Appendix B

Water Quality Statistics Table

Appendix B Water Quality Statistics Table

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
PH-L	pH Units	E1	1	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	7.87	N/A
		E2	1	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	7.64	N/A
		Pit1	19	7.42	7.572	7.6	7.7	7.89	7.9	7.904	7.944	8	8	8	7.802	0.172
		Pit2	18	7.4	7.7	7.824	7.863	7.915	8.188	8.2	8.26	8.43	8.566	8.6	7.989	0.278
		W1	83	6.7	7.276	7.464	7.505	7.75	7.93	8.002	8.158	8.377	8.993	9.05	7.744	0.406
		W2	85	6.89	7.36	7.518	7.53	7.78	7.97	8.024	8.376	8.542	8.743	8.81	7.796	0.383
		W3	95	6.81	7.294	7.476	7.52	7.8	8	8.05	8.162	8.225	8.407	8.51	7.749	0.357
		W4	17	7.37	7.542	7.576	7.6	7.86	8.07	8.142	8.218	8.282	8.352	8.37	7.861	0.287
		W5	11	7.33	7.36	7.38	7.42	7.64	8.115	8.27	8.42	8.425	8.429	8.43	7.788	0.426
		WA	19	7.37	7.456	7.466	7.505	7.63	7.665	7.726	7.956	8.034	8.135	8.16	7.645	0.206
		WB	77	6.47	7.372	7.474	7.53	7.73	7.95	7.99	8.094	8.288	8.586	8.73	7.733	0.351
COND-L	µS/cm	E1	1	181	181	181	181	181	181	181	181	181	181	181	181	N/A
		E2	1	100	100	100	100	100	100	100	100	100	100	100	100	N/A
		Pit1	19	2000	2200	2300	2305	2950	3285	3576	4110	4214	4675	4790	2995	786.5
		Pit2	18	3800	4168	4560	4705	5240	6563	7240	8060	8470	9694	10000	5821	1676
		W1	83	70	88	95.8	102.5	135	214	235	290.8	312.8	912.4	3420	202.1	365.6
		W2	85	68	98	106	114	167	273	294.4	466.6	552.8	769.7	910	227.6	162.8
		W3	95	60	71	98.8	105	150	277	285.4	302.2	338.5	392.7	404	183.4	94.83
		W4	17	100	103.6	138.2	163	233	275	275.8	327.6	374	418.8	430	220.9	93.32
		W5	11	97	101	142	149.5	234	283.5	295	374	627	829.4	880	274.5	217.9
		WA	19	60	81.4	88.8	90	108	151.5	173.6	212.8	260.9	469	521	143.7	102.6
		WB	77	55	79	88.2	94	111	180	218	236	266	304.6	313	141.6	66.1
SO4-T	mg/L	E1	1	2	2	2	2	2	2	2	2	2	2	2	2	N/A
		E2	1	2	2	2	2	2	2	2	2	2	2	2	2	N/A

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		Pit1	19	240	998	1160	1200	1500	1990	2126	2240	2410	2482	2500	1574	571.7
		Pit2	18	2300	2401	2640	2728	3205	3950	4000	4151	4290	4378	4400	3281	683.2
		W1	83	0.5	1	2	2	4	11	11.6	24.8	36.7	162.5	634	16.54	69.54
		W2	85	0.5	2	4	5	10	26	31.2	53.2	118	192.8	260	25.18	42.17
		W3	95	0.5	0.5	2	2.25	4	6	10	15.2	18.9	25.92	56	6.337	7.542
		W4	17	0.5	2	3	3	11	18	27.6	42.8	50.4	51.68	52	16.15	16.7
		W5	11	0.5	2	2.5	2.75	7	17.5	26	125	178.5	221.3	232	38.36	73.62
		WA	19	0.5	0.5	1	1	2	3	3.4	4.4	24.3	156.1	189	11.97	42.89
		WB	77	0.5	0.5	1	1	2	4	4.8	8	8.6	13.92	20	3.143	3.376
AL-T	mg/L	E1	1	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	N/A
		E2	1	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	N/A
		Pit1	18	0.01	0.01	0.022	0.025	0.025	0.0385	0.07	0.148	0.193	0.207	0.21	0.0524	0.0614
		Pit2	17	0.0038	0.005	0.005	0.005	0.025	0.025	0.085	0.33	0.402	0.44	0.45	0.0855	0.144
		W1	83	0.005	0.02	0.054	0.095	0.55	1.41	1.512	2.054	2.817	4.585	5.11	0.925	1.091
		W2	85	0.005	0.005	0.02	0.03	0.45	1.2	1.368	1.868	2.02	3.483	3.92	0.724	0.833
		W3	95	0.005	0.005	0.01	0.03	0.52	1.52	1.642	3.218	5.849	9.796	16	1.366	2.446
		W4	17	0.02	0.026	0.068	0.1	0.16	1.4	1.448	1.54	1.628	1.718	1.74	0.62	0.685
		W5	11	0.005	0.005	0.02	0.02	0.36	1.26	1.38	1.44	1.77	2.034	2.1	0.658	0.747
		WA	19	0.005	0.286	0.622	0.705	1.67	2.665	2.854	3.51	3.869	4.726	4.94	1.831	1.359
		WB	77	0.005	0.01	0.02	0.04	0.54	1.54	2.066	3.026	3.802	5.486	5.57	1.095	1.35
AS-T	mg/L	E1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		E2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		Pit1	19	0.012	0.0174	0.0202	0.0215	0.026	0.043	0.0592	0.086	0.125	0.233	0.26	0.0478	0.0576
		Pit2	17	0.007	0.0223	0.05	0.05	0.072	0.2	0.208	0.247	0.486	1.169	1.34	0.172	0.311
		W1	83	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.003	0.003	0.00536	0.007	0.00116	0.00122
		W2	85	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.003	0.006	0.0108	0.0186	0.032	0.00265	0.00441

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		W3	95	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.0022	0.003	0.004	0.0066	0.016	0.00171	0.00191
		W4	17	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.002	0.0022	0.00284	0.003	0.00091	0.00073
		W5	11	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.00114	0.00071
		WA	19	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0006	0.0011	0.00182	0.002	0.00061	0.00036
		WB	77	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.002	0.00272	0.005	0.00074	0.00063
CD-T	mg/L	E1	1	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	N/A
		E2	1	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	N/A
		Pit1	16	0.0018	0.0114	0.015	0.015	0.0221	0.0261	0.0291	0.0383	0.0417	0.0451	0.046	0.0226	0.0115
		Pit2	17	0.0004	0.0005	0.00052	0.0006	0.001	0.0016	0.00288	0.00382	0.00412	0.0045	0.0046	0.0016	0.00137
		W1	83	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.0002	0.00058	0.00191	0.0024	0.00014	0.00034
		W2	85	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.0001	0.00018	0.00071	0.0013	8.2E-05	0.00015
		W3	95	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.0002	0.0005	0.0005	0.0005	9.4E-05	0.00012
		W4	17	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	1.4E-20
		W5	11	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.0007	0.00265	0.00421	0.0046	0.00052	0.00137
		WA	19	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00012	0.00058	0.0007	8.4E-05	0.00015
		WB	77	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00006	0.00029	0.0009	6.3E-05	9.7E-05
CO-T	mg/L	E1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		E2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		Pit1	18	0.005	0.005	0.005	0.00525	0.025	0.025	0.0298	0.0541	0.644	3.201	3.84	0.234	0.9
		Pit2	16	0.002	0.002	0.002	0.002	0.0055	0.025	0.025	0.213	0.448	0.562	0.591	0.0714	0.169
		W1	83	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.002	0.002	0.00418	0.005	0.00081	0.00081
		W2	85	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0016	0.002	0.00216	0.003	0.0007	0.00051
		W3	88	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.00313	0.004	0.00064	0.00051
		W4	17	0.0005	0.0005	0.0005	0.0005	0.0005	0.002	0.002	0.0024	0.0032	0.00384	0.004	0.00132	0.00107
		W5	11	0.0005	0.0005	0.0005	0.0005	0.0005	0.00075	0.001	0.002	0.002	0.002	0.002	0.00082	0.0006
		WA	19	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00055	0.00091	0.001	0.00053	0.00011

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		WB	77	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.003	0.003	0.00071	0.00054
Cr-T	mg/L	E1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		E2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		Pit1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		Pit2	1	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	0.001	N/A
		W1	83	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.002	0.0029	0.00518	0.006	0.00093	0.00106
		W2	85	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.002	0.00416	0.005	0.00076	0.00071
		W3	95	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.002	0.0053	0.0117	0.022	0.00137	0.00268
		W4	17	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.001	0.0012	0.00184	0.002	0.00071	0.0004
		W5	11	0.0005	0.0005	0.0005	0.0005	0.0005	0.00075	0.001	0.001	0.0015	0.0019	0.002	0.00073	0.00047
		WA	19	0.0005	0.0005	0.0005	0.0005	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.00134	0.00073
		WB	77	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.002	0.003	0.005	0.005	0.00104	0.00103
CU-T	mg/L	E1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		E2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		Pit1	18	0.001	0.002	0.002	0.002	0.005	0.01	0.0118	0.0253	0.043	0.0566	0.06	0.0106	0.0155
		Pit2	17	0.002	0.002	0.0022	0.003	0.005	0.006	0.006	0.0128	0.0276	0.0615	0.07	0.00906	0.0161
		W1	83	0.0005	0.0005	0.001	0.001	0.002	0.003	0.004	0.006	0.0107	0.0435	0.114	0.00455	0.013
		W2	85	0.0005	0.0005	0.0005	0.0005	0.002	0.003	0.003	0.004	0.0058	0.013	0.018	0.0022	0.00256
		W3	95	0.0005	0.0005	0.0005	0.001	0.002	0.003	0.004	0.006	0.0096	0.0212	0.024	0.00302	0.0039
		W4	17	0.0005	0.0005	0.0006	0.001	0.002	0.002	0.0028	0.003	0.0032	0.00384	0.004	0.00182	0.00104
		W5	11	0.0005	0.0005	0.001	0.0015	0.002	0.003	0.003	0.003	0.0045	0.0057	0.006	0.00227	0.00154
		WA	19	0.0005	0.0018	0.002	0.002	0.003	0.004	0.004	0.004	0.0047	0.00974	0.011	0.00324	0.00214
		WB	77	0.0005	0.0005	0.0005	0.0005	0.002	0.004	0.004	0.007	0.0082	0.01	0.01	0.0027	0.00261
MN-T	mg/L	E1	1	0.272	0.272	0.272	0.272	0.272	0.272	0.272	0.272	0.272	0.272	0.272	0.272	N/A
		E2	1	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	0.028	N/A
		Pit1	13	0.455	0.493	0.756	1.1	1.34	1.7	2.24	3.112	3.452	3.706	3.77	1.593	1.029

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		Pit2	12	0.025	0.025	0.025	0.025	0.0675	0.0953	0.107	0.217	1.156	2.063	2.29	0.257	0.643
		W1	83	0.016	0.0242	0.0284	0.031	0.046	0.0785	0.102	0.144	0.191	0.359	0.459	0.0731	0.0731
		W2	85	0.0005	0.026	0.032	0.038	0.073	0.184	0.224	0.335	0.387	1.034	1.72	0.151	0.223
		W3	88	0.0005	0.0277	0.0328	0.038	0.064	0.085	0.0958	0.149	0.2	0.3	0.333	0.0781	0.0618
		W4	17	0.008	0.0308	0.0388	0.042	0.064	0.096	0.109	0.127	0.153	0.192	0.202	0.0742	0.0482
		W5	11	0.006	0.025	0.028	0.029	0.063	0.128	0.141	0.158	0.275	0.369	0.392	0.0986	0.11
		WA	19	0.009	0.0128	0.015	0.0155	0.026	0.0725	0.0944	0.115	0.133	0.208	0.227	0.0521	0.0566
		WB	77	0.009	0.0166	0.024	0.027	0.047	0.085	0.111	0.261	0.443	0.669	0.988	0.101	0.157
MO-T	mg/L	E1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		E2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		Pit1	18	0.012	0.025	0.0338	0.0478	0.0515	0.0633	0.0652	0.0682	0.0754	0.0951	0.1	0.0518	0.0206
		Pit2	16	0.025	0.0415	0.051	0.0548	0.075	0.245	0.29	0.3	0.305	0.317	0.32	0.138	0.111
		W1	83	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.0019	0.002	0.002	0.00064	0.00038
		W2	85	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.002	0.003	0.00516	0.006	0.00098	0.00102
		W3	88	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.00113	0.002	0.00057	0.00022
		W4	17	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	2.2E-19
		W5	11	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00275	0.00455	0.005	0.00091	0.00136
		WA	19	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00095	0.00419	0.005	0.00074	0.00103
		WB	77	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00244	0.007	0.0006	0.00074
NI-T	mg/L	E1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		E2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		Pit1	17	0.01	0.0186	0.0216	0.024	0.025	0.036	0.04	0.0428	0.0442	0.0448	0.045	0.0281	0.00999
		Pit2	16	0.002	0.002	0.002	0.00238	0.00275	0.0175	0.025	0.025	0.0438	0.0888	0.1	0.0141	0.0246
		W1	83	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.002	0.003	0.00418	0.005	0.00101	0.00094
		W2	85	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.002	0.002	0.00316	0.004	0.00091	0.00072
		W3	95	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.003	0.004	0.00642	0.013	0.00125	0.00165

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		W4	17	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.0014	0.0022	0.00284	0.003	0.00085	0.00068
		W5	11	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.00114	0.00071
		WA	19	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.002	0.002	0.002	0.002	0.002	0.00116	0.00062
		WB	77	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.002	0.003	0.00324	0.004	0.001	0.00081
PB-T	mg/L	E1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		E2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		Pit1	18	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.0046	0.0395	0.16	0.19	0.0118	0.0446
		Pit2	16	0.0005	0.0005	0.0005	0.0005	0.002	0.0025	0.0025	0.0085	0.0108	0.0126	0.013	0.00303	0.00372
		W1	83	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.003	0.0086	0.012	0.012	0.00142	0.00248
		W2	85	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.002	0.003	0.00648	0.009	0.00104	0.00133
		W3	95	0.0005	0.0005	0.0005	0.0005	0.0005	0.002	0.002	0.003	0.006	0.0105	0.018	0.00152	0.00244
		W4	17	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0009	0.002	0.0022	0.00284	0.003	0.00085	0.00075
		W5	11	0.0005	0.0005	0.0005	0.0005	0.0005	0.00125	0.002	0.002	0.002	0.002	0.002	0.00091	0.0007
		WA	19	0.0005	0.0005	0.0005	0.0005	0.002	0.002	0.002	0.002	0.0021	0.00282	0.003	0.00142	0.00079
		WB	77	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.004	0.006	0.007	0.007	0.0014	0.00173
ZN-T	mg/L	E1	1	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	N/A
		E2	1	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	N/A
		Pit1	19	0.006	0.014	0.028	0.0335	0.152	0.887	1.033	1.936	2.1	2.244	2.28	0.594	0.761
		Pit2	17	0.011	0.034	0.0462	0.047	0.128	0.152	0.174	0.304	0.861	2.572	3	0.283	0.706
		W1	83	0.0025	0.0025	0.0025	0.0025	0.0025	0.008	0.009	0.023	0.0893	0.128	0.177	0.0131	0.0292
		W2	85	0.0025	0.0025	0.0025	0.0025	0.0025	0.009	0.0104	0.0216	0.0292	0.0957	0.115	0.00955	0.0173
		W3	95	0.0025	0.0025	0.0025	0.0025	0.0025	0.008	0.012	0.0172	0.0414	0.0599	0.09	0.00888	0.0141
		W4	17	0.0025	0.0025	0.0025	0.0025	0.0025	0.005	0.005	0.0092	0.013	0.0194	0.021	0.00471	0.00484
		W5	11	0.0025	0.0025	0.0025	0.00425	0.007	0.008	0.008	0.052	0.201	0.32	0.35	0.0411	0.103
		WA	19	0.0025	0.0025	0.0046	0.0065	0.008	0.0105	0.0136	0.0242	0.0278	0.048	0.053	0.0116	0.0119
		WB	77	0.0025	0.0025	0.0025	0.0025	0.0025	0.007	0.0108	0.018	0.028	0.0542	0.074	0.00781	0.0117

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
CN-T	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	3	0.002	0.002	0.002	0.002	0.002	1.111	1.333	1.776	1.998	2.176	2.22	0.741	1.281
		Pit2	3	0.002	0.002	0.002	0.002	0.002	0.188	0.225	0.3	0.337	0.367	0.374	0.126	0.215
		W1	59	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.00326	0.005	0.00205	0.00039
		W2	59	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.00742	0.008	0.00219	0.00101
		W3	69	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	1.3E-18
		W4	12	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	4.5E-19
		W5	10	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	4.6E-19
		WA	11	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.0035	0.0047	0.005	0.00227	0.0009
		WB	52	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	1.3E-18
CN-WAD	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	13	0.002	0.002	0.002	0.002	0.0025	0.0025	0.0025	0.0189	0.0258	0.0292	0.03	0.006	0.00921
		Pit2	12	0.002	0.002	0.002	0.002	0.0025	0.0025	0.0025	0.0111	0.0341	0.0556	0.061	0.008	0.0169
		W1	23	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.0098	0.012	0.00243	0.00209
		W2	24	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.0243	0.031	0.00321	0.00592
		W3	32	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.0199	0.028	0.00281	0.0046
		W4	5	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0
		W5	1	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	N/A
		WA	8	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0
		WB	24	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	0.002	1.3E-18
Alkalinity	mg/L	E1	1	76	76	76	76	76	76	76	76	76	76	76	76	N/A
		E2	1	44	44	44	44	44	44	44	44	44	44	44	44	N/A
		Pit1	2	45	57.5	70	76.25	107.5	138.8	145	157.5	163.8	168.8	170	107.5	88.39
		Pit2	3	28	40.2	52.4	58.5	89	90	90.2	90.6	90.8	90.96	91	69.33	35.81

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		W1	1	43	43	43	43	43	43	43	43	43	43	43	43	N/A
		W2	2	43	44.7	46.4	47.25	51.5	55.75	56.6	58.3	59.15	59.83	60	51.5	12.02
		W3	8	24	25.4	27.2	28.25	30	32	32	37.4	43.7	48.74	50	31.63	7.927
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	1	45	45	45	45	45	45	45	45	45	45	45	45	N/A
FE-T	mg/L	E1	0.5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	N/A
		E2	0.5	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	N/A
		Pit1	2	0.105	0.116	0.127	0.1325	0.16	0.1925	0.199	0.212	0.2185	0.2235	0.225	0.1635	0.12
		Pit2	2	0.5325	0.553	0.5735	0.584	0.635	0.8375	0.878	0.959	0.9995	1.032	1.04	0.736	0.537
		W1	0.5	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	N/A
		W2	1.5	0.16	0.1875	0.215	0.229	0.2975	0.3665	0.38	0.4075	0.4215	0.4325	0.435	0.2975	0.389
		W3	4.5	0.65	1.1365	1.357	1.3675	1.985	2.9915	3.651	5.52	6.825	7.865	8.125	2.799	4.867
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0.5	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	N/A
Ca	mg/L	E1	1	10	10	10	10	10	10	10	10	10	10	10	10	N/A
		E2	1	6	6	6	6	6	6	6	6	6	6	6	6	N/A
		Pit1	7	302	317	330	334.5	349	405	408	444	469.5	489.9	495	375	65.38
		Pit2	7	452	459.2	474.4	490	580	595.5	598.8	605.8	609.4	612.3	613	545.1	67.16
		W1	59	2	3	5	5	8	13	13	17.2	18.1	20	20	8.898	5.175
		W2	60	3	3	6	6	12	19	19.2	26.3	34	38.05	41	13.9	9.214
		W3	69	2	3	4	6	8	16	18	20	20.6	24	24	10.77	6.463
		W4	11	6	6	6	7	10	13.5	14	14	14.5	14.9	15	10.09	3.506

