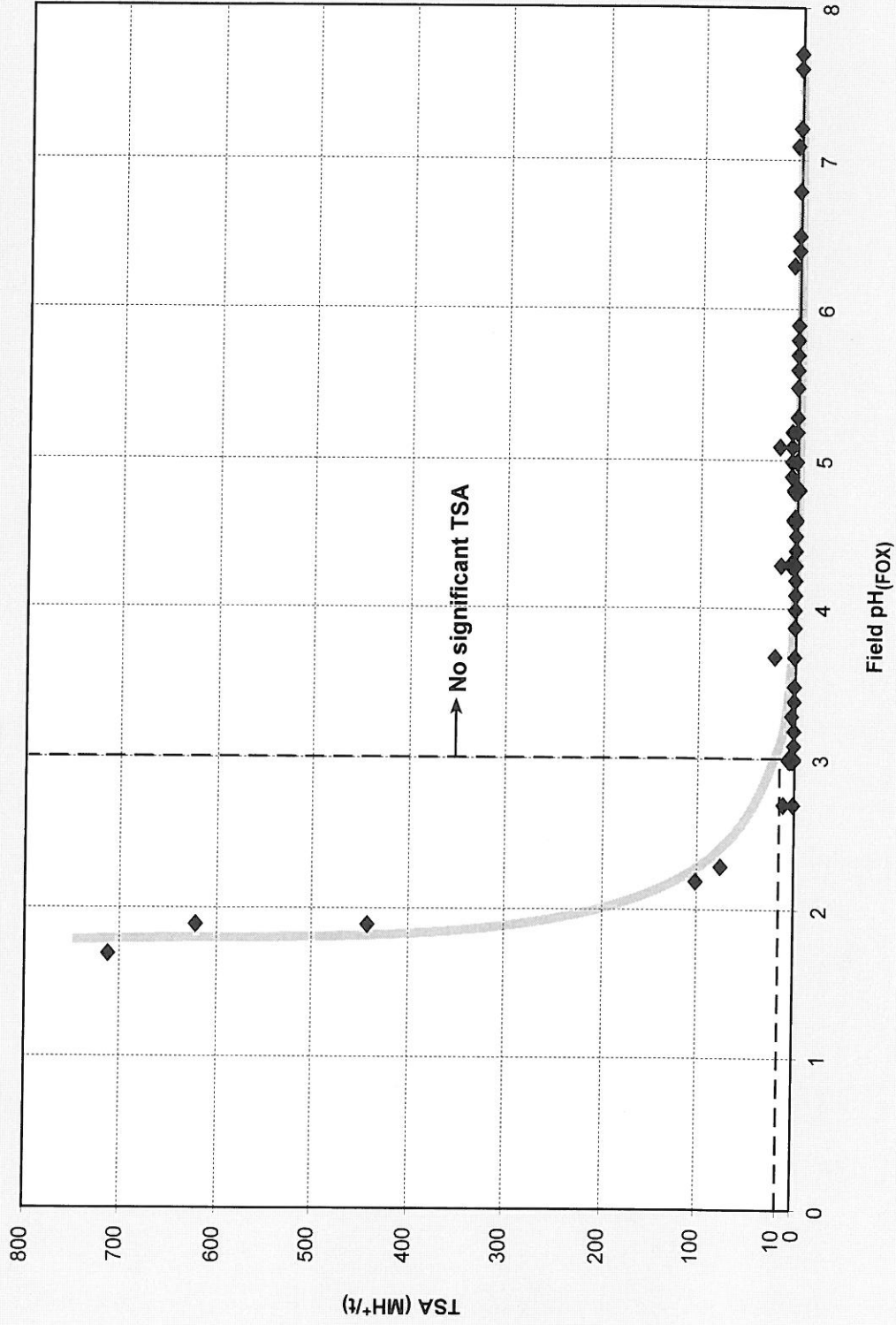


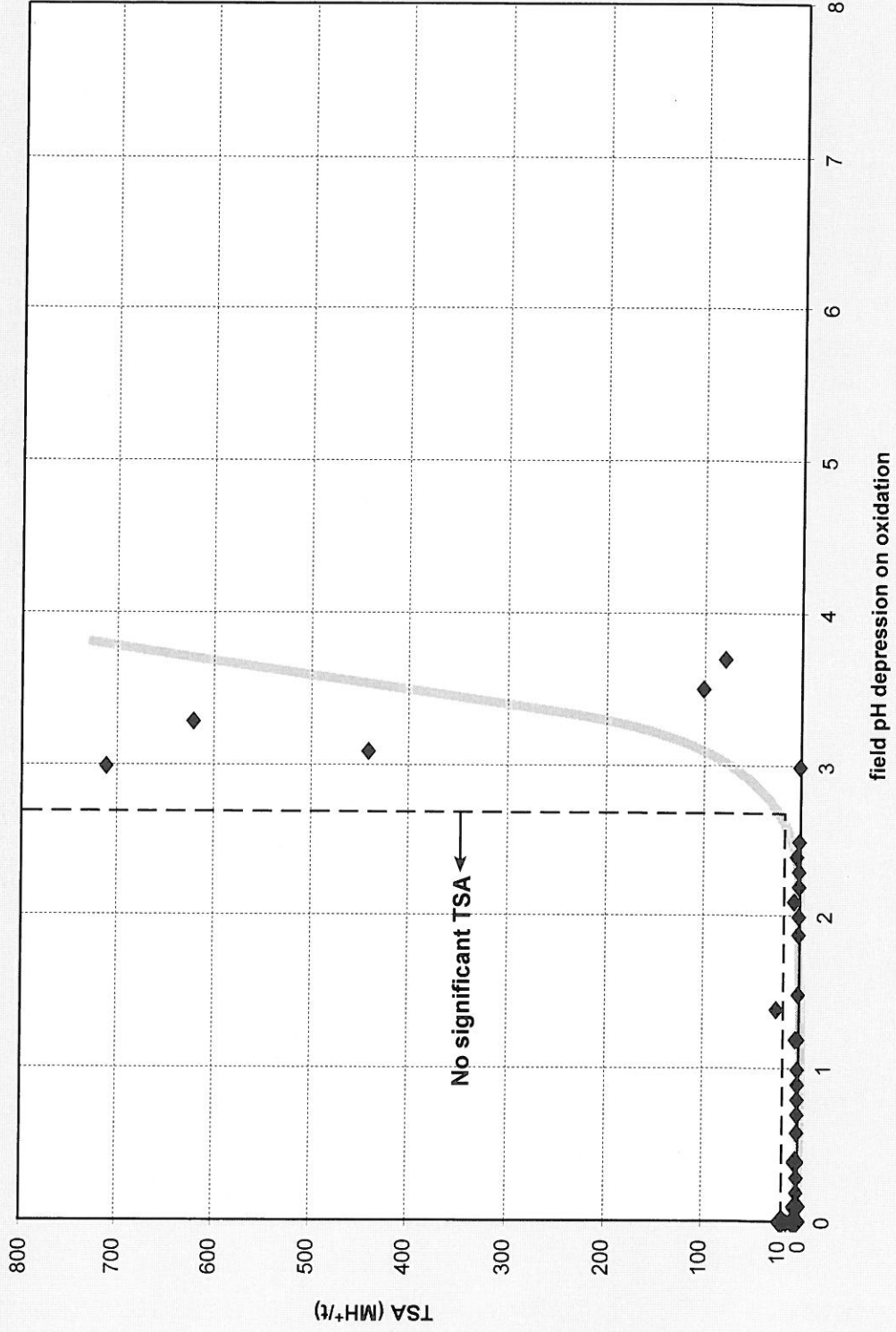
Appendix E

**CORRELATION—FIELD AND
LABORATORY ANALYTICAL
DATA**

pH_(FOX) vs TSA



pH depression (field) vs TSA



Graph E2
CSR DONNYBROOK
Correlation between field pH depression
(pH of 1:5 extract—pH on rapid oxidation)
and Laboratory Determined TSA)

