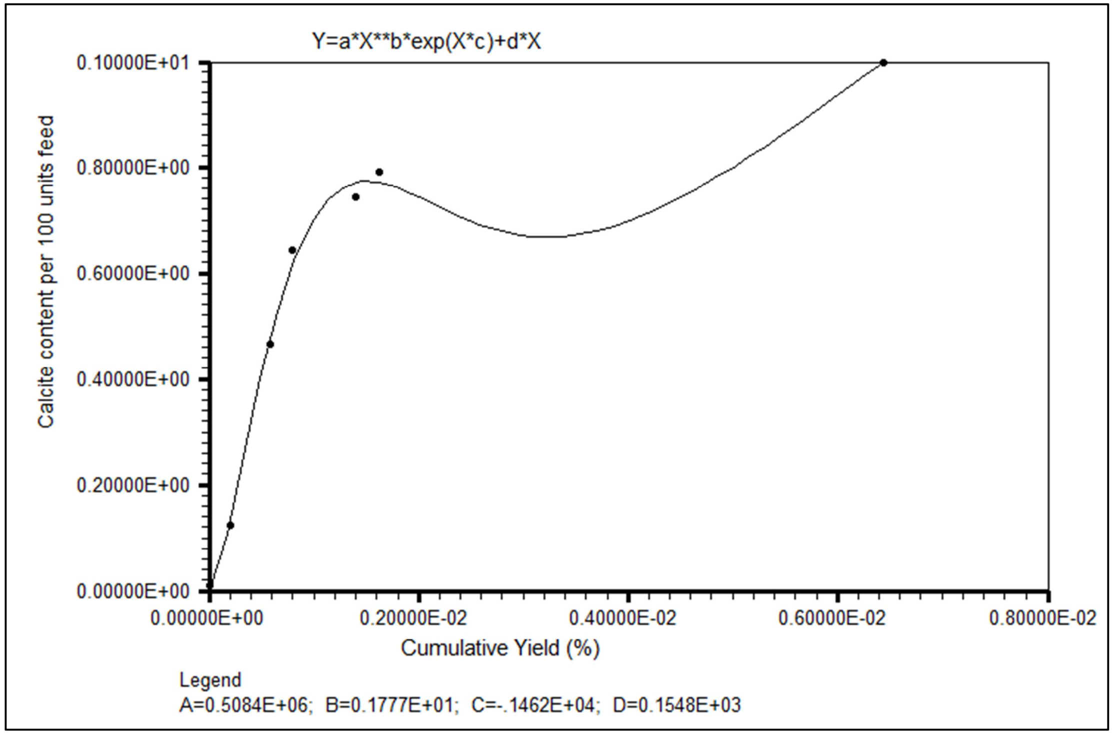
Kaolinite

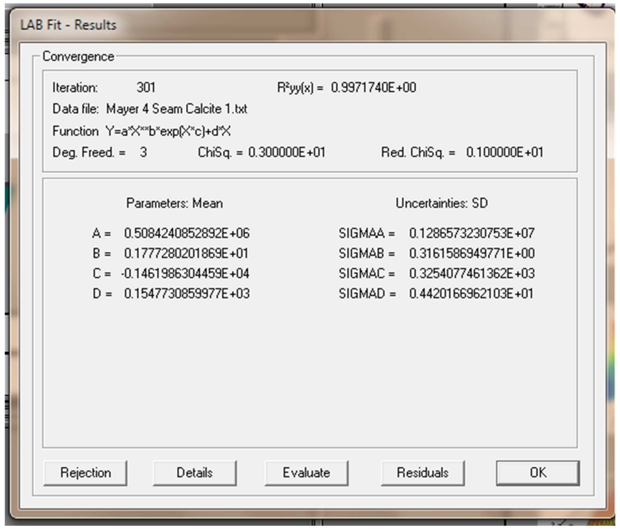


Kaolinite M-Curve WITBANK No. 4 Seam
Y=a*X**b*exp(X*c)+d*X
Kaolinite content bper 100 units of feed
0.10000E+01
0.80000E+00
0.60000E+00
0.40000E+00
0.20000E+00
0.00000E+00
0.00000E+00
0.50000E-01
0.10000E+00
0.15000E+00
0.20000E+00
0.25000E+00
Cumulative Yield (%)
Legend
A=0.4701E+01; B=0.9597E+00; C=-.6336E+01; D=0.3501E+01

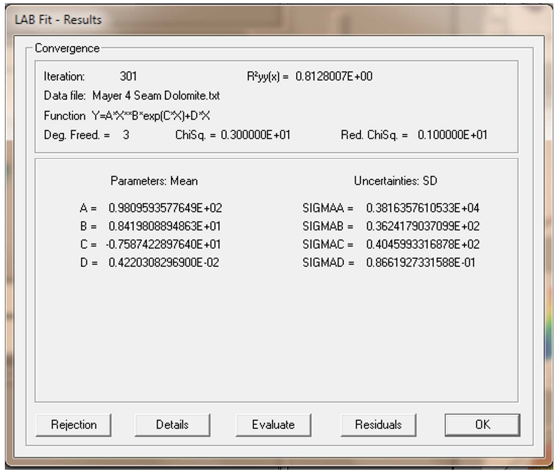

LAB Fit - Results
Convergence
Iteration: 19
R²yy(x) = 0.9999911E+00
Data file: Mayer 4 Seam Kaolinite 1.txt
Function Y=a*X**b*exp(X*c)+d*X
Deg. Freed. = 3
ChiSq. = 0.300000E+01
Red. ChiSq. = 0.100000E+01
Parameters: Mean
Uncertainties: SD
A = 0.4700758699819E+01
B = 0.9596968310101E+00
C = -0.6335766812633E+01
D = 0.3501179894365E+01
SIGMAA = 0.4088111103668E+00
SIGMAB = 0.2904797767057E-01
SIGMAC = 0.8355077530202E+00
SIGMAD = 0.1918014286028E+00
Rejection
Details
Evaluate
Residuals
OK

Calcite

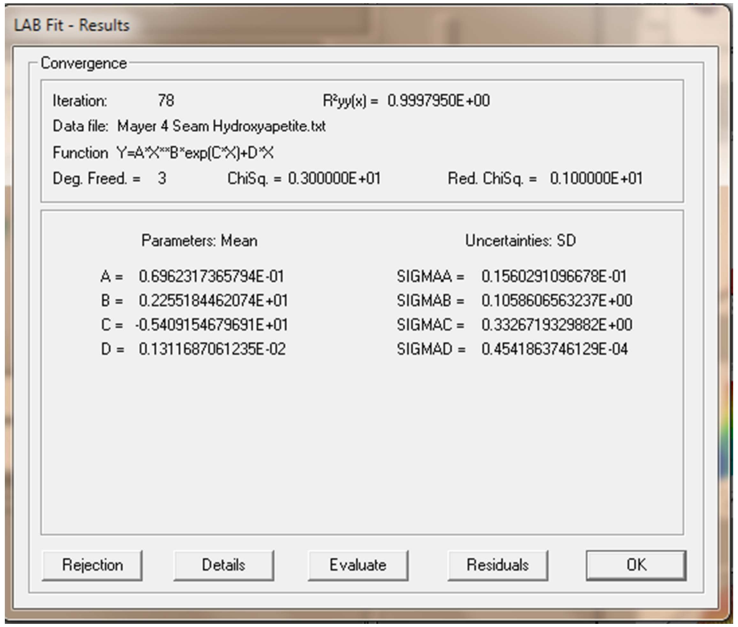

Y=a*X**b*exp(X*c)+d*X
Calcite content per 100 units feed
0.10000E+01
0.80000E+00
0.60000E+00
0.40000E+00
0.20000E+00
0.00000E+00
0.00000E+00
0.20000E-02
0.40000E-02
0.60000E-02
0.80000E-02
Cumulative Yield (%)
Legend
A=0.5084E+06; B=0.1777E+01; C=-.1462E+04; D=0.1548E+03


LAB Fit - Results
Convergence
Iteration: 301
R²yy(x) = 0.9971740E+00
Data file: Mayer 4 Seam Calcite 1.txt
Function Y=a*X**b*exp(X*c)+d*X
Deg. Freed. = 3
ChiSq. = 0.300000E+01
Red. ChiSq. = 0.100000E+01
Parameters: Mean
A = 0.5084240852892E+06
B = 0.1777280201869E+01
C = -0.1461986304459E+04
D = 0.1547730859977E+03
Uncertainties: SD
SIGMAA = 0.1286573230753E+07
SIGMAB = 0.3161586949771E+00
SIGMAC = 0.3254077461362E+03
SIGMAD = 0.4420166962103E+01
Rejection
Details
Evaluate
Residuals
OK

Dolomite


LAB Fit - Results
Convergence
Iteration: 301
R²yy(x) = 0.8128007E+00
Data file: Mayer 4 Seam Dolomite.txt
Function Y=A*X**B*exp(C*X)+D*X
Deg. Freed. = 3
ChiSq. = 0.300000E+01
Red. ChiSq. = 0.100000E+01
Parameters: Mean
A = 0.9809593577649E+02
B = 0.8419808894863E+01
C = -0.7587422897640E+01
D = 0.4220308296900E-02
Uncertainties: SD
SIGMAA = 0.3816357610533E+04
SIGMAB = 0.3624179037099E+02
SIGMAC = 0.4045993316878E+02
SIGMAD = 0.8661927331588E-01
Rejection
Details
Evaluate
Residuals
OK

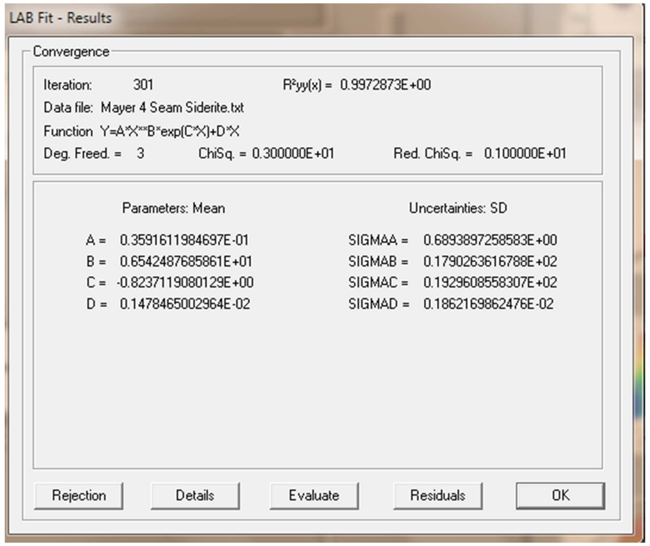
Apatite



Muscovite

Rutile

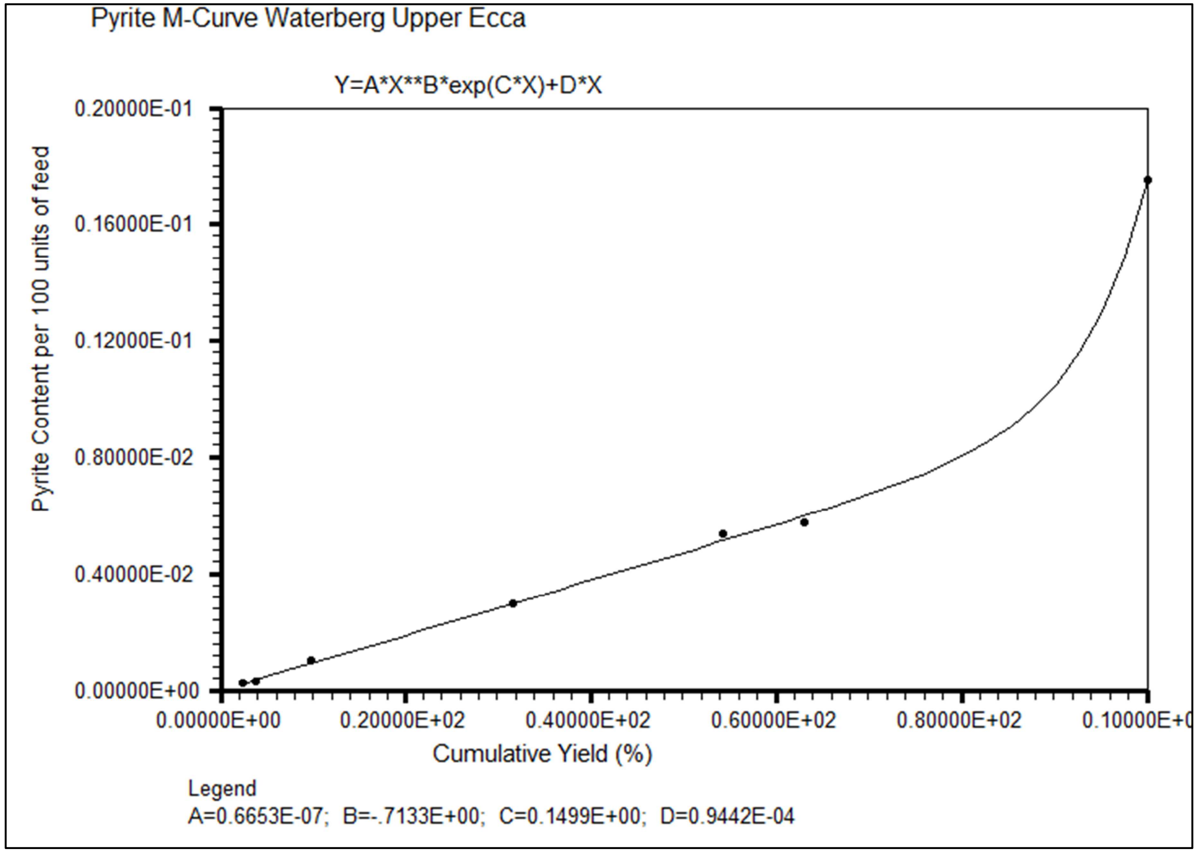
Siderite

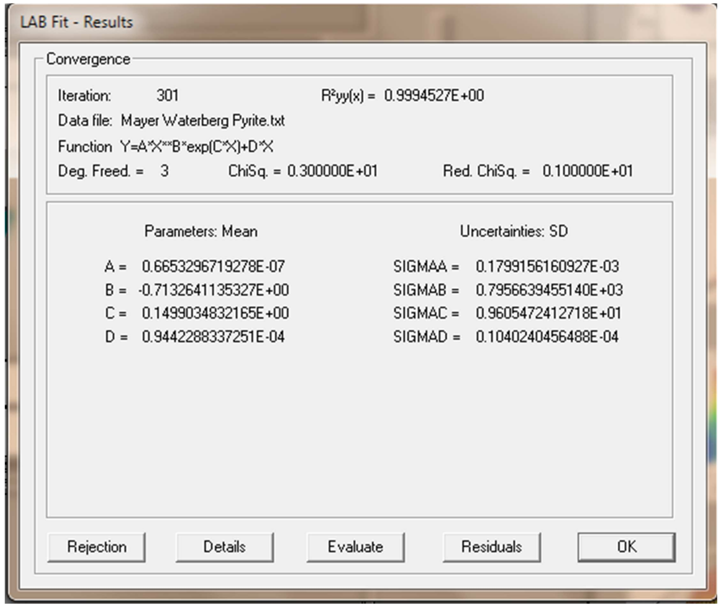


Quartz

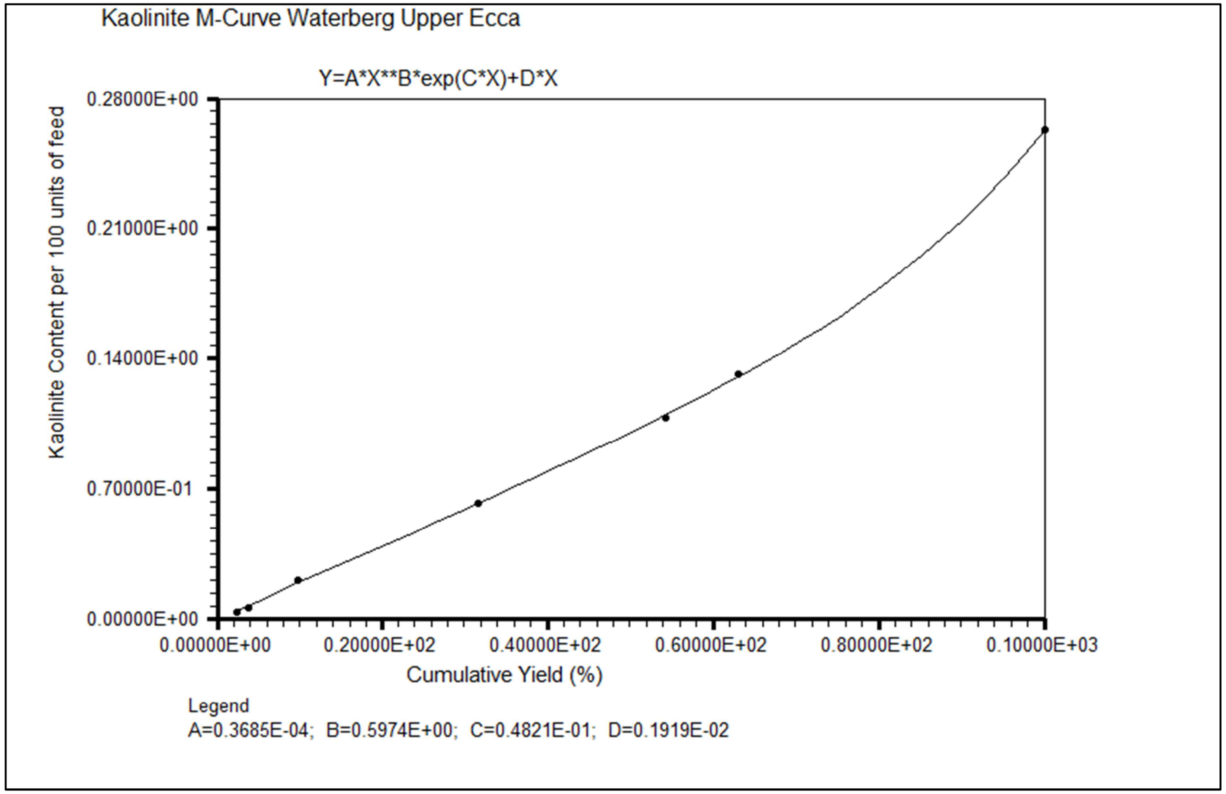
Mineral Liberation of Waterberg Upper Ecca

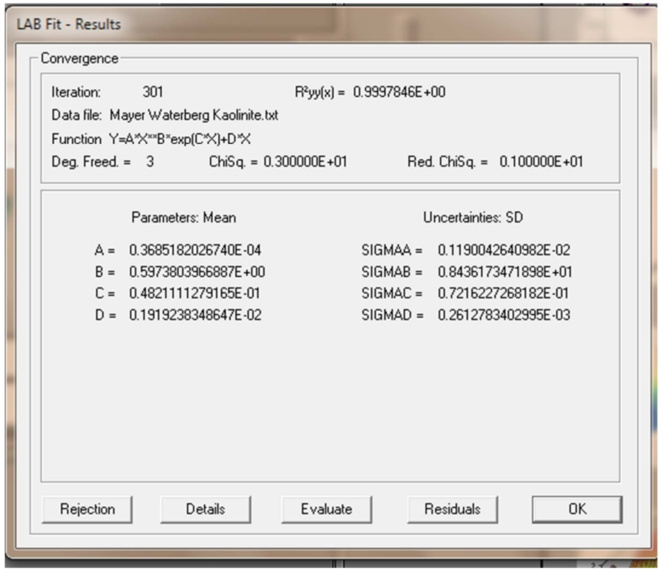
Pyrite


Pyrite M-Curve Waterberg Upper Ecca
Y=A*X**B*exp(C*X)+D*X
Pyrite Content per 100 units of feed
0.20000E-01
0.16000E-01
0.12000E-01
0.80000E-02
0.40000E-02
0.00000E+00
0.00000E+00
0.20000E+02
0.40000E+02
0.60000E+02
0.80000E+02
Cumulative Yield (%)
Legend
A=0.6653E-07; B=-.7133E+00; C=0.1499E+00; D=0.9442E-04

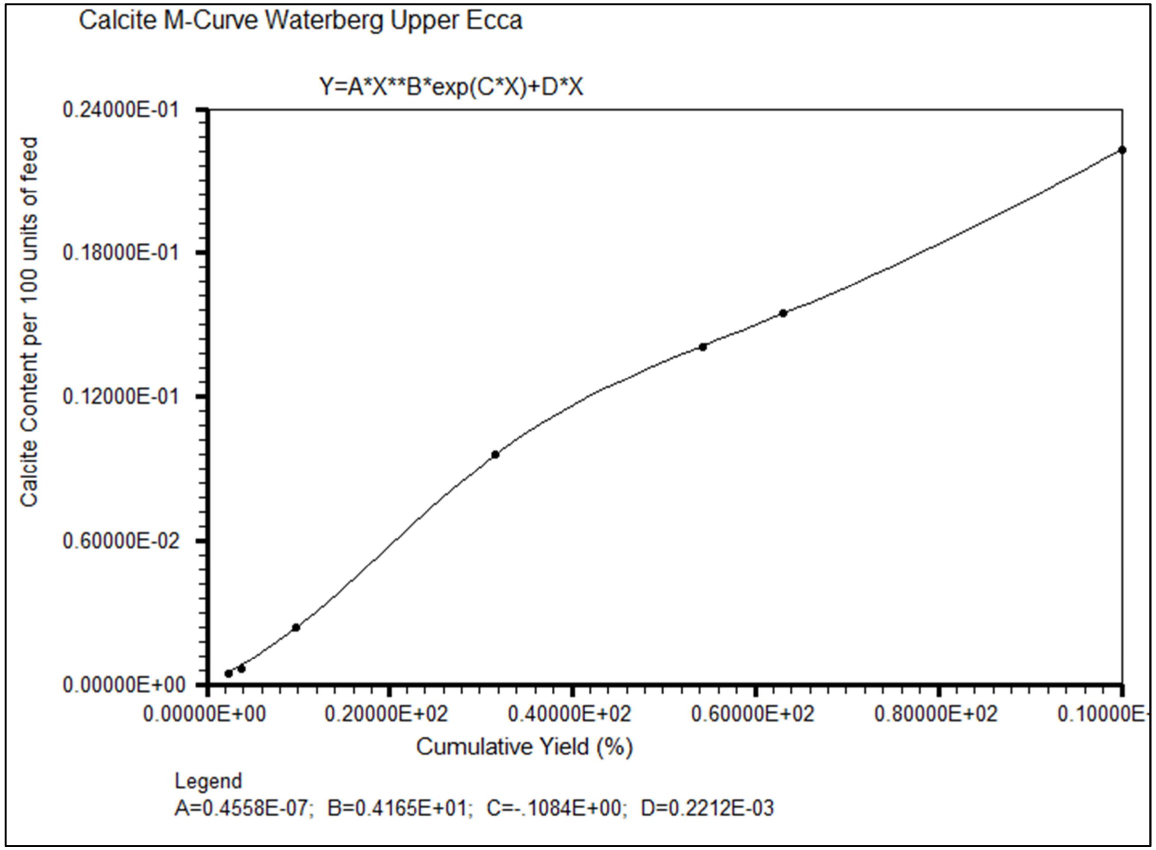

LAB Fit - Results
Convergence
Iteration: 301
R²yy(x) = 0.9994527E+00
Data file: Mayer Waterberg Pyrite.txt
Function Y=A*X**B*exp(C*X)+D*X
Deg. Freed. = 3
ChiSq. = 0.300000E+01
Red. ChiSq. = 0.100000E+01
Parameters: Mean
Uncertainties: SD
A = 0.6653296719278E-07
SIGMAA = 0.1799156160927E-03
B = -0.7132641135327E+00
SIGMAB = 0.7956639455140E+03
C = 0.1499034832165E+00
SIGMAC = 0.9605472412718E+01
D = 0.9442288337251E-04
SIGMAD = 0.1040240456488E-04
Rejection
Details
Evaluate
Residuals
OK

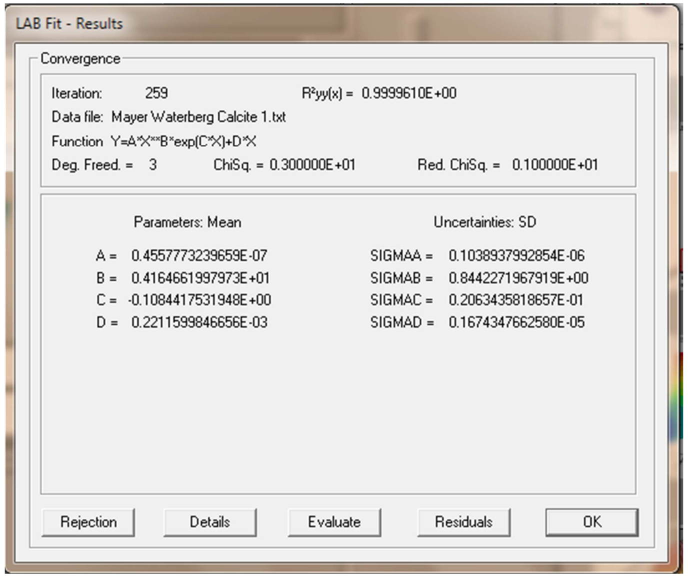
Kaolinite


Kaolinite M-Curve Waterberg Upper Ecca
Y=A*X**B*exp(C*X)+D*X
Kaolinite Content per 100 units of feed
0.28000E+00
0.21000E+00
0.14000E+00
0.70000E-01
0.00000E+00
0.00000E+00
0.20000E+02
0.40000E+02
0.60000E+02
0.80000E+02
0.10000E+03
Cumulative Yield (%)
Legend
A=0.3685E-04; B=0.5974E+00; C=0.4821E-01; D=0.1919E-02