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		W5	9	6	6	6	6	12	26	26.8	29.2	31.6	33.52	34	15.67	10.89
		WA	10	6	6	6	6	8	15.5	17.8	23.5	34.75	43.75	46	13.5	12.55
		WB	52	0.5	3	3.4	5	7	13.25	14	16	18.9	22.98	24	8.933	5.638
Mg	mg/L	E1	1	7	7	7	7	7	7	7	7	7	7	7	7	N/A
		E2	1	3	3	3	3	3	3	3	3	3	3	3	3	N/A
		Pit1	7	90	90.6	92.4	94.5	98	100	100	110.4	118.2	124.4	126	100.4	12
		Pit2	7	130	134.2	137.2	137.5	138	141.5	142.4	161.8	175.9	187.2	190	145.1	20.17
		W1	60	1	1	2	2	5	9	10	12	14	15.41	16	5.95	4.156
		W2	61	1	1	3	4	7	12	12	18	20	27	30	8.705	6.611
		W3	70	1	1	2	3	5	9.75	10	11	12	13.62	15	5.971	3.978
		W4	12	3	3	3.2	3.75	4	7	7	7	11.05	15.01	16	5.75	3.646
		W5	10	3	3	3	3	5.5	6.75	8.8	16.6	19.3	21.46	22	7.4	6.45
		WA	11	2	2	2	2.5	4	5.5	6	16	23	28.6	30	7	8.602
		WB	53	0.5	1	2	3	4	7	9	10	12	14.92	17	5.255	3.723
Na	mg/L	E1	1	20	20	20	20	20	20	20	20	20	20	20	20	N/A
		E2	1	11	11	11	11	11	11	11	11	11	11	11	11	N/A
		Pit1	1	287	287	287	287	287	287	287	287	287	287	287	287	N/A
		Pit2	2	591	592	593	593.5	596	598.5	599	600	600.5	600.9	601	596	7.071
		W1	1	11	11	11	11	11	11	11	11	11	11	11	11	N/A
		W2	2	10	10	10	10	10	10	10	10	10	10	10	10	0
		W3	8	4	4	4	4	4	4.25	4.6	6.8	8.9	10.58	11	5	2.449
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	1	10	10	10	10	10	10	10	10	10	10	10	10	N/A
K	mg/L	E1	1	2	2	2	2	2	2	2	2	2	2	2	2	N/A

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		E2	1	2	2	2	2	2	2	2	2	2	2	2	2	N/A
		Pit1	1	44	44	44	44	44	44	44	44	44	44	44	44	N/A
		Pit2	2	116	116.1	116.2	116.3	116.5	116.8	116.8	116.9	117	117	117	116.5	0.707
		W1	1	2	2	2	2	2	2	2	2	2	2	2	2	N/A
		W2	2	2	2	2	2	2	2	2	2	2	2	2	2	0
		W3	8	1	1.7	2	2	2	2	2	2	2	2	2	1.875	0.354
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	1	2	2	2	2	2	2	2	2	2	2	2	2	N/A
Cl	mg/L	E1	1	12	12	12	12	12	12	12	12	12	12	12	12	N/A
		E2	1	6	6	6	6	6	6	6	6	6	6	6	6	N/A
		Pit1	1	91	91	91	91	91	91	91	91	91	91	91	91	N/A
		Pit2	2	181	181	181	181	181	181	181	181	181	181	181	181	0
		W1	1	5	5	5	5	5	5	5	5	5	5	5	5	N/A
		W2	2	6	6.2	6.4	6.5	7	7.5	7.6	7.8	7.9	7.98	8	7	1.414
		W3	8	3	3	3.4	3.75	4	4.25	4.6	5.3	5.65	5.93	6	4.125	0.991
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	1	6	6	6	6	6	6	6	6	6	6	6	6	N/A
F	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8	N/A
		Pit2	2	4.3	4.38	4.46	4.5	4.7	4.9	4.94	5.02	5.06	5.092	5.1	4.7	0.566
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		W2	1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	N/A
		W3	7	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	7.5E-18
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Al-F	mg/L	E1	1	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	N/A
		E2	1	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	0.46	N/A
		Pit1	8	0.005	0.005	0.005	0.005	0.005	0.00875	0.014	0.02	0.02	0.02	0.02	0.00875	0.00694
		Pit2	6	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0
		W1	72	0.005	0.005	0.005	0.00875	0.15	0.515	0.578	0.807	1.015	1.979	3.86	0.335	0.534
		W2	69	0.005	0.005	0.005	0.005	0.05	0.38	0.474	0.804	0.982	1.529	2.25	0.255	0.399
		W3	82	0.005	0.005	0.005	0.005	0.125	0.488	0.644	1.026	1.166	1.588	2.09	0.331	0.442
		W4	16	0.005	0.0075	0.01	0.01	0.045	0.32	0.41	1.07	1.3	1.54	1.6	0.311	0.494
		W5	10	0.005	0.005	0.005	0.005	0.0775	0.54	0.622	0.876	1.083	1.249	1.29	0.332	0.448
		WA	16	0.005	0.125	0.18	0.188	0.645	1.225	1.36	1.765	1.815	1.875	1.89	0.81	0.639
		WB	66	0.005	0.005	0.005	0.005	0.21	0.48	0.52	0.815	1.058	2.979	3.33	0.37	0.598
As-F	mg/L	E1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		E2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		Pit1	7	0.01	0.01	0.0104	0.011	0.013	0.041	0.05	0.056	0.056	0.056	0.056	0.0261	0.0211
		Pit2	6	0.0226	0.0253	0.028	0.029	0.038	0.195	0.245	0.718	0.954	1.143	1.19	0.26	0.463
		W1	58	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.003	0.00386	0.005	0.0009	0.0009
		W2	59	0.0005	0.0005	0.0005	0.0005	0.0005	0.002	0.002	0.005	0.0091	0.0156	0.022	0.00204	0.00351
		W3	69	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.002	0.0026	0.006	0.006	0.00109	0.00113
		W4	12	0.0005	0.0005	0.0005	0.0005	0.0005	0.00125	0.0018	0.002	0.00245	0.00289	0.003	0.001	0.00085
		W5	10	0.0005	0.0005	0.0005	0.0005	0.0005	0.00163	0.002	0.002	0.002	0.002	0.002	0.00095	0.00072

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		WA	11	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.0015	0.0019	0.002	0.00068	0.00046
		WB	53	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.00296	0.004	0.00071	0.00059
Cd-F	mg/L	E1	1	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	N/A
		E2	1	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	N/A
		Pit1	7	0.0011	0.00812	0.0131	0.0135	0.0203	0.0233	0.0235	0.027	0.0296	0.0316	0.0321	0.0182	0.00989
		Pit2	6	0.0002	0.00035	0.0005	0.0005	0.00055	0.0006	0.0006	0.0009	0.00105	0.00117	0.0012	0.0006	0.00033
		W1	60	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00069	0.0014	7.5E-05	0.00018
		W2	59	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00014	0.0002	5.3E-05	2E-05
		W3	69	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00006	0.0005	0.0005	0.0005	9E-05	0.00013
		W4	12	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	1.4E-20
		W5	10	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	8.5E-05	0.00024	0.00037	0.0004	8.5E-05	0.00011
		WA	11	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00038	0.00064	0.0007	0.00011	0.0002
		WB	53	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	6.8E-21
Co-F	mg/L	E1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		E2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		Pit1	7	0.003	0.0036	0.004	0.004	0.005	0.005	0.005	0.0146	0.0218	0.0276	0.029	0.00786	0.00935
		Pit2	6	0.0005	0.0005	0.0005	0.00088	0.002	0.002	0.002	0.012	0.017	0.021	0.022	0.00483	0.00844
		W1	60	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00053	0.001	0.001	0.00053	0.00011
		W2	61	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	3.3E-19
		W3	63	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	3.3E-19
		W4	12	0.0005	0.0005	0.0005	0.0005	0.0005	0.002	0.002	0.002	0.002	0.002	0.002	0.00104	0.00072
		W5	10	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00055	0.00078	0.00096	0.001	0.00055	0.00016
		WA	11	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	1.1E-19
		WB	53	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.002	0.00058	0.00031
Cr-F	mg/L	E1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		E2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		Pit1	7	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
		Pit2	6	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
		W1	56	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.00145	0.002	0.00056	0.00023
		W2	55	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00065	0.001	0.001	0.00053	0.00011
		W3	65	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.00136	0.002	0.00055	0.00022
		W4	12	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	1.1E-19
		W5	10	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	1.1E-19
		WA	11	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	1.1E-19
		WB	53	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0009	0.001	0.002	0.002	0.00059	0.00031
Cu-F	mg/L	E1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		E2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		Pit1	7	0.0005	0.0008	0.001	0.001	0.002	0.002	0.002	0.0032	0.0041	0.00482	0.005	0.00193	0.00148
		Pit2	6	0.0005	0.00075	0.001	0.001	0.001	0.001	0.001	0.0015	0.00175	0.00195	0.002	0.00108	0.00049
		W1	49	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.0024	0.004	0.005	0.00552	0.006	0.0018	0.0015
		W2	42	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.002	0.003	0.004	0.004	0.004	0.00155	0.00113
		W3	58	0.0005	0.0005	0.0005	0.0005	0.0015	0.002	0.002	0.003	0.00415	0.00629	0.008	0.00169	0.00142
		W4	11	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.002	0.002	0.003	0.0038	0.004	0.00145	0.00108
		W5	9	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.002	0.0022	0.0026	0.00292	0.003	0.00128	0.00087
		WA	9	0.0005	0.0009	0.001	0.001	0.002	0.002	0.0024	0.0032	0.0036	0.00392	0.004	0.00194	0.00107
		WB	43	0.0005	0.0005	0.0005	0.0005	0.002	0.0025	0.003	0.004	0.0049	0.005	0.005	0.00187	0.00137
Mn-F	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	1	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	0.024	N/A
		Pit1	7	0.091	0.247	0.378	0.418	1.21	1.335	1.38	1.99	2.425	2.773	2.86	1.095	0.93
		Pit2	5	0.002	0.002	0.002	0.002	0.003	0.061	0.0744	0.101	0.115	0.125	0.128	0.0392	0.0558
		W1	58	0.0005	0.0037	0.007	0.008	0.016	0.0238	0.026	0.0351	0.0464	0.0749	0.1	0.0184	0.0168
		W2	57	0.001	0.008	0.0162	0.018	0.035	0.094	0.113	0.185	0.248	0.299	0.309	0.0685	0.0777

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		W3	62	0.0005	0.009	0.013	0.0143	0.023	0.0388	0.0438	0.0683	0.105	0.176	0.182	0.034	0.0349
		W4	12	0.006	0.0171	0.018	0.018	0.0295	0.054	0.0628	0.0669	0.0994	0.131	0.139	0.0418	0.0363
		W5	10	0.002	0.0047	0.0154	0.0185	0.0425	0.0633	0.0668	0.0758	0.0839	0.0904	0.092	0.0419	0.0313
		WA	10	0.005	0.0068	0.0166	0.0195	0.0285	0.056	0.0682	0.106	0.127	0.144	0.148	0.0462	0.0458
		WB	51	0.0005	0.005	0.01	0.012	0.029	0.058	0.108	0.224	0.375	0.698	0.877	0.0826	0.157
Mo-F	mg/L	E1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		E2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		Pit1	6	0.05	0.05	0.05	0.0508	0.0565	0.06	0.06	0.06	0.06	0.06	0.06	0.0555	0.00505
		Pit2	5	0.045	0.0454	0.0458	0.046	0.054	0.058	0.063	0.073	0.078	0.082	0.083	0.0572	0.0154
		W1	58	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00065	0.001	0.00143	0.002	0.00057	0.00024
		W2	55	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.002	0.002	0.00292	0.004	0.00075	0.00065
		W3	61	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.00052	9E-05
		W4	12	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	1.1E-19
		W5	10	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00095	0.00298	0.0046	0.005	0.00095	0.00142
		WA	9	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
		WB	53	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	3.3E-19
Ni-F	mg/L	E1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		E2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		Pit1	7	0.002	0.0134	0.0214	0.022	0.025	0.027	0.0276	0.032	0.035	0.0374	0.038	0.0233	0.0109
		Pit2	6	0.0005	0.0005	0.0005	0.00088	0.002	0.00275	0.003	0.0065	0.00825	0.00965	0.01	0.003	0.00356
		W1	56	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.00145	0.002	0.00059	0.00025
		W2	54	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.00147	0.002	0.0006	0.00026
		W3	64	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.00137	0.002	0.00058	0.00024
		W4	12	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.00095	0.001	0.001	0.001	0.00058	0.00019
		W5	9	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
		WA	9	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0007	0.001	0.001	0.001	0.001	0.00061	0.00022

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		WB	50	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.002	0.002	0.00063	0.00033
Pb-F	mg/L	E1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		E2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		Pit1	7	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
		Pit2	6	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0
		W1	56	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.002	0.00245	0.003	0.00066	0.00048
		W2	57	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0014	0.002	0.002	0.002	0.00068	0.00047
		W3	68	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.001	0.001	0.00266	0.004	0.00063	0.0005
		W4	12	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	1.1E-19
		W5	10	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	1.1E-19
		WA	11	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	1.1E-19
		WB	50	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.002	0.002	0.00251	0.003	0.00073	0.00056
Zn-F	mg/L	E1	1	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	N/A
		E2	1	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	N/A
		Pit1	7	0.097	0.111	0.122	0.125	0.688	0.976	1.08	1.39	1.57	1.714	1.75	0.677	0.624
		Pit2	5	0.023	0.0382	0.0534	0.061	0.106	0.115	0.117	0.12	0.122	0.124	0.124	0.0858	0.0427
		W1	50	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.003	0.009	0.01	0.0451	0.077	0.00508	0.0107
		W2	54	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.006	0.0077	0.01	0.0185	0.028	0.00408	0.00401
		W3	65	0.001	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0078	0.0114	0.012	0.00306	0.00197
		W4	10	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	4.6E-19
		W5	8	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.00325	0.00413	0.00483	0.005	0.00281	0.00088
		WA	9	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.003	0.004	0.0048	0.005	0.00278	0.00083
		WB	47	0.0005	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0062	0.0087	0.0116	0.013	0.00327	0.00234
HCO3	mg/L	E1	1	92.72	92.72	92.72	92.72	92.72	92.72	92.72	92.72	92.72	92.72	92.72	92.72	N/A
		E2	1	53.68	53.68	53.68	53.68	53.68	53.68	53.68	53.68	53.68	53.68	53.68	53.68	N/A
		Pit1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		Pit2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W1	1	52.46	52.46	52.46	52.46	52.46	52.46	52.46	52.46	52.46	52.46	52.46	52.46	N/A
		W2	6	0.0025	0.00375	0.005	0.00525	0.0065	0.00775	0.008	26.23	39.35	49.84	52.46	8.748	21.41
		W3	8	29.28	30.99	33.18	34.47	36.6	39.04	39.04	45.63	53.31	59.46	61	38.58	9.671
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	1	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	54.9	N/A
Hydroxide Alkalinitya sCaCO3	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	7	0.5	0.8	1.2	1.5	2	11	14	30	40.5	48.9	51	11.21	18.36
		W3	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Carbonat eAlkalinity asCaCO3	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	3	0.188	0.251	0.313	0.344	0.5	0.55	0.56	0.58	0.59	0.598	0.6	0.429	0.215
		W3	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TDS	mg/L	E1	1	118	118	118	118	118	118	118	118	118	118	118	118	N/A
		E2	1	65	65	65	65	65	65	65	65	65	65	65	65	N/A
		Pit1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W1	1	61	61	61	61	61	61	61	61	61	61	61	61	N/A
		W2	2	64	67.5	71	72.75	81.5	90.25	92	95.5	97.25	98.65	99	81.5	24.75
		W3	1	68	68	68	68	68	68	68	68	68	68	68	68	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	1	62	62	62	62	62	62	62	62	62	62	62	62	N/A
Hardness	mg/L	E1	1	54	54	54	54	54	54	54	54	54	54	54	54	N/A
		E2	1	27	27	27	27	27	27	27	27	27	27	27	27	N/A
		Pit1	7	1130	1184	1228	1242	1274	1402	1422	1563	1658	1735	1754	1350	203.8
		Pit2	7	1700	1712	1747	1788	2008	2056	2076	2178	2245	2298	2312	1958	217
		W1	59	9.1	11.6	20.7	21.95	40.5	67.35	76.64	90.92	98.53	104	104.9	46.63	28.67
		W2	61	0	11.6	27.3	27.3	56.2	96.7	101.7	134.7	162.9	206.2	208	69.4	50.26
		W3	69	10.35	11.6	18.2	27.3	40.5	81	88.28	95.6	99.2	109.1	121.5	51.34	32.4
		W4	11	27.3	27.3	31.4	33.9	39.8	62.45	63.7	63.7	64.95	65.95	66.2	44.98	15.53
		W5	9	27.3	27.3	27.3	27.3	50.5	89.6	91.6	110.7	143	168.8	175.2	65.59	48.95
		WA	10	23.2	23.2	25.2	26.1	33.1	58.23	65.82	93.19	165.6	223.5	238	58.76	65.57
		WB	52	3.3	11.6	16.7	23.78	33.9	62	71.9	87.93	91.95	113.8	124.7	43.73	28.97

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
Be-F	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		Pit2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		W3	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ba-F	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	0.036	N/A
		Pit2	1	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	0.038	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	1	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	0.023	N/A
		W3	1	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Se-F	mg/L	E1	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		E2	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		Pit1	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		Pit2	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		W1	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		W2	2	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0
		W3	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
V-F	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		Pit2	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		W3	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B-F	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	N/A
		Pit2	1	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	1	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	N/A
		W3	1	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fe-F	mg/L	E1	1	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	N/A
		E2	1	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	N/A
		Pit1	1	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	N/A
		Pit2	1	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	N/A
		W1	1	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	0.23	N/A
		W2	2	0.025	0.0425	0.06	0.0688	0.113	0.156	0.165	0.183	0.191	0.198	0.2	0.113	0.124
		W3	1	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	0.19	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	1	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	0.21	N/A
Be-T	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		Pit2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		W3	1	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	0.0005	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ba-T	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	0.042	N/A
		Pit2	1	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	0.044	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	1	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	0.027	N/A
		W3	1	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	0.032	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Se-T	mg/L	E1	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		E2	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		Pit1	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		Pit2	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		W1	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		W2	2	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0
		W3	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
V-T	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		Pit2	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		W2	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		W3	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
B-T	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	0.0025	N/A
		Pit2	1	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	N/A
		W3	1	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Fe-T	mg/L	E1	0.5	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	N/A
		E2	0.5	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	0.72	N/A
		Pit1	2	0.105	0.116	0.127	0.1325	0.16	0.1925	0.199	0.212	0.2185	0.2235	0.225	0.1635	0.12
		Pit2	2	0.5325	0.553	0.5735	0.584	0.635	0.8375	0.878	0.959	0.9995	1.032	1.04	0.736	0.537
		W1	0.5	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	0.71	N/A
		W2	1.5	0.16	0.1875	0.215	0.229	0.2975	0.3665	0.38	0.4075	0.4215	0.4325	0.435	0.2975	0.389
		W3	4.5	0.65	1.1365	1.357	1.3675	1.985	2.9915	3.651	5.52	6.825	7.865	8.125	2.799	4.867
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0.5	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	0.67	N/A
Hg-F	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	N/A
		Pit2	1	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	1	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	N/A
		W3	1	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Hg-T	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	N/A
		Pit2	1	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	1	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	N/A
		W3	1	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	0.00005	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
U-F	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		Pit1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W3	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
U-T	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W3	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Ammonia	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	N/A
		Pit2	1	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	0.31	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	2	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		W3	1	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	0.05	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nitrite	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		Pit2	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	2	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0
		W3	1	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nitrate	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	5.45	5.45	5.45	5.45	5.45	5.45	5.45	5.45	5.45	5.45	5.45	5.45	N/A
		Pit2	1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	2	0.005	0.0105	0.016	0.0188	0.0325	0.0463	0.049	0.0545	0.0573	0.0595	0.06	0.0325	0.0389
		W3	1	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nitrite+Nitrate	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	2	0.005	0.0105	0.016	0.0188	0.0325	0.0463	0.049	0.0545	0.0573	0.0595	0.06	0.0325	0.0389
		W3	1	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	0.06	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
TKN	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	1.5	N/A
		Pit2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0
		W3	1	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total N	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	7	7	7	7	7	7	7	7	7	7	7	7	N/A

Variable	Units	Site	Num Obs	Minimum	10%ile	20%ile	25%ile (Q1)	50%ile (Q2)	75%ile (Q3)	80%ile	90%ile	95%ile	99%ile	Maximum	Mean	SD
		Pit2	1	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	0.9	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	2	0.2	0.21	0.22	0.225	0.25	0.275	0.28	0.29	0.295	0.299	0.3	0.25	0.0707
		W3	1	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	0.4	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Total P	mg/L	E1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		E2	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		Pit1	1	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	0.025	N/A
		Pit2	1	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	N/A
		W1	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W2	2	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0
		W3	1	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	N/A
		W4	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		W5	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WA	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
		WB	0	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Appendix C

Pit Profiling

Appendix C Pit Profiling

The Eldridge Pit contains approximately 240m depth of water. Given its considerable depth it is not likely that the water column will be uniform throughout. Generally in lakes and other deep bodies of water, the water column will separate into a number of distinct layers based on temperature, salinity and other parameters. This is known as stratification. The concentration of water quality parameters in the Eldridge Pit may change with depth. Given the volume of water contained in the Eldridge Pit these changes need to be understood and known.