Appendix F

**WATER QUALITY BASELINE
DATA—SUMMARY**

Appendix F

Water quality baseline data—summary

Table F.1 Bullock Creek Site B (15/09/95–14/08/00)

Parameter	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio
Number samples	43	43	43	43	43	43	43	43	43
Min	6.6	3,830	0.01	0.26	0.006	0.03	140	1,400	5.9
10%ile	6.9	23,580	0.07	0.34	0.022	0.11	1,220	10,120	6.6
50%ile	7.3	36,400	0.26	0.77	0.060	0.16	2,300	18,100	7.6
90%ile	7.7	49,800	0.44	3.88	0.100	1.18	2,980	21,000	9.1
Max	8.1	55,600	2.1	4.6	0.400	3.9	3,400	22,400	10.0

Table F.2 Bullock Creek Site C (15/09/95–14/08/00)

Parameter	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio
Number samples	15	15	15	15	15	15	15	15	15
Min	5.7	69	0.17	0.46	0.05	0.11	0.5	17	6.3
10%ile	5.8	107	0.29	0.60	0.08	0.23	0.5	21	6.5
50%ile	6.2	183	0.57	1.30	0.20	0.31	1.0	34	29.0
90%ile	6.4	287	1.04	2.00	0.50	1.32	40.6	306	63.2
Max	6.9	333	1.2	4.50	1.10	2.6	90.0	585	92.3

Table F.3 Bullock Creek Site 1 (14/07/00–14/08/00)

Date	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio
14/07/00	7.3	43,000	<0.005	0.33	<0.020	0.260	2,100	18,000	8.6
14/08/00	7.4	54,000	0.013	0.017	<0.005	0.009	2,400	22,000	9.2

	Total Kjeldahl Nitrogen (mg/L)	Nitrate and Nitrite (mg/L)	Total Nitrogen (mg/L)	Ammonia (mg/L)	Total Phosphorus (mg/L)	Ortho Phosphorus (mg/L)
14/07/00	0.24	0.008	0.25	0.013	<0.010	<0.002
14/08/00	0.37	<0.020	0.37	<0.06	0.033	<0.020

Table F.4 Bullock Creek Site 2 (14/07/00–14/08/00)

Date	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio
14/07/00	7.5	45,000	<0.005	1.2	0.040	0.55	2,200	19,000	8.6
14/08/00	7.5	53,000	0.007	0.052	<0.005	0.062	2,200	20,000	9.1

	Total Kjeldahl Nitrogen (mg/L)	Nitrate and Nitrite (mg/L)	Total Nitrogen (mg/L)	Ammonia (mg/L)	Total Phosphorus (mg/L)	Ortho Phosphorus (mg/L)
14/07/00	0.29	0.007	0.3	0.029	0.014	<0.002
14/08/00	0.52	<0.002	0.52	0.52	0.085	<0.02

Table F.5 Elimbah Creek Site H (15/09/95–14/08/00)

Parameter	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio
Number samples	44	44	39	44	44	43	44	39	39.0
Min	6.3	200	0.01	0.14	0.005	0.02	6	43	6.3
10%ile	6.4	564	0.08	0.25	0.012	0.05	19	148	6.8
50%ile	6.9	9,995	0.20	0.69	0.050	0.08	500	4,100	7.8
90%ile	7.4	26,520	0.65	2.37	0.200	0.49	1,585	11,200	10.1
Max	7.5	32,800	1	4	0.500	2.40	1,800	13,800	13.4

Table F.6 Elimbah Creek Site K (15/09/95–28/05/99)