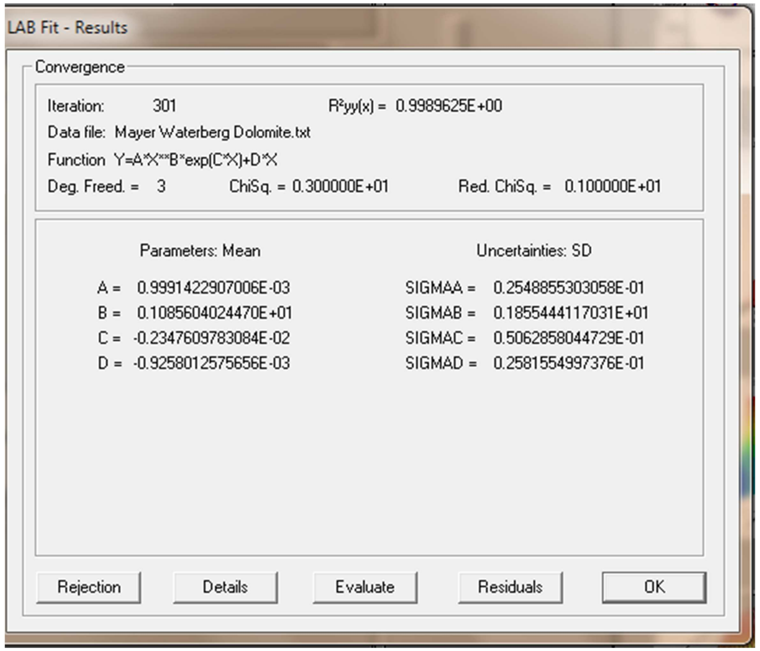

LAB Fit - Results
Convergence
Iteration: 301
R²yy(x) = 0.9997846E+00
Data file: Mayer Waterberg Kaolinite.txt
Function Y=A*X**B*exp(C*X)+D*X
Deg. Freed. = 3
ChiSq. = 0.300000E+01
Red. ChiSq. = 0.100000E+01
Parameters: Mean
Uncertainties: SD
A = 0.3685182026740E-04
SIGMAA = 0.1190042640982E-02
B = 0.5973803966887E+00
SIGMAB = 0.8436173471898E+01
C = 0.4821111279165E-01
SIGMAC = 0.7216227268182E-01
D = 0.1919238348647E-02
SIGMAD = 0.2612783402995E-03
Rejection
Details
Evaluate
Residuals
OK

Calcite

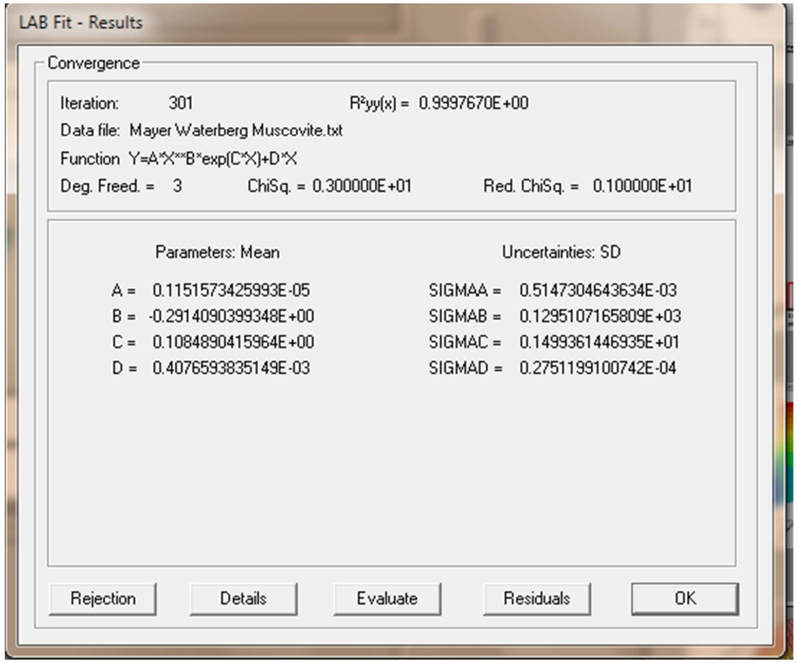

Calcite M-Curve Waterberg Upper Ecca
Y=A*X**B*exp(C*X)+D*X
0.24000E-01
0.18000E-01
0.12000E-01
0.60000E-02
0.00000E+00
Calcite Content per 100 units of feed
0.00000E+00
0.20000E+02
0.40000E+02
0.60000E+02
0.80000E+02
0.10000E
Cumulative Yield (%)
Legend
A=0.4558E-07; B=0.4165E+01; C=-.1084E+00; D=0.2212E-03


LAB Fit - Results
Convergence
Iteration: 259
R²yy(x) = 0.9999610E+00
Data file: Mayer Waterberg Calcite 1.txt
Function Y=A*X**B*exp(C*X)+D*X
Deg. Freed. = 3
ChiSq. = 0.300000E+01
Red. ChiSq. = 0.100000E+01
Parameters: Mean
Uncertainties: SD
A = 0.4557773239659E-07
B = 0.4164661997973E+01
C = -0.1084417531948E+00
D = 0.2211599846656E-03
SIGMAA = 0.1038937992854E-06
SIGMAB = 0.8442271967919E+00
SIGMAC = 0.2063435818657E-01
SIGMAD = 0.1674347662580E-05
Rejection
Details
Evaluate
Residuals
OK

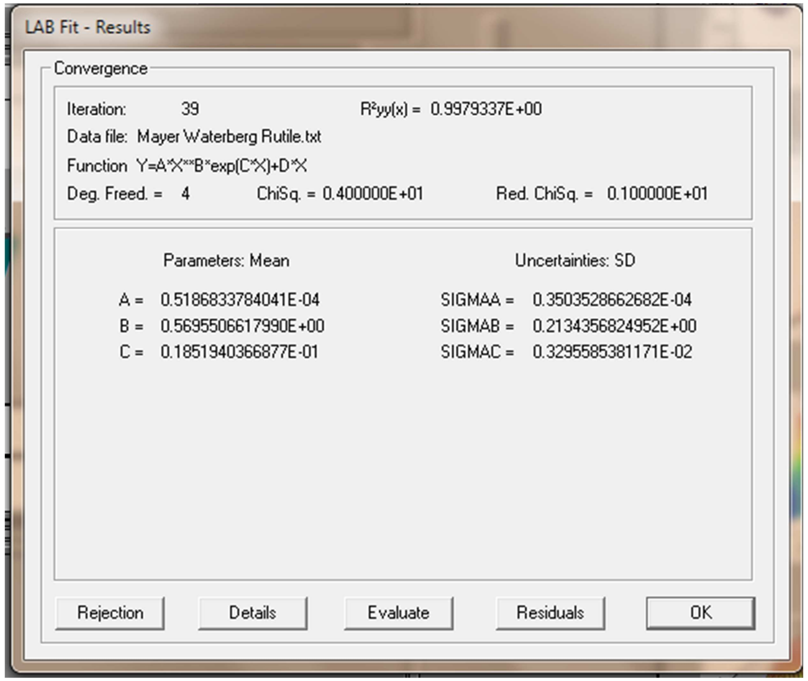
Dolomite


LAB Fit - Results
Convergence
Iteration: 301
R²yy(x) = 0.9989625E+00
Data file: Mayer Waterberg Dolomite.txt
Function Y=A*X**B*exp(C*X)+D*X
Deg. Freed. = 3
ChiSq. = 0.300000E+01
Red. ChiSq. = 0.100000E+01
Parameters: Mean
Uncertainties: SD
A = 0.9991422907006E-03
B = 0.1085604024470E+01
C = -0.2347609783084E-02
D = -0.9258012575656E-03
SIGMAA = 0.2548855303058E-01
SIGMAB = 0.1855444117031E+01
SIGMAC = 0.5062858044729E-01
SIGMAD = 0.2581554997376E-01
Rejection
Details
Evaluate
Residuals
OK

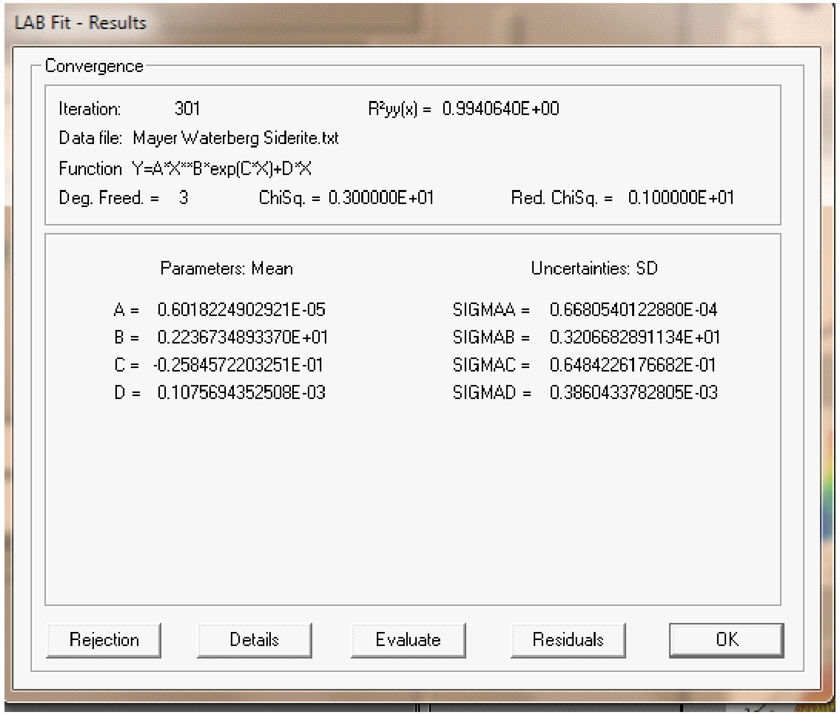
Muscovite


LAB Fit - Results
Convergence
Iteration: 301
R²yy(x) = 0.9997670E+00
Data file: Mayer Waterberg Muscovite.txt
Function Y=A*X**B*exp(C*X)+D*X
Deg. Freed. = 3
ChiSq. = 0.300000E+01
Red. ChiSq. = 0.100000E+01
Parameters: Mean
Uncertainties: SD
A = 0.1151573425993E-05
SIGMAA = 0.5147304643634E-03
B = -0.2914090399348E+00
SIGMAB = 0.1295107165809E+03
C = 0.1084890415964E+00
SIGMAC = 0.1499361446935E+01
D = 0.4076593835149E-03
SIGMAD = 0.2751199100742E-04
Rejection
Details
Evaluate
Residuals
OK

Rutile


LAB Fit - Results
Convergence
Iteration: 39
R²yy(x) = 0.9979337E+00
Data file: Mayer Waterberg Rutile.txt
Function Y=A*X**B*exp(C*X)+D*X
Deg. Freed. = 4
ChiSq. = 0.400000E+01
Red. ChiSq. = 0.100000E+01
Parameters: Mean
Uncertainties: SD
A = 0.5186833784041E-04
SIGMAA = 0.3503528662682E-04
B = 0.5695506617990E+00
SIGMAB = 0.2134356824952E+00
C = 0.1851940366877E-01
SIGMAC = 0.3295585381171E-02
Rejection
Details
Evaluate
Residuals
OK

Siderite



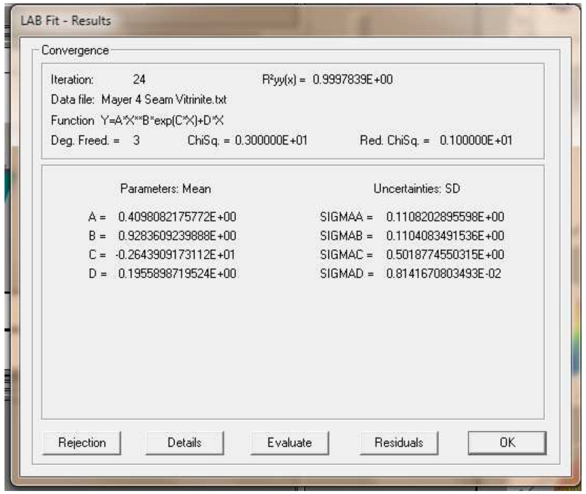
Quartz

Table XVIII: Curve Fitting Data – LabFit Regression Data for Macerals

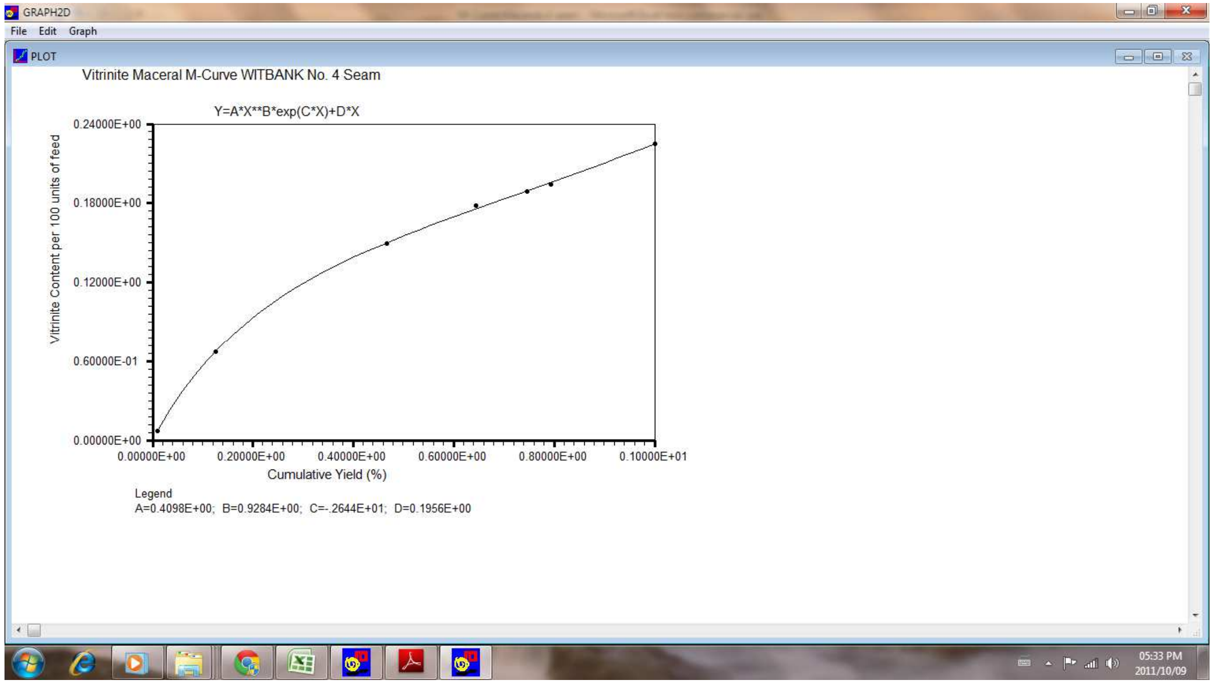
Maceral & Microlithotype Liberation of Witbank Coalfield No. 4 Seam

Macerals

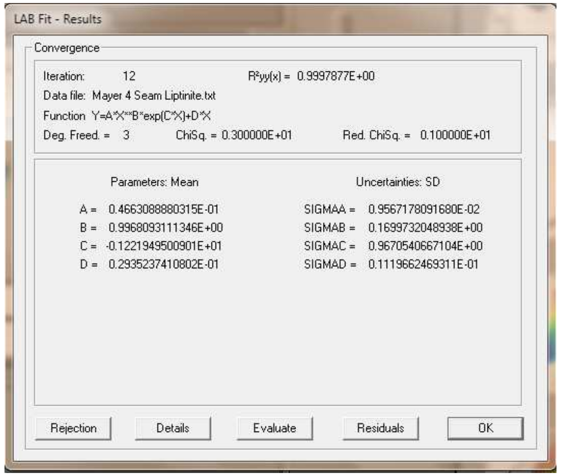
Vitrinite

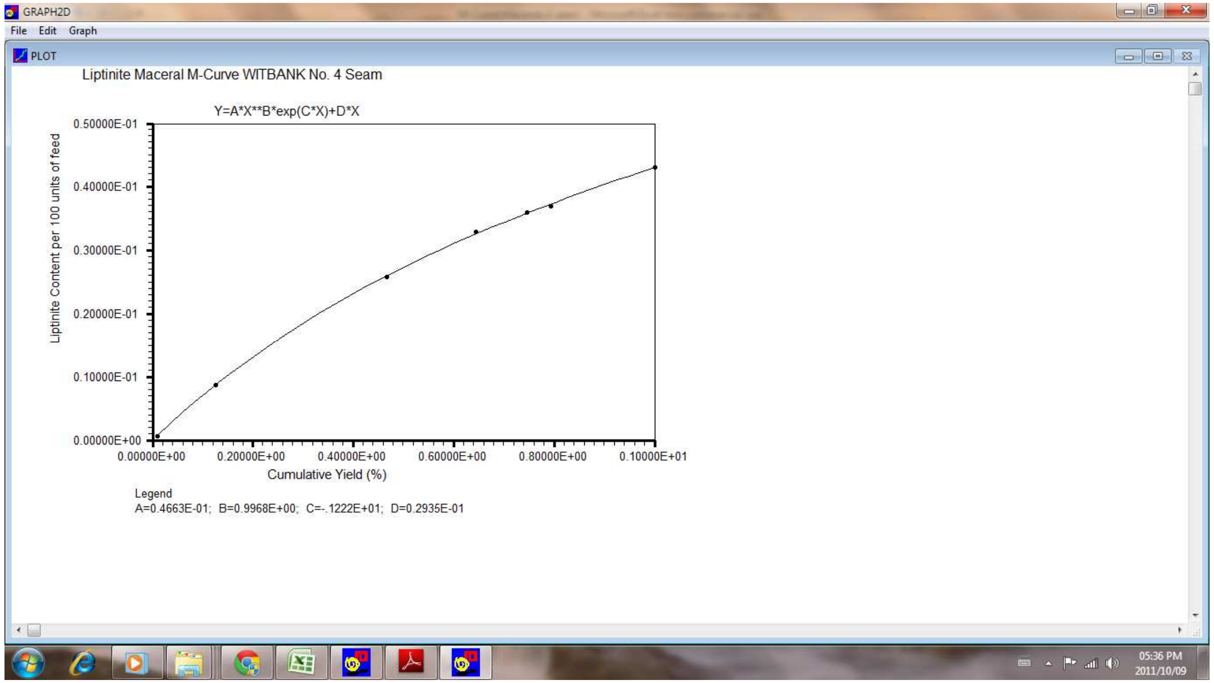


LAB Fit - Results
Convergence
Iteration: 24
R²yy(x) = 0.9997839E+00
Data file: Mayer 4 Seam Vitrinite.txt
Function Y=A*X**B*exp(C*X)+D*X
Deg. Freed. = 3
ChiSq. = 0.300000E+01
Red. ChiSq. = 0.100000E+01
Parameters: Mean
A = 0.4098082175772E+00
B = 0.9283609239888E+00
C = -0.2643909173112E+01
D = 0.1955898719524E+00
Uncertainties: SD
SIGMAA = 0.1108202895598E+00
SIGMAB = 0.1104083491536E+00
SIGMAC = 0.5018774550315E+00
SIGMAD = 0.8141670803493E-02
Rejection
Details
Evaluate
Residuals
OK

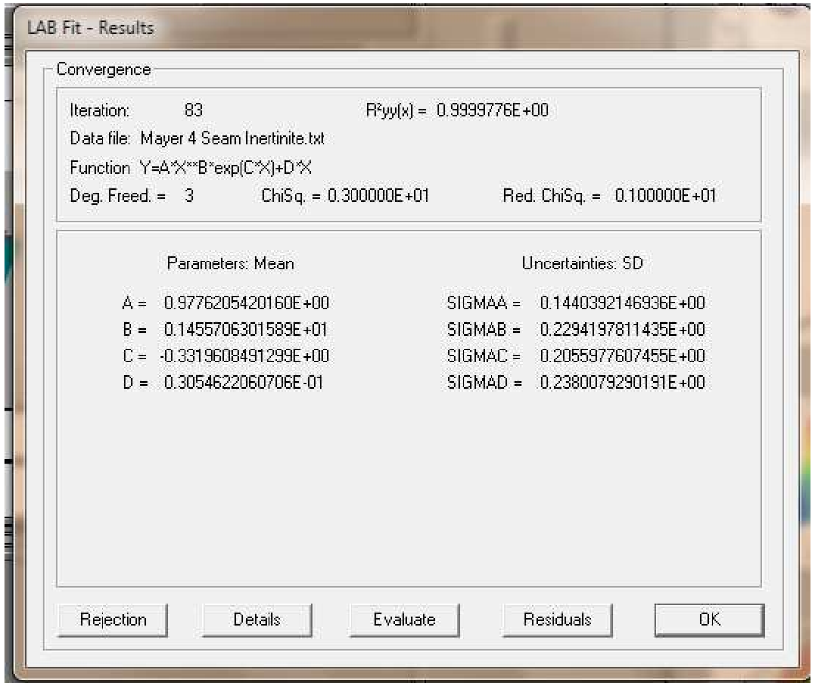

GRAPH2D
File Edit Graph
PLOT
Vitrinite Maceral M-Curve WITBANK No. 4 Seam
Y=A*X**B*exp(C*X)+D*X
Vitrinite Content per 100 units of feed
0.24000E+00
0.18000E+00
0.12000E+00
0.60000E-01
0.00000E+00
0.00000E+00
0.20000E+00
0.40000E+00
0.60000E+00
0.80000E+00
0.10000E+01
Cumulative Yield (%)
Legend
A=0.4098E+00; B=0.9284E+00; C=-.2644E+01; D=0.1956E+00
05:33 PM
2011/10/09

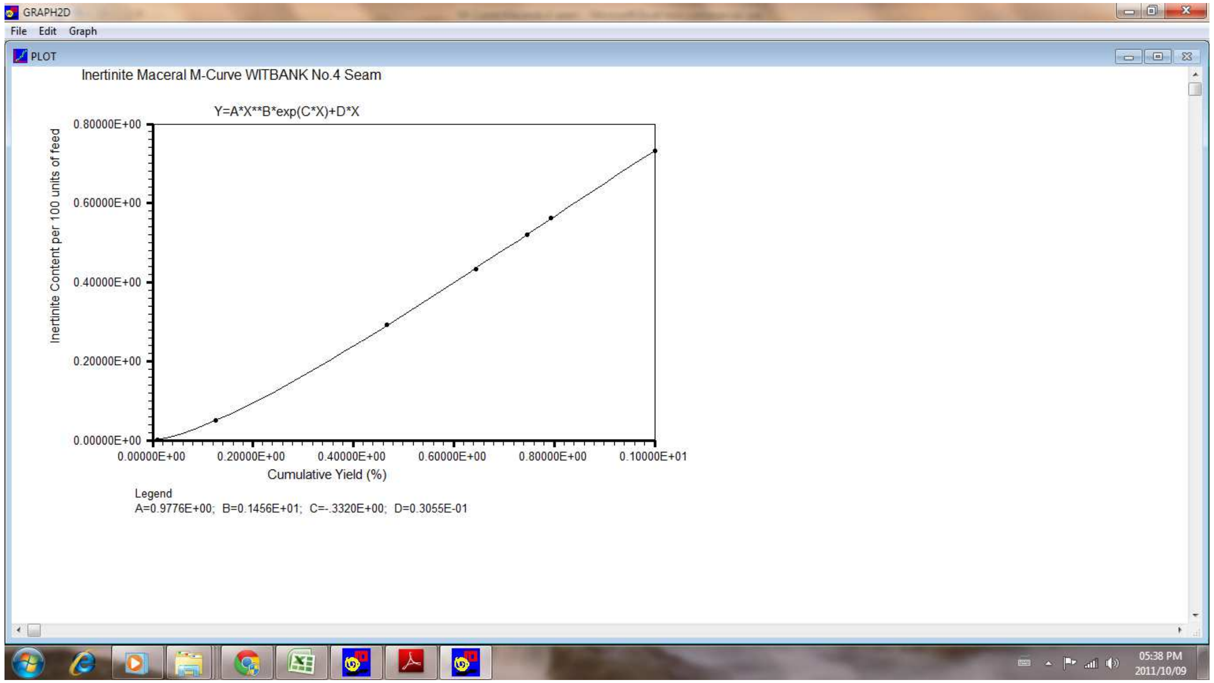
Liptinite


LAB Fit - Results
Convergence
Iteration: 12
R²yy(x) = 0.9997877E+00
Data file: Mayer 4 Seam Liptinite.txt
Function Y=A*X**B*exp(C*X)+D*X
Deg. Freed. = 3
ChiSq. = 0.300000E+01
Red. ChiSq. = 0.100000E+01
Parameters: Mean
Uncertainties: SD
A = 0.4663088880315E-01
B = 0.9968093111346E+00
C = -0.1221949500901E+01
D = 0.2935237410802E-01
SIGMAA = 0.9567178091680E-02
SIGMAB = 0.1699732048938E+00
SIGMAC = 0.9670540667104E+00
SIGMAD = 0.1119662469311E-01
Rejection
Details
Evaluate
Residuals
OK