Contrary to the Eldridge Pit, the Wises Pit contains approximately 10m depth of water and the water column is expected to be relatively uniform. Even if the Wises Pit is stratified, the volumes of water held in the pit that may have different concentrations than at the surface are minimal compared to the total volume of water that will be redistributed internally as part of the Project.

The Kidston Pumped Storage project Bankable Feasibility Study undertook depth profiling of the Eldridge Pit in October 2016 (Entura, 2016). Profiles were taken for in-situ parameters at 10m intervals to a total depth of 200m. Discrete samples for laboratory analysis were taken at 10m intervals to 50m, and then every 50m to 200m and a final sample taken at a depth of 230m (Table 112). This work found only two discrete layers of water, one from the surface down to approximately 20-30m depth and the remainder of the water column below 20-30m. Marginally higher concentrations of sulfate and some metal/metalloid substances were found at the surface of the Eldridge Pit (0-30m) compared to deeper intervals (Entura, 2016). However higher concentrations of arsenic and manganese were found at depth (230m) compared to concentrations in the remainder of the water column (Entura, 2016).

Table 112 Existing Eldridge Pit Water Quality Profiling (Entura, 2016)

Parameter Suite	Depth Intervals	Parameters*
In-situ parameters	Every 10m to 200m	pH, turbidity, DO, EC, temperature
Discrete interval water samples	Every 10m to 50m Every 50m from 50m to 200m 230m	• Al • Sb • As • B • Cd • Cr • Co • Cu • Fe • Pb • Mn • Mo • Ni • Se • Ag • SO4 • Cl • Ca • Mg • Na • K • total cyanide

*Metals analysed for total and filtered fraction

Overall metal concentrations showed a trend of having slightly higher concentrations at depths below 20m and a relatively uniform water quality profile throughout the majority of the water column (Figure 77).

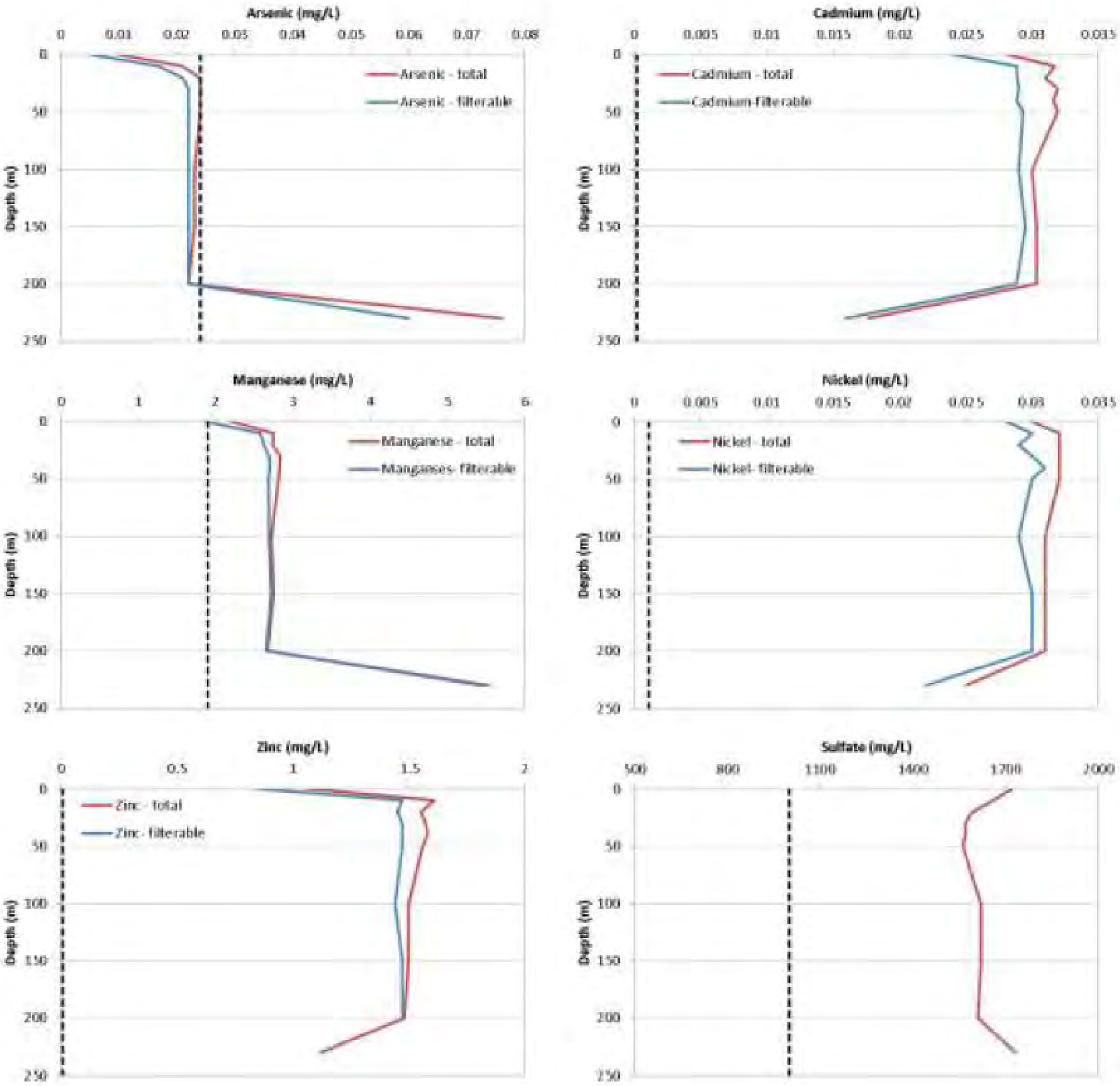


Figure 77 Metal concentrations with depth in the Eldridge Pit (Entura, 2016)

Sulphide oxidation could result in the generation of anaerobic water which could be found in a thick lens at the base of the pit, or a thinner lens near the edges. Oxygen diffusion in still water is approximately 8000 times lower than in air (Australasian Groundwater & Enviornmental Consultants, Gilbert & Associates, Dobos & Associates, 2001). As a consequence, sulphide minerals in contact with oxygenated water will deoxygenate the water in the immediate vicinity. Following this deoxygenation, anaerobic water found in this location could hinder further oxygenation of sulphides by reducing the mobility of oxygenated water into the surrounding pit wall rock. Significant water level fluctuations in the order of 40-50m as part of the Project could expose the pit wall rock to oxygen, causing acid rock drainage and the oxidation of sulphides or pyrite minerals that may be present. Since the depth profiling by Entura (2016) did not reach the base of the pit, AECOM undertook additional depth profiling with the express purpose of:

- Assessing consistency with the findings of Entura (2016).
- Specifically searching for anaerobic water in the pit (<1mg/L DO).
- Profiling the Eldridge Pit to the base (approximately 240m).

- Searching for acidic, saline and/or sub-oxic water that could settle at the base of the pit. The presence of this water would indicate acidic and/or metalliferous drainage may be occurring.

The remainder of this section presents the findings of the 2018 depth profiling.

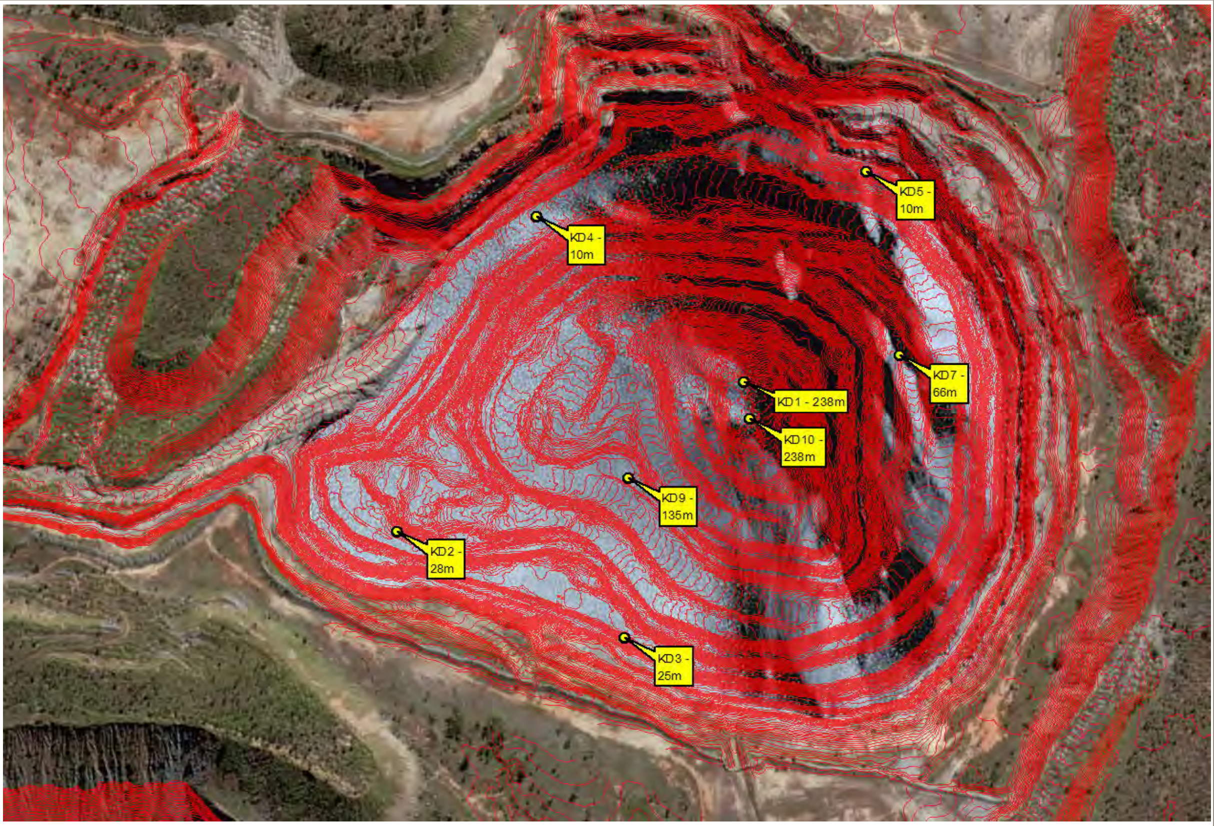
Methods

Eight profiles of the Eldridge Pit were conducted using a YSI Exo2 water quality sonde on 1 March 2018. The sonde is the only water quality meter that is rated to 250m available in Queensland. The sonde is capable of reading and logging the following parameters to an on-board data logger in real-time:

- pH
- EC
- Turbidity
- Oxidation Reduction Potential (ORP)
- DO
- Temperature
- Depth.

For each profile, the Exo2 water quality sonde was lowered slowly and held stationary at 10m depth intervals in order to ensure that the in-situ parameters had stabilised before descending another 10m interval. During the field investigation it was noted that this was not required as there was negligible lag for all parameters; nevertheless the approach was maintained for all profiles.

Profiles were conducted in the deepest parts of the pit that could be found with a depth-sounder attached to a 6m boat launched from the pit's ramp, as well as around the outer perimeter of the pit near the pit wall. Locations and depths of profiles of the Eldridge Pit are shown below in Figure 78. Note that pit bathymetry was not available at the time of sampling. The deepest part of the pit is profiled in KD1 and KD10. KD9 is also a relatively deep profile as well.



Profile	Easting (MGA Zone 55)	Northing (MGA Zone 55)	Maximum Depth (m)
KD1	200694	7911169	238
KD2	200342	7911017	28
KD3	200573	7910909	25
KD4	200484	7911336	10
KD5	200818	7911382	10
KD7	200852	7911196	66
KD9	200577	7911071	135
KD10	200700	7911131	238

Figure 78 Location and depths of water quality pit profiles

Results

Vertical Water Quality Changes

The deepest profiles are KD1 and KD10. Both profiles were commenced after undertaking multiple transects of the pit with the depth sounder and have a depth of 238m. KD9 is also a relatively deep profile with a depth of 135m.

Depth profiles show that the pit is stratified into two distinct layers. One layer extends from the surface to between 20 to 50m, depending on the parameter. The second layer extends from 20-50m to the base of the profile (Figure 79 to Figure 81). The upper layer has a range of values, extending typically from the highest reading to lower readings, while the lower layer is quite stable, with almost no variability in parameter measurements. This agrees with the findings of Entura (2016) which found a sharp change in parameters at 20m with little variation at greater depths. The only parameter that does not show this trend is ORP, which displays variability for different profiles. This likely reflects the instability of ORP measurements in general.

Lack of Water Indicating Sulfide Oxidation

There was no low oxygen water (<1mg/L) found in any of the profiles (Figure 79). DO concentrations were approximately 7mg/L at the surface and declined to 3.6-3.9mg/L by a depth of 40m. Concentrations remained constant at greater depths (Figure 79). A few readings found DO concentrations that decreased from 3.8 to 3.5mg/L at the greatest depths. These also correspond with high turbidity readings and it is evident from the data that the Exo3 sonde had settled in sediment at the base of the Pit (Figure 79).

There is no evidence of anaerobic water held within the Eldridge Pit based on ORP readings (Figure 79). Field ORP readings plotted on Figure 80 range from 180 to 270 mV. Translated to standard hydrogen electrode (SHE) values (typically used for comparison with geochemical data), the ORP ranges from about 380 to 470 mV, indicating oxidising conditions throughout the pit profiles. Differences between individual profiles are likely due to inherent difficulties in obtaining quantitative ORP readings in all but acid water. Since the pH of pit water ranges from about 7 to 8 (Figure 81), and is stable below 50m, there is no evidence of acidic conditions in pit water. ORP results and filtered oxygen readings indicate an oxidising environment within the entire water column for every depth profile.

Any leachable material found in inundated areas of the Pit is exposed to aerobic processes in its current environment. Therefore flushing of acidic or metalliferous drainage products as a result of the proposed hydro scheme will not be as high as what might occur if anaerobic water were present.

Horizontal Water Quality Changes

There are negligible changes to water quality horizontally within the Pit. Figure 79 to Figure 81 show all results from each profile stacked on top of each other. All of the results (except for ORP) show that water quality results at the surface of the pit are relatively similar for each profile. As discussed below ORP results are relative in nature and are not expected to be similar for each profile.

Discussion

Stratification

The presence of a single thermocline/chemocline within the pit is slightly unusual given its depth of 240m. Typical conceptual models of deep lakes and mine pit lakes would suggest that there should be additional thermoclines or chemoclines that form. A layer of denser water (hypolimnium) is not evident at the base of the pit, given the uniformity of the EC plot below about 40m (Figure 81).

Waters at depth appear uniform. Comparison between the deepest profiles (KD1, KD9 and KD10) shows that values for pH, EC, DO, temperature and turbidity fall within a narrow range between profiles at depths greater than approximately 50m (100m for pH) (Figure 81).

The uniform nature of the pit water could be a result of the accelerated flooding of the pit. A large volume of water was pumped into the pit to raise the water level to the estimated long-term equilibrium in 2001. This water would have been of a reasonably good quality, sourced from the Copperfield Dam. Therefore the majority of water held within the Eldridge Pit would still comprise water sourced for the accelerated flooding, explaining the relative uniformity pit profile. The reactivity of the pit walls is expected to be relatively low, otherwise changes to water quality throughout the water column would have occurred.

Temperature and wind only affects the top 40m of the water column as evidenced by the plots in Figure 80; however, all water beneath this level is relatively static. In addition, a number of pump-back systems operate around the mine. These systems pump excess water collected by the site’s seepage interception system back to the Eldridge Pit. Water from these pump-back systems is allowed to free-fall over the crest of the pit wall into the void in waterfalls. This will add additional DO and play a small role in promoting mixing within the upper part of the water column.