Parameter	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio
Number samples	42	42	42	42	42	42	42	42	42.0
Min	6.3	529	0.03	0.19	0.01	0.03	9	80	6.1
10%ile	6.5	1,059	0.09	0.23	0.02	0.04	38	289	6.7
50%ile	7.1	17,300	0.21	0.63	0.05	0.11	950	7,025	7.4
90%ile	7.5	34,250	0.45	2.18	0.11	0.50	1,800	13,195	8.4
Max	7.8	38,000	1.2	44	0.03	4	2,700	19,000	9.2

Table F.7 Surface Water Site D (15/09/95–28/05/99)

Parameter	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio
Number samples	28	28	28	28	28	28	28	28	28.0
Min	5.7	90	0.21	0.63	0.01	0.04	0.5	10	2.5
10%ile	5.8	113	0.43	1.48	0.04	0.10	0.5	13	9.8
50%ile	6.1	148	1.40	6.05	0.11	0.42	1.0	23	35.0
90%ile	6.9	325	4.33	12.00	0.4.0	0.88	3.0	39	56.6
Max	7.1	660	10.00	45.00	0.50	5.4	51.0	395	76.0

Table F.8 Surface Water Site E (15/09/95–28/05/99)

Parameter	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio
Number samples	28	28	28	28	28	28	28	28	28.0
Min	5.8	84	0.03	1.30	0.005	0.03	0.5	14	14.0
10%ile	5.9	116	0.32	1.90	0.020	0.07	0.5	19	18.4
50%ile	6.2	151	0.80	2.75	0.080	0.15	0.5	33	59.0
90%ile	6.5	207	2.03	4.99	0.300	0.56	1.0	40	76.6
Max	6.8	228	3.30	8.20	0.4.00	4.90	2.0	43	86.0

Table F.9 Surface Water Site J (15/09/95–14/08/00)

Parameter	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio
Number samples	43	43	42	43	43	43	43	42	42
Min	4.9	51	0.13	0.29	0.02	0.04	0.5	12	1.2
10%ile	5.4	106	0.21	0.67	0.03	0.06	0.5	24	8.7
50%ile	5.6	180	0.45	1.30	0.12	0.16	1.0	42	25.4
90%ile	6.2	274	0.91	4.20	0.38	1.46	16.2	136	94.0
Max	8	670	1.30	33.00	0.54	4.6.0	72.0	530	102.0

Table F.10 Groundwater Site 1 (15/09/95–21/08/00)

Parameter	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio
Number samples	41	41	41	41	41	41	41	41	41
Min	4.6	3,100	0.01	22	0.05	0.07	80	1,630	4.2
10%ile	4.8	10,700	31.00	54	0.05	0.36	580	4,000	4.7
50%ile	5.1	26,500	81.00	91	0.36	0.59	2,100	11,750	5.5
90%ile	5.7	35,000	94.00	110	0.82	3.00	2,600	13,300	7.2
Max	6.3	37,100	121.00	126	2.70	15.00	2,950	16,000	24.8

Table F.11 Groundwater Site 2 (15/09/95–21/08/00)

Parameter	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio
Number samples	39	39	39	39	39	39	39	39	39
Min	3.7	1,700	0.18	0.56	0.01	0.2	130	800	5.2
10%ile	4.2	5,192	24.06	26.40	0.09	0.5	214	1,700	5.8
50%ile	4.6	14,100	92.00	98.00	1.10	2.4	700	5,200	7.1
90%ile	5.8	17,000	130.00	145.00	9.12	10.2	900	5,610	8.3
Max	6.5	18,200	140.00	150.00	10.00	15.0	1,150	6,450	40.8

Table F.12 Groundwater Site 3 (15/09/95–21/08/00)