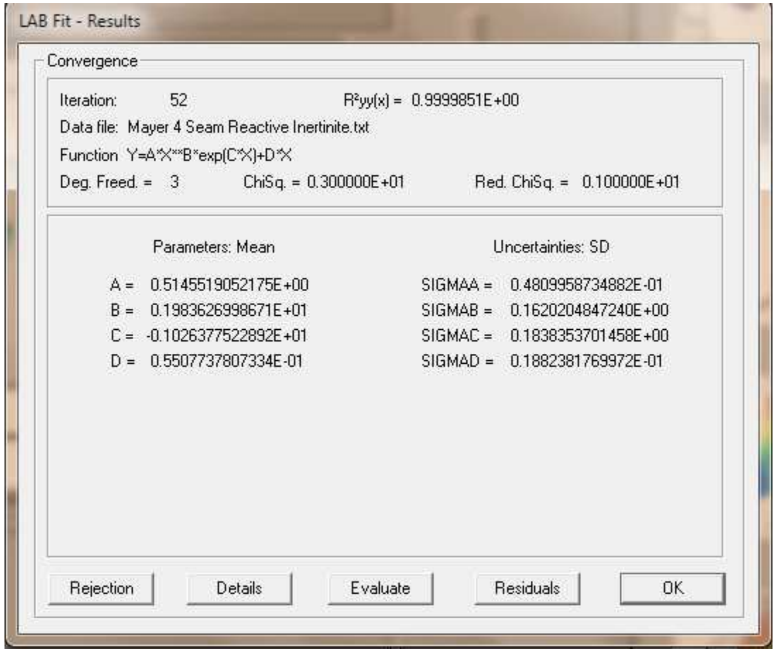

GRAPH2D
File Edit Graph
PLOT
Liptinite Maceral M-Curve WITBANK No. 4 Seam
Y=A*X**B*exp(C*X)+D*X
Liptinite Content per 100 units of feed
0.50000E-01
0.40000E-01
0.30000E-01
0.20000E-01
0.10000E-01
0.00000E+00
0.00000E+00
0.20000E+00
0.40000E+00
0.60000E+00
0.80000E+00
0.10000E+01
Cumulative Yield (%)
Legend
A=0.4663E-01; B=0.9968E+00; C=-.1222E+01; D=0.2935E-01
05:36 PM
2011/10/09

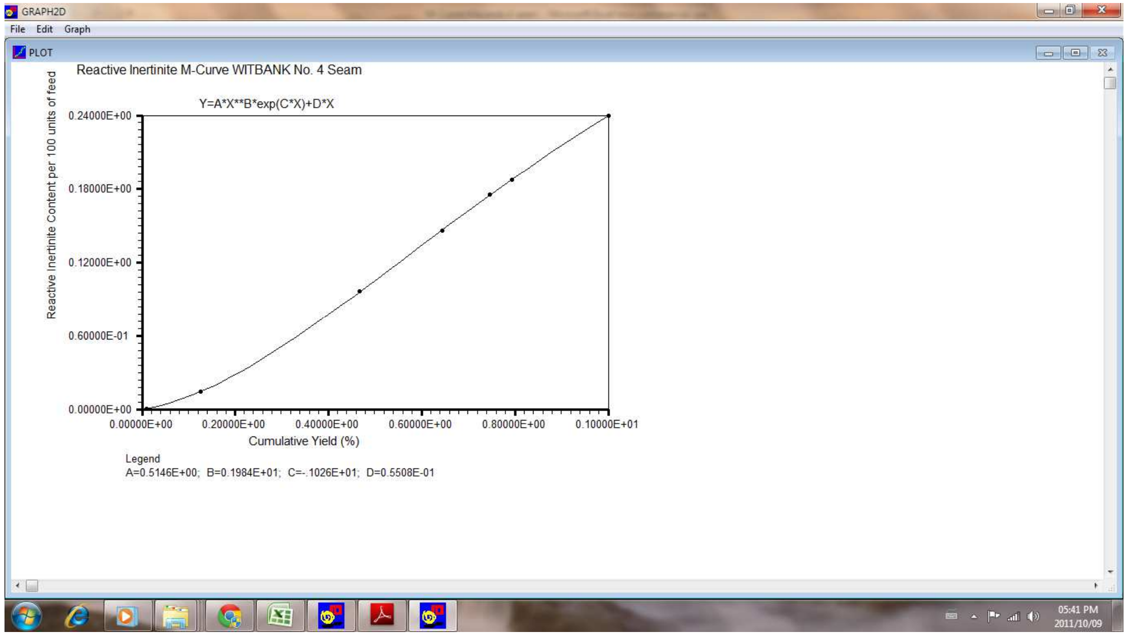
Inertininite





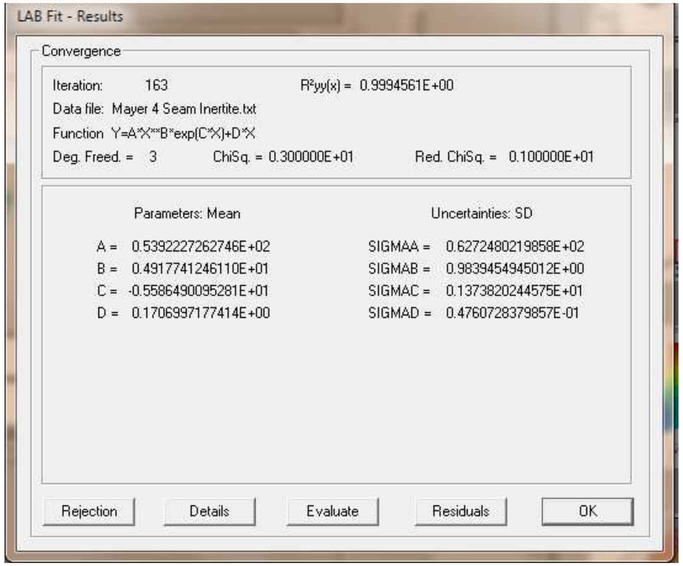
Reactive Inertinite

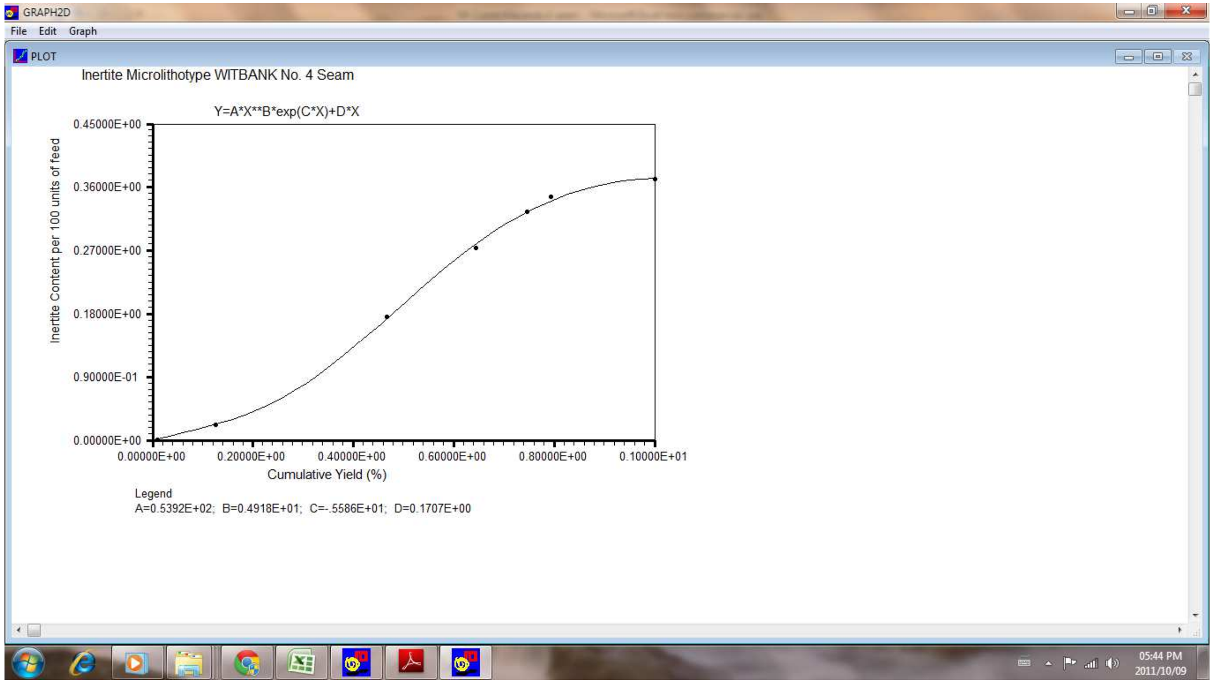

LAB Fit - Results
Convergence
Iteration: 52
R²yy(x) = 0.9999851E+00
Data file: Mayer 4 Seam Reactive Inertinite.txt
Function Y=A*X**B*exp(C*X)+D*X
Deg. Freed. = 3
ChiSq. = 0.300000E+01
Red. ChiSq. = 0.100000E+01
Parameters: Mean
Uncertainties: SD
A = 0.5145519052175E+00
SIGMAA = 0.4809958734882E-01
B = 0.1983626998671E+01
SIGMAB = 0.1620204847240E+00
C = -0.1026377522892E+01
SIGMAC = 0.1838353701458E+00
D = 0.5507737807334E-01
SIGMAD = 0.1882381769972E-01
Rejection
Details
Evaluate
Residuals
OK



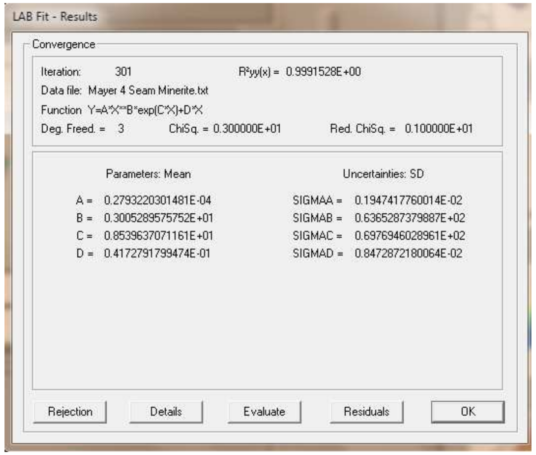
Microlithotypes

Inertite


LAB Fit - Results
Convergence
Iteration: 163
R²yy(x) = 0.9994561E+00
Data file: Mayer 4 Seam Inertite.txt
Function Y=A*X**B*exp(C*X)+D*X
Deg. Freed. = 3
ChiSq. = 0.300000E+01
Red. ChiSq. = 0.100000E+01
Parameters: Mean
Uncertainties: SD
A = 0.5392227262746E+02
SIGMAA = 0.6272480219858E+02
B = 0.4917741246110E+01
SIGMAB = 0.9839454945012E+00
C = -0.5586490095281E+01
SIGMAC = 0.1373820244575E+01
D = 0.1706997177414E+00
SIGMAD = 0.4760728379857E-01
Rejection
Details
Evaluate
Residuals
OK


GRAPH2D
File Edit Graph
PLOT
Inertite Microlithotype WITBANK No. 4 Seam
Y=A*X**B*exp(C*X)+D*X
0.45000E+00
0.36000E+00
0.27000E+00
0.18000E+00
0.90000E-01
0.00000E+00
Inertite Content per 100 units of feed
0.00000E+00
0.20000E+00
0.40000E+00
0.60000E+00
0.80000E+00
0.10000E+01
Cumulative Yield (%)
Legend
A=0.5392E+02; B=0.4918E+01; C=-.5586E+01; D=0.1707E+00
05:44 PM
2011/10/09

Minerite


LAB Fit - Results
Convergence
Iteration: 301
R²yy(x) = 0.9991528E+00
Data file: Mayer 4 Seam Minerite.txt
Function Y=A*X**B*exp(C*X)+D*X
Deg. Freed. = 3
ChiSq. = 0.300000E+01
Red. ChiSq. = 0.100000E+01
Parameters: Mean
Uncertainties: SD
A = 0.2793220301481E-04
B = 0.3005289575752E+01
C = 0.8539637071161E+01
D = 0.4172791799474E-01
SIGMAA = 0.1947417760014E-02
SIGMAB = 0.6365287379887E+02
SIGMAC = 0.6976946028961E+02
SIGMAD = 0.8472872180064E-02
Rejection
Details
Evaluate
Residuals
OK

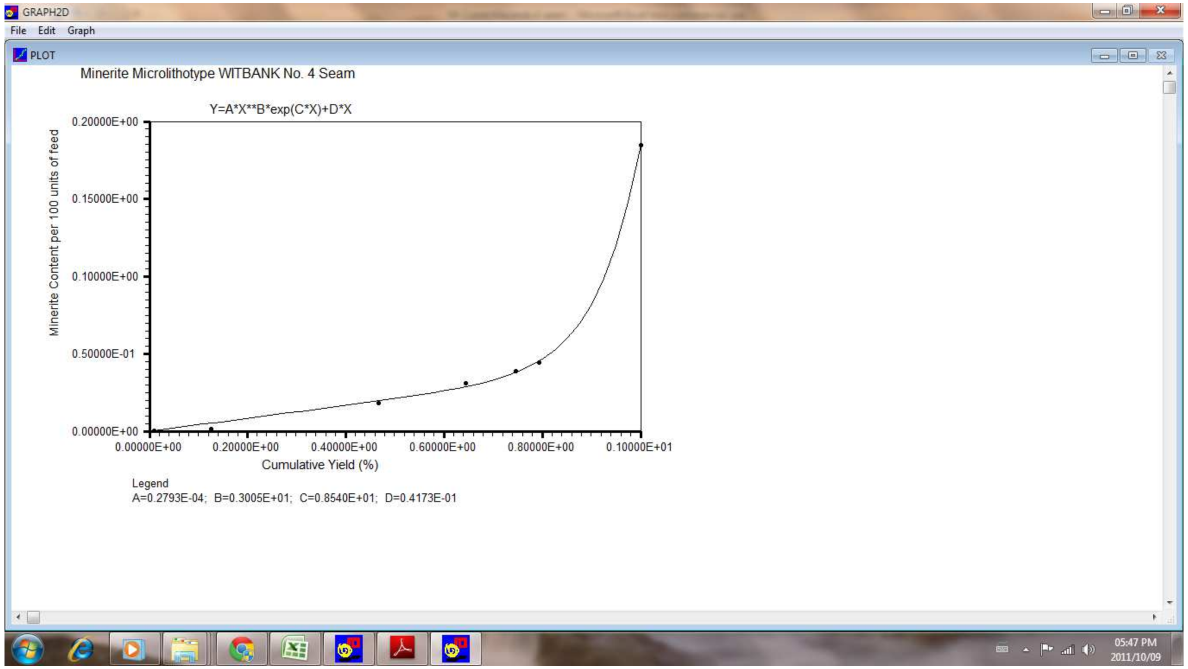

GRAPH2D
File Edit Graph
PLOT
Minerite Microlithotype WITBANK No. 4 Seam
Y=A*X**B*exp(C*X)+D*X
Minerite Content per 100 units of feed
0.20000E+00
0.15000E+00
0.10000E+00
0.50000E-01
0.00000E+00
0.00000E+00
0.20000E+00
0.40000E+00
0.60000E+00
0.80000E+00
0.10000E+01
Cumulative Yield (%)
Legend
A=0.2793E-04; B=0.3005E+01; C=0.8540E+01; D=0.4173E-01
05:47 PM
2011/10/09

Table XIX: Costing data – Mintek parameters for equation, illustrative table

Description	a	b	c	Size/Capacity	Amount	Amount*	x (tph)	Unit Cost 1996 (R'000)	Chemical Engineering Cost Factor	Cost 2012 (R'000)	Range	
											Min	Max
filter press, pate and frane, semi-automatic	2.06E+02	3.07E+00	-4.15E-03	m^2 filtration	-	1	20	265.82	1.67	443.92		
decanter	3.18E+02	5.82E+01	7.45E-04	m^3/h	2	2		318.10	1.67	531.23		
screens (horizontal) vibrating pu	-126.6	42.09	-1.07	m^2	4	4	13.94	252.15	1.67	1684.38	7	18
screens (horizontal) vibrating pu	-126.6	42.09	-1.07	m^2	7	7	15.79	271.26	1.67	3171.07	7	18
screens (horizontal) vibrating pu	-126.6	42.09	-1.07	m^2	#NAME?	12	14.87	262.73	1.67	5265.04	7	18
screens (horizontal) vibrating pu	3.118	20.43	-6.29E-01	m^2	#NAME?	1	6.69	111.63	1.67	186.41	1	6
screens (horizontal) vibrating pu	3.118	20.43	-6.29E-01	m^2	1	1	6.69	111.63	1.67	186.41	1	6
screens (horizontal) vibrating pu	-126.6	42.09	-1.07	m^2	8	8	#NAME?	#NAME?	1.67	#NAME?	7	18
screens (horizontal) vibrating pu	-126.6	42.09	-1.07	m^2	11	12	14.87	262.73	1.67	5265.04	7	18
static screen	1.35E+01	7.83E+00	1.73E+00	m	#NAME?	12	#NAME?	#NAME?	1.67	#NAME?	0.5	3
static screen	3.118	20.43	-6.29E-01	m	#NAME?	8	#NAME?	#NAME?	1.67	#NAME?	1	6
Classifier Hydrocyclone, 20 deg Cone, rubber lined	2.137	1.52E-02	2.47E-05	mm-diameter	1	1	750	27.38	1.67	45.73	100	1300
Classifier Hydrocyclone, 20 deg Cone, rubber lined	2.137	1.52E-02	2.47E-05	mm-diameter	2	2	600	20.11	1.67	67.17	100	1300
Classifier Hydrocyclone, 20 deg Cone, rubber lined	2.137	1.52E-02	2.47E-05	mm-diameter	2	2	600	20.11	1.67	67.17	100	1300
Wemco Drums				tph		4	350	750.00	1.67	3000.00		
36 x 60 RB 135 SECONDARY SHUMAR CRUSHER	-	-	-	-				-	1.67	918.62		
Thickener - free standing tank, mild steel	7.87E+01	3.43E+01	1.21E+00	m (diameter)	1	1	39.44	3311.17	1.67	5529.65	6	15.5
DMS Cyclone				tph	2	2	260	840.00	1.67	437.50		
Magnetic Separartor,wet drum, 1220 mm diam.	6.96E+01	-4.44E-02	7.61E-04	m^3/h	#NAME?	4		69.57	1.67	116.18		
C200 Pipe Densifier, 200 mm	4.27	0.023	4.62E-05	mm	#NAME?	4	200	10.72	1.67	35.80	100	1300
Pumps, vacuum, 60 Torr.,8kPa, Cast Iron, Liquid Iron	8.54E+00	3.10E-02	-1.73E-06	m^3/h	2	2	#NAME?	#NAME?	1.67	#NAME?	5	280
Pumps(slurry duties-rubber lined)	5.29E+00	4.88E-02	1.21E-04	m^3/h	1	2	#NAME?	#NAME?	1.67	#NAME?	5	280
Pumps, vacuum, 60 Torr.,8kPa, Cast Iron, Liquid Iron	8.54E+00	3.10E-02	-1.73E-06	m^3/h	1	2	#NAME?	#NAME?	1.67	#NAME?	5	280
Pumps(slurry duties-rubber lined)	5.29E+00	4.88E-02	1.21E-04	m^3/h	1	2	#NAME?	#NAME?	1.67	#NAME?	5	280
Pumps, vacuum, 60 Torr.,8kPa, Cast Iron, Liquid Iron	8.54E+00	3.10E-02	-1.73E-06	m^3/h	2	2	#NAME?	#NAME?	1.67	#NAME?	5	280
Pumps(Clearwater)	7.67E+00	4.86E-02	-6.22E-05	m^3/h	1	2	#NAME?	#NAME?	1.67	#NAME?	5	280
Pumps(slurry duties-rubber lined)	5.29E+00	4.88E-02	1.21E-04	m^3/h	2	2	#NAME?	#NAME?	1.67	#NAME?	5	280
Pumps(Clearwater)	7.67E+00	4.86E-02	-6.22E-05	m^3/h	2	2	#NAME?	#NAME?	1.67	#NAME?	5	280
Pumps(Clearwater)	7.67E+00	4.86E-02	-6.22E-05	m^3/h	2	4	#NAME?	#NAME?	1.67	#NAME?	5	280
Pumps(Clearwater)	7.67E+00	4.86E-02	-6.22E-05	m^3/h	1	4	#NAME?	#NAME?	1.67	#NAME?	5	280
Pumps(Clearwater)	7.67E+00	4.86E-02	-6.22E-05	m^3/h	2	2	#NAME?	#NAME?	1.67	#NAME?	5	280
Tank(mild steel 60 deg cone) Natural rubber	6.14E+01	5.38E-01	1.54E-05	m^3	4	4.00	#NAME?	#NAME?	1.67	#NAME?	20	200
Tank(mild steel 60 deg cone) Natural rubber	1.79E+01	1.04E+00	-1.17E-03	m^3	1	1	#NAME?	#NAME?	1.67	#NAME?	20	200
Tank(mild steel 60 deg cone) Natural rubber	1.79E+01	1.04E+00	-1.17E-03	m^3	1	2	#NAME?	#NAME?	1.67	#NAME?	20	200
Tank(mild steel 60 deg cone) Natural rubber	1.79E+01	1.04E+00	-1.17E-03	m^3	1	1	#NAME?	#NAME?	1.67	#NAME?	20	200
Tank(mild steel 60 deg cone) Natural rubber	1.79E+01	1.04E+00	-1.17E-03	m^3	1	1	#NAME?	#NAME?	1.67	#NAME?	20	200
Tank(mild steel 60 deg cone) Natural rubber	1.79E+01	1.04E+00	-1.17E-03	m^3	1	1	#NAME?	#NAME?	1.67	#NAME?	20	200
Tank(mild steel 60 deg cone) Natural rubber	1.79E+01	1.04E+00	-1.17E-03	m^3	1	6.00	#NAME?	#NAME?	1.67	#NAME?	20	200
Tank(mild steel 60 deg cone) Natural rubber	1.79E+01	1.04E+00	-1.17E-03	m^3	1	2.00	#NAME?	#NAME?	1.67	#NAME?	20	200
Tank(mild steel 60 deg cone) Natural rubber	1.79E+01	1.04E+00	-1.17E-03	m^3	1	1.00	#NAME?	#NAME?	1.67	#NAME?	20	200
Tank(mild steel 60 deg cone) Natural rubber	1.79E+01	1.04E+00	-1.17E-03	m^3	1	2.00	#NAME?	#NAME?	1.67	#NAME?	20	200
	6.14E+01	5.38E-01	1.54E-05	m^3	2	4	#NAME?	#NAME?	1.67	#NAME?		
Electric, squirrel cage,380V,1420/1440 to 1490 rpm,3 phase	-6.17E-01	2.9970E-01	-5.049E-04	kW,Power	2	2	127.00	29.30	1.67	48.93	10	200
Motors, electric, DC, 380 V. variable speed. Range 10:1	8.19E+00	8.95E-01	-9.44E-03	kW,Power	1	2	19.00	21.78	1.67	36.38	2.5	25
Electric, squirrel cage,380V,1420/1440 to 1490 rpm,3 phase	-6.17E-01	2.9970E-01	-5.049E-04	kW,Power	1	2	70.00	17.89	1.67	29.87	10	200
Motors, electric, DC, 380 V. variable speed. Range 10:1	8.19E+00	8.95E-01	-9.44E-03	kW,Power	1	2	7.00	13.99	1.67	23.36	2.5	25
Electric, squirrel cage,380V,1420/1440 to 1490 rpm,3 phase	-6.17E-01	2.9970E-01	-5.049E-04	kW,Power	2	2	30.00	7.92	1.67	13.23	10	200
Motors, electric, DC, 380 V. variable speed. Range 10:1	8.19E+00	8.95E-01	-9.44E-03	kW,Power	1	2	7.00	13.99	1.67	23.36	2.5	25
Electric, squirrel cage,380V,1420/1440 to 1490 rpm,3 phase	-6.17E-01	2.9970E-01	-5.049E-04	kW,Power	2	2	63.00	16.26	1.67	27.15	2.5	25
Electric, squirrel cage,380V,1420/1440 to 1490 rpm,3 phase	-6.17E-01	2.9970E-01	-5.049E-04	kW,Power	2	2	30.00	7.92	1.67	13.23	10	200
Electric, squirrel cage,380V,1420/1440 to 1490 rpm,3 phase	-6.17E-01	2.9970E-01	-5.049E-04	kW,Power	2	2	50.00	13.11	1.67	21.89	10	200
Motors, electric, DC, 380 V. variable speed. Range 10:1	8.19E+00	8.95E-01	-9.44E-03	kW,Power	1	2	50.00	29.33	1.67	48.98	2.5	25
Motors, electric, DC, 380 V. variable speed. Range 10:2	8.19E+00	8.95E-01	-9.44E-03	kW,Power	2	2	19.00	21.78	1.67	36.38	2.5	25
valves, pinch type, cast iron, complete installed	1.98E-01	9.02E-03	1.58E-05	mm-diameter	20	20	50	0.69	1.67	1.15	2.5	25
Conveyor, belt, 12 Deg inclined, belt width 1050 mm	9.36E+01	5.20E+00	1.01E-02	m	1	1	75	539.81	1.67	901.48	5	240
Conveyors horizontal 600mm	5.86E+01	9.48E-01	6.10E-04	m	1	1	75	133.13	1.67	222.32	5	400
Conveyors horizontal 600mm	5.86E+01	9.48E-01	6.10E-04	m	1	1	75	133.13	1.67	222.32	5	400
Conveyors horizontal 600mm	5.86E+01	9.48E-01	6.10E-04	m	1	1	75	133.13	1.67	222.32	5	400
Conveyors horizontal 600mm	5.86E+01	9.48E-01	6.10E-04	m	1	1	75	133.13	1.67	222.32	5	400
Conveyors horizontal 600mm	5.86E+01	9.48E-01	6.10E-04	m	1	1	75	133.13	1.67	222.32	5	400
Conveyor, belt, 12 Deg inclined, belt width 600 mm	1.07E+02	1.71E+00	1.27E-02	m	1	2	150	648.63	1.67	1083.20	5	240
Conveyors horizontal 600mm	5.86E+01	9.48E-01	6.10E-04	m	1	1	125	186.63	1.67	311.68	5	400
Conveyors horizontal 600mm	5.86E+01	9.48E-01	6.10E-04	m	1	1	75	133.13	1.67	222.32	5	400
Conveyors horizontal 600mm	5.86E+01	9.48E-01	6.10E-04	m	1	1	75	133.13	1.67	222.32	5	400
Conveyors horizontal 600mm	5.86E+01	9.48E-01	6.10E-04	m	1	1	50	107.51	1.67	179.55	5	400
Conveyors horizontal 600mm	5.86E+01	9.48E-01	6.10E-04	m	1	1	50	107.51	1.67	179.55	5	400
Conveyor, belt, 12 Deg inclined, belt width 600 mm	1.07E+02	1.71E+00	1.27E-02	m	1	2	150	648.63	1.67	1083.20	5	240
Conveyors horizontal 600mm	5.86E+01	9.48E-01	6.10E-04	m	1	1	75	133.13	1.67	222.32	5	400
Bins, Mild Steel	4.04E+01	-4.37E-01	6.54E-03	m^3	#NAME?	10	#NAME?	#NAME?	1.67	#NAME?	50	200
Silo's, concrete, (storage of ore)	1.18E+02	2.60E-01	1.73E-05	m^3	2.00	2	#NAME?	#NAME?	1.67	#NAME?	400	2000