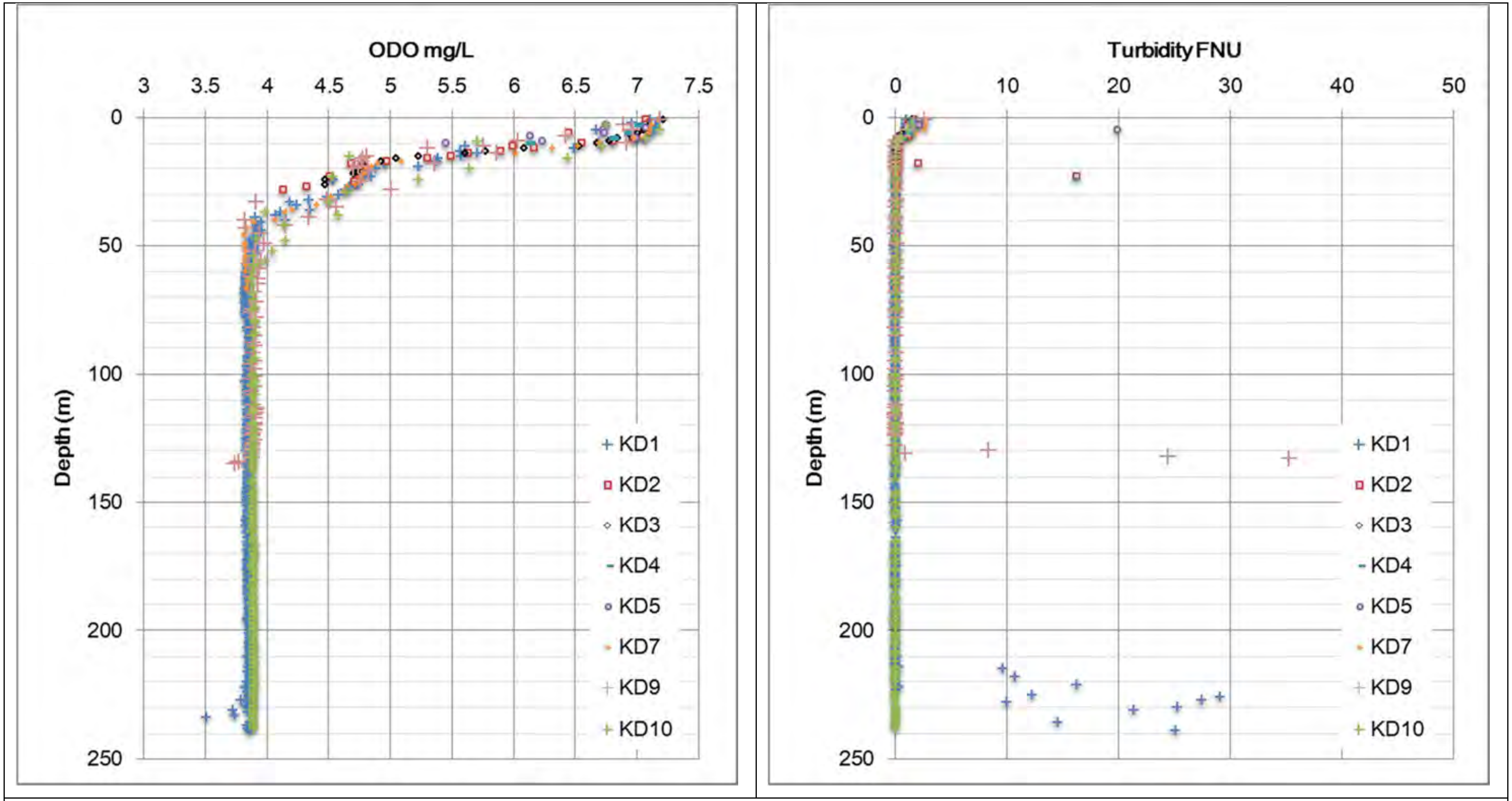


Figure 79 Depth Profiles for Filtered Oxygen and Turbidity

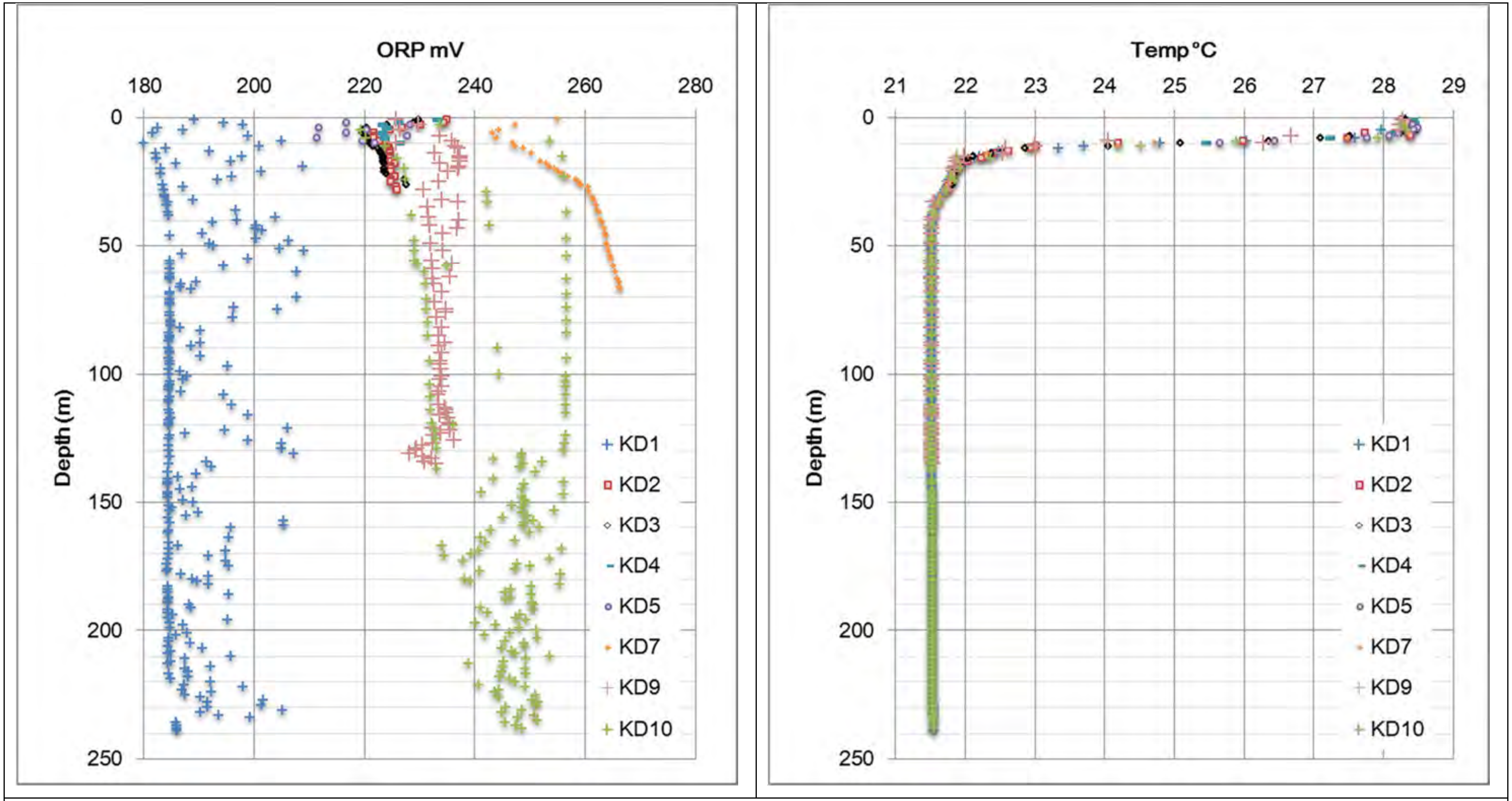


Figure 80 Depth Profiles for ORP and Temperature

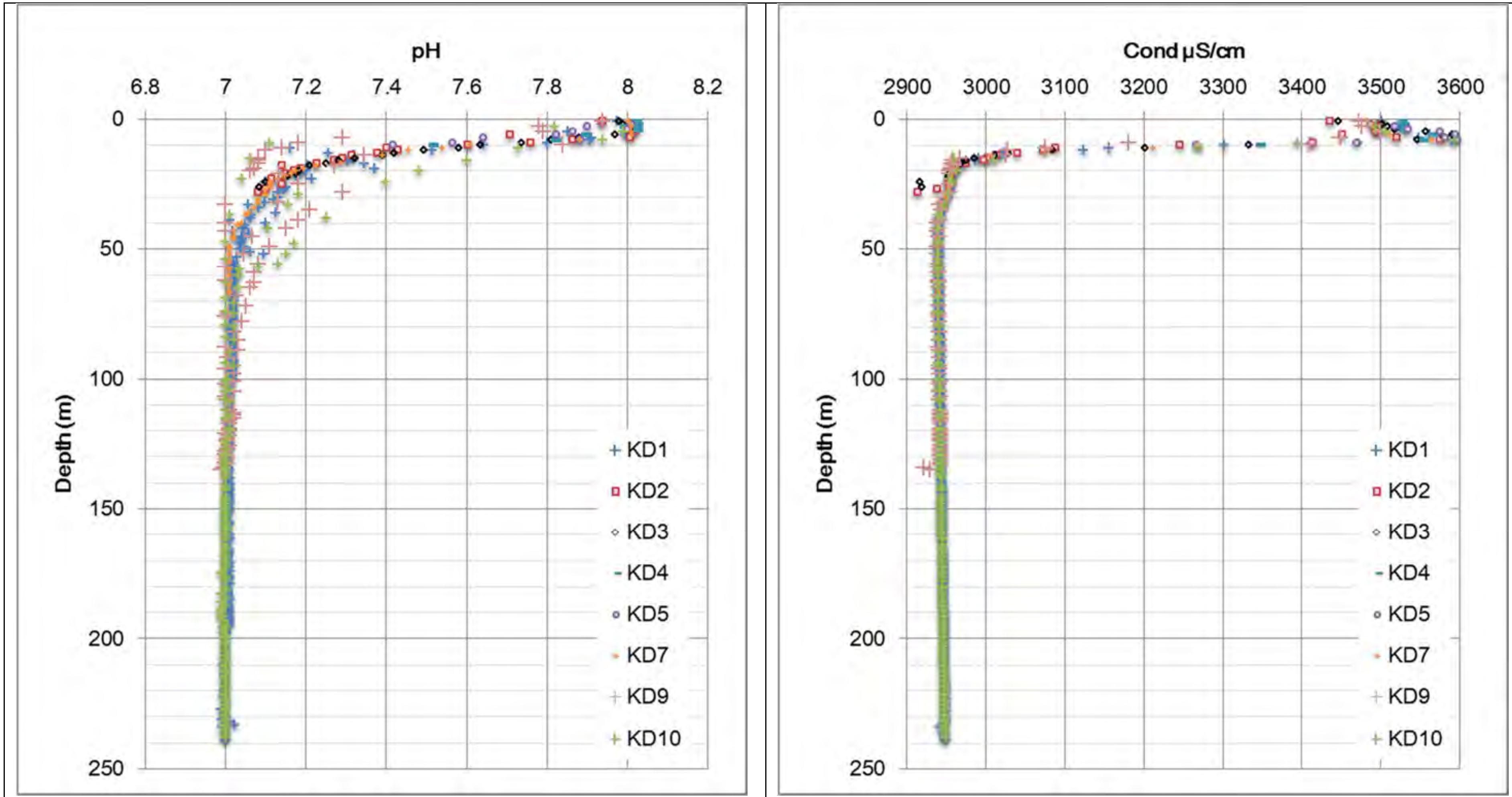


Figure 81 Depth Profiles for pH and EC

Changes with Depth

It is slightly unusual that there are waters with a higher EC at the surface of the Pit profile compared to deeper layers. Typically higher EC waters have a higher density (higher concentrations of dissolved minerals) and will sink to the base of the Pit. The EC of waters at the surface in all profiles is approximately 3400µS/cm to 3600µS/cm and is accompanied by water with a DO concentration of 5.5mg/L to 7.0mg/L and waters with a higher turbidity.

As mentioned earlier, the site's seepage pump-back system was operational during Pit profiling exercises. This seepage pump back system collects water that has emanated from the toes of waste rock dumps around the site and delivers it to the Wises Pit and Eldridge Pit to reduce the chances of uncontrolled discharges of the seepage collection dams. EC information for the seepage pump back system collected between 2012 and 2015 indicates that the average EC of seepage water is between 3,500µS/cm and 4,000µS/cm.

Therefore it is theorised that at the time of Pit profiling, water with a higher EC was being input into the Eldridge Pit from the seepage pump back system (and possibly runoff from the waste rock dumps, but this is unlikely). This water likely had an EC between 3,500µS/cm and 4,000µS/cm. This water would have delivered relatively high dissolved oxygen levels to the surface of the Pit as it cascades over waste rock before entering the water column. This explains the high EC and dissolved oxygen readings at the surface of the Pit. As the difference in EC between the seepage pump back water (3,500µS/cm) and the overall water column (approx. 2,950µS/cm) is not large, the seepage pump back water would not quickly sink below the lower EC water of the water column (i.e. a larger EC difference, such as that between seawater (60,000µS/cm) and freshwater (200µS/cm) would result in more rapid mixing). Therefore the seepage pump back water is, in general terms, sitting on 'top' of the water column in the Eldridge Pit (and likely the Wises Pit with a much shallower water column).

Samples collected over time in both Pits *could* be skewed towards the quality of the seepage pump back water. Sensitivity analysis has been incorporated into the dilution ratio to account for potential vertical changes in metal concentrations down the pit profile as encountered by Entura (2016).

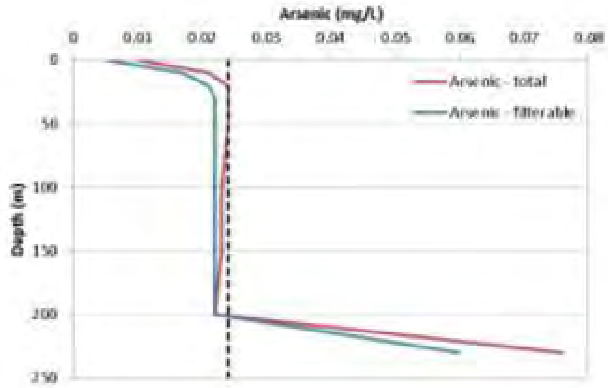
Addendum – August 2018 Pit Profiling

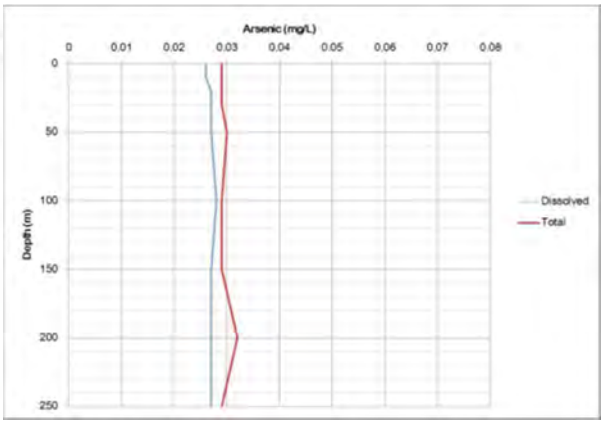
In August 2018, Genex undertook an additional round of water quality sampling within Eldridge Pit. Samples were collected from the same depths as previously sampled and analysed by the laboratory for the same parameters. The purpose of the additional sampling was to assess whether similar trends in water quality with depth were observed. Results are compared against the Entura pit profiling undertaken in 2016 (refer to Figure 82 below).

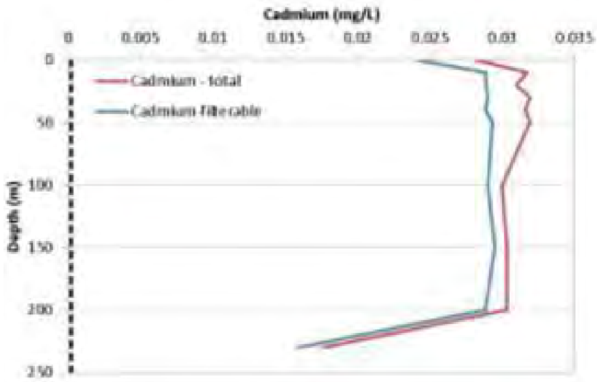
Overall, the August 2018 results are comparable to the 2016 Entura profiles: in general, dissolved metal/metalloid concentrations reported from the August 2018 profile sampling are slightly lower than those recorded in 2016. The August 2018 results also indicate an apparent homogeneity along the pit profile. The differences may be due to the different sampling methods (a Niskin bottle was used in the 2016 study, whereas HydraSleeves were employed in the 2018 work) and/or may reflect seasonal variations (the 2016 study was completed in the wet season, whereas the 2018 study was conducted in the dry season). The 2016 study reported variations in water quality both at the top and the base of the pit profile, which are not observed (or not observed in the same magnitude) in the 2018 investigation: differences in surface water quality may reflect seasonal variations. The 2016 study may have perturbed the base of the pit leading to marked variations in water quality in the lowest section of the profile; these were not observed in the 2018 study. August 2018 dissolved nickel concentrations are reportedly higher than total nickel concentrations; however, total suspended solids are recorded at or below limits of detection for most of the 2018 profile. In addition, repeat analysis of profile samples indicates that the total and dissolved concentrations are within analytical precision. It is suggested, therefore, that there were very little suspended solids entrained in the water column during sampling and that the total and dissolved concentrations are equivalent.

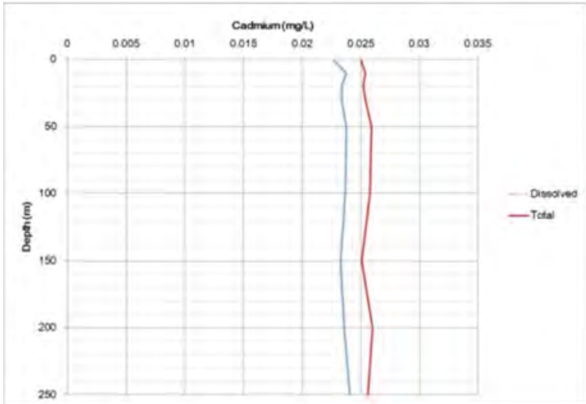
ENTURA 2016

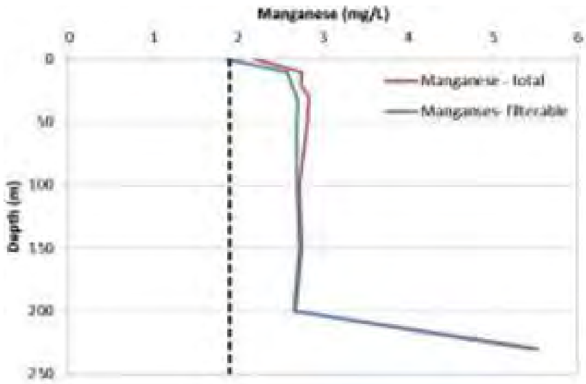
GENEX August 2018

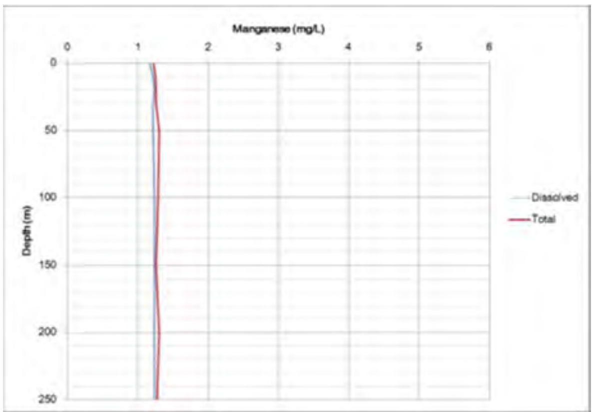


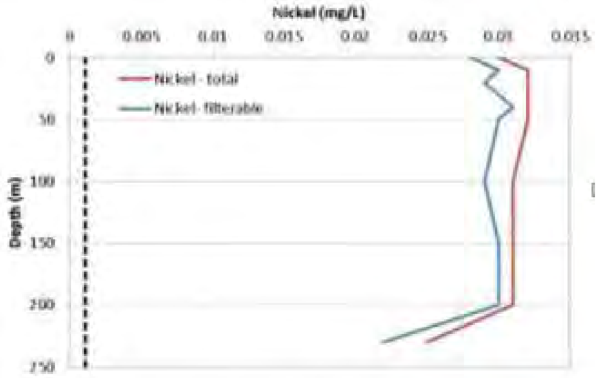


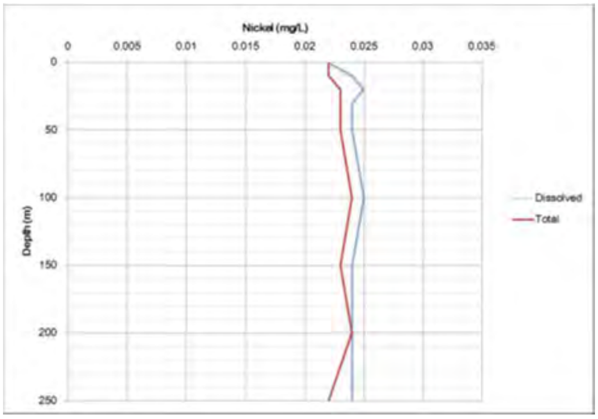


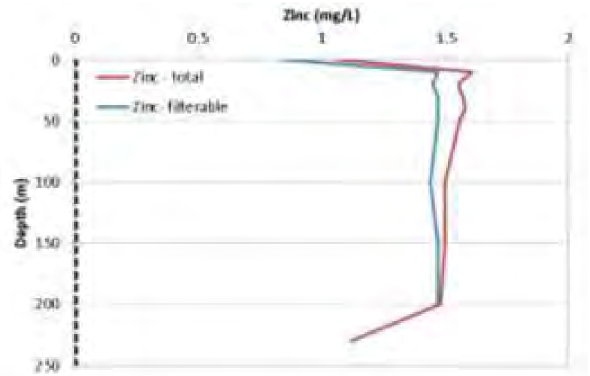


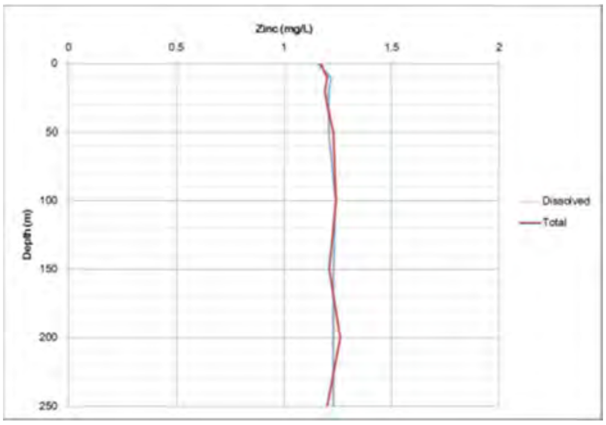


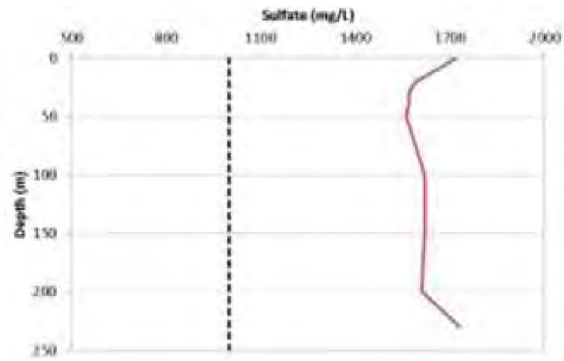


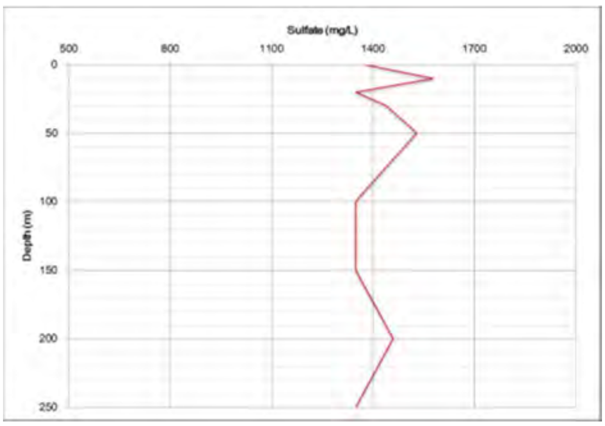

Nickel (mg/L)
Nickel - total
Nickel- filterable
Depth (m)