Parameter	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio
Number samples	40	40	40	40	40	40	40	40	40
Min	3.6	860	5.9	10	0.05	0.2	32	274	4.6
10%ile	4.0	1,739	28.6	29.9	0.05	0.3	39	642	5.2
50%ile	4.9	4,745	72.5	81	0.20	0.5	180	1,500	8.8
90%ile	5.4	9,950	120.0	160	0.64	3.7	528	3,788	18.5
Max	5.6	24,000	160.0	180	2.90	15.0	1,950	8,950	28.1

Table F.13 Groundwater Site 4 (15/09/95–21/08/00)

Parameter	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio
Number samples	40	40	40	40	40	40	40	40	40
Min	4.7	277	0.2	1.3	0.01	0.1	8	53	5.3
10%ile	5.4	1,090	0.5	6.1	0.05	0.3	23	243	6.3
50%ile	5.7	4,555	4.6	13.0	0.10	0.6	175	1,365	7.5
90%ile	6.3	6,859	26.6	38.7	0.50	7.0	284	1,874	9.8
Max	6.8	25,600	100.0	110.0	1.20	13.0	2,300	12,100	42.8

Table F.14 Groundwater Bore 5A (26/07/00–21/08/00)

Date	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio	Total Dissolved Salts (mg/L)
26/07/00	4.5	32,000	68	74	0.36	0.53	2,300	18,000	7.8	20,000
21/08/00	4.6	39,000	78	84	0.58	0.66	2,300	14,000	6.1	25,000

	Alkalinity as CaCO ₃	Nitrate & Nitrite (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Filtered Manganese	Total Manganese
26/07/00	<1	<0.02	<0.01	<0.02	360	980	7,900	220	1.7	1.6
21/08/00	8	<0.02	<0.02	<0.02	290	920	7,900	240	1.1	1.2

Table F.15 Groundwater Bore 5B (26/07/00–21/08/00)

Date	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio	Total Dissolved Salts (mg/L)
26/07/00	4.9	16,000	42	49	<0.05	0.73	810	6,000	7.4	10,000
21/08/00	4.9	20,000	65	69	0.06	0.11	780	6,000	7.7	13,000

	Alkalinity as CaCO ₃	Nitrate & Nitrite (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Filtered Manganese	Total Manganese
26/07/00	22	<0.02	<0.01	<0.02	110	320	3200	100	1.5	1.50
21/08/00	14	<0.02	<0.02	<0.02	110	370	3500	120	0.5	0.47

Table F.16 Groundwater Bore 6A (26/07/00–21/08/00)

Date	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio	Total Dissolved Salts (mg/L)
26/07/00	5.5	17,000	39	46	0.26	0.74	560	7,800	13.9	11,000
21/08/00	4.8	43,000	100	110	2.50	3.00	1,900	15,000	7.9	28,000

	Alkalinity as CaCO ₃	Nitrate & Nitrite (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Filtered Manganese	Total Manganese
26/07/00	42	<0.02	<0.01	<0.02	220	570	3,500	67	1.6	1.8
21/08/00	10	<0.02	<0.02	<0.02	370	1,200	7,300	140	1.8	1.9

Table F.17 Groundwater Bore 6B (26/07/00–21/08/00)

Date	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio	Total Dissolved Salts (mg/L)
26/07/00	5.5	5,300	1.6	4.8	0.33	4.8	210	1,400	6.7	3,400
21/08/00	5.2	6,800	3.1	3.1	0.16	0.33	190	2,200	11.6	4,400

	Alkalinity as CaCO ₃	Nitrate & Nitrite (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Filtered Manganese	Total Manganese
26/07/00	20	<0.02	<0.01	<0.02	31	58	810	12	1.1	1.3
21/08/00	14	<0.02	<0.02	<0.02	35	92	1,300	13	1.1	1.2

Table F.18 Groundwater Bore 7 (26/07/00–21/08/00)