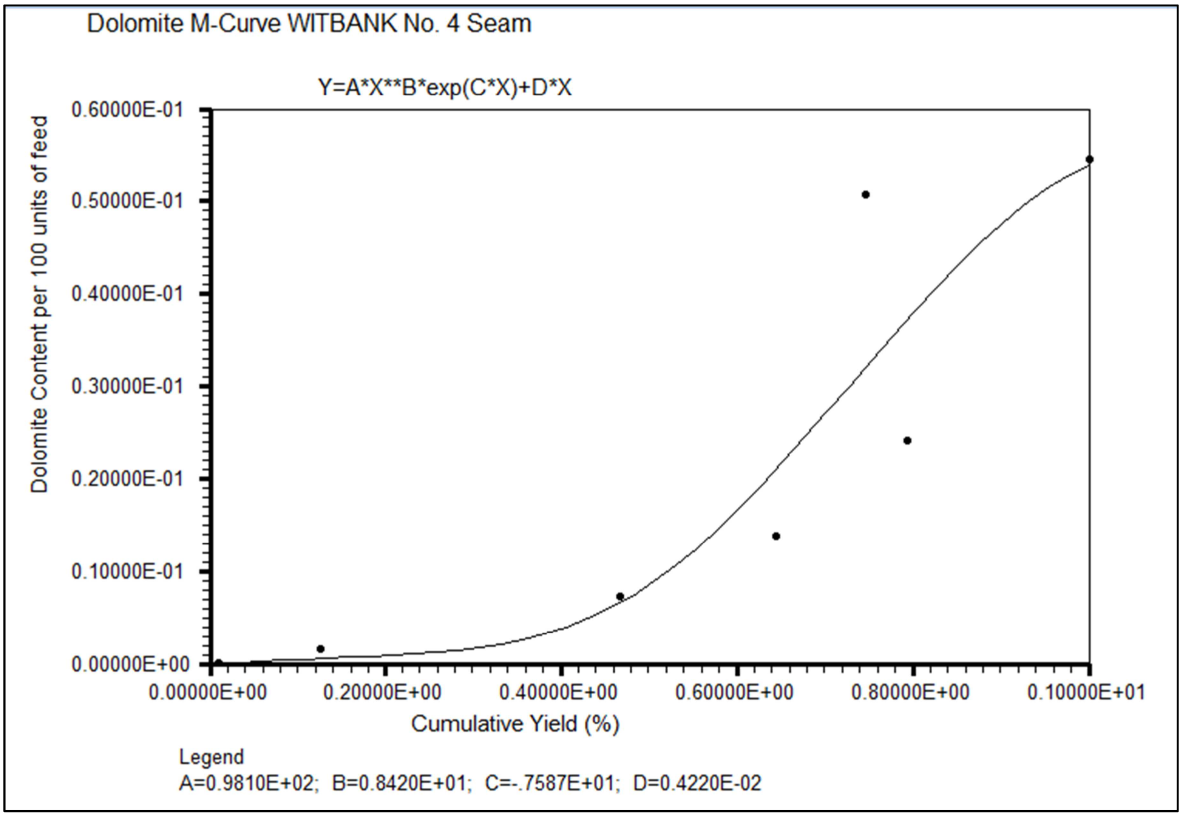
Table XX: Block Seams, Sub Seams and intra seam partings. Thickness cut off for total ES1, ES2 and ES3 at 1.5m. (AATC Geology Department)

Table 5.2.1: PUE	0.97	Interbanded and interlaminated bright and dull coal and carbonaceous mudstone	16.15	29.29
PUP2	1.02	Mudstone	0.92	2.10
PUD	5.01	Interbanded and interlaminated bright and dull coal and carbonaceous mudstone	13.31	24.96
PUC	5.20	Interbanded and interlaminated bright and dull coal and carbonaceous mudstone	17.49	32.51
PUB	3.72	Interbanded and interlaminated bright and dull coal and carbonaceous mudstone	12.49	24.07
PUP1	1.41	Mudstone	1.53	4.05
PUA	3.24	Interbanded and interlaminated bright and dull coal and carbonaceous mudstone	15.21	27.93
PMP1	2.04	Mudstone	1.38	3.42
PMD	5.22	Interbanded and interlaminated bright and dull coal and carbonaceous mudstone	9.27	18.92
PMC	6.40	Interbanded and interlaminated bright and dull coal and carbonaceous mudstone	12.68	25.29
PMB	3.63	Interbanded and interlaminated bright and dull coal and carbonaceous mudstone	7.80	16.27
PMA	7.39	Interbanded and interlaminated bright and dull	9.77	19.94

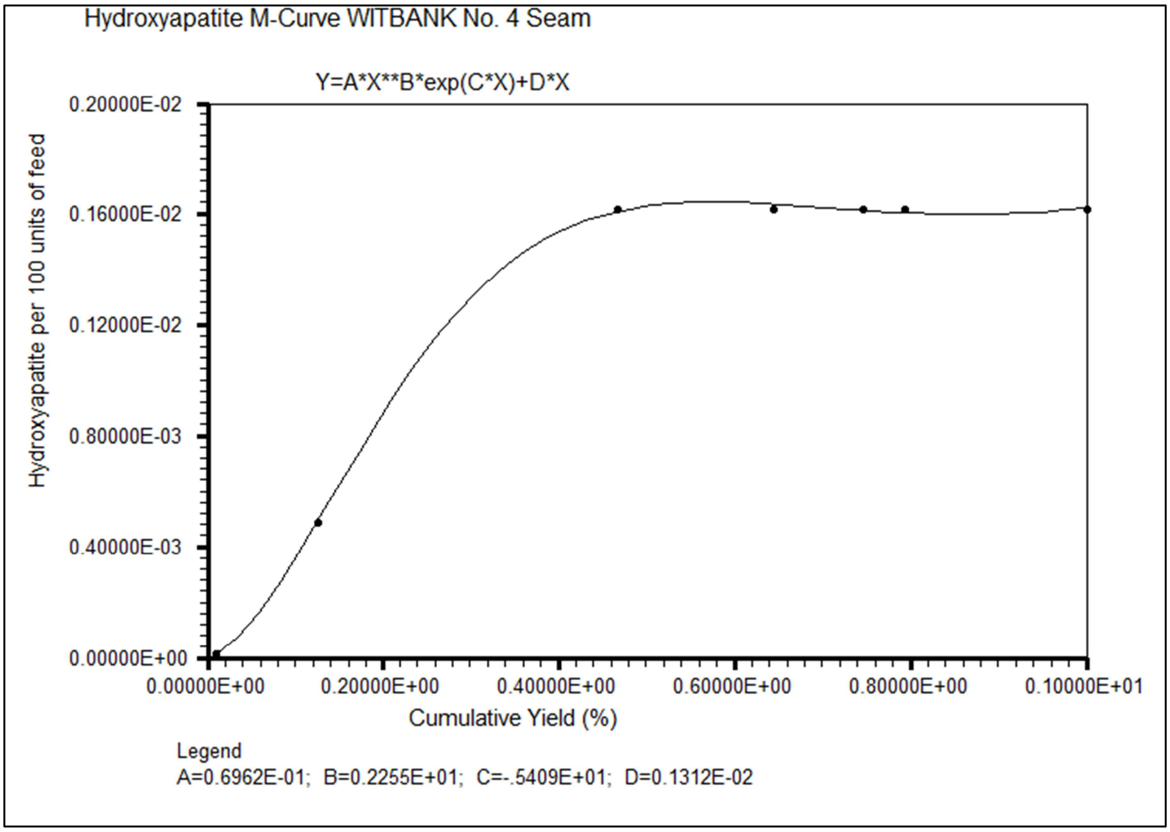
		coal and carbonaceous mudstone		
PLP2	2.23	Mudstone	3.59	10.31
PLC	9.87	Interbanded and interlaminated bright and dull coal and carbonaceous mudstone	10.58	22.75
PLB	8.10	Interbanded and interlaminated bright and dull coal and carbonaceous mudstone	13.19	29.18
PLP1	3.09	Mudstone	2.12	5.66
PLA	3.15	Interbanded and interlaminated bright and dull coal and carbonaceous mudstone	13.24	28.66
TRP2	2.86	Mudstone	2.19	5.77
TRB	6.70	Interbanded and interlaminated dull coal and carbonaceous mudstone	7.54	18.56
TRA	3.83	Interbanded and interlaminated dull coal and carbonaceous mudstone	11.33	26.40
TRP1	3.70	Mudstone	3.36	8.35
ES3	2.26	Dull Coal	15.65	35.95
ES2	3.92	Interbanded dull and bright coal	18.68	40.93
ES2U	1.73	Interbanded dull coal and carbonaceous mudstone	14.36	35.03
ES2S	2.01	Interbanded dull and bright coal	21.48	46.88
ES2L	0.99	Interbanded dull coal and carbonaceous mudstone	15.62	29.82
ES1	2.87	Interbanded dull and bright coal	20.51	46.45

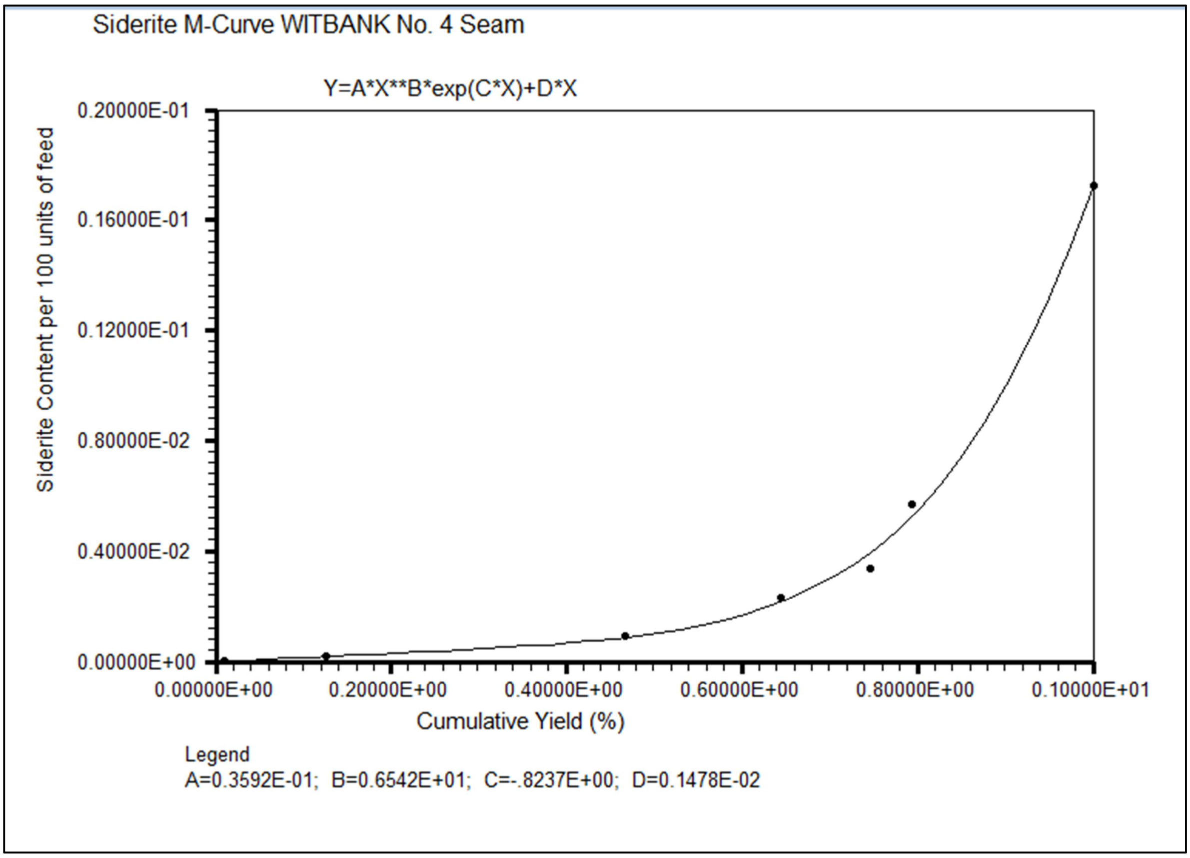
Table XXI: Remainder of WC4S mineral liberation curves

Dolomite



Apatite




Siderite M-Curve WITBANK No. 4 Seam
Y=A*X**B*exp(C*X)+D*X
Siderite Content per 100 units of feed
0.20000E-01
0.16000E-01
0.12000E-01
0.80000E-02
0.40000E-02
0.00000E+00
0.00000E+00
0.20000E+00
0.40000E+00
0.60000E+00
0.80000E+00
0.10000E+01
Cumulative Yield (%)
Legend
A=0.3592E-01; B=0.6542E+01; C=-.8237E+00; D=0.1478E-02

Quartz

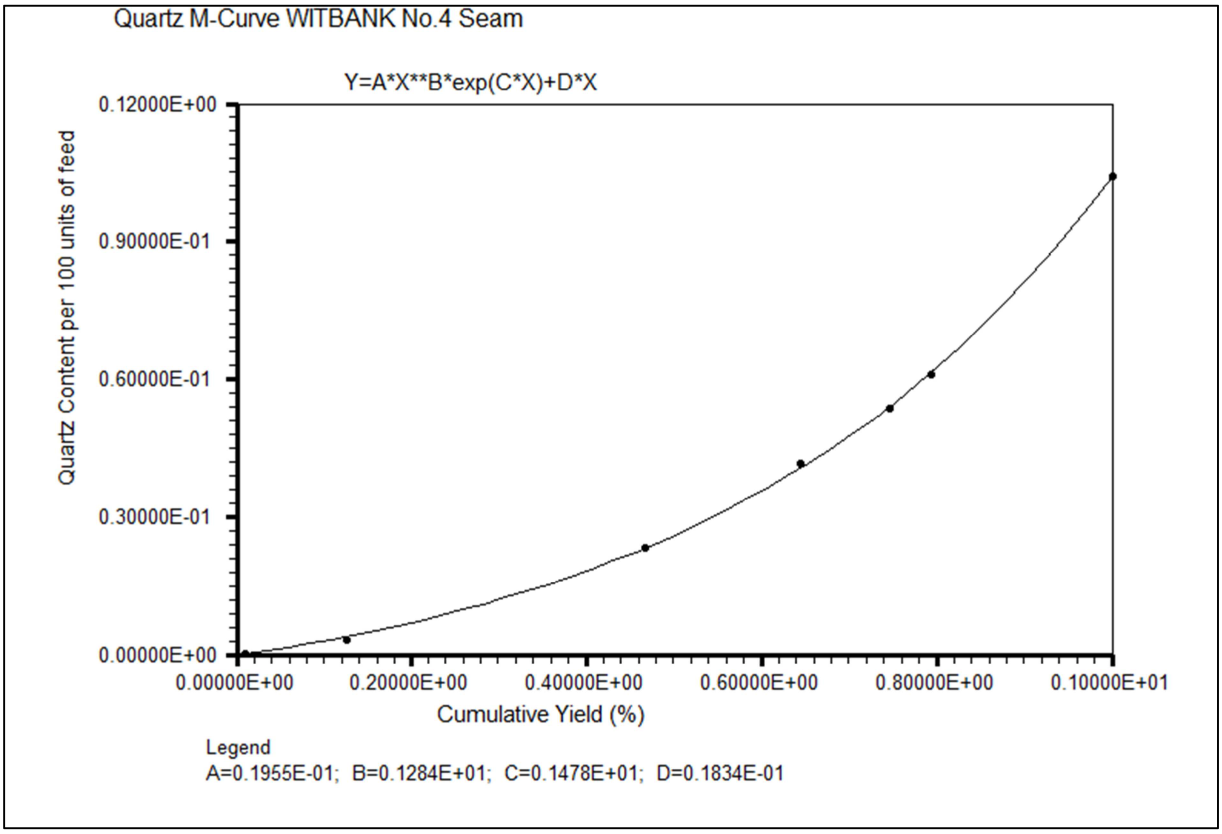
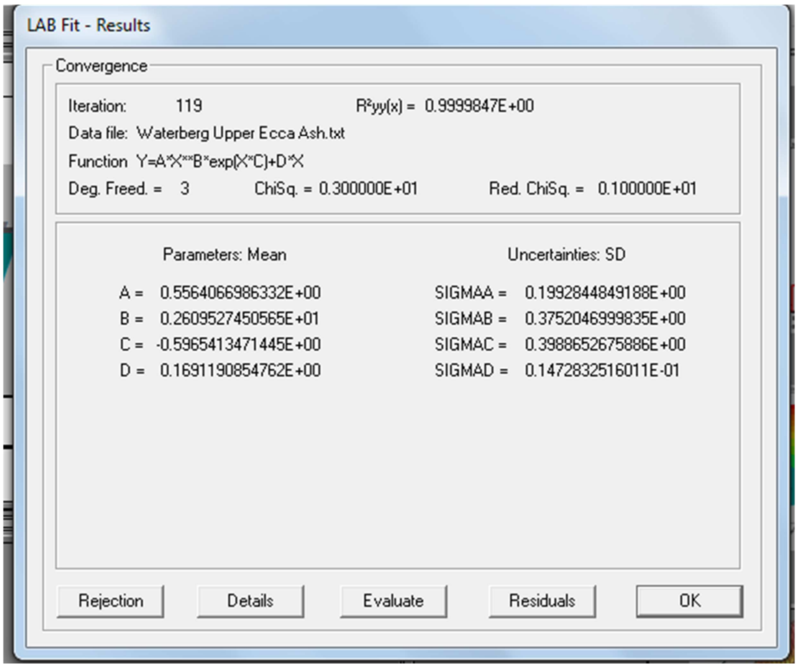
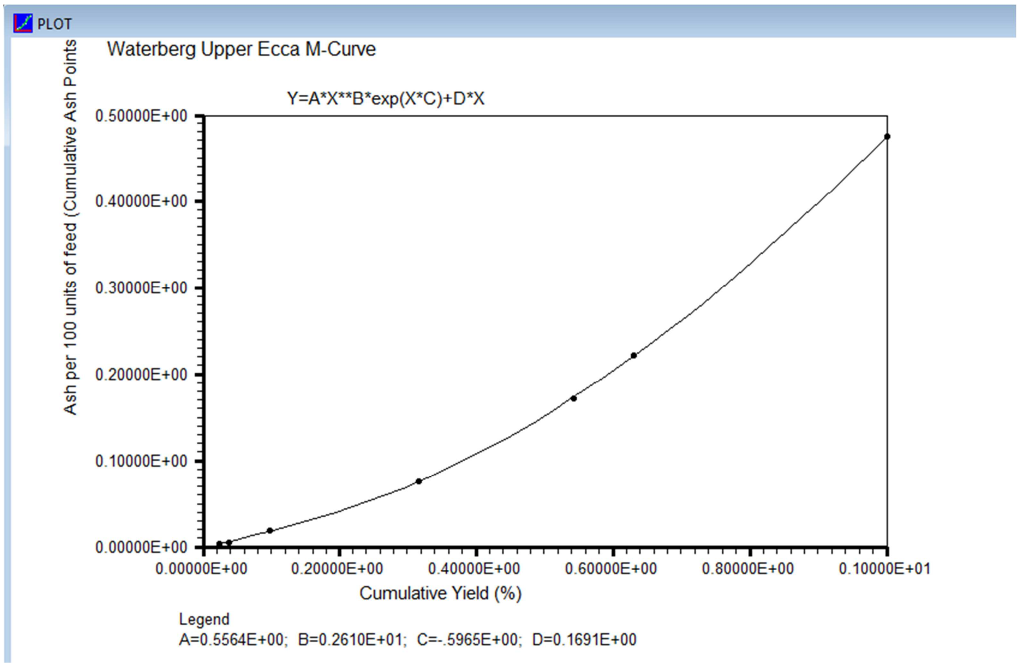

Quartz M-Curve WITBANK No.4 Seam
Y=A*X**B*exp(C*X)+D*X
Quartz Content per 100 units of feed
0.12000E+00
0.90000E-01
0.60000E-01
0.30000E-01
0.00000E+00
0.00000E+00
0.20000E+00
0.40000E+00
0.60000E+00
0.80000E+00
0.10000E+01
Cumulative Yield (%)
Legend
A=0.1955E-01; B=0.1284E+01; C=0.1478E+01; D=0.1834E-01