Nickel (mg/L)
Dissolved
Total
Depth (m)


Zinc (mg/L)
Zinc - total
Zinc- filterable
Depth (m)


Zinc (mg/L)
Dissolved
Total
Depth (m)


Sulfate (mg/L)
Depth (m)


Sulfate (mg/L)
Depth (m)

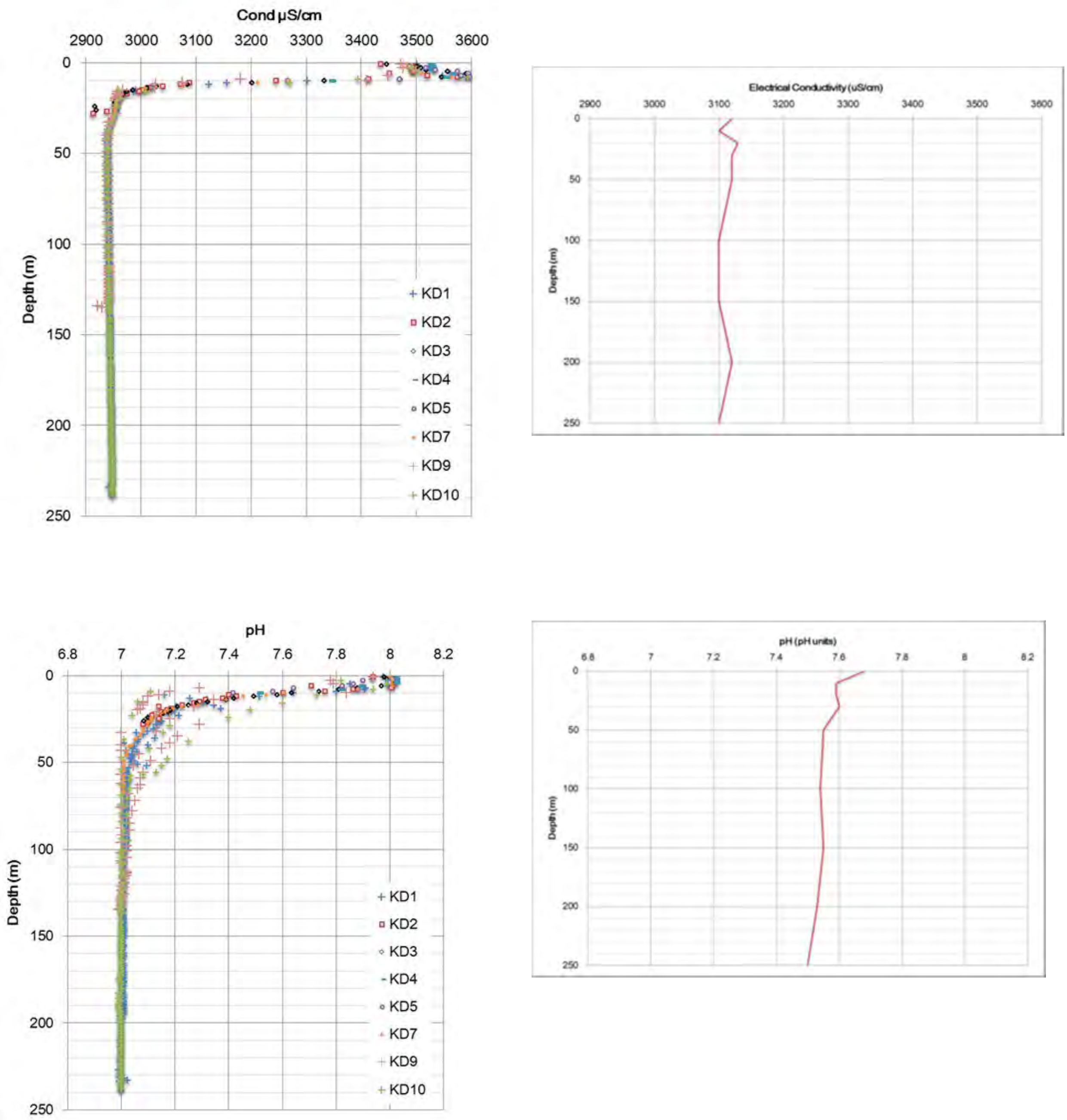


Figure 82 August 2018 Depth Profiles

Appendix D

Pit Water Quality Time Series

Appendix D Pit Water Quality Time Series

Yearly grab samples have been taken of the Wises and Eldridge Pits since 2003 and sent for analysis at a NATA accredited laboratory. Grab samples have been obtained at the surface (approx. 30cm below the surface) and represent the surface water quality. Further discussion on changes in water quality with depth in the Eldridge Pit are provided in Section 4.3. The majority of samples have been obtained in October of each year, corresponding to the peak of the dry season when evapo-concentration would have increased the concentration of filtered minerals in each pit. Samples have been analysed for total metal concentrations since 2003. Samples have only been passed through a 0.45µm filter and analysed for total as well as filtered metal concentrations within each of the pits since 2013.

Water quality in the pits is compared to the default WQOs. WQOs are designed to apply to receiving waters following mixing of any discharges; therefore an exceedance of a WQO in pit waters does not indicate a potential impact to the EVs of the receiving environment. Water quality of the pits is also compared in Appendix C and Appendix D for convenience. Overall the following parameters exceed the default WQOs in the Eldridge or Wises Pits, where an exceedance is taken to be the 95th percentile of the data.

- EC
- Sulfate as SO_4
- Total aluminium (however filtered aluminium is below all WQOs)
- Filtered and total arsenic
- Filtered and total cadmium
- Total cobalt (however filtered cobalt is below all WQOs)
- Filtered and total copper
- Filtered and total manganese
- Filtered and total molybdenum
- Filtered and total nickel
- Filtered and total zinc
- Total cyanide (occasionally).

These parameters were plotted as time series in Figure 83 to Figure 94 below to indicate variability throughout time as well as the concentrations of the most recent samples. A discussion on each of these parameters is outlined below.

The water quality results from a composite sample which is representative of the operational water quality for the Project (a mixture of Eldridge Pit water and Wises Pit water as outlined the main report) are also shown and discussed in the sections below.

Parameters which do not exceed WQOs are not discussed further in this Section.

Electrical Conductivity and Sulfate

EC is relatively elevated in both pits compared to the default WQO. The long-term record shows the highest values between the end of 2006 and the end of 2011 in Wises Pit (Figure 83). These levels decreased to a concentration that is more fitting with the long-term trend following 2011. In Eldridge pit the values show a relatively steady but slightly increasing trend over time (Figure 83). EC values for the representative sample is 4,600μS/cm which is above the Aquatic Ecosystem WQO.

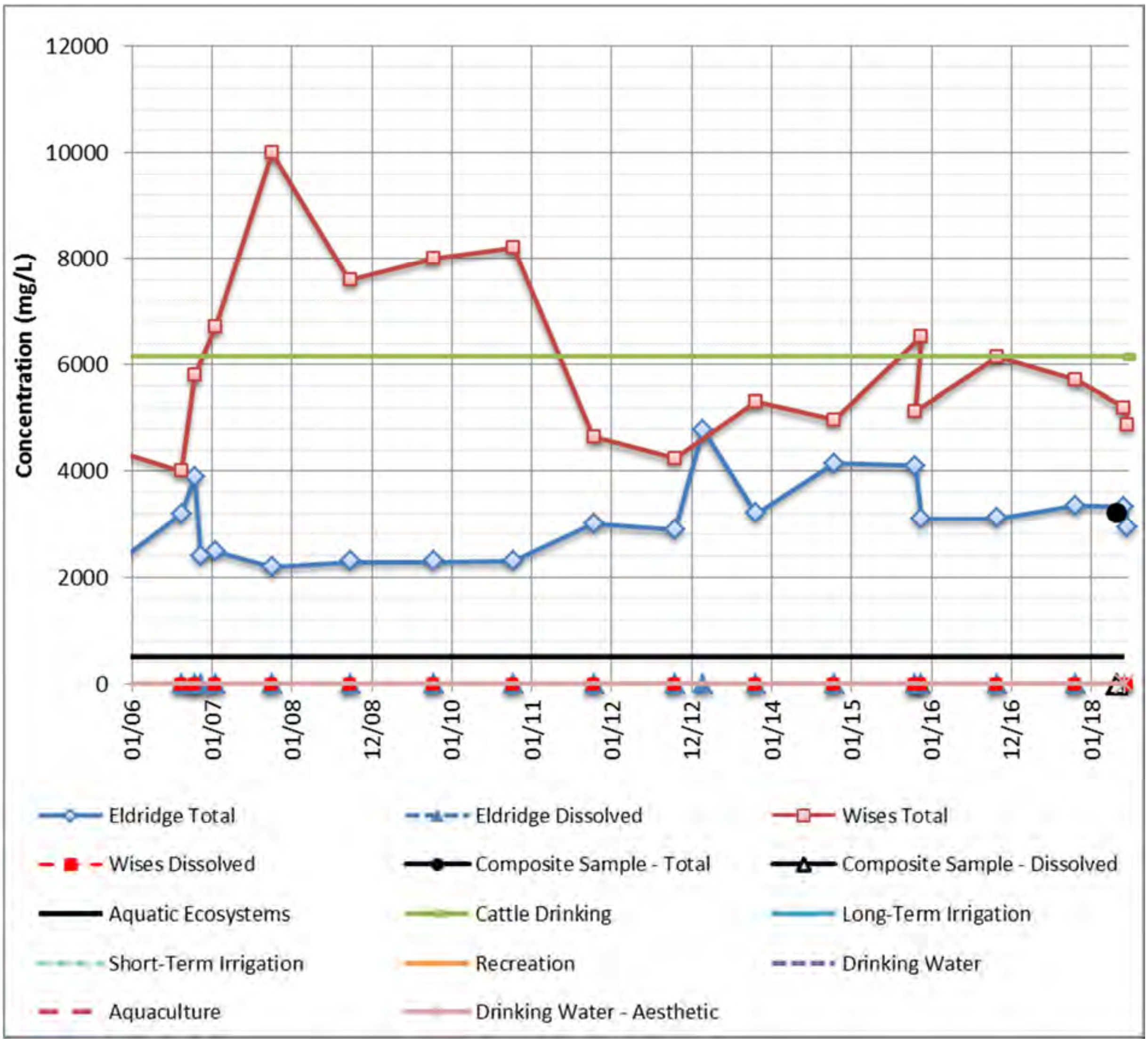


Figure 83 EC time series for Eldridge and Wises Pits

Sulfate concentrations (Figure 84) show similar trends to EC. Sulfate concentrations in both pits are generally above the WQO for Recreation, Drinking Water and Cattle Drinking for almost the entire record. A sample taken in 2008 for the Eldridge Pit shows an unusually low sulfate concentration and is generally considered an outlier (Figure 84).

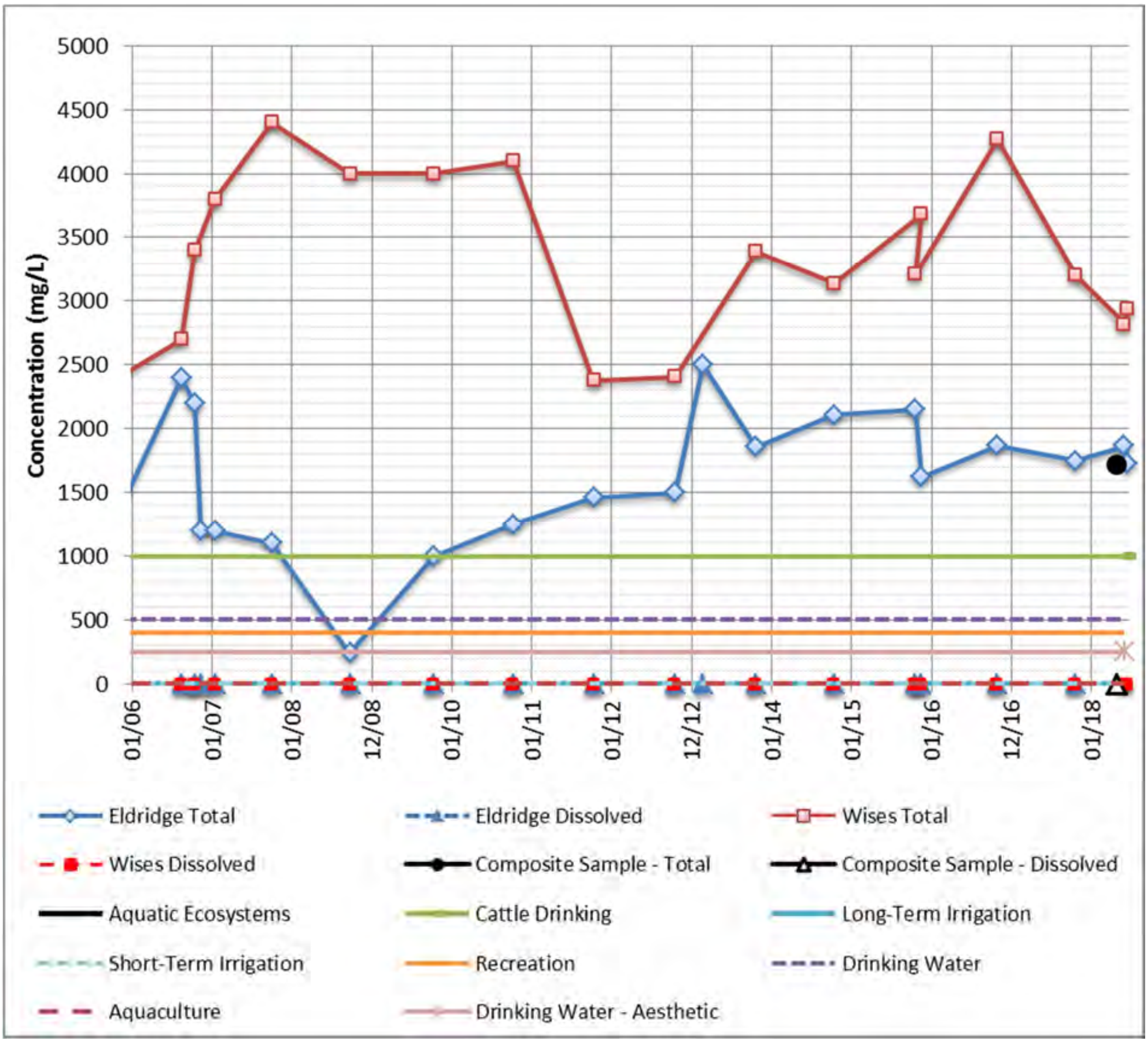


Figure 84 Sulfate time series concentration

There is a good relationship between EC and sulfate in the waters in both pits (Figure 85). A logarithmic relationship is plotted through each sample with an R^2 value of 0.9175 which is very good. This shows that the sulfate concentration can be estimated based on real-time in-situ measurement of EC. The strength of the relationship indicates that variations in EC values with depth in the pit can be used to estimate sulfate concentrations. There are negligible relationships between any other in-situ parameters and laboratory parameters that have been measured to date.

Pit profiling exercises show that the Eldridge Pit is only separated into two layers via vertical stratification. Using the EC results from in-situ profiling exercises it is estimated that sulfate will decrease from approximately 2150mg/L at the surface to a value of 1620mg/L at 30m depth. This concentration (approximately 1620mg/L) is expected to be relatively uniform throughout the rest of the water column.

Time-series graphs of surface concentrations (Figure 83) show that sulfate concentrations in the Eldridge pit have been relatively uniform over time and are generally not increasing. Therefore the likelihood of sulfate concentrations within the pit being sourced from the oxidation of pyrite within the pit walls is very low.

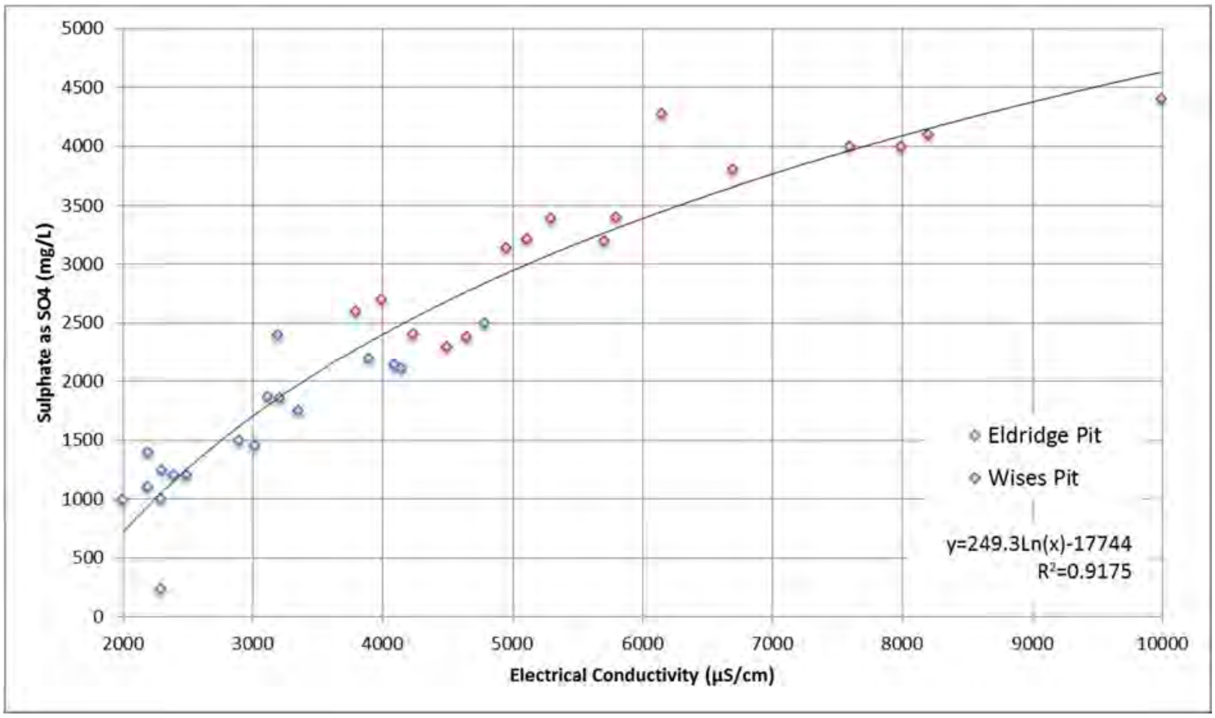


Figure 85 Relationship between EC and SO4 in the pit water.