Date	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio	Total Dissolved Salts (mg/L)
26/07/00	5.6	1,100	21	28	<0.05	0.55	510	3,700	7.3	11,000
21/08/00	5.1	1,700	46	53	0.19	0.57	630	6,000	9.5	7,000

	Alkalinity as CaCO ₃	Nitrate & Nitrite (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Filtered Manganese	Total Manganese
26/07/00	20	<0.02	<0.01	<0.02	46	130	2,300	57	1.3	1.3
21/08/00	14	<0.02	<0.02	<0.02	68	210	3,300	77	2.1	2.6

Table F.19 Groundwater Bore 8 (26/07/00–21/08/00)

Date	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio	Total Dissolved Salts (mg/L)
26/07/00	5.6	11,000	35	45	0.23	0.66	590	3,900	6.6	7,000
21/08/00	5.6	12,000	12	42	<0.05	0.21	460	3,800	8.3	7,700

	Alkalinity as CaCO ₃	Nitrate & Nitrite (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Filtered Manganese	Total Manganese
26/07/00	40	<0.02	<0.01	<0.02	75	220	2,000	130	0.5	0.48
21/08/00	36	<0.02	<0.02	<0.02	77	220	2,100	130	0.5	0.44

Table F.20 Groundwater Bore 9A (26/07/00–21/08/00)

Date	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio	Total Dissolved Salts (mg/L)
26/07/00	5.5	42,000	42	66	<0.05	0.24	2,800	21,000	7.5	27,000
21/08/00	5.6	52,000	56	69	–	–	2,600	21,000	8.1	33,000

	Alkalinity as CaCO ₃	Nitrate & Nitrite (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Filtered Manganese	Total Manganese
26/07/00	74	<0.02	<0.01	<0.02	520	1,600	11,000	340	1.2	1.2
21/08/00	73	<0.02	<0.02	<0.02	420	1,700	11,000	470	1.0	1.2

Table F.21 Groundwater Bore 9B (26/07/00–21/08/00)

Date	pH	EC (μ S/cm)	Filt Fe (mg/L)	Total Fe (mg/L)	Filt Al (mg/L)	Total Al (mg/L)	Sulphate (mg/L)	Chloride (mg/L)	Cl:SO ₄ ratio	Total Dissolved Salts (mg/L)
26/07/00	4.2	19,000	68	71	10	11	1,300	7,100	5.5	12,000
21/08/00	4.3	22,000	66	68	8.3	10	1,100	7,900	7.2	14,000

	Alkalinity as CaCO ₃	Nitrate & Nitrite (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Calcium (mg/L)	Magnesium (mg/L)	Sodium (mg/L)	Potassium (mg/L)	Filtered Manganese	Total Manganese
26/07/00	<1	<0.02	<0.01	<0.02	110	540	3,900	150	0.9	1.3
21/08/00	<1	<0.02	<0.02	<0.02	120	560	4,100	150	1.1	1.1

Appendix G

**EMP MEASURES—ASS
MANAGEMENT
AND WATER QUALITY
MANAGEMENT**

EMP measures—ASS management and water quality management

Table G1 Issue 1—ASS management

Objective/performance criteria

- To ensure that ASS within the site are managed, so that they do not result in any significant effects off-site, and effects within the site are controlled and minimised.

Statutory requirements

- Planning approval conditions
- EPA
- Environmental authority conditions.