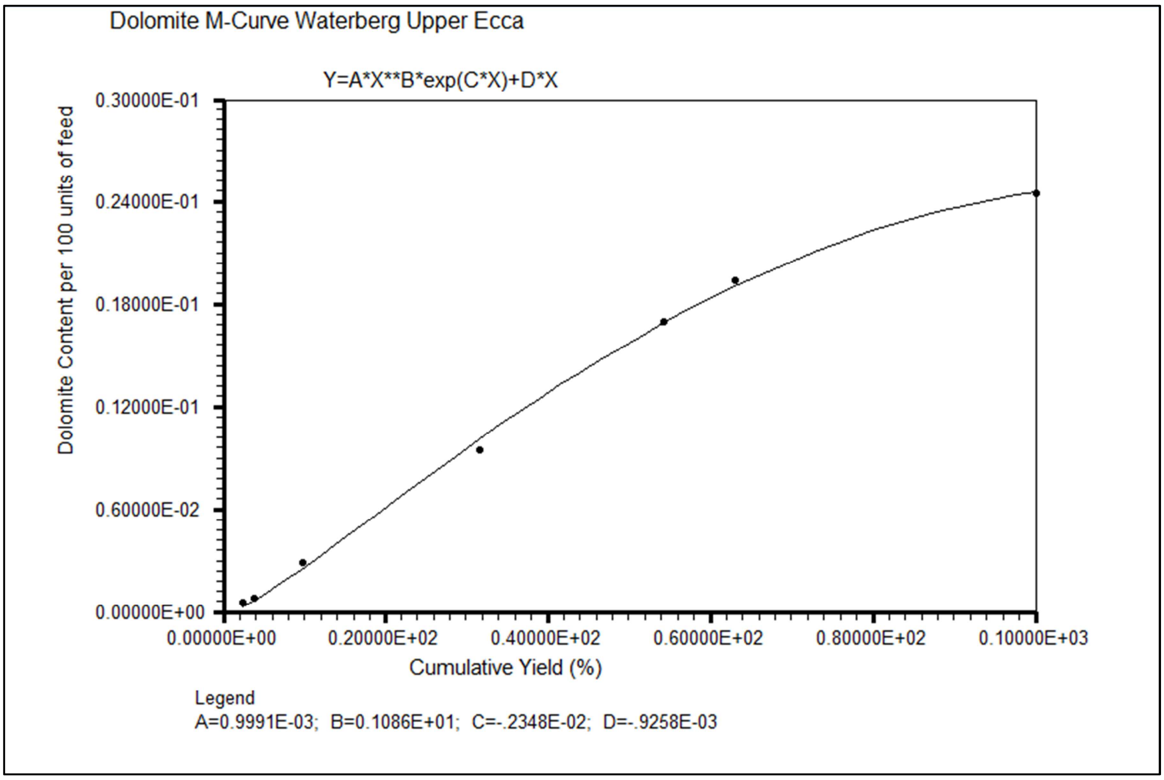
Table XXII: Remainder of WBUE general and mineral liberation curves

General Ash

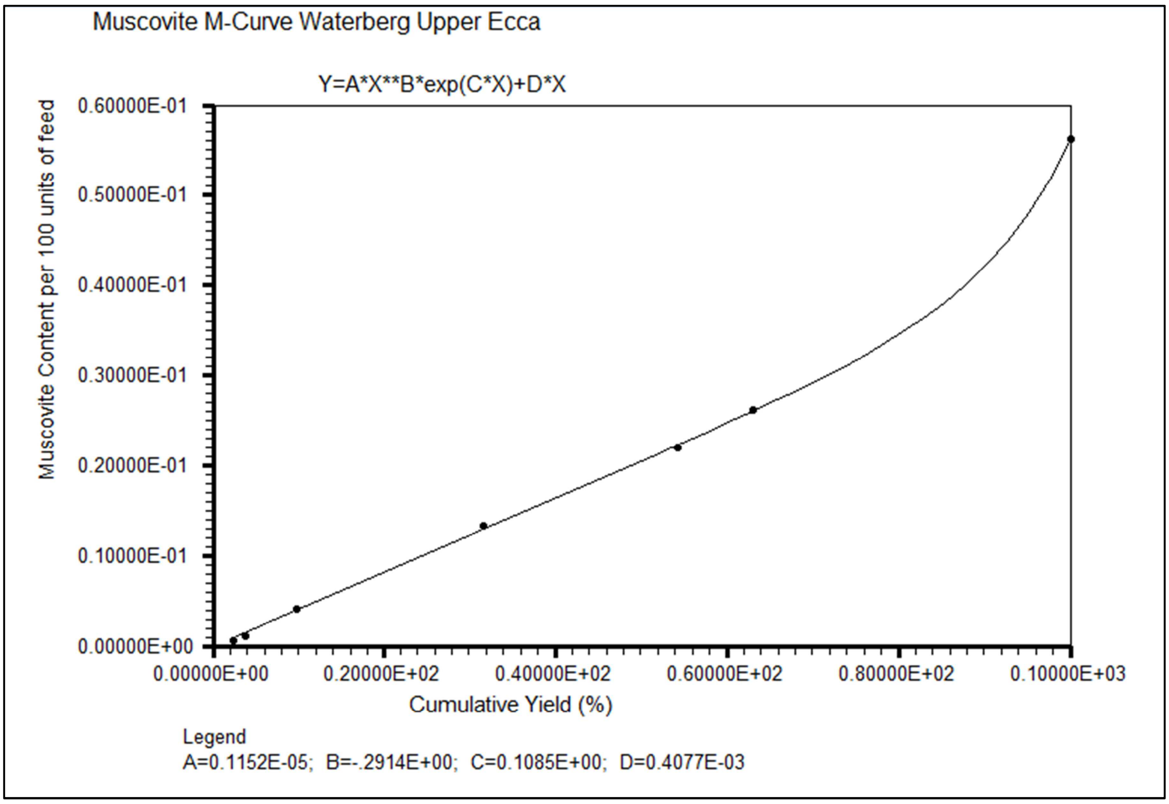




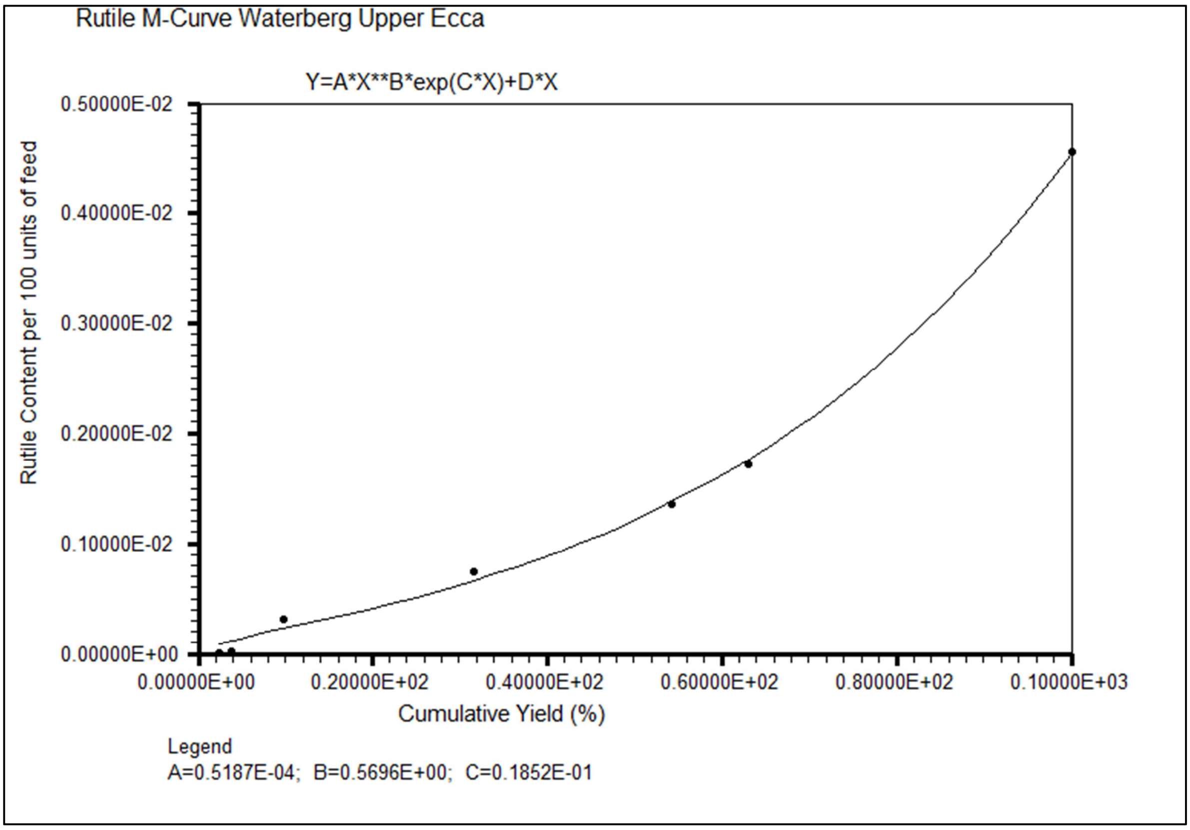
Dolomite



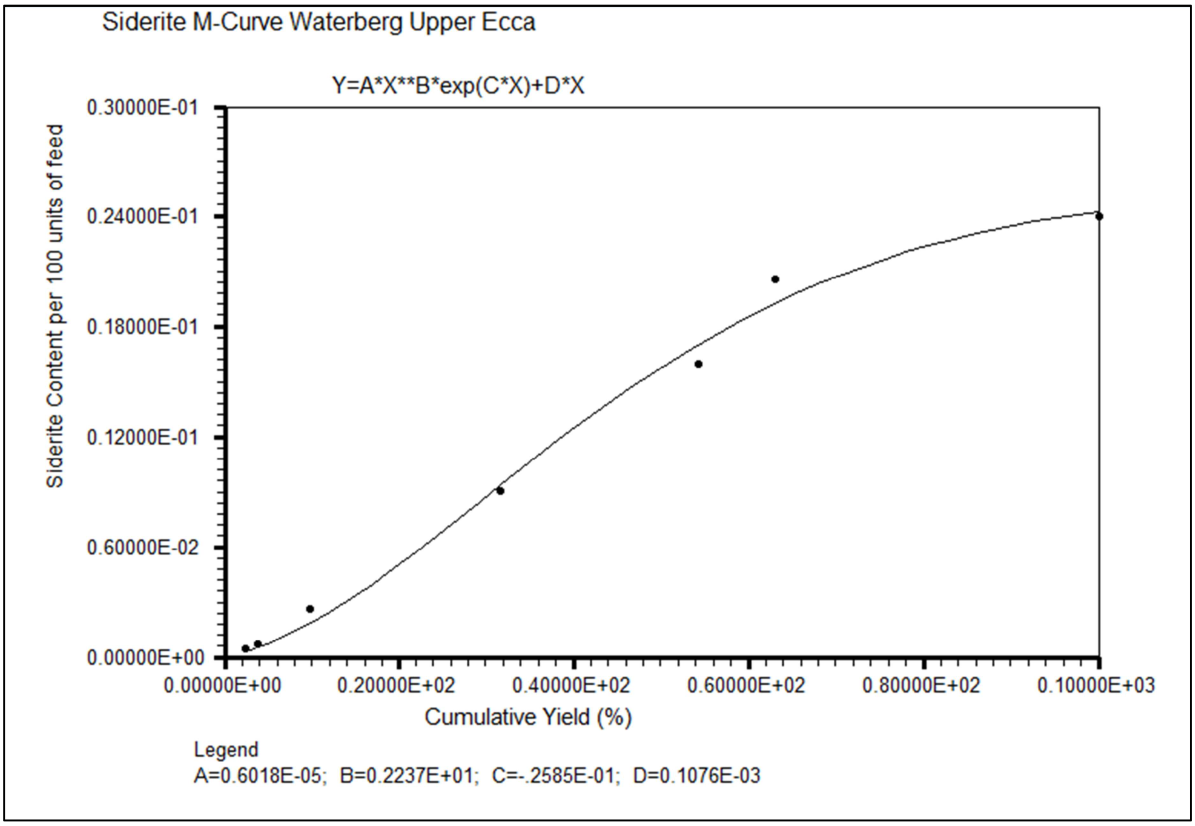
Muscovite



Rutile



Siderite



Quartz

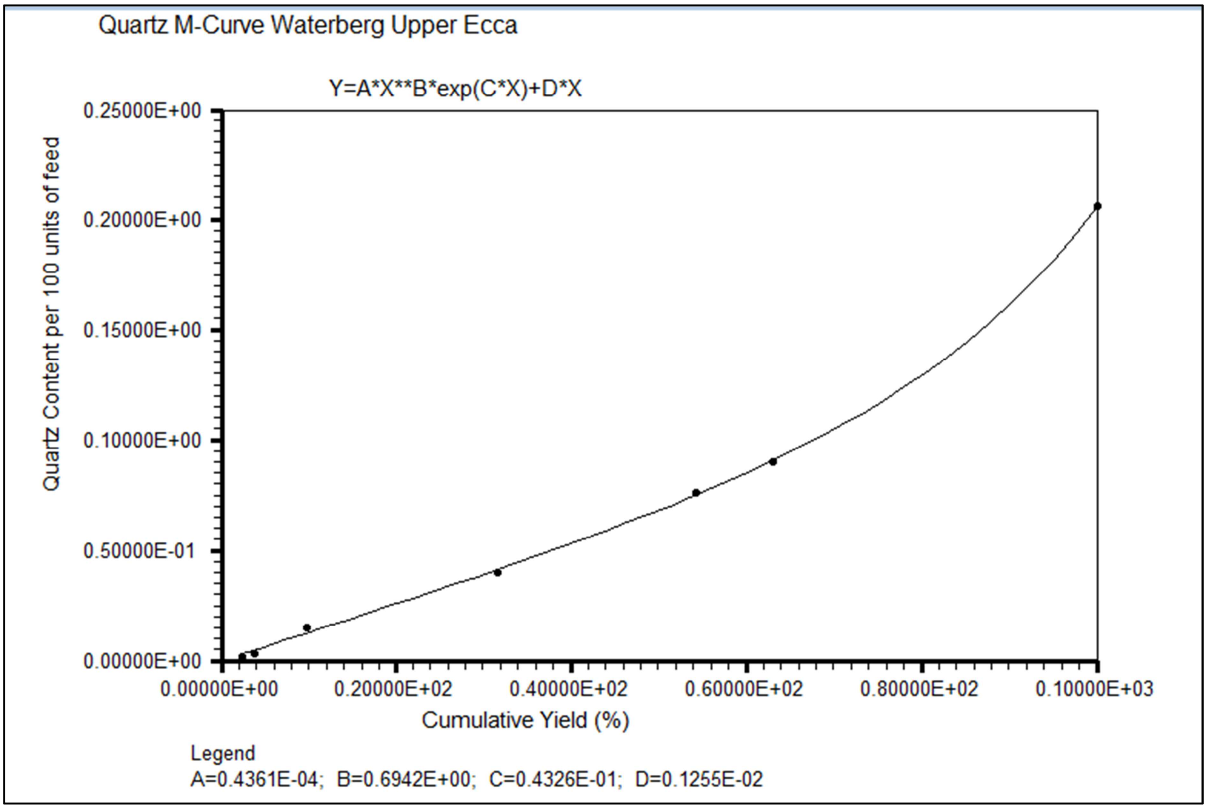
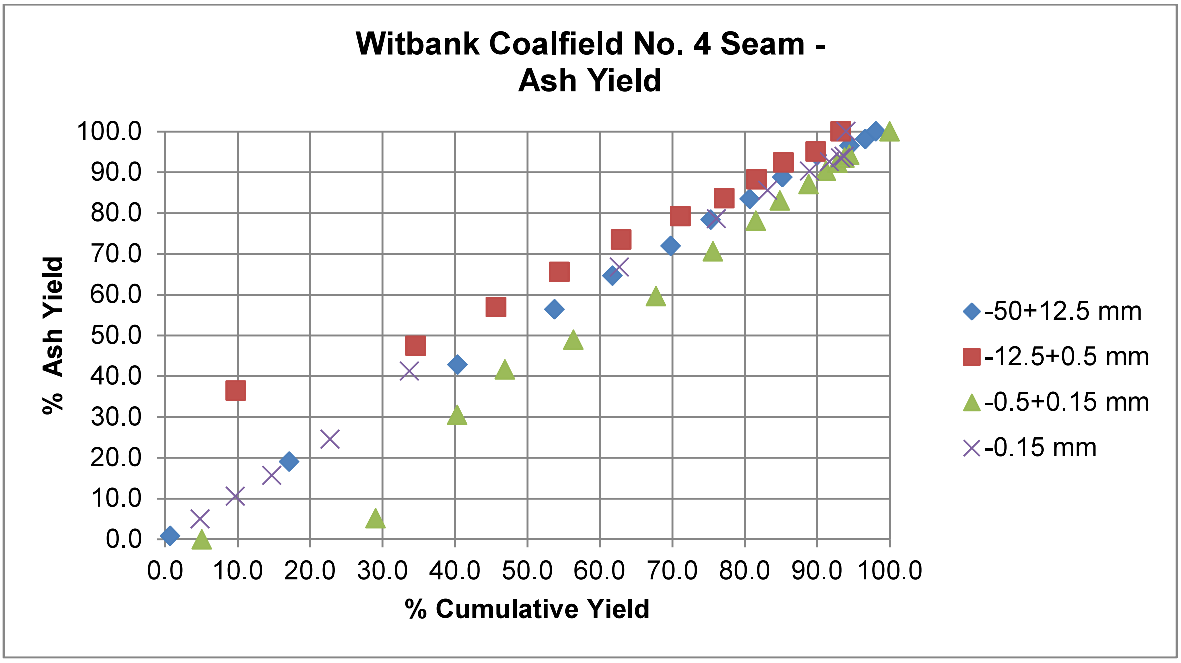
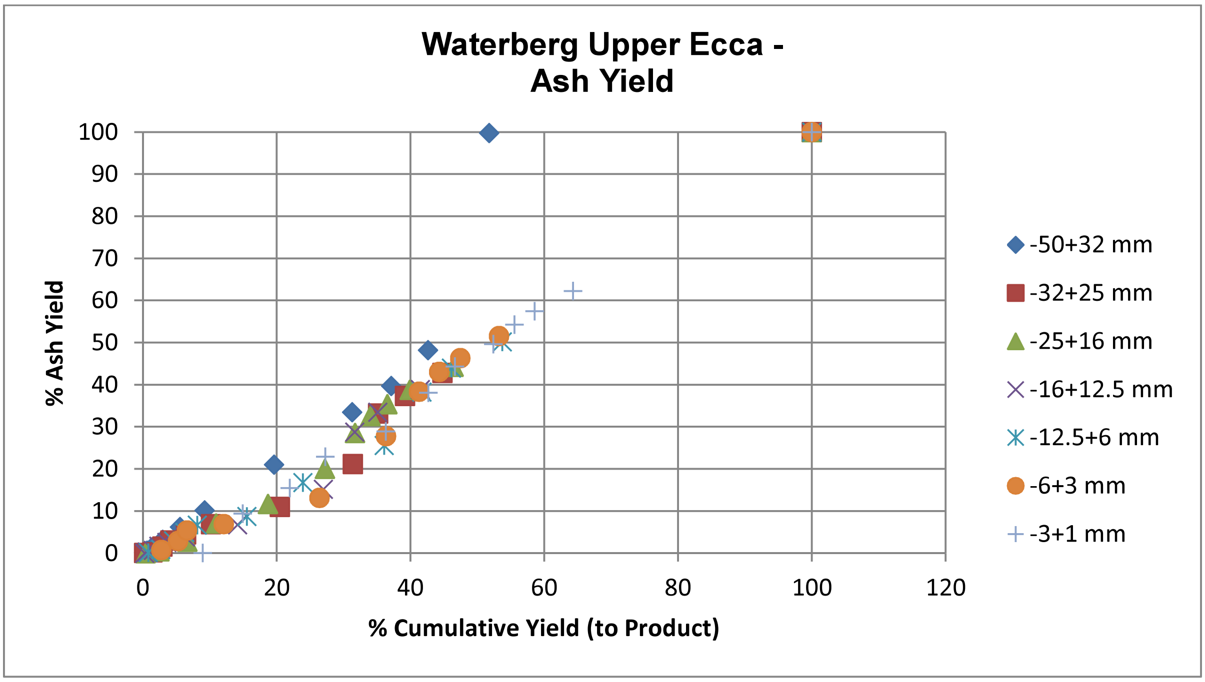

Quartz M-Curve Waterberg Upper Ecca
Y=A*X**B*exp(C*X)+D*X
Quartz Content per 100 units of feed
0.25000E+00
0.20000E+00
0.15000E+00
0.10000E+00
0.50000E-01
0.00000E+00
0.00000E+00
0.20000E+02
0.40000E+02
0.60000E+02
0.80000E+02
0.10000E+03
Cumulative Yield (%)
Legend
A=0.4361E-04; B=0.6942E+00; C=0.4326E-01; D=0.1255E-02

Table XXIII: Ash yield curves at various liberated sizes





Appendix F. Petrographic Analysis Reports

F.1 Witbank Coalfield

TEST REPORT

A PETROGRAPHIC INVESTIGATION OF

SEVEN GOEDEHOOP COLLIERY COALS:

NO.	SAMPLE	FRACTION
1	2804275	F @-1.30
2	2804276	1.30-1.40
3	2804277	1.40-1.50
4	2804278	1.50-1.60
5	2804279	1.60-1.70
6	2804280	1.70-1.80
7	2804281	S @-1.80

REQUESTED BY ANGLO COAL

VM du Cann

Coal and Organic Petrology

Independent Consultant

PETROGRAPHICS SA

PSA 2011-199

PRETORIA

SOUTH AFRICA

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CONTENTS

APPENDIX:

A PETROGRAPHIC INVESTIGATION OF SEVEN GOEDEHOOP COLLIERY COALS REQUESTED BY ANGLO COAL

1 INTRODUCTION

Mr. Kobus Bergh, of Anglo Operations Limited, Goedehoop Colliery, requested that Petrographics SA carry out microscopic analyses on seven bituminous coals.

The samples were marked:

NO.	BLOCK	FRACTION
1	275	F @-1.30
2	276	1.30-1.40
3	277	1.40-1.50
4	278	1.50-1.60
5	279	1.60-1.70
6	280	1.70-1.80
7	281	S @-1.80

2 OBJECTIVES

The main purpose of this investigation was to assess the coals in terms of their petrographic properties (rank, organic composition, mineral groups and general condition).

3 BACKGROUND AND INFORMATION

A brief summary of the basic aspects of coal petrology

Coals are complex combustible sedimentary rocks formed from consolidated plant remains.

They can be ranked as lignite, sub-bituminous coal, bituminous coal or anthracite according to their degree of maturation in the continuous evolution towards a pure carbon structure.

Coal petrology involves the microscopic examination of coals together with the interpretation of the analytical data and can provide valuable information regarding organic composition, maturity and the associations of the organic matter and minerals that the coals contain.

Petrographic data should be used, together with chemical and physical parameters, for the full characterization of coals necessary to gain insight into their behaviour in technological processes.

3.1 Classification

Coals can be classified according to three major fundamental and independent parameters:

- **Organic composition:**

This relates to the **microscopically discernable organic components of coal that are termed "macerals"** and which are analogous to minerals in inorganic rocks.

Three maceral groups are recognized - *vitrinite, liptinite and inertinite*.

These are distinguished from one another under the petrographic microscope by differences in reflectance, morphology, colour, shape, size, polishing hardness and fluorescence.

Their optical, physical, chemical and technological characteristics alter as the coal matures.

- **Rank:**

This refers to the **degree of maturation**, i.e., the stage in the evolution or coalification of the plant remains.

- **Grade:**

This relates to the impurities present, conveniently represented by the **ash yield** (incombustibles remaining after burning).

The organic composition (i.e., the relative proportions of the macerals), the rank, the grade and the "freshness" of a coal, together with the process conditions applied, are all influential factors governing the technological performance of the coal.

3.2 Reactivity to heating

When bituminous rank coal is heated to temperatures above approximately 350°C, vitrinites, liptinites and some inertinites start to soften, become plastic and expand. The rest of the inertinites and most of the minerals remain largely unchanged. The degree of expansion is influenced by the heating rate and the final temperature applied. As the volatiles are released, vesicles may be formed in the reactive coal macerals.

Reactives-rich components in bituminous coal increase in volume on heating to form cellular structures producing porous coke/char. These products then provide greatly increased surface areas for reactions to occur.

Most inertinites however, and particularly fusinites, do not soften, degasify or develop into porous structures, but form quite dense chars.

4 EXPERIMENTAL

A petrographic block of each coal sample was prepared by WITS University in accordance with the ISO Standard 7404 - 2, 1985 and then examined under the microscope at Petrographics SA.

Maceral analysis (to determine the petrographic compositions of the coals) and reflectance measurements (to determine the rank) were carried out.

The group maceral analysis was carried out in accordance with the ISO Standard 7404 - 3, 1994.

The reactive inertinite macerals were identified according to Smith, Roux and Steyn for South African coals (reference: Smith, WH, Roux, HJ and Steyn, JGH (1983): The classification of coal macerals and their relation to certain chemical and physical parameters of coal. Special publication of the Geological Society of South Africa, 7:111-115).

Vitrinite random reflectance measurements (100 over the polished surface of each particulate petrographic block) were taken in accordance with the ISO Standard 7404 - 5, 1994.

Microlithotype, carbominerite and minerite analyses (to determine the organic/inorganic associations) were conducted in accordance with the ISO Standard 7404 – 4, 1988.

Mineral group analysis was also performed on each coal sample. In this type of analysis, the components were quantified using a 500 point-count technique as described in the ISO Standard 7404 - 3, 1994.