Aluminium

Aluminium concentrations in the Pits are relatively low compared to the concentrations in the receiving environment. Overall the levels of total aluminium in the Eldridge and Wises Pits are below all WQOs for the majority of samples (Figure 86). There was an increase in aluminium concentrations in the Eldridge Pit in December 2012 (Figure 86). Total aluminium concentrations in the Wises Pit have been increasing since the end of 2016. Concentrations of total aluminium in the 2017 samples exceed the WQO for Aquatic Ecosystems and Recreation. However the dissolved aluminium concentrations are still very low in both Pits and are compliant with all WQOs. This indicates that results reported as total aluminium concentrations may be a result of aluminium attaching to colloidal material rather than as aluminium within the water column.

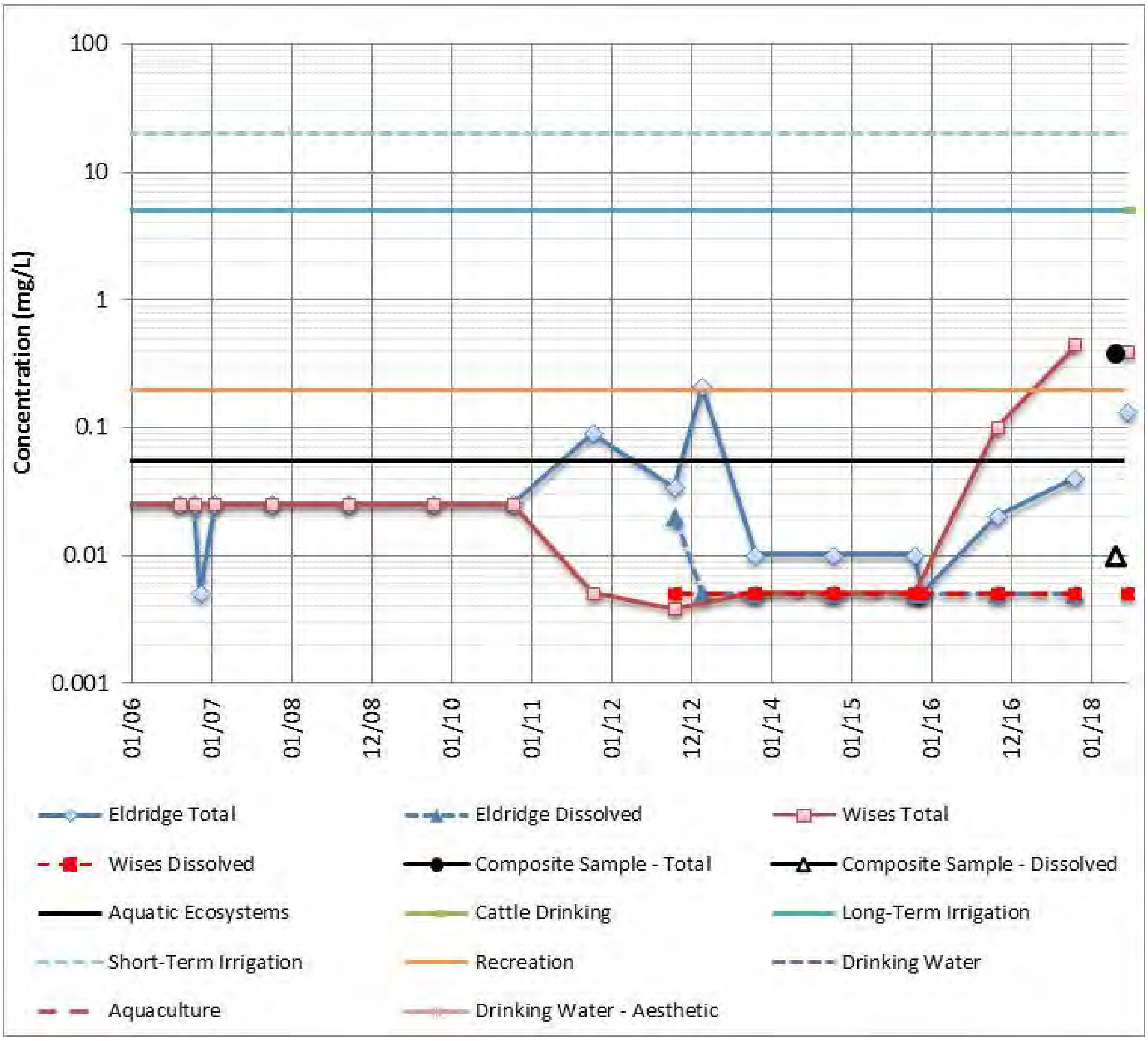


Figure 86 Aluminium concentrations in the Eldridge and Wises Pits

The composite sample shows a high concentration of total aluminium, generally above the historical concentrations in the Wises and Eldridge Pits. However the dissolved aluminium concentration is relatively low, fitting with the historical baseline. Overall the composite sample is representative of aluminium concentrations that may be expected once the waters it the two pits is mixed.

Arsenic

The majority of samples show total and filtered arsenic within both pits above the Drinking Water and Aquatic Ecosystem WQO for the majority of the record. Concentrations in the Wises Pit are consistently above concentrations in the Eldridge Pit. This is likely as a result of the Wises Pit being backfilled with tailings which are more geochemically reactive than the pit wall rock. In the most recent samples, the concentration of total and filtered arsenic is above the Cattle Drinking WQO but below the Short-Term Irrigation WQO. The composite sample representing the mixture of Eldridge Pit water and Wises Pit water expected during operations is above the Drinking Water, Aquatic Ecosystems, Recreation and Long-Term Irrigation WQOs but below the Cattle Drinking and Short-Term Irrigation WQOs.

Increases in pH values can increase the filtered arsenic concentration as the particle desorbs from iron mineral surfaces. At the pH values found within the pit waters, the majority of arsenic is filtered. There was a large increase in filtered and total arsenic in both pits between the 2016 and the 2017 samples. This could be a result of the relatively large wet season compared to relatively dry wet seasons experienced beforehand. In 2017, the relatively large wet season caused increased operation of the seepage pump back system, whereby seepage interception dams are dewatered back to the pits. This could have been the cause of an increase arsenic levels within both pits.

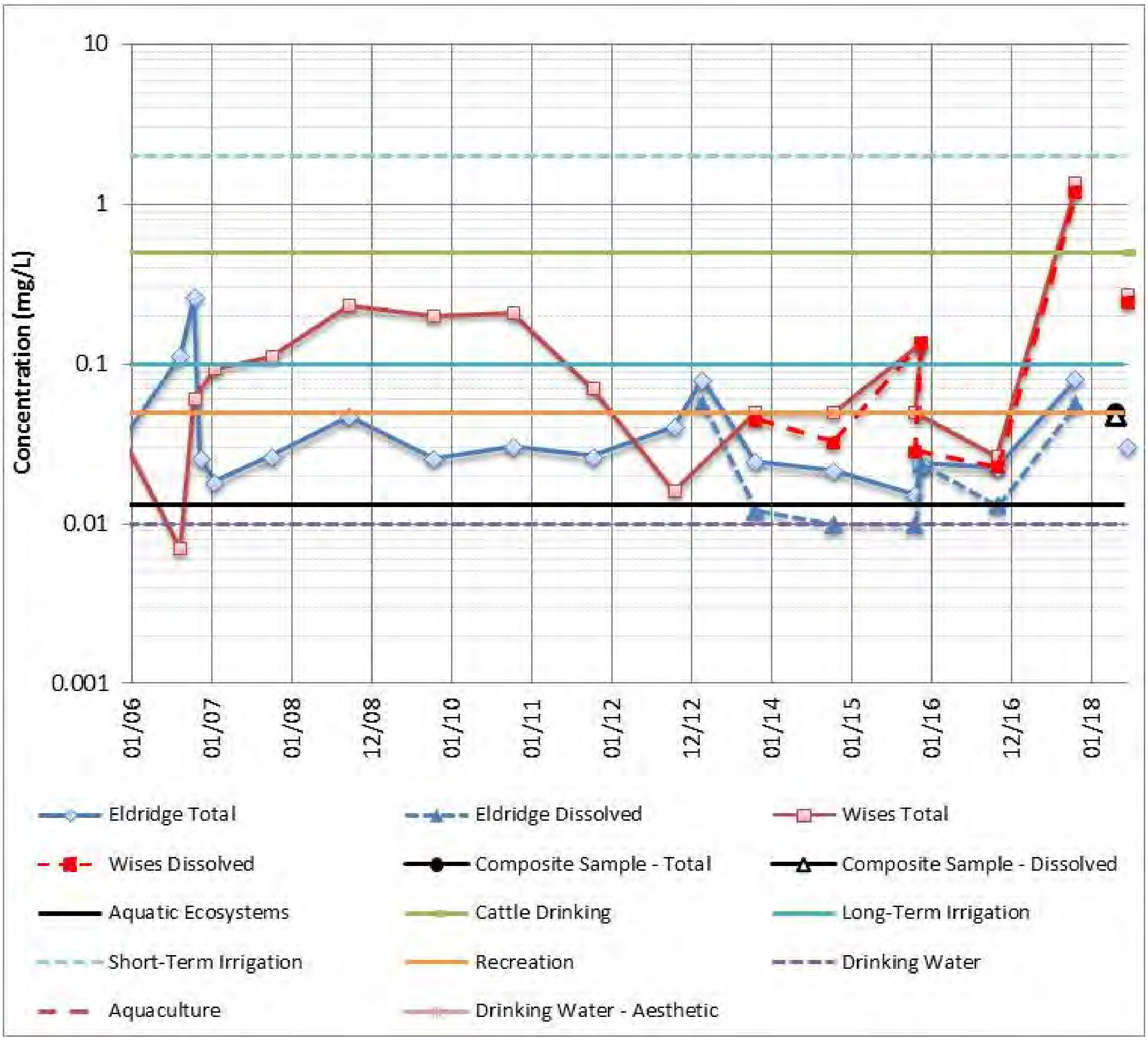


Figure 87 Arsenic Concentrations in the Eldridge and Wises Pits

The composite sample is more representative of water quality conditions within the Eldridge Pit than the Wises Pit. This is considered appropriate given that the majority of water in the operation will be sourced from the Eldridge Pit. Total arsenic within the composite sample represents approximately the 80th percentile of arsenic concentrations in the water quality history of the Eldridge Pit. The concentration of arsenic in the composite sample is above the WQO for Drinking Water and Aquatic Ecosystems.

Cadmium

Total and filtered cadmium time series graphs show that concentrations in the Eldridge Pit are almost constantly elevated above the all WQOs (Figure 88). Concentrations in the Eldridge Pit are much higher than the Wises Pit as found with manganese and nickel. An anomalous low concentration is found in late 2012, which also corresponds to low concentrations of manganese and nickel in the Eldridge Pit (Figure 88). Concentrations in the Eldridge Pit are only below the Short Term Irrigation WQO while concentrations in the Wises Pit are only above the Aquatic Ecosystem WQO.

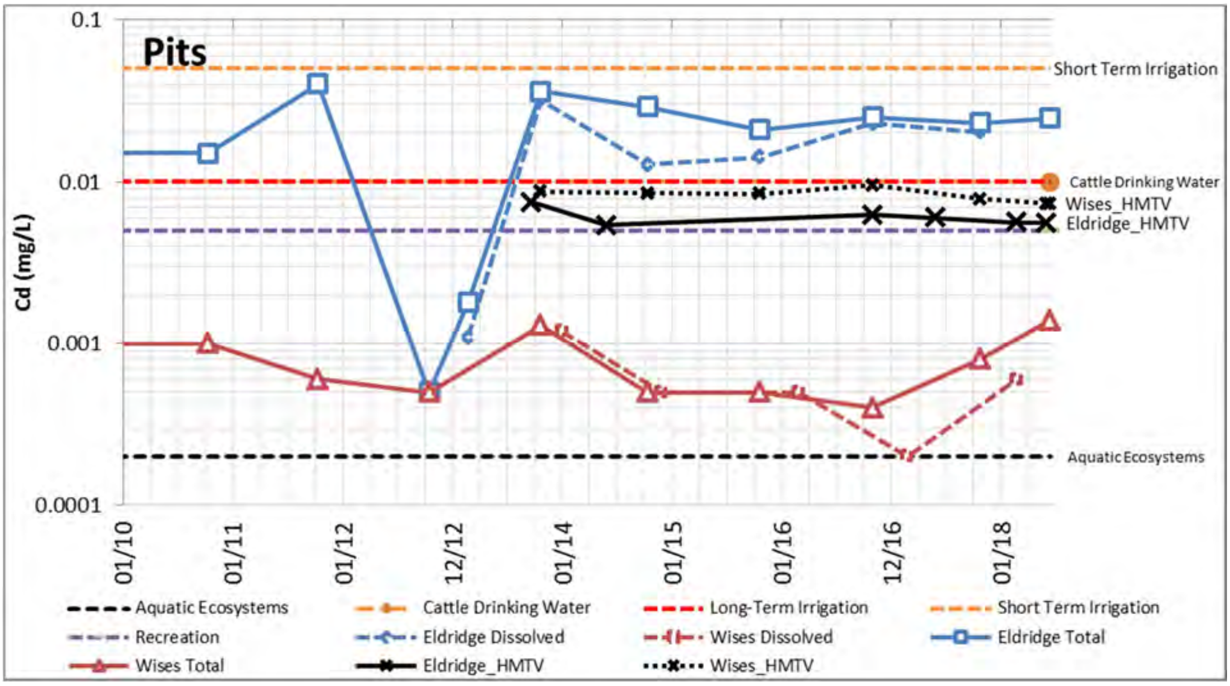


Figure 88 Cadmium Concentrations in the Eldridge and Wises Pits

The composite sample shows cadmium concentrations almost wholly representative of the Eldridge Pit (Figure 88). These concentrations are relatively high. The concentration of total cadmium in the composite sample (0.0222mg/L) is approximately equivalent to the 60th percentile value of the Eldridge Pit.

<u>Comparison to Hardness Modified Trigger Values</u>

Although the majority of samples for dissolved cadmium are above the Aquatic Ecosystem WQO of 0.0002mg/L, the toxicity of cadmium is related to water hardness. As discussed previously the water in the Eldridge Pit and Wises Pit is relatively hard (median of 1270mg/L and 2008mg/L respectively). In contrast the default WQO for dissolved cadmium has been developed for waters with a hardness of 30mg/L.

Consequently a hardness modified trigger value was developed on a sample by sample basis for the waters in both Pits in accordance with Table 3.4.3 of the ANZECC (2000) guidelines whereby the WQO for dissolved cadmium is calculated based on the hardness of the sample.

Figure 88 also shows a comparison between the HMTV and concentrations of dissolved cadmium within the Eldridge and Wises Pits. Almost all values within the Eldridge Pit are elevated above the HMTV for cadmium whereas all samples in the Wises Pit are below the HMTV.

Cobalt

Total and filtered cobalt concentrations in both the Eldridge and Wises Pits are generally below all WQO values except for a major spike occurring in 2012 and early values recorded in 2006 (Figure 88). This high spike in cobalt also corresponds to unusually low concentrations of manganese and cadmium. There is an increasing trend in total and filtered cobalt in the Wises Pit. This is likely a result of the operation of the seepage pump back system and the tailings stored within the pit. The composite sample which is taken to represent the operational water quality of the Project shows filtered (0.004mg/L) and total cobalt (0.005mg/L) concentrations are above the low reliability Aquatic Ecosystem WQO for cobalt (0.0028mg/L) (Figure 89).

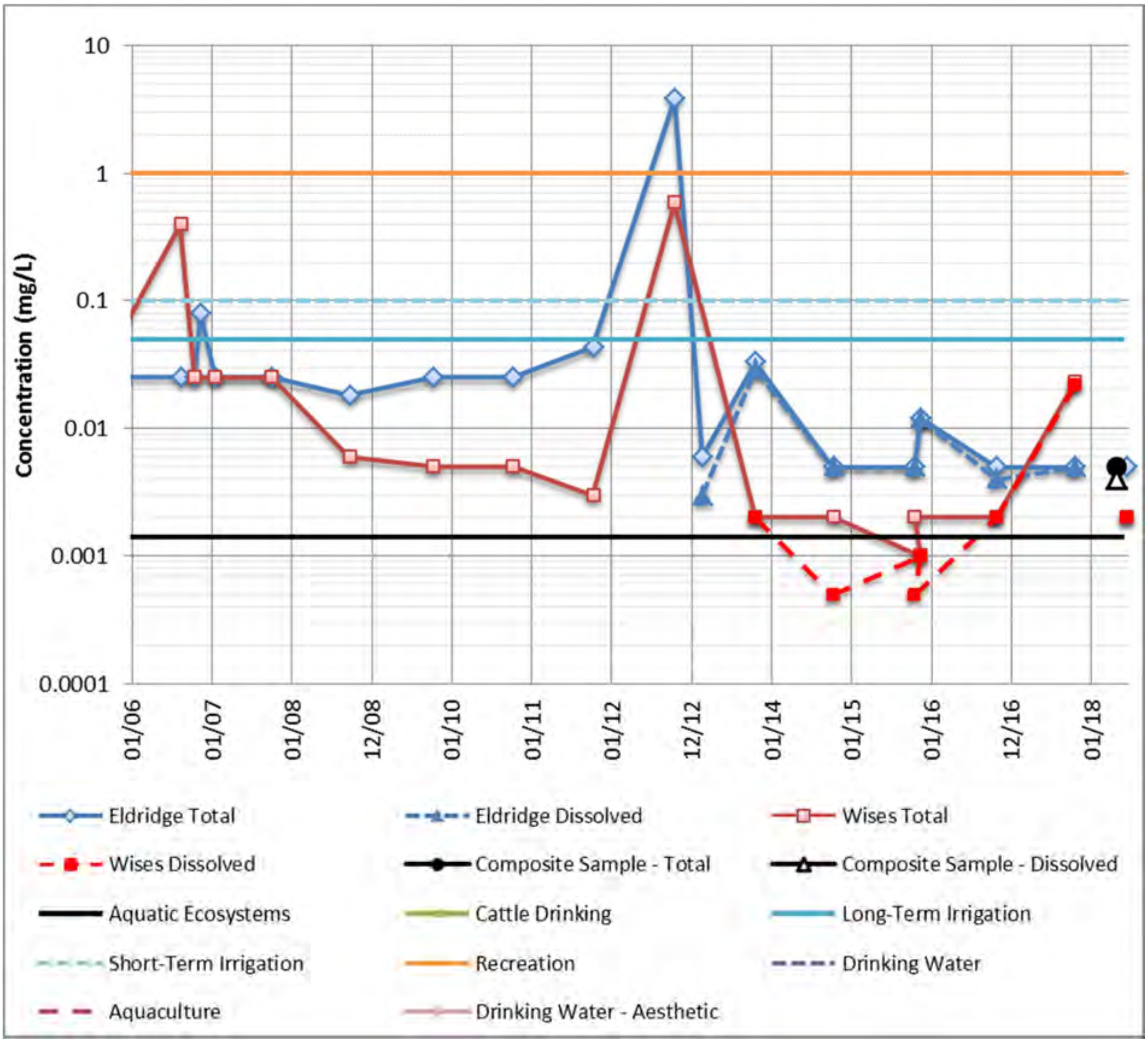


Figure 89 Cobalt Concentrations in the Eldridge and Wises Pits

Cobalt concentrations are relatively low compared to the historical water quality time series of the Pits. Dissolved cobalt concentrations would need to increase to 0.42mg/L to affect the Contaminant of Potential Concern (COPC) and dilution ratio equations used in Section 6.1.1.1 of the main report. This concentration is considerably above the concentrations of dissolved cobalt evident in 6 samples taken each from the Eldridge Pit and Wises Pits since 2013. However the concentration of dissolved cobalt is close to the concentration of total cobalt. Therefore total cobalt concentrations can be assumed approximately represent the concentrations of dissolved cobalt. Total cobalt has been analysed for a longer period than dissolved cobalt samples. Subsequently the concentrations of dissolved cobalt required to affect the COPC calculations (0.42mg/L) fall somewhere between the 90th percentile and 95th percentile of total cobalt concentrations historically measured in the Wises and Eldridge Pits between 17 samples taken since 2004.

Copper

Copper values in the Pits are variable with historically high concentrations of total copper experienced in the Eldridge Pit in late 2012. However concentrations have generally decreased since this date and only begun rising in the previous few months (Figure 90).