ASS management issue	Management measure	Monitoring	Performance criteria
1. Overburden stripping	<ul style="list-style-type: none"> • No ASS constraints for overburden. • No ASS constraints for interburden above -5.0m AHD. • Adopt precautionary approach to monitoring of overburden stripping. 	<ul style="list-style-type: none"> • Monitor colour and morphology of soil to be stripped. • pH_F (1:5) and pH_{Fox} (60 min) on overburden once per day while stripping. • Confirmatory laboratory POCAS analysis once per week while stripping. • Ensure lime is not spread beyond limits of disturbance area - visual inspection. • Ensure even coverage - visual inspection. 	<ul style="list-style-type: none"> • Overburden - non ASS. • Interburden above -5.0 m AHD—non-ASS. • pH_{Fox} >3.0—non ASS. • Correlate POCAS results with pH_{Fox}
2. Bund and plant area platform construction	<ul style="list-style-type: none"> • Apply layer of finely divided agricultural lime (CaCO₃) to footprint of bunds and plant area. Use agricultural lime spreader and rate of 10–12 t/ha. • Apply lime progressively with bund construction. • After completion of each section of bund, apply agricultural lime to surface at 10 t/ha prior to placement of topsoil layer. 	<ul style="list-style-type: none"> • Check condition of small sedimentation pond. • Check build-up of sediment. • Check sediment deposited into dredge pond. 	<ul style="list-style-type: none"> • Lime contained to footprint of bunds and platform. • Good coverage of areas to be treated.
3. Dredging operation	<ul style="list-style-type: none"> • Construct outlet from small sedimentation pond which will keep accumulated sediment submerged. • Ensure sediment accumulated in dredge pond from dredge return remains submerged. • Permanently submerge sediment removed from small sedimentation pond in the dredge pond. 		
4. Re-establishing floodway	<ul style="list-style-type: none"> • Ensure settled fines remain at the bottom of the fill profile, below the prevailing groundwater table 	Check fines placement within the fill profile	<ul style="list-style-type: none"> • Fines located at bottom of profile, not exposed to surface

Table G1 (continued)

ASS management issue	Management measure	Monitoring	Performance criteria
5. Product handling and end use	<ul style="list-style-type: none"> • Ensure leachates and runoff from stockpile area return to dredge pond. • Adopt precautionary approach to monitoring of product 	<ul style="list-style-type: none"> • Visual check. • pH_F (1:5) and pH_{Fox} (60 min.) on product once per day while producing. • Confirmatory laboratory POCAS analysis one per week while producing • pH monitoring. • Refer 'Issue 2'. 	<ul style="list-style-type: none"> • Runoff contained and directed to pond. • pH_F (1:5) >4.0. • pH_{Fox} >3.0. • Correlate POCAS results with pH_{Fox}.
6. Pond water management	<ul style="list-style-type: none"> • Install system for pH correction on pond. • Dose dredge return with suitable neutralising agent as required. • Keep minimum of 2 t of calcined magnesia or equivalent weight of other neutralising agent on-site. • Refer to 'Issue 2—Water Quality Management. 	<ul style="list-style-type: none"> • Visual inspection. • Field testing if necessary. 	<ul style="list-style-type: none"> • Pond water pH 6.5 to 8.5.
7. Rehabilitation	<ul style="list-style-type: none"> • Ensure no disturbed ASS remain above pond water level. • Permanently submerge all ASS below at least -1.0 m AHD. 	<ul style="list-style-type: none"> • Visual inspection. • Field testing if necessary. 	<ul style="list-style-type: none"> • All ASS below -1.0 m AHD (i.e. approx 1.8m below prevailing pond water level).

Table G2 (continued)

ASS management issue	Management measure	Monitoring	Performance criteria
4. Rehabilitation and long term pond water quality	<ul style="list-style-type: none"> Continue to monitor dredge pond pH and dose if required after completion of operations. 	<ul style="list-style-type: none"> Monitor pH at four locations in dredge pond weekly for three months after completion of operations. After three months, monitor at one location in pond once every 3 months for 'on maintenance' period (parameters to include depth profile of pH, cond, temp, DO and Laboratory analysis for Cl₁, SO₄, Fe (tot & disc) and AL (tot and diss). 	<ul style="list-style-type: none"> pH remains in range 6.0 to 8.5 at all locations. pH remains in range 6.0 to 8.5 at all locations. Interpretation of other parameters by Consultant appropriately qualified in the management of ASS and water quality.