5 PRESENTATION OF RESULTS

The results of the analyses are shown in the Appendix as follows:

Table 1: Coal maceral analysis and mean reflectance values

Table 2: Vitrinite random reflectance data

Table 3: Microlithotype analysis

Table 4: Explanation of abbreviations and terms

Table 5: Mineral group analysis

Table 6: Summary of major petrographic characteristics

Table 7: Organic constituent analysis - repeatability limit

Vitrinite reflectance histograms

6 DISCUSSION

6.1 REFLECTANCE PROPERTIES

Reflectance measurements were conventionally taken on the vitrinite maceral Telovitrinite.

The vitrinite random reflectance measurements showed that, according to the ISO 11760 - 2005 Coal Classification, these coals are characterized as bituminous, **Medium Rank C coals**.

The rank parameter of the Classification is based on vitrinite random reflectance.

The mean random reflectance values were as follows:

No.	BLOCK	Fraction	Rr %	Distribution %	σ	Rank designation
1	275	F @-1.30	0.74	V 5 – V 9	0.072	Medium Rank C
2	276	1.30-1.40	0.76	V 6 – V 9	0.074	Medium Rank C
3	277	1.40-1.50	0.76	V 6 – V 9	0.077	Medium Rank C
4	278	1.50-1.60	0.75	V 6 – V 9	0.086	Medium Rank C
5	279	1.60-1.70	0.77	V 5 – V 9	0.080	Medium Rank C
6	280	1.70-1.80	0.78	V 5 – V 10	0.098	Medium Rank C
7	281	S @-1.80	0.79	V 6 – V 10	0.093	Medium Rank C

See Tables 1 and 2, and the reflectance histograms.

- The vitrinite-class distributions of the samples showed standard deviations of < 0.1, typical of non-blend coals (terminology of the ECE-UN[1] International Codification System for Medium and High Rank coals).

[1] Economic Commission for Europe of the United Nations

6.2 PETROGRAPHIC COMPOSITION

6.2.1 In terms of the maceral analysis (mmf) - see Table 1:

- The vitrinite and total reactive maceral contents of the samples showed reductions with increase in relative density (percentages given by volume, mineral matter-free basis).

- The changes in organic composition were substantial from the F @-1.30 to the 1.50-1.60 fraction (vitrinite concentrations from 75% down to 16% and total reactives from 86% to 48%, with corresponding increases in total inertinites from 18% up to 80%).

- Thereafter, the changes in the relative proportions of the vitrinite, total reactives and total inertinites from the 1.60-1.70 fraction to the S @-1.80 were slight (within 5% mmf in all three organic categories).

For the purposes of the current investigation, reactivity is defined as the propensity of the organic constituents of the coal to react to heating.

The considerations that follow are based purely on the characteristics of the products as expressed by the petrographic analyses.

These properties, together with the chemical and physical characteristics, give insight into expected behaviour. They do not take into account the specific conditions to which the coals may be subjected, nor do they consider the possible kinetics and chemical reactions that may occur in a particular process.

It is generally accepted that the vitrinites and liptinites of bituminous coals are the reactive organic components (macerals).

Also, certain inertinite group macerals are known to behave in a similar manner to vitrinites. Such reactive inertinites are identified as those inertinites (semifusinites and inertodetrinites) displaying low relief, with colour and reflectance very similar to those of the associated vitrinites in a coal.

At sufficiently high temperature, the vitrinites and reactive inertinites of bituminous coals degasify, soften, swell and form porous chars, providing increased surface areas for reactions to occur easily and rapidly.

Inert coal macerals do not degasify as readily as vitrinite or become porous on heating and consequently form dense chars.

The total reactive maceral contents (<u>mineral matter-free basis</u>) were made up as follows:

No.	BLOCK	Fraction	Total reactives %	Vitrinite %	Liptinite %	Reactive inertinite %
1	275	F @-1.30	**86**	75	7	4
2	276	1.30-1.40	**71**	52	7	12
3	277	1.40-1.50	**53**	24	5	24
4	278	1.50-1.60	**48**	16	4	28
5	279	1.60-1.70	**43**	11	3	29
6	280	1.70-1.80	**39**	11	2	26
7	281	S @-1.80	**43**	15	3	25

6.2.2 In terms of the maceral/mineral associations (Microlithotype, carbominerite and minerite analyses, % by volume, mineral matter basis) – see Table 3

Microlithotype counts can provide an indication of relative ease of reaction where vitrinite/liptinite associations are positive factors in the technological process while inertinites and high occurrences of carbominerite can have a negative impact.

No.	BLOCK	Fraction	Vitrite "pure" vitrinite %	Inertite "pure" inertinite %	Intermediates maceral mixtures %	Carbominerite maceral/mineral mixtures %	Minerite mineral rich %

1	275	F @-1.30	43	6	46	4	1
2	276	1.30-1.40	28	19	46	6	1
3	277	1.40-1.50	8	45	35	7	5
4	278	1.50-1.60	8	55	19	11	7
5	279	1.60-1.70	5	50	17	20	8
6	280	1.70-1.80	5	46	18	20	11
7	281	S @-1.80	3	12	7	10	68

- "Pure" vitrinite commonly occurred in the F @-1.30 sample at 43%, decreasing substantially to 8% in the 1.40-1.50 fraction. "Pure" inertinite, initially accounting for a total of 6%, reached a maximum of 55% in the 1.50-1.60 sample before deceasing to 46% at 1.70-1.80.
- Iintermediate maceral/maceral associations showed a strong decrease from 46% down to 19% at 1.50-1.60, with little further change to 1.70-1.80.
- Maceral/mineral mixtures (carbominerite) and mineral-rich particles represented proportions of generally < 10% of the whole coal in the fractions to 1.50-1.60. Thereafter maceral/mineral mixtures increased to 20% at 1.60-1.70 and 1.70-1.80, while mineral-rich particles (minerite) remained relatively unchanged in occurrence at approximately 10%.
- The S @-1.80 sample represented approximately 10% of carbominerite and nearly 70% of minerite.

6.2.3 In terms of the general condition of the coals:

- The majority of the particles examined were of a predominantly "fresh" nature.

  Sometimes, particles displaying cracks and micro-fissures were seen.

  However, some of these cracks may have developed during handling and preparation due to the brittle nature of the coal, particularly vitrinite, at this level of rank.

- Very occasionally, organic particles exhibited signs of severe weathering or general disintegration.

- No severely heat affected or charred particles were encountered in these samples.

Note:

The petrographic properties should be considered together with the chemical and physical data to give insight into the expected behaviour of the coals. It is also critical that the influences of the operating conditions be taken into account in the prediction of the technological performance.

7 PRECISION

- **REFLECTANCE MEASUREMENTS - (Reference: ISO 7404 – 5, 1994)**

Reflectance measurements - Repeatability

The repeatability of the determination of the mean maximum or mean random reflectance is that value of the difference between two single determinations each based on the same number of measurements carried out by the same operator on the same block using the same apparatus, below which 95% of such differences are expected to lie.

The repeatability depends on:

a) Accuracy in calibration

b) Drift in calibration

c) The number of measurements made and the range of reflectance

The combined effect of these factors can be expressed as a standard deviation of the mean reflectance of up to 0.02% for a single seam coal.

This corresponds to a repeatability of up to 0.06%.

Reflectance measurement - Reproducibility

The reproducibility of the determination of the mean maximum or mean random reflectance is that value of the difference between two single determinations each based on the same number of measurements carried out by two different operators on two different sub-samples taken from the same sample, using different equipment, below which 95% of such differences are expected to lie.

Provided that operators are adequately trained in the identification of vitrinite or the appropriate submacerals and that the reflectances of the standards used are reliably known, determinations of the mean reflectance by different operators in different laboratories show standard deviations in the order of 0.03%.

The reproducibility is thus in the order of 0.08%.

- **ORGANIC COMPOSITION**

MACERAL ANALYSIS - REPEATABILITY (Reference: ISO Standard 7404 - 3, 1994)

The theoretical standard deviation and repeatability limit of the percentage of a component, based on counts of 500 points, are shown in Table 7.

TABLE 4

EXPLANATION OF ABBREVIATIONS AND TERMS

MACERAL ANALYSIS *(% by volume, mineral matter-free basis)* - see Table 1

VIT	:	Vitrinite
PV	:	Pseudovitrinite
TV	:	Total vitrinite
S/R/C	:	Sporinite/resinite/cutinite
ALG	:	Alginite
TOT L	:	Total liptinite (formerly referred to as exinite)
RSF	:	Reactive semifusinite
ISF	:	Inert semifusinite
F/SEC	:	Fusinite/secretinite
MIC	:	Micrinite
R INT	:	Reactive inertodetrinite
I INT	:	Inert inertodetrinite
TOT I	:	Total inertinite
Reactive Macerals	**:**	**Vitrinite + liptinite + RSF + reactive inertodetrinite**

REFLECTANCE MEASUREMENTS - see Tables 1 and 2

Rr %	:	Random reflectance of vitrinite, oil immersion
σ	:	Standard deviation

MICROLITHOTYPE ANALYSIS *(% by volume, mineral matter basis)* - see Table 3

VITRITE	:	Vitrinite > 95 %	)
LIPTITE	:	Liptinite > 95 %	) ***Monomacerals***
INERTITE	:	Inertinite > 95 %	)
CLARITE	:	Vitrinite + Liptinite > 95 %	)
DURITE	:	Inertinite + Liptinite > 95 %	) ***Intermediates***
VITRINERTITE	:	Vitrinite + Inertinite > 95 %	)
TRIMACERITE	:	Vitrinite, Inertinite, Liptinite > 5 %	)
CARBOMINERITE	:	Total inorganic/organic microlithotypes	
MINERITE	:	> 60 Vol % minerals	

TABLE 7

Maceral analysis

Theoretical standard deviation and repeatability limit of the percentage of a component, based on counts of 500 points

Volume %	Standard Deviation	Coefficient of Variation	Repeatability limit
5	1.0	20	2.8
20	1.8	9	5.1
50	2.2	4.4	6.3
80	1.8	2.3	5.1
95	1.0	1.1	2.8

For example, if the volume percentage of vitrinite in a sample is 80%, then the analyst can expect to obtain two results differing by less than 5.1 percentage points (e.g. 78% and 83%) in 19 cases out of 20.

Reference: ISO 7404 - 3, 1994

F.2 Waterberg Upper Ecca

TEST REPORT

A PETROGRAPHIC INVESTIGATION OF

FOUR WATERBERG COAL SAMPLES:

No.	Batch	Sample ID	Bottle No.	Fraction
1	A00020337	WBGX Fines	A00020337001	Fines
2	A00020337	WBGX 1.35-1.40	A00020337002	1.35-1.40
3	A00020337	WBGX 1.50-1.70	A00020337003	1.50-1.70
4	A00020337	WBGX 1.90-2.00	A00020337004	1.90-2.00

REQUESTED BY ALS NALEDI (PTY) LIMITED
M 616

VM du Cann

Coal and Organic Petrology

Consultant to Mining and Minerals

SOUTH AFRICAN BUREAU OF STANDARDS

P 017-2012

PRETORIA

SOUTH AFRICA

March 2012

Total number of pages: 20

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APPENDIX:

A PETROGRAPHIC INVESTIGATION OF FOUR WATERBERG COAL SAMPLES REQUESTED BY ALS NALEDI (PTY) LIMITED

M 616

1 INTRODUCTION

Ms. V. Ratshimbilani, of ALS Naledi (Pty) Limited, requested that the Petrographic Laboratory of SABS, Pretoria, carry out analyses on four bituminous coal samples, reference number M 616.

The samples were marked:

No.	Batch	Sample ID	Bottle No.	Fraction
1	A00020337	WBGX Fines	A00020337001	Fines
2	A00020337	WBGX 1.35-1.40	A00020337002	1.35-1.40
3	A00020337	WBGX 1.50-1.70	A00020337003	1.50-1.70
4	A00020337	WBGX 1.90-2.00	A00020337004	1.90-2.00

2 OBJECTIVE

The purpose of this investigation was to assess the coals in terms of their petrographic properties (rank and organic composition).

3 ANALYTICAL METHODS

A petrographic block of each sample was prepared by SABS, Pretoria, in accordance with the ISO Standard 7404 - 2, 1985 and then examined under the microscope at Petrographics SA.

Maceral analysis (to determine the petrographic composition of the coal) and reflectance measurements (to determine the degree of maturity) were carried out.

The group maceral analysis was carried out in accordance with the ISO Standard 7404 - 3, 1994.

The reactive inertinite macerals were identified according to Steyn & Smith for South African coals.

Vitrinite random reflectance measurements (100 on each sample) were taken in accordance with the ISO Standard 7404 - 5, 1994.

Microlithotype, carbominerite and minerite analyses (to determine the organic/inorganic associations) were carried out in accordance with the ISO Standard 7404 - 4. 1988.

4 PRESENTATION OF RESULTS

The results of the maceral analyses and the mean random reflectance values are given in Table 1 in the **Appendix**.

The results of the microlithotype and carbominerite analyses are shown in Tables 2 and 3.

An explanation of the terms used is provided in Table 4.

The reflectance data are set out in Table 5.

A summary of the major characteristics of the coals is presented in Table 6.

The repeatability limit for maceral analysis is given in Table 7, followed by the reflectance histograms.

5 COMMENTS AND INTERPRETATION OF DATA

5.1 RANK (Degree of maturity)

Reflectance measurements were conventionally taken on the vitrinite maceral Collotelinite.

The mean random reflectance values were:

No.	Sample	Rr %	Rank designation
1	WBGX Fines	**0.62**	Medium Rank C
2	WBGX 1.35-1.40	**0.61**	Medium Rank C
3	WBGX 1.50-1.70	**0.63**	Medium Rank C
4	WBGX 1.90-2.00	**0.61**	Medium Rank C

See Table 1 In the Appendix.

According to the ISO 11760 - 2005 Classification of Coals, these samples are recognized as Bituminous, **Medium Rank C coals.**

The rank parameter of the Classification is based on vitrinite random reflectance.

The vitrinite-class distributions of these samples did not reveal any major abnormalities with standard deviations of < 0.1.

5.2 PETROGRAPHIC COMPOSITION

Maceral composition - % by volume, mineral matter-free basis; microlithotype and carbominerite analyses

5.2.1 In terms of maceral composition: - see Table 1

- Samples 1 and 2 were high in total vitrinite content (approximately 80% to 85%), percentages by volume, mineral matter-free basis.
- Sample 3 was medium in total vitrinite content (57%), while sample 4 was low (30%).
- The liptinites (3% to 7%) predominantly comprised of sporinite and cutinite. Alginite was seen only very occasionally in these coals.

In accordance with the current approach of the Petrographic Laboratory of SABS, the reactive inertinites of bituminous coals are identified as those inertinites (semifusinites and inertodetrinites) displaying low relief, with colour and reflectance very similar to those of the associated vitrinites. Such reactive inertinites are expected to behave in a manner very similar to that of the vitrinites.

However, in order to provide a basis for comparison with the total reactives as expressed in previous standard reports, semi-reactive inertinites have been included in the reactive maceral contents reported for the current samples.

The total reactive maceral contents (mineral matter-free basis) were made up as follows:

		Total Reactives	Vitrinite	Liptinite	Reactive + Semi-reactive inertinite
No.	Sample	%	%	%	%
1	WBGX Fines	**85**	79	3	3
2	WBGX 1.35-	**93**	86	5	2
3	WBGX 1.50-	**69**	57	7	5
4	WBGX 1.90-	**46**	30	4	12

5.2.2 In terms of the microlithotype analysis:

		Vitrite "pure"	Inertite "pure"	Intermediates maceral	Carbominerite Maceral/mineral	Minerite mineral
No.	Sample	%	%	%	%	%
1	WBGX Fines	33	7	8	14	38
2	WBGX	59	5	23	11	2
3	WBGX 1.50-	22	14	32	23	9
4	WBGX 1.90-	6	7	8	28	51

6 SUMMARY

The major petrographic properties of the samples are presented in Table 6.

The following points summarize the characteristics of the coals:

In terms of the degree of maturity:

- According to the ISO 11760 - 2005 Classification of Coals, these samples are characterized as **Bituminous, Medium Rank C coals**.
- The mean random reflectance values fell in the range of 0.61% up to 0.63% Rr.

In terms of organic composition:

- Sample 1 represented 79% of total vitrinite (mmf), while sample 2 contained 86%.

  Samples 3 and 4 were lower in vitrinite content (57% and 30% respectively).
- In samples 2 and 3, visible minerals were mostly mixed with coal macerals in carbominerite.

  In samples 1 and 4, minerite (mineral-rich particles) predominated - 38% and 51% of the whole coal.

In terms of general condition:

- Some of the coal macerals in these samples displayed cracking and fissuration. However, some cracking probably occurred during handling and preparation due to the somewhat brittle nature of coal (particularly vitrinite) of this level of maturity, i.e., Medium Rank C.

- Signs of weathering were sometimes observed.

7 PRECISION

7.1 REFLECTANCE MEASUREMENTS (Reference: ISO 7404 – 5, 1994)

Repeatability

The repeatability of the determination of the mean maximum or mean random reflectance is that value of the difference between two single determinations each based on the same number of measurements carried out by the same operator on the same block using the same apparatus, below which 95% of such differences are expected to lie.

The repeatability depends on:

a) Accuracy in calibration

b) Drift in calibration

c) The number of measurements made and the range of reflectance

The combined effect of these factors can be expressed as a standard deviation of the mean reflectance of up to 0.02% for a single seam coal.

This corresponds to a repeatability of up to 0.06%.

Reproducibility

The reproducibility of the determination of the mean maximum or mean random reflectance is that value of the difference between two single determinations each based on the same number of measurements carried out by two different operators on two different sub-samples taken from the same sample, using different equipment, below which 95% of such differences are expected to lie.

Provided that operators are adequately trained in the identification of vitrinite or the appropriate submacerals and that the reflectances of the standards used are reliably known, determinations of the mean reflectance by different operators in different laboratories show standard deviations in the order of 0.03%.

The reproducibility is thus in the order of 0.08%.

7.2 MACERAL ANALYSIS - REPEATABILITY (Reference: ISO Standard 7404 - 3, 1994)

The theoretical standard deviation and repeatability limit of the percentage of a component, based on counts of 500 points, are shown in Table 7.

Appendix G. Beneficiation Modelling Models Included

G.1 Witbank Coalfield

150 x 12 mm modelling

Coal Processing Simulation Model	Dense Medium Bath 50x12.5mm fraction			Processing unit
	WC No.4 Seam			
Sinks Re-wash	0			
Separation Density :	1.460	Theor Yield % :	18.3	Calculate
		Organic Eff % :	85.8	H % = 4.00
Ecart Probable :	0.016	Sink in Float % :	2.6	H% (mc) 3.83
Ave Particle Size (mm) :	32	Float in Sink % :	2.3	Print
		Tot Misplaced % :	5.0	
		% Near Dens + -	0.05	= 18.3

	Yield %	C.V.	I.H2O	Ash	V.M.	F.C.	S	S.H2O	T.H2O	
Air-dry ->	%	MJ/kg	%	%	%	%	%	%	%	Tons
Feed	100.00	21.16	0.00	26.88	26.7	0.0	1.6			4.12
Product	15.66	27.45	0.00	10.92	32.1	0.0	0.8	5.00	5.00	0.65
Discard	84.34	19.99	0.00	29.84	25.7	0.0	1.8			3.48
Product		27.45	0.00	10.92	32.07	0.00	0.84	5.00	5.00	0.65
Prod Quality	Target ->	6000		Actual:		6013	kCals/kg	NAR		

Coal Processing Simulation Model	Dense Medium Bath 50x12.5mm fraction			Processing unit
	WC No.4 Seam			
Sinks Re-wash	0			
Separation Density :	1.480	Theor Yield % :	22.7	Calculate
		Organic Eff % :	89.3	H % = 4.00
Ecart Probable :	0.016	Sink in Float % :	3.7	H% (mc) 3.83
Ave Particle Size (mm) :	32	Float in Sink % :	2.9	Print
		Tot Misplaced % :	6.5	
		% Near Dens + -	0.05	= 20.4

	Yield %	C.V.	I.H2O	Ash	V.M.	F.C.	S	S.H2O	T.H2O	
Air-dry ->	%	MJ/kg	%	%	%	%	%	%	%	Tons
Feed	100.00	21.16	0.00	26.88	26.7	0.0	1.6			4.12
Product	20.27	27.06	0.00	11.87	31.6	0.0	0.9	5.00	5.00	0.84
Discard	79.73	19.66	0.00	30.69	25.4	0.0	1.8			3.29
Product		27.06	0.00	11.87	31.56	0.00	0.88	5.00	5.00	0.84
Prod Quality	Target ->	5900		Actual:		5923	kCals/kg	NAR		

Coal Processing Simulation Model	Dense Medium Bath 50x12.5mm fraction			Processing unit
	WC No.4 Seam			
Sinks Re-wash	0			
Separation Density :	1.510	Theor Yield % :	29.3	Calculate
		Organic Eff % :	90.7	H % = 4.00
Ecart Probable :	0.018	Sink in Float % :	3.6	H% (mc) 3.83
Ave Particle Size (mm) :	32	Float in Sink % :	2.9	Print
		Tot Misplaced % :	6.5	
		% Near Dens + -	0.05	= 22.5

	Yield %	C.V.	I.H2O	Ash	V.M.	F.C.	S	S.H2O	T.H2O	
Air-dry ->	%	MJ/kg	%	%	%	%	%	%	%	Tons
Feed	100.00	21.16	0.00	26.88	26.7	0.0	1.6			4.12
Product	26.60	26.59	0.00	12.97	31.0	0.0	0.9	5.00	5.00	1.10
Discard	73.40	19.19	0.00	31.92	25.1	0.0	1.9			3.02
Product		26.59	0.00	12.97	30.97	0.00	0.89	5.00	5.00	1.10
Prod Quality	Target ->	5800		Actual:		5817	kCals/kg	NAR		

12 x 0.5 mm modelling

Coal Processing Simulation Model — DSM Cyclone — WC No.4 Seam
Sinks Re-wash — 0 — Processing unit

Separation Density :	1.627	Theor Yield % :	61.2		
Circ Medium RD :	1.550	Organic Eff % :	96.7	H % =	4.00
Ecart Probable :	0.026	Sink in Float % :	4.3	H% (mc)	3.82
Ave Particle Size (mm) :	6.5	Float in Sink % :	4.2		
Cyclone Diameter (mm):	660	Tot Misplaced % :	8.5		
		% Near Dens + -	0.05	=	22.6

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	20.79	0.00	27.67	0.0	0.0	0.7			4.12
Product	59.19	25.20	0.00	16.31	0.0	0.0	0.5	5.00	5.00	2.44
Discard	40.81	14.39	0.00	44.15	0.0	0.0	0.9			1.68
Product		25.20	0.00	16.31	0.00	0.00	0.49	5.00	5.00	2.44

Prod Quality — Target -> 5500 — Actual: 5502 kCals/kg NAR

Coal Processing Simulation Model — DSM Cyclone — WC No.4 Seam
Sinks Re-wash — 0 — Processing unit

Separation Density :	1.883	Theor Yield % :	86.1		
Circ Medium RD :	1.778	Organic Eff % :	99.8	H % =	4.00
Ecart Probable :	0.032	Sink in Float % :	1.4	H% (mc)	3.82
Ave Particle Size (mm) :	6.5	Float in Sink % :	1.2		
Cyclone Diameter (mm):	660	Tot Misplaced % :	2.5		
		% Near Dens + -	0.05	=	5.0

Calculate

Print

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	20.79	0.00	27.67	0.0	0.0	0.7			4.12
Product	85.94	22.98	0.00	22.13	0.0	0.0	0.4	5.00	5.00	3.54
Discard	14.06	7.35	0.00	61.52	0.0	0.0	1.9			0.58
Product		22.98	0.00	22.13	0.00	0.00	0.45	5.00	5.00	3.54

Prod Quality — Target -> 5000 — Actual: 5000 kCals/kg NAR

Coal Processing Simulation Model — DSM Cyclone — WC No.4 Seam
Sinks Re-wash — 0 — Processing unit

Separation Density :	1.810	Theor Yield % :	82.0		
Circ Medium RD :	1.713	Organic Eff % :	99.7	H % =	4.00
Ecart Probable :	0.030	Sink in Float % :	1.3	H% (mc)	3.82
Ave Particle Size (mm) :	6.5	Float in Sink % :	0.6		
Cyclone Diameter (mm):	660	Tot Misplaced % :	1.9		
		% Near Dens + -	0.05	=	6.5

Calculate

Print

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	20.79	0.00	27.67	0.0	0.0	0.7			4.12
Product	81.78	23.43	0.00	20.93	0.0	0.0	0.4	5.00	5.00	3.37
Discard	18.22	8.92	0.00	57.95	0.0	0.0	1.6			0.75
Product		23.43	0.00	20.93	0.00	0.00	0.45	5.00	5.00	3.37

Prod Quality — Target -> 5100 — Actual: 5101 kCals/kg NAR

Coal Processing Simulation Model — DSM Cyclone — WC No.4 Seam
Sinks Re-wash — 0 — Processing unit