Compared to default WQOs for Aquatic Ecosystems the concentrations of Copper in both pits are elevated. However the toxicity of copper, like cadmium and chromium, is dependent on the hardness of the water. As discussed previously the Pits have a hardness of approximately 1500mg/L and

2000mg/L respectively, compared to a hardness of 30mg/L which has been used to develop the Aquatic Ecosystems WQO.

Dissolved copper concentrations are relatively low compared to the HMTV (Figure 90) for both pits. The HMTV is an order of magnitude greater than copper concentrations between 2014 and 2016 (Figure 90).

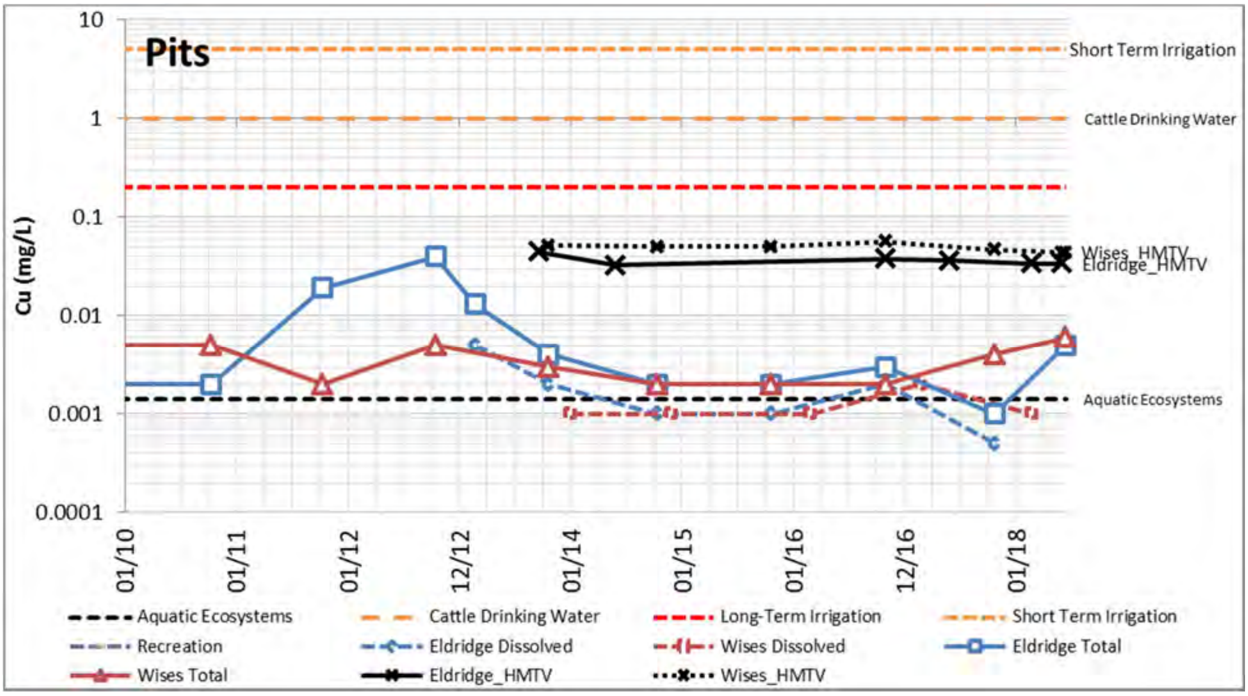


Figure 90 Copper concentrations in the Pits over time

Manganese

Historically, manganese concentrations in the Eldridge Pit are significantly higher than in the Wises Pit (Figure 91). The majority of manganese in both pits exists as filtered manganese, given the small difference between the total and filtered concentrations (Figure 91). Overall manganese concentrations in the Eldridge Pit are relatively constant between 1 and 4mg/L except for two exceptions in late 2006 and late 2012 where a relatively low concentration was recorded. Concentrations of manganese in the Wises Pit have been increasing since late 2015 and the concentration now exceeds the Eldridge Pit. This is likely a result of the tailings currently stored in the pit as well as the operation of the pump back system.

The relatively low anomalies in the data from the Eldridge Pit consist of the only two samples that contain concentrations below all WQOs (Figure 91).

The composite sample analysed for the purposes of this study also exceeds the default WQOs for Recreation and Long-Term Irrigation and Drinking Water but are below the WQO for Aquatic Ecosystems (Figure 91). The composite sample is fairly representative of concentrations found historically in the Eldridge Pit.

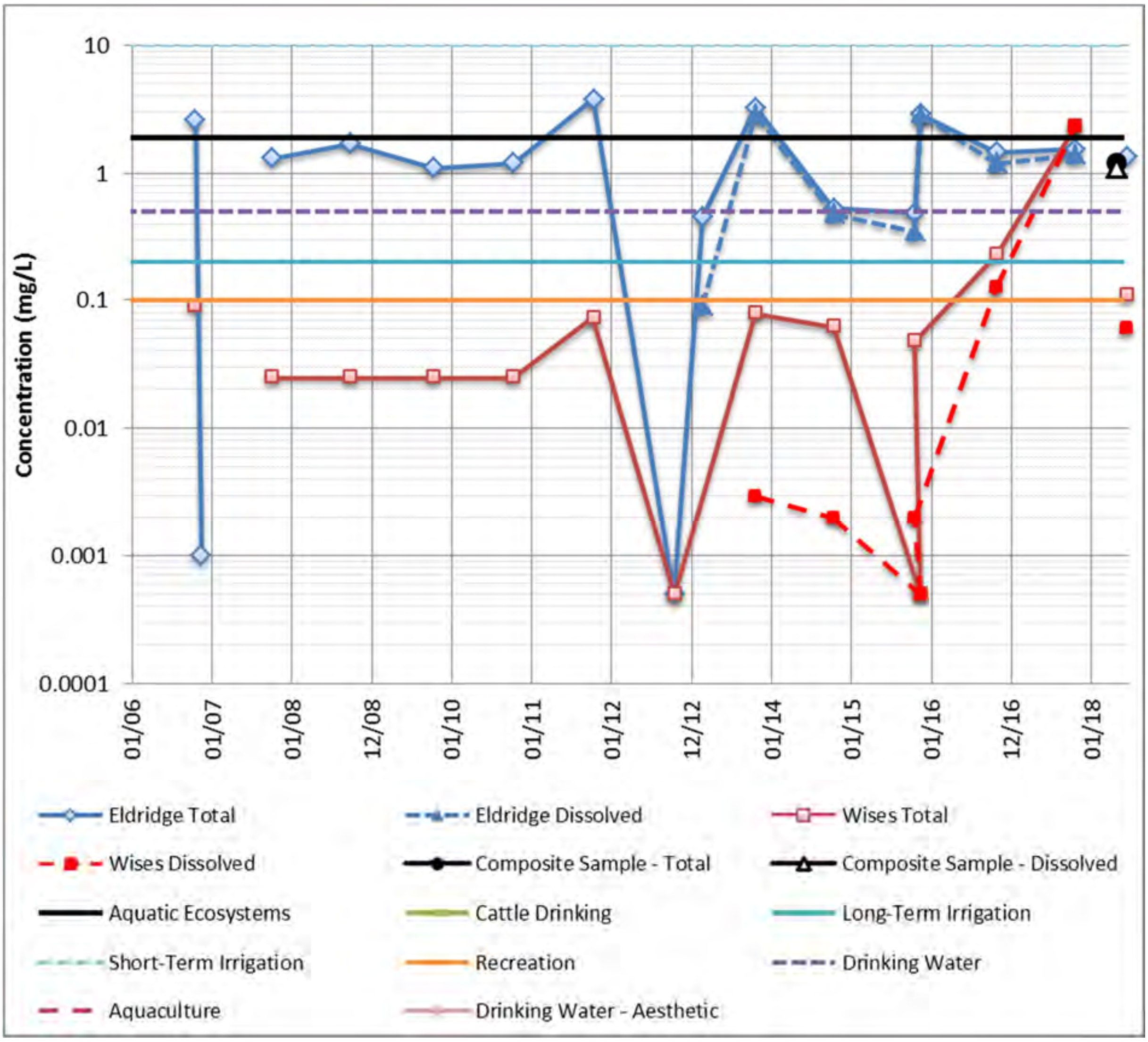


Figure 91 Manganese Concentrations in the Eldridge and Wises Pits

Molybdenum

The concentrations of filtered molybdenum in the Eldridge and Wises Pits have been relatively stable since the end of 2012. Concentrations fluctuate from being above or below the Drinking Water WQO (Figure 92). However concentrations are generally above the low reliability Aquatic Ecosystem WQO for molybdenum (Figure 92).

Concentrations of total molybdenum were historically elevated in the Wises Pit between 2007 and 2011 (Figure 92). The composite sample shows a concentration of total concentration of molybdenum above the Drinking Water and Aquatic Ecosystems WQO and is generally representative of water quality of both pits since 2012. Concentrations of molybdenum are significantly elevated compared to concentrations in the receiving environment (Appendix B).

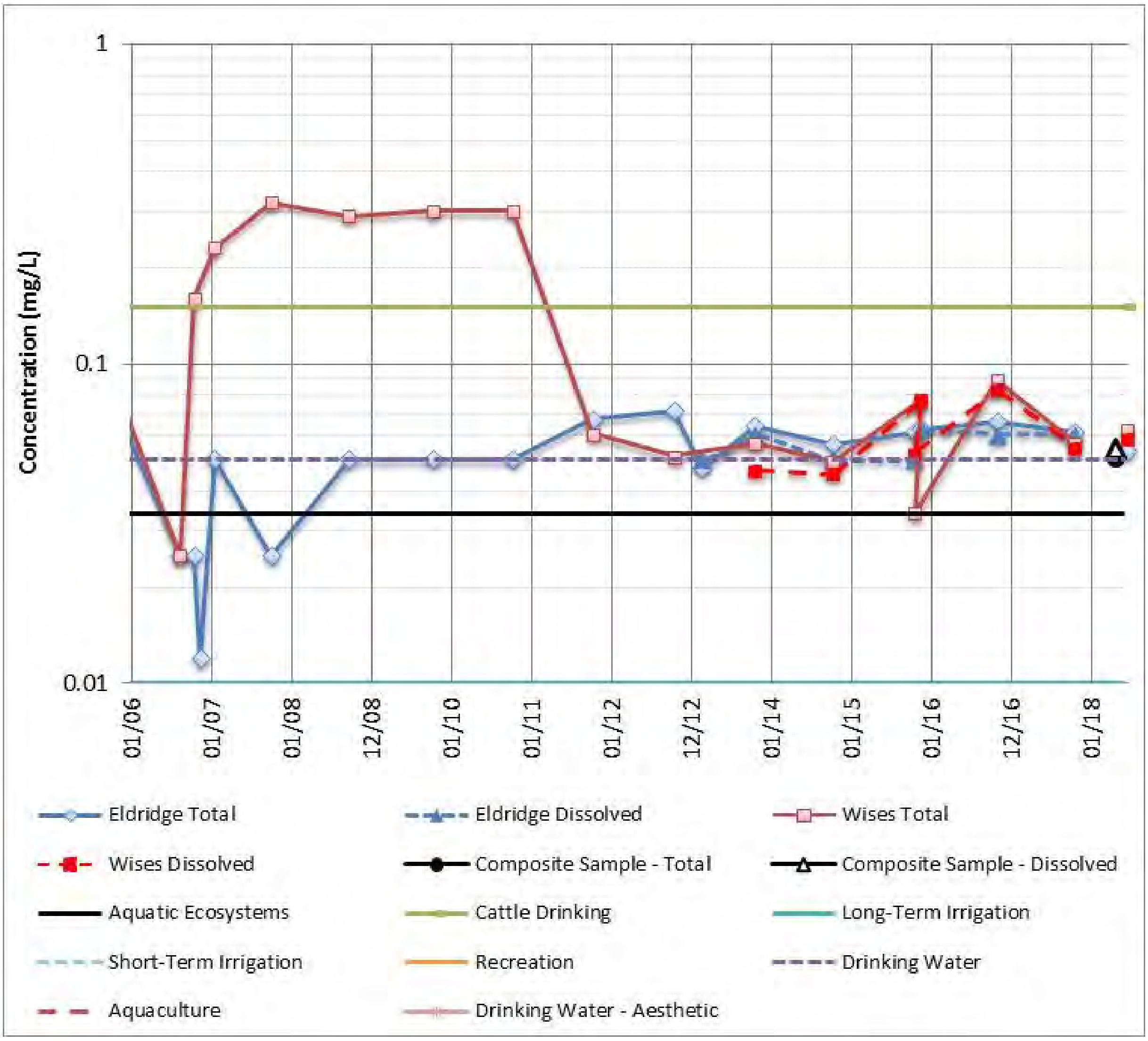


Figure 92 Molybdenum Concentrations in the Eldridge and Wises Pits

Nickel

Nickel concentrations are consistently higher in the Eldridge Pit compared to the Wises Pit (Figure 93). There have only been two samples of nickel (total) in the Eldridge Pit that show concentrations below all WQOs (Figure 93). Although concentrations are raised above Aquatic Ecosystem and Drinking Water WQOs in the Eldridge Pit there is no overall increase in the concentration of filtered or total nickel. Concentrations are relatively stable between 0.01 and 0.05mg/L except for one outlier in December 2012. Concentrations in the Wises Pit appear to be on an upwards trend since 2015. Concentrations in the composite sample (0.022mg/L) are above the Aquatic Ecosystem WQO and are generally consistent with concentrations in the Eldridge Pit.

Concentrations of dissolved nickel are well below the HMTVs provided for each pit (Figure 93). This is because the hardness values in the Pits are several orders of magnitude (i.e. between 1500mg/L and 2000mg/L) compared to the hardness values used to develop Aquatic Ecosystem WQOs (30mg/L).

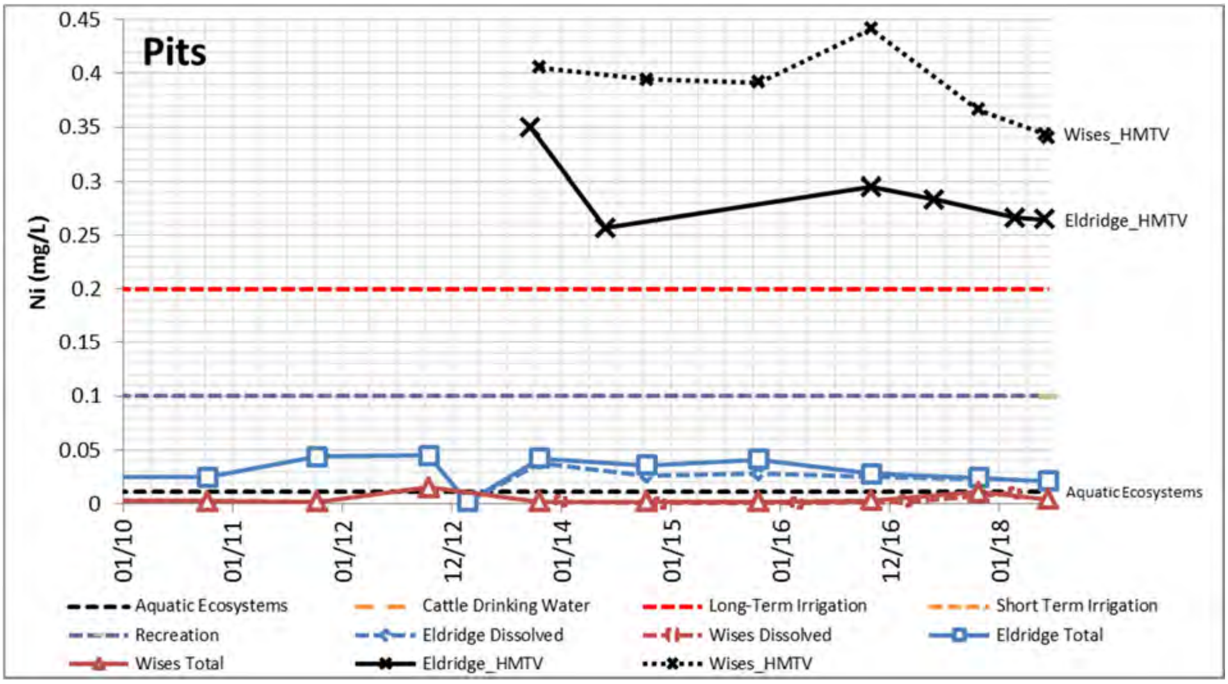


Figure 93 Nickel Concentrations in the Eldridge and Wises Pits

Zinc

Dissolved and total zinc concentrations in the Eldridge Pit are subject to high fluctuations (Figure 94) between 0.006mg/L to 2mg/L. There is sometimes an order of magnitude difference in the concentration of zinc within the Eldridge pit in consecutive samples and the concentrations do not correlate well with any other parameters that are currently analysed. Zinc concentrations in the Wises Pit are a little more stable than concentrations in the Eldridge Pit and are generally lower. Zinc concentrations in both pits were consistently above the WQO for Aquatic Ecosystems, with the exception of two samples from the Eldridge Pit in 2008 and 2009. The composite sample shows a concentration (approximately 1.04mg/L) above the Aquatic Ecosystem WQOs.

The toxicity of zinc is dependant on hardness. Higher hardness values will see higher competition between calcium and magnesium ions with zinc, therefore lowering toxicity. Subsequently a HMTV for zinc was calculated on a sample by sample basis in accordance with table 3.4.3 of the ANZECC (2000) Guidelines. These values are designed for Aquatic Ecosystem protection and over-ride the default WQO where they are larger. As discussed previously the Pits have a significantly higher hardness (1500-2000mg/L) compared to the values used to calculate the default WQO (30mg/L).

Subsequently it is only recent samples in the Wises Pit which have exceeded the HMTV for zinc (Figure 94). This sample was collected in early 2018. However the concentration of dissolved zinc in the Wises Pit decreased to below the HMTV in the June 2018 sample. Samples from the Eldridge Pit have exceeded the HMTV for dissolved zinc since late 2016. Concentrations of dissolved zinc in the Eldridge Pit (0.8-1.2mg/L) are roughly an order of magnitude above the HMTVs for the same period (approximately 0.2mg/L).

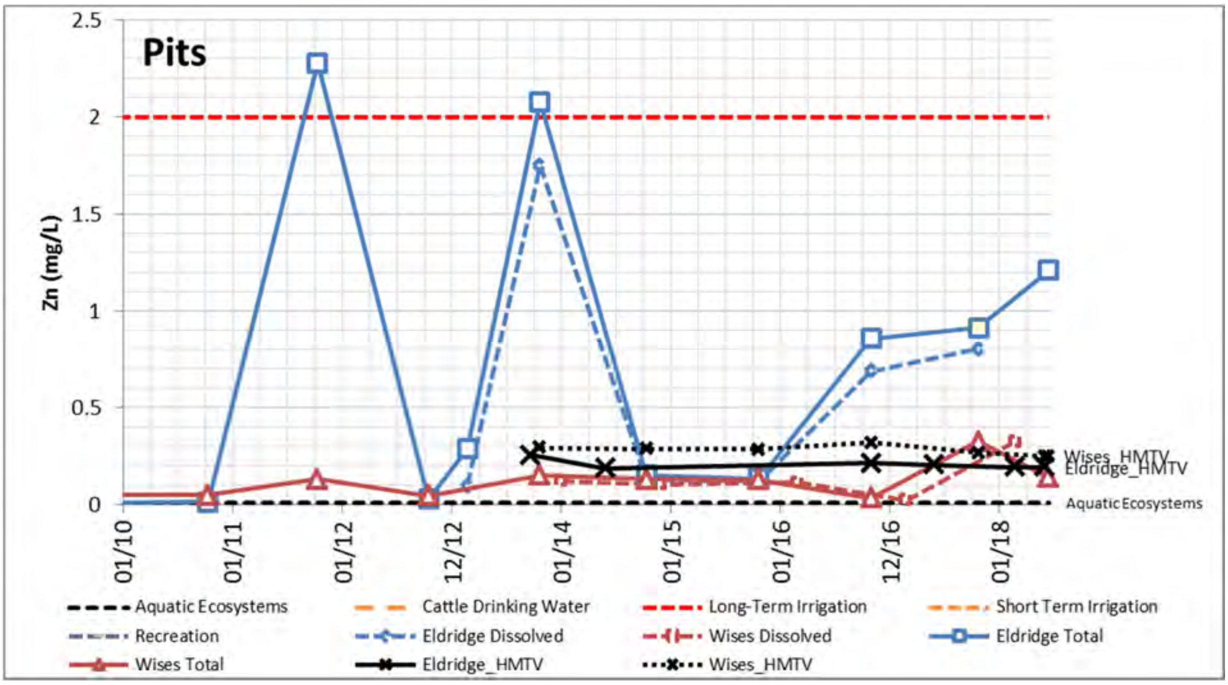


Figure 94 Zinc Concentrations in the Eldridge and Wises Pits

Cyanide

There have only been three samples collected from the Eldridge and Wises Pits which have been analysed for total cyanide. These concentrations are plotted below in Figure 95 Historical samples taken in 2012 show total cyanide concentrations above WQOs for both pits. However recent samples, as well as the composite sample are well below WQOs, and show concentrations which are below the LOR (<0.004mg/L). Therefore cyanide is not considered a contaminant of concern since it has not been detected in any samples since 2012.