Separation Density :	1.746	Theor Yield % :	77.3		
Circ Medium RD :	1.655	Organic Eff % :	99.4	H % =	4.00
Ecart Probable :	0.029	Sink in Float % :	3.8	H% (mc)	3.82
Ave Particle Size (mm) :	6.5	Float in Sink % :	0.4		
Cyclone Diameter (mm):	660	Tot Misplaced % :	4.2		
		% Near Dens + -	0.05	=	8.0

Calculate

Print

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	20.79	0.00	27.67	0.0	0.0	0.7			4.12
Product	76.86	23.87	0.00	19.74	0.0	0.0	0.5	5.00	5.00	3.17
Discard	23.14	10.56	0.00	54.02	0.0	0.0	1.3			0.95
Product		23.87	0.00	19.74	0.00	0.00	0.45	5.00	5.00	3.17

0.5 x 0.1 mm modelling

SPIRALS

Coal Processing WC4S Sim 0.5 x 0.15 mm
Simulation Model 25102011
Sinks Re-wash 0

Processing unit

Calculate

Print

Separation Density :	1.350	Theor Yield % :	87.7		
		Organic Eff % :	25.9	H % =	4.00
Ecart Probable :	0.217	Sink in Float % :	20.4	H% (mc)	3.84
		Float in Sink % :	2.4		
		Tot Misplaced % :	22.7		
		% Near Dens + -	0.1	=	11.1

	Yield %	C.V.	I.H2O	Ash	V.M.	F.C.	S	S.H2O	T.H2O	
Air-dry ->	%	MJ/kg	%	%	%	%	%	%	%	Tons
Feed	100.00	21.11	0.00	24.36	20.6	0.0	1.1			4.12
Product	22.73	23.30	0.00	19.23	23.4	0.0	1.0	5.00	5.00	0.94
Discard	77.27	20.47	0.00	25.87	19.7	0.0	1.2			3.18
Product		23.30	0.00	19.23	23.38	0.00	1.02	5.00	5.00	0.94

Prod Quality	Target ->	6000	Actual:	5070	kCals/kg	NAR

Coal Processing WC4S Sim 0.5 x 0.15 mm
Simulation Model 25102011
Sinks Re-wash 0

Processing unit

Calculate

Print

Separation Density :	1.350	Theor Yield % :	87.7		
		Organic Eff % :	25.9	H % =	4.00
Ecart Probable :	0.217	Sink in Float % :	20.4	H% (mc)	3.84
		Float in Sink % :	2.4		
		Tot Misplaced % :	22.7		
		% Near Dens + -	0.1	=	11.1

	Yield %	C.V.	I.H2O	Ash	V.M.	F.C.	S	S.H2O	T.H2O	
Air-dry ->	%	MJ/kg	%	%	%	%	%	%	%	Tons
Feed	100.00	21.11	0.00	24.36	20.6	0.0	1.1			4.12
Product	22.73	23.30	0.00	19.23	23.4	0.0	1.0	5.00	5.00	0.94
Discard	77.27	20.47	0.00	25.87	19.7	0.0	1.2			3.18
Product		23.30	0.00	19.23	23.38	0.00	1.02	5.00	5.00	0.94

Prod Quality	Target ->	5900	Actual:	5070	kCals/kg	NAR

FINE DSM

Coal Processing	WC4S Sim 0.5 x 0.15 mm				Processing unit
Simulation Model	25102011				
Sinks Re-wash	0				Calculate
Separation Density :	1.846	Theor Yield % :	90.5		
Circ Medium RD :	1.744	Organic Eff % :	90.1	H % = 4.00	
Ecart Probable :	0.070	Sink in Float % :	2.8	H% (mc) 3.84	
Ave Particle Size (mm) :	0.5	Float in Sink % :	10.4		Print
Cyclone Diameter (mm):	300	Tot Misplaced % :	13.1		
		% Near Dens + -	0.1	= 60.0	

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	21.11	0.00	24.36	20.6	0.0	1.1			4.12
Product	81.54	22.99	0.00	20.25	22.6	0.0	1.1	5.00	5.00	3.36
Discard	18.46	12.80	0.00	42.53	11.6	0.0	1.5			0.76
Product		22.99	0.00	20.25	22.58	0.00	1.06	5.00	5.00	3.36

Prod Quality	Target ->	5000	24.36	Actual:	5000	kCals/kg NAR

Coal Processing	WC4S Sim 0.5 x 0.15 mm				Processing unit
Simulation Model	25102011				
Sinks Re-wash	0				Calculate
Separation Density :	1.799	Theor Yield % :	87.6		
Circ Medium RD :	1.703	Organic Eff % :	82.5	H % = 4.00	
Ecart Probable :	0.068	Sink in Float % :	15.5	H% (mc) 3.84	
Ave Particle Size (mm) :	0.5	Float in Sink % :	12.7		Print
Cyclone Diameter (mm):	300	Tot Misplaced % :	28.2		
		% Near Dens + -	0.1	= 63.3	

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	21.11	0.00	24.36	20.6	0.0	1.1			4.12
Product	72.26	23.43	0.00	19.19	23.1	0.0	1.0	5.00	5.00	2.98
Discard	27.74	15.06	0.00	37.83	13.9	0.0	1.6			1.14
Product		23.43	0.00	19.19	23.10	0.00	0.95	5.00	5.00	2.98

Prod Quality	Target ->	5100	24.36	Actual:	5100	kCals/kg NAR

G.2 Waterberg Upper Ecca Coalfield

50 x 32 mm modelling

dsm cyclones

Coal Processing Simulation Model — **Primary Wash**
WBG UE 50x32 fraction
Sampled 15/12/2010
0
Processing unit | Calculate | Print

Separation Density :	1.940	Theor Yield % :	38.9		
		Organic Eff % :	91.9	H % =	4.00
Ecart Probable :	0.030	Sink in Float % :	4.4	H% (mc)	3.87
Ave Particle Size (mm) :	40	Float in Sink % :	0.0		
		Tot Misplaced % :	4.4		
		% Near Dens + -	0.05	=	7.3

Air-dry ->	Yield % %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	9.47	0.00	62.75	17.3	0.0	0.8			100.00
Product	35.72	18.76	0.00	37.13	26.5	0.0	1.8	5.00	5.00	35.72
Discard	64.28	4.31	0.00	76.99	12.2	0.0	0.3			64.28
Product		18.76	0.00	37.13	26.53	0.00	1.80	5.00	5.00	35.72

Prod Quality | Target -> 4000 | Actual: 4039 kCals/kg NAR

Coal Processing Simulation Model — **Primary Wash**
WBG UE 50x32 fraction
Sampled 15/12/2010
0
Processing unit | Calculate | Print

Separation Density :	1.910	Theor Yield % :	34.9		
		Organic Eff % :	94.0	H % =	4.00
Ecart Probable :	0.029	Sink in Float % :	2.1	H% (mc)	3.87
Ave Particle Size (mm) :	40	Float in Sink % :	0.7		
		Tot Misplaced % :	2.8		
		% Near Dens + -	0.05	=	8.8

Air-dry ->	Yield % %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	9.47	0.00	62.75	17.3	0.0	0.8			100.00
Product	32.75	19.47	0.00	35.19	27.2	0.0	1.9	5.00	5.00	32.75
Discard	67.25	4.60	0.00	76.17	12.5	0.0	0.3			67.25
Product		19.47	0.00	35.19	27.23	0.00	1.89	5.00	5.00	32.75

Prod Quality | Target -> 4200 | Actual: 4201 kCals/kg NAR

Coal Processing Simulation Model — **Primary Wash**
WBG UE 50x32 fraction
Sampled 15/12/2010
0
Processing unit | Calculate | Print

Separation Density :	1.849	Theor Yield % :	27.8		
		Organic Eff % :	92.3	H % =	4.00
Ecart Probable :	0.027	Sink in Float % :	6.1	H% (mc)	3.88
Ave Particle Size (mm) :	40	Float in Sink % :	0.0		
		Tot Misplaced % :	6.1		
		% Near Dens + -	0.05	=	8.8

Air-dry ->	Yield % %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	9.47	0.00	62.75	17.3	0.0	0.8			100.00
Product	25.70	20.36	0.00	32.71	28.2	0.0	2.1	5.00	5.00	25.70
Discard	74.30	5.71	0.00	73.14	13.5	0.0	0.4			74.30
Product		20.36	0.00	32.71	28.16	0.00	2.09	5.00	5.00	25.70

Prod Quality | Target -> 4400 | Actual: 4401 kCals/kg NAR

jigging

Coal Processing Simulation Model — **Sinks Re-wash**
WBG UE 50x32mm
Jigging
0
Processing unit | Calculate | Print

Separation Density :	1.630	Theor Yield % :	39.2		
		Organic Eff % :	50.8	H % =	4.00
Ecart Probable :	0.052	Sink in Float % :	8.7	H% (mc)	3.87
Ave Particle Size (mm) :	40	Float in Sink % :	4.2		
		Tot Misplaced % :	12.9		
		% Near Dens + -	0.05	=	18.1

Air-dry ->	Yield % %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	9.47	0.00	62.75	17.3	0.0	0.8			4.12
Product	19.91	18.66	0.00	37.27	26.6	0.0	1.7	5.00	5.00	0.82
Discard	80.09	7.19	0.00	69.08	15.0	0.0	0.6			3.30
Product		18.66	0.00	37.27	26.61	0.00	1.69	5.00	5.00	0.82

Prod Quality | Target -> 4000 | Actual: 4017 kCals/kg NAR

Coal Processing Simulation Model — **Sinks Re-wash**
WBG UE 50x32mm
Jigging
0
Processing unit | Calculate | Print

Separation Density :	1.598	Theor Yield % :	34.3		
		Organic Eff % :	43.2	H % =	4.00
Ecart Probable :	0.049	Sink in Float % :	7.7	H% (mc)	3.86
Ave Particle Size (mm) :	40	Float in Sink % :	1.9		
		Tot Misplaced % :	9.6		
		% Near Dens + -	0.05	=	12.1

Air-dry ->	Yield % %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	9.47	0.00	62.75	17.3	0.0	0.8			4.12
Product	14.84	19.48	0.00	34.94	27.5	0.0	1.6	5.00	5.00	0.61
Discard	85.16	7.73	0.00	67.59	15.5	0.0	0.7			3.51
Product		19.48	0.00	34.94	27.52	0.00	1.64	5.00	5.00	0.61

Prod Quality | Target -> 4200 | Actual: 4203 kCals/kg NAR

Coal Processing Simulation Model — **Sinks Re-wash**
WBG UE 50x32mm
Jigging
0
Processing unit | Calculate | Print

Separation Density :	1.570	Theor Yield % :	25.8		
		Organic Eff % :	43.0	H % =	4.00
Ecart Probable :	0.047	Sink in Float % :	5.8	H% (mc)	3.86
Ave Particle Size (mm) :	40	Float in Sink % :	1.7		
		Tot Misplaced % :	7.5		
		% Near Dens + -	0.05	=	8.2

Air-dry ->	Yield % %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	9.47	0.00	62.75	17.3	0.0	0.8			4.12
Product	11.12	20.43	0.00	32.23	28.6	0.0	1.6	5.00	5.00	0.46
Discard	88.89	8.10	0.00	66.56	15.9	0.0	0.7			3.66
Product		20.43	0.00	32.23	28.56	0.00	1.60	5.00	5.00	0.46

Prod Quality | Target -> 4400 | Actual: 4418 kCals/kg NAR

32 x 25 mm modelling

dsm cyclones

Coal Processing Simulation Model – **Primary Wash** — WBG UEc32x25fraction, Sampled 15/12/2010, 0 — Processing unit — Calculate — Print

Separation Density	:	2.020	Theor Yield %	:	43.0		
Circ Medium RD	:	1.900	Organic Eff %	:	92.9	H % =	4.00
Ecart Probable	:	0.021	Sink in Float %	:	4.8	H% (mc)	3.85
Ave Particle Size (mm) :		27	Float in Sink %	:	0.0		
Cyclone Diameter (mm):		1000	Tot Misplaced % :		4.8		
			% Near Dens + -		0.05	=	3.9

	Yield %	C.V.	I.H2O	Ash	V.M.	F.C.	S	S.H2O	T.H2O	
Air-dry ->	%	MJ/kg	%	%	%	%	%	%	%	Tons
Feed	100.00	9.51	0.00	62.83	17.5	0.0	0.9			100.00
Product	39.97	18.76	0.00	36.68	27.8	0.0	1.2	5.00	5.00	39.97
Discard	60.03	3.35	0.00	80.23	10.7	0.0	0.7			60.03
Product		18.76	0.00	36.68	27.79	0.00	1.18	5.00	5.00	39.97

Prod Quality | Target -> 4000 | Actual: 4039 kCals/kg NAR

Coal Processing Simulation Model – **Primary Wash** — WBG UEc32x25fraction, Sampled 15/12/2010, 0 — Processing unit — Calculate — Print

Separation Density	:	2.000	Theor Yield %	:	40.1		
Circ Medium RD	:	1.882	Organic Eff %	:	94.8	H % =	4.00
Ecart Probable	:	0.021	Sink in Float %	:	2.9	H% (mc)	3.85
Ave Particle Size (mm) :		27	Float in Sink %	:	0.0		
Cyclone Diameter (mm):		1000	Tot Misplaced % :		2.9		
			% Near Dens + -		0.05	=	3.9

	Yield %	C.V.	I.H2O	Ash	V.M.	F.C.	S	S.H2O	T.H2O	
Air-dry ->	%	MJ/kg	%	%	%	%	%	%	%	Tons
Feed	100.00	9.51	0.00	62.83	17.5	0.0	0.9			100.00
Product	38.00	19.50	0.00	34.60	28.6	0.0	1.2	5.00	5.00	38.00
Discard	62.00	3.38	0.00	80.13	10.7	0.0	0.7			62.00
Product		19.50	0.00	34.60	28.61	0.00	1.20	5.00	5.00	38.00

Prod Quality | Target -> 4200 | Actual: 4207 kCals/kg NAR

Coal Processing Simulation Model – **Primary Wash** — WBG UEc32x25fraction, Sampled 15/12/2010, 0 — Processing unit — Calculate — Print

Separation Density	:	1.970	Theor Yield %	:	36.3		
Circ Medium RD	:	1.855	Organic Eff %	:	97.3	H % =	4.00
Ecart Probable	:	0.020	Sink in Float %	:	1.9	H% (mc)	3.85
Ave Particle Size (mm) :		27	Float in Sink %	:	0.8		
Cyclone Diameter (mm):		1000	Tot Misplaced % :		2.7		
			% Near Dens + -		0.05	=	3.8

	Yield %	C.V.	I.H2O	Ash	V.M.	F.C.	S	S.H2O	T.H2O	
Air-dry ->	%	MJ/kg	%	%	%	%	%	%	%	Tons
Feed	100.00	9.51	0.00	62.83	17.5	0.0	0.9			100.00
Product	35.37	20.44	0.00	31.95	29.7	0.0	1.2	5.00	5.00	35.37
Discard	64.63	3.52	0.00	79.73	10.8	0.0	0.8			64.63
Product		20.44	0.00	31.95	29.68	0.00	1.21	5.00	5.00	35.37

Prod Quality | Target -> 4400 | Actual: 4421 kCals/kg NAR

jigging

Coal Processing Simulation Model – **Sinks Re-wash** — WBG UE 32 x 25 mm, Jigging, 0 — Processing unit — Calculate — Print

Separation Density	:	1.669	Theor Yield %	:	43.8		
			Organic Eff %	:	62.7	H % =	4.00
Ecart Probable	:	0.060	Sink in Float %	:	9.0	H% (mc)	3.84
Ave Particle Size (mm) :		27	Float in Sink %	:	6.1		
			Tot Misplaced % :		15.1		
			% Near Dens + -		0.05	=	19.6

	Yield %	C.V.	I.H2O	Ash	V.M.	F.C.	S	S.H2O	T.H2O	
Air-dry ->	%	MJ/kg	%	%	%	%	%	%	%	Tons
Feed	100.00	9.51	0.00	62.83	17.5	0.0	0.9			4.12
Product	27.42	18.59	0.00	37.21	27.5	0.0	1.1	5.00	5.00	1.13
Discard	72.58	6.08	0.00	72.51	13.7	0.0	0.8			2.99
Product		18.59	0.00	37.21	27.55	0.00	1.10	5.00	5.00	1.13

Prod Quality | Target -> 4000 | Actual: 4001 kCals/kg NAR

Coal Processing Simulation Model – **Sinks Re-wash** — WBG UE 32 x 25 mm, Jigging, 0 — Processing unit — Calculate — Print

Separation Density	:	1.628	Theor Yield %	:	40.3		
			Organic Eff %	:	51.5	H % =	4.00
Ecart Probable	:	0.057	Sink in Float %	:	9.0	H% (mc)	3.84
Ave Particle Size (mm) :		27	Float in Sink %	:	4.2		
			Tot Misplaced % :		13.2		
			% Near Dens + -		0.05	=	17.6

	Yield %	C.V.	I.H2O	Ash	V.M.	F.C.	S	S.H2O	T.H2O	
Air-dry ->	%	MJ/kg	%	%	%	%	%	%	%	Tons
Feed	100.00	9.51	0.00	62.83	17.5	0.0	0.9			4.12
Product	20.74	19.47	0.00	34.73	28.5	0.0	1.1	5.00	5.00	0.85
Discard	79.26	6.90	0.00	70.18	14.6	0.0	0.9			3.27
Product		19.47	0.00	34.73	28.47	0.00	1.09	5.00	5.00	0.85

Prod Quality | Target -> 4200 | Actual: 4202 kCals/kg NAR

Coal Processing Simulation Model – **Sinks Re-wash** — WBG UE 32 x 25 mm, Jigging, 0 — Processing unit — Calculate — Print

Separation Density	:	1.590	Theor Yield %	:	36.6		
			Organic Eff %	:	41.5	H % =	4.00
Ecart Probable	:	0.053	Sink in Float %	:	7.7	H% (mc)	3.84
Ave Particle Size (mm) :		27	Float in Sink %	:	1.9		
			Tot Misplaced % :		9.6		
			% Near Dens + -		0.05	=	12.0

	Yield %	C.V.	I.H2O	Ash	V.M.	F.C.	S	S.H2O	T.H2O	
Air-dry ->	%	MJ/kg	%	%	%	%	%	%	%	Tons
Feed	100.00	9.51	0.00	62.83	17.5	0.0	0.9			4.12
Product	15.18	20.41	0.00	32.11	29.4	0.0	1.1	5.00	5.00	0.63
Discard	84.82	7.56	0.00	68.32	15.4	0.0	0.9			3.50
Product		20.41	0.00	32.11	29.44	0.00	1.09	5.00	5.00	0.63

Prod Quality | Target -> 4400 | Actual: 4414 kCals/kg NAR

25 x 16 mm modelling

dsm cyclones

Coal Processing Simulation Model — WBG UE 25x16 fraction — Sampled 15/12/2010
Primary Wash 0
Processing unit — Calculate — Print

Separation Density :	2.020	Theor Yield % :	45.0
Circ Medium RD :	1.900	Organic Eff % :	93.8
Ecart Probable :	0.024	Sink in Float % :	5.6
Ave Particle Size (mm) :	18	Float in Sink % :	0.0
Cyclone Diameter (mm):	800	Tot Misplaced % :	5.6
		% Near Dens + - 0.05 =	2.9

H % = 4.00 H% (mc) 3.84

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	9.91	0.00	61.82	17.6	0.0	0.8			100.00
Product	42.21	18.74	0.00	36.59	27.4	0.0	1.1	5.00	5.00	42.21
Discard	57.79	3.45	0.00	80.25	10.5	0.0	0.6			57.79
Product		18.74	0.00	36.59	27.44	0.00	1.10	5.00	5.00	42.21

Prod Quality — Target -> 4000 — Actual: 4037 kCals/kg NAR

Coal Processing Simulation Model — WBG UE 25x16 fraction — Sampled 15/12/2010
Primary Wash 0
Processing unit — Calculate — Print

Separation Density :	2.000	Theor Yield % :	42.0
Circ Medium RD :	1.882	Organic Eff % :	95.4
Ecart Probable :	0.024	Sink in Float % :	3.6
Ave Particle Size (mm) :	18	Float in Sink % :	0.1
Cyclone Diameter (mm):	800	Tot Misplaced % :	3.7
		% Near Dens + - 0.05 =	2.9

H % = 4.00 H% (mc) 3.84

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	9.91	0.00	61.82	17.6	0.0	0.8			100.00
Product	40.10	19.50	0.00	34.44	28.3	0.0	1.1	5.00	5.00	40.10
Discard	59.89	3.48	0.00	80.15	10.5	0.0	0.6			59.90
Product		19.50	0.00	34.44	28.28	0.00	1.12	5.00	5.00	40.10

Prod Quality — Target -> 4200 — Actual: 4207 kCals/kg NAR

Coal Processing Simulation Model — WBG UE 25x16 fraction — Sampled 15/12/2010
Primary Wash 0
Processing unit — Calculate — Print

Separation Density :	1.970	Theor Yield % :	38.6
Circ Medium RD :	1.855	Organic Eff % :	97.3
Ecart Probable :	0.023	Sink in Float % :	2.3
Ave Particle Size (mm) :	18	Float in Sink % :	0.6
Cyclone Diameter (mm):	800	Tot Misplaced % :	2.9
		% Near Dens + - 0.05 =	2.5

H % = 4.00 H% (mc) 3.84

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	9.91	0.00	61.82	17.6	0.0	0.8			100.00
Product	37.62	20.41	0.00	31.84	29.3	0.0	1.2	5.00	5.00	37.62
Discard	62.38	3.57	0.00	79.90	10.6	0.0	0.6			62.38
Product		20.41	0.00	31.84	29.31	0.00	1.15	5.00	5.00	37.62

Prod Quality — Target -> 4400 — Actual: 4415 kCals/kg NAR

jigging

Coal Processing Simulation Model — WBG UE 25x16 mm — Jigging
Sinks Re-wash 0
Processing unit — Calculate — Print

Separation Density :	1.690	Theor Yield % :	45.5
		Organic Eff % :	82.6
Ecart Probable :	0.068	Sink in Float % :	7.9
Ave Particle Size (mm) :	18	Float in Sink % :	3.9
		Tot Misplaced % :	11.9
		% Near Dens + - 0.05 =	5.4

H % = 4.00 H% (mc) 3.84

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	9.91	0.00	61.82	17.6	0.0	0.8			4.12
Product	37.56	18.63	0.00	36.95	27.4	0.0	1.1	5.00	5.00	1.55
Discard	62.44	4.66	0.00	76.79	11.8	0.0	0.7			2.57
Product		18.63	0.00	36.95	27.35	0.00	1.08	5.00	5.00	1.55

Prod Quality — Target -> 4000 — Actual: 4011 kCals/kg NAR

Coal Processing Simulation Model — WBG UE 25x16 mm — Jigging
Sinks Re-wash 0
Processing unit — Calculate — Print

Separation Density :	1.658	Theor Yield % :	42.2
		Organic Eff % :	80.2
Ecart Probable :	0.065	Sink in Float % :	6.4
Ave Particle Size (mm) :	18	Float in Sink % :	4.6
		Tot Misplaced % :	10.9
		% Near Dens + - 0.05 =	6.8

H % = 4.00 H% (mc) 3.84

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	9.91	0.00	61.82	17.6	0.0	0.8			4.12
Product	33.85	19.48	0.00	34.54	28.3	0.0	1.1	5.00	5.00	1.39
Discard	66.15	5.01	0.00	75.78	12.2	0.0	0.7			2.73
Product		19.48	0.00	34.54	28.30	0.00	1.10	5.00	5.00	1.39

Prod Quality — Target -> 4200 — Actual: 4203 kCals/kg NAR

Coal Processing Simulation Model — WBG UE 25x16 mm — Jigging
Sinks Re-wash 0
Processing unit — Calculate — Print

Separation Density :	1.620	Theor Yield % :	38.7
		Organic Eff % :	76.0
Ecart Probable :	0.062	Sink in Float % :	5.6
Ave Particle Size (mm) :	18	Float in Sink % :	5.2
		Tot Misplaced % :	10.8
		% Near Dens + - 0.05 =	11.5

H % = 4.00 H% (mc) 3.84

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	9.91	0.00	61.82	17.6	0.0	0.8			4.12
Product	29.36	20.43	0.00	31.84	29.4	0.0	1.1	5.00	5.00	1.21
Discard	70.64	5.53	0.00	74.28	12.7	0.0	0.7			2.91
Product		20.43	0.00	31.84	29.38	0.00	1.11	5.00	5.00	1.21

Prod Quality — Target -> 4400 — Actual: 4419 kCals/kg NAR

16 x 12 mm modelling

Coal Processing
Simulation Model
Primary Wash

WBG UE16x12.5 fraction
Sampled 15/12/2010
0

Processing unit

Calculate

Print

Separation Density :	2.000	Theor Yield % :	40.2		
Circ Medium RD :	1.882	Organic Eff % :	90.1	H % =	4.00
Ecart Probable :	0.027	Sink in Float % :	4.9	H% (mc)	3.84
Ave Particle Size (mm) :	13.5	Float in Sink % :	0.3		
Cyclone Diameter (mm):	800	Tot Misplaced % :	5.2		
		% Near Dens + -	0.05	=	4.1

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	9.40	0.00	63.11	16.9	0.0	0.8			100.00
Product	36.23	18.61	0.00	37.13	26.6	0.0	1.1	5.00	5.00	36.23
Discard	63.77	4.17	0.00	77.87	11.5	0.0	0.6			63.77
Product		18.61	0.00	37.13	26.59	0.00	1.08	5.00	5.00	36.23

Prod Quality	Target ->	4000	Actual:	4007	kCals/kg	NAR

Coal Processing
Simulation Model
Primary Wash

WBG UE16x12.5 fraction
Sampled 15/12/2010
0

Processing unit

Calculate

Print

Separation Density :	1.970	Theor Yield % :	35.8		
Circ Medium RD :	1.855	Organic Eff % :	92.2	H % =	4.00
Ecart Probable :	0.026	Sink in Float % :	3.6	H% (mc)	3.84
Ave Particle Size (mm) :	13.5	Float in Sink % :	1.3		
Cyclone Diameter (mm):	800	Tot Misplaced % :	4.9		
		% Near Dens + -	0.05	=	4.7

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	9.40	0.00	63.11	16.9	0.0	0.8			100.00
Product	32.96	19.70	0.00	34.09	27.7	0.0	1.1	5.00	5.00	32.96
Discard	67.04	4.34	0.00	77.38	11.6	0.0	0.6			67.04
Product		19.70	0.00	34.09	27.74	0.00	1.12	5.00	5.00	32.96

Prod Quality	Target ->	4200	Actual:	4254	kCals/kg	NAR

Coal Processing
Simulation Model
Primary Wash

WBG UE16x12.5 fraction
Sampled 15/12/2010
0

Processing unit

Calculate

Print

Separation Density :	1.950	Theor Yield % :	33.0		
Circ Medium RD :	1.837	Organic Eff % :	93.5	H % =	4.00
Ecart Probable :	0.026	Sink in Float % :	2.7	H% (mc)	3.84
Ave Particle Size (mm) :	13.5	Float in Sink % :	2.2		
Cyclone Diameter (mm):	800	Tot Misplaced % :	4.9		
		% Near Dens + -	0.05	=	4.7

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	9.40	0.00	63.11	16.9	0.0	0.8			100.00
Product	30.88	20.39	0.00	32.17	28.5	0.0	1.2	5.00	5.00	30.88
Discard	69.13	4.50	0.00	76.93	11.8	0.0	0.6			69.12
Product		20.39	0.00	32.17	28.47	0.00	1.15	5.00	5.00	30.88

Prod Quality	Target ->	4400	Actual:	4411	kCals/kg	NAR

12 6 mm modelling

Coal Processing			WBG UE 12.5x6 fraction						Processing unit	
Simulation Model			Sampled 15/12/2010							
Primary Wash			0							
Separation Density :		2.020		Theor Yield % :		55.8			Calculate	
Circ Medium RD :		1.900		Organic Eff % :		88.3	H % =	4.00		
Ecart Probable :		0.032		Sink in Float % :		7.7	H% (mc)	3.84		
Ave Particle Size (mm) :		8.5		Float in Sink % :		0.1			Print	
Cyclone Diameter (mm):		660		Tot Misplaced % :		7.8				
				% Near Dens + -		0.05	=	5.0		
	Yield %	C.V.	I.H2O	Ash	V.M.	F.C.	S	S.H2O	T.H2O	
Air-dry ->	%	MJ/kg	%	%	%	%	%	%	%	Tons
Feed	100.00	10.86	0.00	57.56	19.0	0.0	1.0			100.00
Product	49.25	18.60	0.00	36.77	26.6	0.0	1.0	5.00	5.00	49.25
Discard	50.75	3.35	0.00	77.73	11.7	0.0	1.0			50.75
Product		18.60	0.00	36.77	26.63	0.00	0.99	5.00	5.00	49.25
Prod Quality	Target ->	4000		Actual:		4004	kCals/kg	NAR		

Coal Processing			WBG UE 12.5x6 fraction						Processing unit	
Simulation Model			Sampled 15/12/2010							
Primary Wash			0							
Separation Density :		1.990		Theor Yield % :		50.1			Calculate	
Circ Medium RD :		1.873		Organic Eff % :		90.6	H % =	4.00		
Ecart Probable :		0.031		Sink in Float % :		5.1	H% (mc)	3.84		
Ave Particle Size (mm) :		8.5		Float in Sink % :		0.9			Print	
Cyclone Diameter (mm):		660		Tot Misplaced % :		6.0				
				% Near Dens + -		0.05	=	5.4		
	Yield %	C.V.	I.H2O	Ash	V.M.	F.C.	S	S.H2O	T.H2O	
Air-dry ->	%	MJ/kg	%	%	%	%	%	%	%	Tons
Feed	100.00	10.86	0.00	57.56	19.0	0.0	1.0			100.00
Product	45.43	19.61	0.00	34.03	27.6	0.0	1.0	5.00	5.00	45.43
Discard	54.57	3.57	0.00	77.14	11.9	0.0	1.0			54.57
Product		19.61	0.00	34.03	27.64	0.00	1.00	5.00	5.00	45.43
Prod Quality	Target ->	4200		Actual:		4234	kCals/kg	NAR		

Coal Processing			WBG UE 12.5x6 fraction						Processing unit	
Simulation Model			Sampled 15/12/2010							
Primary Wash			0							
Separation Density :		1.960		Theor Yield % :		45.6			Calculate	
Circ Medium RD :		1.846		Organic Eff % :		92.5	H % =	4.00		
Ecart Probable :		0.031		Sink in Float % :		4.1	H% (mc)	3.84		
Ave Particle Size (mm) :		8.5		Float in Sink % :		2.2			Print	
Cyclone Diameter (mm):		660		Tot Misplaced % :		6.2				
				% Near Dens + -		0.05	=	5.7		
	Yield %	C.V.	I.H2O	Ash	V.M.	F.C.	S	S.H2O	T.H2O	
Air-dry ->	%	MJ/kg	%	%	%	%	%	%	%	Tons
Feed	100.00	10.86	0.00	57.56	19.0	0.0	1.0			100.00
Product	42.14	20.46	0.00	31.75	28.5	0.0	1.0	5.00	5.00	42.14
Discard	57.86	3.87	0.00	76.36	12.1	0.0	1.0			57.86
Product		20.46	0.00	31.75	28.50	0.00	1.00	5.00	5.00	42.14
Prod Quality	Target ->	4400		Actual:		4426	kCals/kg	NAR		

6x 3 mm modelling

Coal Processing		WBG UE 6x3 fraction		Processing unit
Simulation Model		Sampled 15/12/2010		
Primary Wash		0		

Separation Density	:	2.030	Theor Yield %	:	59.4			
Circ Medium RD	:	1.909	Organic Eff %	:	91.2	H % =	4.00	Calculate
Ecart Probable	:	0.038	Sink in Float %	:	10.0	H% (mc)	3.84	
Ave Particle Size (mm) :		5.5	Float in Sink %	:	0.1			Print
Cyclone Diameter (mm):		660	Tot Misplaced % :		10.1			
			% Near Dens + -		0.05	=	3.1	

Air-dry ->	Yield % %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	11.62	0.00	54.99	20.0	0.0	1.0			100.00
Product	54.19	18.89	0.00	35.69	27.0	0.0	1.0	5.00	5.00	54.19
Discard	45.81	3.02	0.00	77.82	11.7	0.0	1.0			45.81
Product		18.89	0.00	35.69	26.99	0.00	1.01	5.00	5.00	54.19

Prod Quality	Target ->	4000		Actual:	4071	kCals/kg	NAR

Coal Processing		WBG UE 6x3 fraction		Processing unit
Simulation Model		Sampled 15/12/2010		
Primary Wash		0		

Separation Density	:	2.010	Theor Yield %	:	55.0			
Circ Medium RD	:	1.891	Organic Eff %	:	93.5	H % =	4.00	Calculate
Ecart Probable	:	0.037	Sink in Float %	:	7.4	H% (mc)	3.84	
Ave Particle Size (mm) :		5.5	Float in Sink %	:	0.3			Print
Cyclone Diameter (mm):		660	Tot Misplaced % :		7.7			
			% Near Dens + -		0.05	=	3.1	

Air-dry ->	Yield % %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	11.62	0.00	54.99	20.0	0.0	1.0			100.00
Product	51.42	19.69	0.00	33.57	27.8	0.0	1.0	5.00	5.00	51.42
Discard	48.58	3.09	0.00	77.65	11.7	0.0	1.0			48.58
Product		19.69	0.00	33.57	27.76	0.00	1.01	5.00	5.00	51.42

Prod Quality	Target ->	4200		Actual:	4251	kCals/kg	NAR

Coal Processing		WBG UE 6x3 fraction		Processing unit
Simulation Model		Sampled 15/12/2010		
Primary Wash		0		

Separation Density	:	1.990	Theor Yield %	:	51.8			
Circ Medium RD	:	1.873	Organic Eff %	:	95.0	H % =	4.00	Calculate
Ecart Probable	:	0.037	Sink in Float %	:	5.8	H% (mc)	3.84	
Ave Particle Size (mm) :		5.5	Float in Sink %	:	0.6			Print
Cyclone Diameter (mm):		660	Tot Misplaced % :		6.4			
			% Near Dens + -		0.05	=	3.0	

Air-dry ->	Yield % %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	11.62	0.00	54.99	20.0	0.0	1.0			100.00
Product	49.24	20.36	0.00	31.80	28.4	0.0	1.0	5.00	5.00	49.24
Discard	50.76	3.15	0.00	77.48	11.8	0.0	1.0			50.76
Product		20.36	0.00	31.80	28.41	0.00	1.02	5.00	5.00	49.24

Prod Quality	Target ->	4400		Actual:	4403	kCals/kg	NAR

3 x 1 mm modelling

Coal Processing	WBG UE 3x1 fraction	Processing unit
Simulation Model	Sampled 15/12/2010	
Primary Wash	0	

Separation Density :	2.090	Theor Yield % :	82.3			
Circ Medium RD :	1.962	Organic Eff % :	92.8	H % =	4.00	Calculate
Ecart Probable :	0.058	Sink in Float % :	2.1	H% (mc)	3.84	
Ave Particle Size (mm) :	1.6	Float in Sink % :	23.3			Print
Cyclone Diameter (mm):	350	Tot Misplaced % :	25.4			
		% Near Dens + -	0.05	=	43.7	

	Yield %	C.V.	I.H2O	Ash	V.M.	F.C.	S	S.H2O	T.H2O	
Air-dry ->	%	MJ/kg	%	%	%	%	%	%	%	Tons
Feed	100.00	15.34	0.00	44.94	22.0	0.0	0.9			100.00
Product	76.36	18.66	0.00	35.79	24.7	0.0	0.9	5.00	5.00	76.36
Discard	23.64	4.61	0.00	74.49	13.3	0.0	1.0			23.64
Product		18.66	0.00	35.79	24.72	0.00	0.92	5.00	5.00	76.36

Prod Quality	Target ->	4000	Actual:	4018	kCals/kg	NAR

Coal Processing	WBG UE 3x1 fraction	Processing unit
Simulation Model	Sampled 15/12/2010	
Primary Wash	0	

Separation Density :	2.068	Theor Yield % :	77.9			
Circ Medium RD :	1.943	Organic Eff % :	92.4	H % =	4.00	Calculate
Ecart Probable :	0.057	Sink in Float % :	5.3	H% (mc)	3.84	
Ave Particle Size (mm) :	1.6	Float in Sink % :	19.1			Print
Cyclone Diameter (mm):	350	Tot Misplaced % :	24.4			
		% Near Dens + -	0.05	=	44.5	

	Yield %	C.V.	I.H2O	Ash	V.M.	F.C.	S	S.H2O	T.H2O	
Air-dry ->	%	MJ/kg	%	%	%	%	%	%	%	Tons
Feed	100.00	15.34	0.00	44.94	22.0	0.0	0.9			100.00
Product	71.94	19.49	0.00	33.50	25.4	0.0	0.9	5.00	5.00	71.94
Discard	28.06	4.68	0.00	74.28	13.4	0.0	1.0			28.06
Product		19.49	0.00	33.50	25.40	0.00	0.92	5.00	5.00	71.94

Prod Quality	Target ->	4200	Actual:	4207	kCals/kg	NAR

Coal Processing	WBG UE 3x1 fraction	Processing unit
Simulation Model	Sampled 15/12/2010	
Primary Wash	0	

Separation Density :	2.040	Theor Yield % :	72.8			
Circ Medium RD :	1.918	Organic Eff % :	92.5	H % =	4.00	Calculate
Ecart Probable :	0.056	Sink in Float % :	12.1	H% (mc)	3.84	
Ave Particle Size (mm) :	1.6	Float in Sink % :	0.3			Print
Cyclone Diameter (mm):	350	Tot Misplaced % :	12.4			
		% Near Dens + -	0.05	=	3.0	

G.3 Free State Coalfield

Cyclones

Coal Processing	Free State - New Vaal ROM			Processing unit
Simulation Model	0			
Primary Wash	0			
Separation Density :	1.860	Theor Yield % :	71.2	
Circ Medium RD :	1.757	Organic Eff % :	99.2	H % = 4.00
Ecart Probable :	0.024	Sink in Float % :	3.4	H% (mc) 3.67
Ave Particle Size (mm) :	15	Float in Sink % :	4.2	
Cyclone Diameter (mm):	1000	Tot Misplaced % :	7.6	
		% Near Dens + -	0.1	= 22.0

Calculate

Print

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	14.92	3.76	38.87	21.4	36.0	0.5			100.00
Product	70.60	18.72	4.03	28.57	23.4	44.0	0.5	5.00	8.83	70.60
Discard	29.40	5.79	3.13	63.62	16.5	16.8	0.6			29.40
Product		18.72	4.03	28.57	23.43	43.97	0.50	5.00	8.83	70.60

Prod Quality	Target ->	4000	Actual:	4019	kCals/kg	NAR

Coal Processing	Free State - New Vaal ROM			Processing unit
Simulation Model	0			
Primary Wash	0			
Separation Density :	1.800	Theor Yield % :	64.0	
Circ Medium RD :	1.704	Organic Eff % :	98.8	H % = 4.00
Ecart Probable :	0.023	Sink in Float % :	1.8	H% (mc) 3.66
Ave Particle Size (mm) :	15	Float in Sink % :	0.9	
Cyclone Diameter (mm):	1000	Tot Misplaced % :	2.7	
		% Near Dens + -	0.1	= 28.2

Calculate

Print

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	14.92	3.76	38.87	21.4	36.0	0.5			100.00
Product	63.26	19.56	4.11	26.32	23.9	45.7	0.5	5.00	8.91	63.26
Discard	36.74	6.93	3.16	60.48	17.1	19.3	0.5			36.74
Product		19.56	4.11	26.32	23.88	45.69	0.52	5.00	8.91	63.26

Prod Quality	Target ->	4200	Actual:	4209	kCals/kg	NAR

Coal Processing	Free State - New Vaal ROM			Processing unit
Simulation Model	0			
Primary Wash	0			
Separation Density :	1.737	Theor Yield % :	54.1	
Circ Medium RD :	1.648	Organic Eff % :	97.4	H % = 4.00
Ecart Probable :	0.022	Sink in Float % :	3.7	H% (mc) 3.66
Ave Particle Size (mm) :	15	Float in Sink % :	6.9	
Cyclone Diameter (mm):	1000	Tot Misplaced % :	10.6	
		% Near Dens + -	0.1	= 28.5

Calculate

Print

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	14.92	3.76	38.87	21.4	36.0	0.5			100.00
Product	52.70	20.41	4.19	23.84	24.5	47.5	0.5	5.00	8.98	52.70
Discard	47.30	8.80	3.29	55.62	17.9	23.2	0.5			47.30
Product		20.41	4.19	23.84	24.50	47.47	0.54	5.00	8.98	52.70

Prod Quality	Target ->	4400	Actual:	4401	kCals/kg	NAR

Coal Processing	Free State - New Vaal ROM			Processing unit
Simulation Model	0			
Primary Wash	0			
Separation Density :	1.650	Theor Yield % :	42.7	
Circ Medium RD :	1.570	Organic Eff % :	91.1	H % = 4.00
Ecart Probable :	0.020	Sink in Float % :	3.8	H% (mc) 3.66
Ave Particle Size (mm) :	15	Float in Sink % :	5.3	
Cyclone Diameter (mm):	1000	Tot Misplaced % :	9.1	
		% Near Dens + -	0.1	= 20.9

Calculate

Print

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	14.92	3.76	38.87	21.4	36.0	0.5			100.00
Product	38.88	21.40	4.26	21.09	25.3	49.4	0.6	5.00	9.05	38.88
Discard	61.12	10.80	3.45	50.18	18.9	27.5	0.5			61.12
Product		21.40	4.26	21.09	25.29	49.35	0.56	5.00	9.05	38.88

Prod Quality	Target ->	4600	Actual:	4626	kCals/kg	NAR

Bath

Coal Processing	Free State - New Vaal ROM			Processing unit
Simulation Model	0			
Primary Wash	0			
Separation Density :	1.869	Theor Yield % :	71.8	
		Organic Eff % :	98.8	H % = 4.00
Ecart Probable :	0.047	Sink in Float % :	3.4	H% (mc) 3.67
Ave Particle Size (mm) :	15	Float in Sink % :	3.7	
		Tot Misplaced % :	7.1	
		% Near Dens + -	0.1	= 22.0

Calculate

Print

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	14.92	3.76	38.87	21.4	36.0	0.5			100.00
Product	70.94	18.64	4.02	28.77	23.4	43.8	0.5	5.00	8.82	70.94
Discard	29.06	5.85	3.13	63.51	16.5	16.9	0.6			29.06
Product		18.64	4.02	28.77	23.40	43.81	0.50	5.00	8.82	70.94

Prod Quality	Target ->	4000	Actual:	4000	kCals/kg	NAR

Coal Processing	Free State - New Vaal ROM			Processing unit
Simulation Model	0			
Primary Wash	0			
Separation Density :	1.790	Theor Yield % :	63.9	
		Organic Eff % :	96.5	H % = 4.00
Ecart Probable :	0.043	Sink in Float % :	4.1	H% (mc) 3.66
Ave Particle Size (mm) :	15	Float in Sink % :	3.5	
		Tot Misplaced % :	7.6	
		% Near Dens + -	0.1	= 28.3

Calculate

Print

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	14.92	3.76	38.87	21.4	36.0	0.5			100.00
Product	61.60	19.55	4.11	26.27	23.9	45.7	0.5	5.00	8.91	61.60
Discard	38.40	7.49	3.21	59.08	17.3	20.4	0.5			38.40
Product		19.55	4.11	26.27	23.92	45.69	0.52	5.00	8.91	61.60

Prod Quality	Target ->	4200	Actual:	4208	kCals/kg	NAR

Coal Processing	Free State - New Vaal ROM			Processing unit
Simulation Model	0			
Primary Wash	0			
Separation Density :	1.720	Theor Yield % :	54.1	
		Organic Eff % :	94.2	H % = 4.00
Ecart Probable :	0.039	Sink in Float % :	4.7	H% (mc) 3.66
Ave Particle Size (mm) :	15	Float in Sink % :	3.9	
		Tot Misplaced % :	8.6	
		% Near Dens + -	0.1	= 28.6

Calculate

Print

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	14.92	3.76	38.87	21.4	36.0	0.5			100.00
Product	50.93	20.41	4.19	23.83	24.5	47.4	0.5	5.00	8.98	50.93
Discard	49.07	9.22	3.33	54.47	18.1	24.1	0.5			49.07
Product		20.41	4.19	23.83	24.53	47.45	0.54	5.00	8.98	50.93

Prod Quality	Target ->	4400	Actual:	4402	kCals/kg	NAR

Coal Processing	Free State - New Vaal ROM			Processing unit
Simulation Model	0			
Primary Wash	0			
Separation Density :	1.637	Theor Yield % :	44.1	
		Organic Eff % :	74.4	H % = 4.00
Ecart Probable :	0.034	Sink in Float % :	4.5	H% (mc) 3.66
Ave Particle Size (mm) :	15	Float in Sink % :	10.4	
		Tot Misplaced % :	14.8	
		% Near Dens + -	0.1	= 17.1

Calculate

Print

Air-dry ->	Yield %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	14.92	3.76	38.87	21.4	36.0	0.5			100.00
Product	32.80	21.29	4.25	21.44	25.2	49.1	0.6	5.00	9.04	32.80
Discard	67.20	11.81	3.53	47.38	19.5	29.6	0.5			67.20
Product		21.29	4.25	21.44	25.21	49.10	0.56	5.00	9.04	32.80

Prod Quality	Target ->	4600	Actual:	4600	kCals/kg	NAR

Coal Processing		Free State - New Vaal ROM			Processing unit
Simulation Model		0			
Primary Wash		0			

Separation Density	:	1.849	Theor Yield %	:	71.7			Calculate
			Organic Eff %	:	90.3	H % =	4.00	
Ecart Probable	:	0.088	Sink in Float %	:	5.3	H% (mc)	3.67	
Ave Particle Size (mm) :		15	Float in Sink %	:	9.3			Print
			Tot Misplaced % :		14.6			
			% Near Dens + -		0.1	=	21.3	

Air-dry ->	Yield % %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	14.92	3.76	38.87	21.4	36.0	0.5			100.00
Product	64.71	18.64	4.03	28.74	23.4	43.8	0.5	5.00	8.83	64.71
Discard	35.29	8.10	3.27	57.45	17.6	21.6	0.6			35.29
Product		18.64	4.03	28.74	23.43	43.80	0.51	5.00	8.83	64.71
Prod Quality	Target ->	4000		Actual:		4000	kCals/kg	NAR		

Coal Processing		Free State - New Vaal ROM			Processing unit
Simulation Model		0			
Primary Wash		0			

Separation Density	:	1.750	Theor Yield %	:	63.6			Calculate
			Organic Eff %	:	81.7	H % =	4.00	
Ecart Probable	:	0.078	Sink in Float %	:	7.4	H% (mc)	3.66	
Ave Particle Size (mm) :		15	Float in Sink %	:	10.1			Print
			Tot Misplaced % :		17.5			
			% Near Dens + -		0.1	=	28.4	

Air-dry ->	Yield % %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	14.92	3.76	38.87	21.4	36.0	0.5			100.00
Product	51.97	19.57	4.11	26.18	24.0	45.7	0.5	5.00	8.91	51.97
Discard	48.03	9.89	3.39	52.60	18.6	25.4	0.5			48.03
Product		19.57	4.11	26.18	24.00	45.70	0.52	5.00	8.91	51.97
Prod Quality	Target ->	4200		Actual:		4210	kCals/kg	NAR		

Coal Processing		Free State - New Vaal ROM			Processing unit
Simulation Model		0			
Primary Wash		0			

Separation Density	:	1.655	Theor Yield %	:	54.2			Calculate
			Organic Eff %	:	65.8	H % =	4.00	
Ecart Probable	:	0.068	Sink in Float %	:	7.5	H% (mc)	3.66	
Ave Particle Size (mm) :		15	Float in Sink %	:	12.9			Print
			Tot Misplaced % :		20.4			
			% Near Dens + -		0.1	=	20.9	

Air-dry ->	Yield % %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	14.92	3.76	38.87	21.4	36.0	0.5			100.00
Product	35.62	20.40	4.18	23.86	24.6	47.4	0.5	5.00	8.97	35.62
Discard	64.38	11.89	3.54	47.17	19.6	29.7	0.5			64.38
Product		20.40	4.18	23.86	24.58	47.38	0.54	5.00	8.97	35.62
Prod Quality	Target ->	4400		Actual:		4400	kCals/kg	NAR		

Coal Processing		Free State - New Vaal ROM			Processing unit
Simulation Model		0			
Primary Wash		0			

Separation Density	:	1.439	Theor Yield %	:	44.0			Calculate
			Organic Eff %	:	6.0	H % =	4.00	
Ecart Probable	:	0.045	Sink in Float %	:	#VALUE!	H% (mc)	3.66	
Ave Particle Size (mm) :		15	Float in Sink %	:	#VALUE!			Print
			Tot Misplaced % :		#VALUE!			
			% Near Dens + -		0.1	=	#VALUE!	

Air-dry ->	Yield % %	C.V. MJ/kg	I.H2O %	Ash %	V.M. %	F.C. %	S %	S.H2O %	T.H2O %	Tons
Feed	100.00	14.92	3.76	38.87	21.4	36.0	0.5			100.00
Product	2.63	21.29	4.25	21.41	25.2	49.1	0.6	5.00	9.04	2.63
Discard	97.37	14.75	3.75	39.34	21.3	35.6	0.5			97.37
Product		21.29	4.25	21.41	25.20	49.14	0.56	5.00	9.04	2.63
Prod Quality	Target ->	4600		Actual:		4601	kCals/kg	NAR		