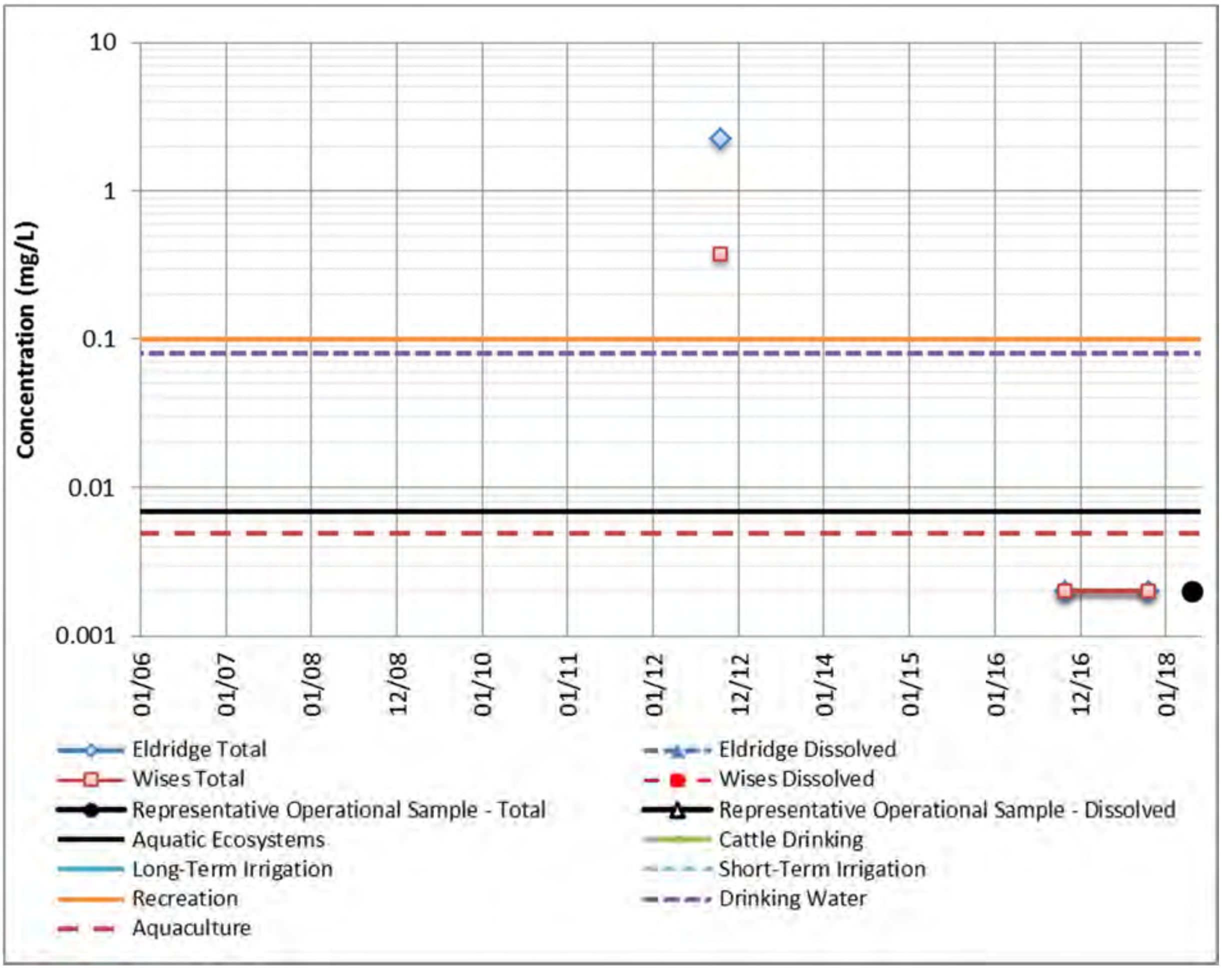


Figure 95 Total Cyanide Concentrations in the Wises and Eldridge Pits

Appendix E

Wet Season Aquatic Ecology Survey - 2018

C&R CONSULTING
Geochemical & Hydrobiological Solutions Pty Ltd
ABN 72 077 518 784

Underground Coal Gasification / Coal Seam Gas Investigations
Mineralogical, Geological, Petrographic and Soils Services
Hydrogeomorphic and Palaeogeomorphic Evaluations
Terrestrial and Aquatic Fauna and Flora Surveys
Climate History and Extreme Events Analysis
Contaminated Site and Mine Water Analysis
Environmental Compliance and Monitoring
Estuarine and Marine Water Assessments
Surface and Groundwater Investigations

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KIDSTON PUMPED STORAGE HYDRO PROJECT

AQUATIC ECOLOGY SURVEY REPORT

REPORT PREPARED FOR:
AECOM Pty Ltd

Date:
June 2018

IMPORTANT NOTE

Christopher Cuff

Dr Chris Cuff
Director

20 June 2018

Date

Cecily Rasmussen

Dr Cecily Rasmussen
Director

20 June 2018

Date

SUMMARY OF RELEVANT INFORMATION

Project Title	Kidston Pumped Storage Hydro Project
Property Location	Kidston, North Queensland
Project Purpose	Aquatic Ecology Survey Report
Client Details	
Company	AECOM Pty Ltd
Nominated Representative	Reece Fraser
Title/Position	Senior Water Resources Scientist
Postal Address	GPO Box 5423 Townsville QLD 4810
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Survey undertaken by:	Mr. M. Knott Mr. D. Buchanan

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1. INTRODUCTION

C&R Consulting Pty Ltd were contracted by AECOM Pty Ltd to undertake aquatic ecology sampling of the Copperfield River reaches associated with the Kidston Pump Storage Hydro Project and provide a report detailing the methods employed, the results, and an assessment of any significant findings. Therefore, this brief includes:

- Section 2 – An overview of the methods used to determine the aquatic flora and fauna communities inhabiting the site, including a literature review and detailed field surveys.
- Section 3 – Details the results of field work including the habitats present as well as describing their condition and the macroinvertebrate, fish, turtle, aquatic flora species identified occurring across the project site.

2. METHODS

2.1 DATABASE SEARCHES

Database searches for this study targeted listed aquatic flora, fauna and communities previously documented in the area (within a 20km radius of the project site). Databases searched included the EPBC Protected Matters Tool (2018) targeting EPBC Act species and communities, and Wildlife Online (2018) targeting NC Act species.

2.2 AQUATIC ECOLOGY FIELD SURVEYS

2.2.1 TIMING

The aquatic ecology field surveys were conducted at the end of the 2017-2018 wet season (23rd – 26th of April 2018), approximately six weeks after significant rain had fallen within the region (pers. comm. AECOM) and the major flows had receded (in accordance with AusRivAS methods; DNRM, 2001). The highly ephemeral nature of the majority of the watercourses within the region, indicates that end of wet season sampling is the most appropriate timing for identification of greatest biodiversity potential. This is also the most appropriate period for determining any potential impacts from upstream influences.

2.2.2 SITE SELECTION

Aquatic ecology sampling site locations were provided by the client and are shown in Figure 1. The six (6) sites were based on historic monitoring locations (WB, W1, W2 and W3) with additional sites (E1 and E2) incorporated to provide further information on the influence of East Creek.

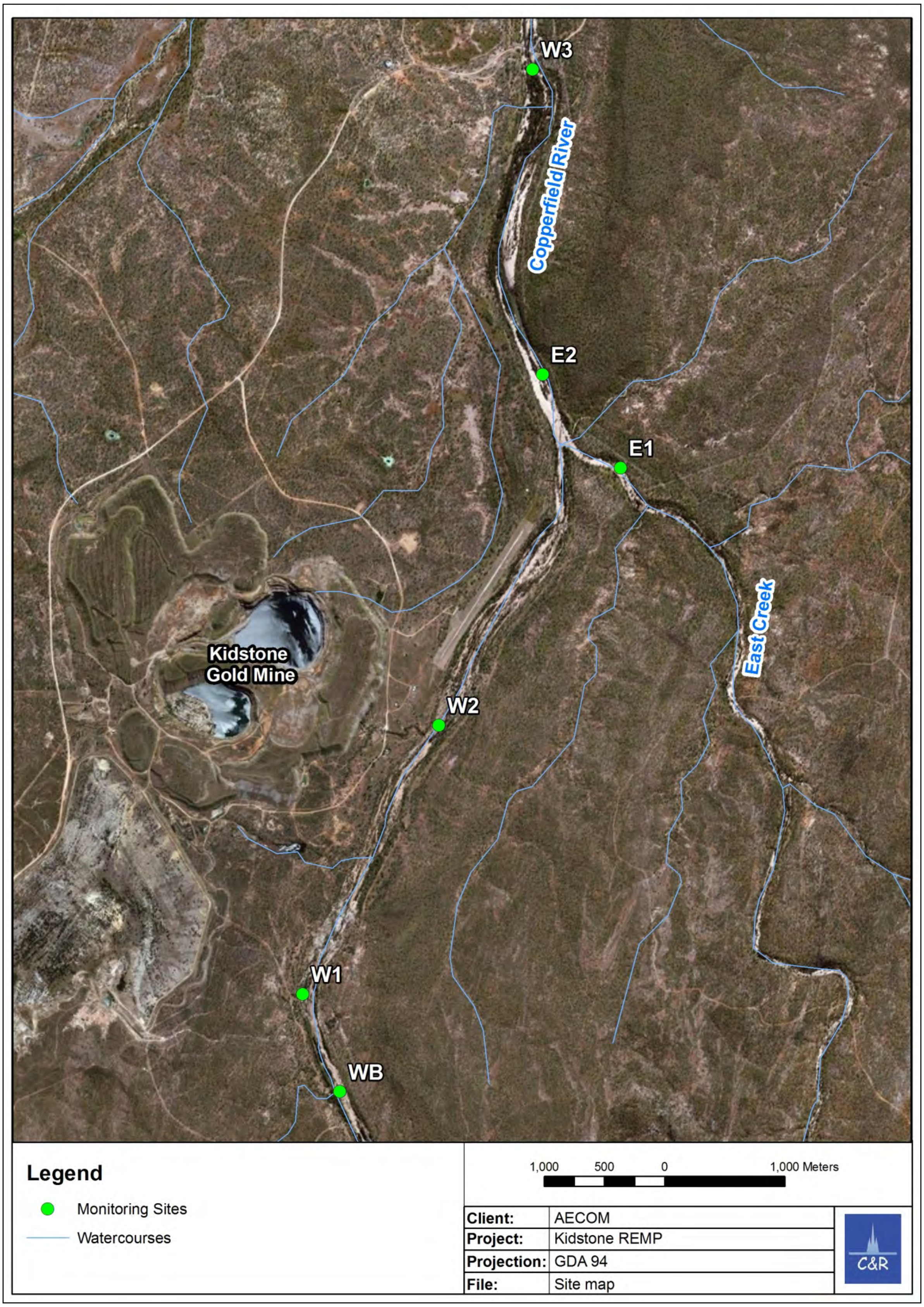

Figure 1: Site map

2.2.3 AQUATIC HABITAT

Habitat Characteristics and Condition

Habitat condition was assessed at each sampling site in accordance with the methods outlined within the *Queensland AUSRIVAS Sampling and Processing Manual* (DNRM, 2001). Under this manual, the following nine key physical habitat characteristics were assessed:

- Bottom substrate/available cover;
- Embeddedness;
- Velocity/depth cover;
- Channel alteration;
- Bottom scouring and deposition;
- Pool/riffle, run/bend ratio;
- Bank stability;
- Bank vegetative stability; and
- Streamside cover.

Habitat characteristics are given a rating based on their condition, with the overall habitat bioassessment score for a site (the sum of all the possible ratings) then allocated to one of four categories signifying habitat condition present at the site (Table 1). The four allocated categories are:

- Excellent (>110);
- Good (75 – 110);
- Fair / moderate (39 – 74); and
- Poor (≤38) (Table 1).

Table 1: Rating system used to determine Habitat Bioassessment Scores (DNRM 2001)

Number	Habitat Variable	Habitat condition rating ranges			
		Poor	**Fair**	**Good**	**Excellent**
1.	Bottom substrate / available cover	0 – 5	6 – 10	11 – 15	16 – 20
2.	Embeddedness	0 – 5	6 – 10	11 – 15	16 – 20
3.	Velocity / depth category	0 – 5	6 – 10	11 – 15	16 – 20
4.	Channel alteration	0 – 3	4 – 7	8 – 11	12 – 15
5.	Bottom scouring and deposition	0 – 3	4 – 7	8 – 11	12 – 15
6.	Pool / riffle, run / bend ratio	0 – 3	4 – 7	8 – 11	12 – 15
7.	Bank stability	0 – 2	3 – 5	6 – 8	9 & 10
8.	Bank vegetative stability	0 – 2	3 – 5	6 – 8	9 & 10
9.	Streamside cover	0 – 2	3 – 5	6 – 8	9 & 10
-	Total Habitat Bioassessment Score	0 – 38	39 – 74	75 – 110	111 – 135

Photos were taken to document habitat variability at each site. This habitat assessment provides a detailed overview of existing habitat condition at each sampling site. It also provides a baseline for each site against which future change can be monitored.

2.2.4 WATER QUALITY

Basic water quality analysis was undertaken at each site to assist in the interpretation of the biological data. Water quality at each site was tested using an Eureka Manta Sub-2 in-situ field meter. The following parameters were measured:

- Water temperature (°C);
- Electrical conductivity (µS/cm);
- pH (Units); and
- Dissolved oxygen (mg/L and %sat).

Water samples were also collected from each site and analysed at a NATA accredited laboratory for a range of parameters discussed further within AECOM's report.

2.2.5 AQUATIC FLORA COMMUNITIES

Aquatic flora can have many different forms, including:

- Submerged macrophytes: Growth is predominantly beneath the water surface although flowers and or leaves of some species protrude the surface of the water;
- Floating macrophytes: Can be either attached or free floating (Sainty & Jacobs, 2003). For example, the introduced water hyacinth floats freely around waterways being moved across the surface by wind or currents, while the waterlilies are rooted to the substrate but the mature leaves float on the surface;
- Emergent macrophytes: Generally grow in the shallower waters and are rooted to the substrate with the majority of the plant (stems, flowers and leaves) protruding above the surface of the water (Sainty & Jacobs, 2003); and,
- Algae: Generally need to be fully submerged to survive.

Aquatic flora surveys were conducted at each site along a 100m reach, with species inhabiting the reach identified. This assessment detailed the presence/absence of all native and exotic aquatic flora and their form (from the four categories listed above) as well as the percent cover of each species within a 50m sub-section at each site. Transects cannot be effectively surveyed in turbid and/or deep habitats, therefore transects generally targeted shallower waters.

Photographs of different macrophyte species present at each site were taken. Specimens of any species that could not be identified in the field were collected for identification purposes within the C&R laboratory.

The data collected provides an indication of the existing condition of aquatic macrophyte communities present within the watercourses of the project site.

2.2.6 AQUATIC MACROINVERTEBRATE COMMUNITIES

At each site both the bed and edge habitats were sampled for macroinvertebrates. Sampling methods followed the procedures set out in the Queensland AusRivAS Sampling Manual (DNRM, 2001). This involves the use of a standard triangular mouthed frame fitted with a 250µm mesh size net to collect all samples. Run habitats were sampled by holding the macroinvertebrate net downstream of the samplers position with the open end facing the sampler. The sampler then disturbs the substrate by kicking the feet and slowly walking upstream while dragging the net through the disturbed plume. This ensures that organisms inhabiting the benthos are collected. Edge habitat samples were taken by selecting the appropriate section (e.g. backwater with leaf litter, exposed tree roots and some trailing vegetation, if available) and vigorously sweeping the net in short upward movements perpendicular to the bank to ensure the substrate is disturbed and then sweep through any suspended material. For both habitats a maximum distance of 10m was sampled.

Samples taken were live picked in the field for a minimum of 30 minutes using tweezers and pipettes. The first 5 minutes of picking targeted the common and most abundant taxa. After the first 5 minutes, the majority of the picking effort focused on the less common, conspicuous taxa. If at the end of the 30 minutes less than 200 animals had been found the samples were picked for a further 10 minutes. Picked specimens from each sample were stored in a vial of 70% alcohol and sent to the C&R laboratory for detailed family identification. Organisms were counted and identified to the lowest practical taxonomic level (in most instances family) to comply with AusRivAS standards. Macroinvertebrate samples for this project were initially identified by a suitably qualified Aquatic Ecologist, with 10% (or greater) of samples randomly chosen for verification by C&R's Senior Aquatic Ecologist to ensure QA/QC.

Data Analysis

The QWQG (2009) are generally used by regulators to assess macroinvertebrate community health within freshwater systems specific to each Queensland region. However, the QWQG (2009) do not provide any guideline values for the region to assess biological communities. Instead, analysis of macroinvertebrate data was undertaken with upstream and downstream sites compared for the following indices:

- **Taxonomic richness** – This represents the total number of different macroinvertebrate taxa collected at each site. This is to determine the diversity of the macroinvertebrate community present at each site. Healthier sites will have a greater diversity.
- **PET Taxa richness –** Indicates the number of families collected from three specific orders; Plecoptera (stoneflies), Ephemeroptera (mayflies) and Trichoptera (caddisflies). These macroinvertebrate orders are considered sensitive to changes within their environment. Therefore, a low number of families collected from these orders (compared to the guidelines values) may suggest habitat degradation.
- **SIGNAL 2 index –** The SIGNAL index (Stream Invertebrate Grade Number – Average Level) was developed by Chessman (1995) to assist in the bioassessment of water quality in Australia. Chessmen (1995) determined sensitivity grade numbers (between 1 and 10) for most freshwater macroinvertebrate families in Australia based on how sensitive each was to various pollutants and other physical and chemical factors. In 2003 Chessman devised a weighted system for analysing SIGNAL indices to provide an overall SIGNAL 2 score for the site. This weighted system of analysis takes into consideration relative family abundance and therefore community composition. The overall SIGNAL 2 score is calculated using the following steps:
    - Determine SIGNAL grade for each different taxa present;
    - Determine weighting of each taxa present based on the number of individuals collected using the categories outlined in Chessman (2003);
    - Multiply the weight value by the SIGNAL grade for each taxa; and,
    - Divide the total weight determined for a site (add up all the weights) by the total SIGNAL grade x weight determined (add up all the values determined in the previous step) to provide an overall SIGNAL 2 score for the site.

  SIGNAL 2 scores are then interpreted using bi-plots and compared against the number of families recorded at each site. The bi-plots can then be divided into quadrants with each separate quadrant identifying the particular conditions occurring within a site (Figure 2). The boundaries that determine the quadrants are generally based on background assessments from the region. However, stream specific boundaries can be identified if sufficient reliable data are available. To date, all previous monitoring undertaken within the region has applied the boundaries for each quadrant based on a whole of Australia assessment undertaken Chessman (2003) (designated interim boundaries). The current study will adopt interim boundaries based on the Central Queensland regional guidelines as these appear most relevant (QWQG, 2009).

Further assessment of the data was also undertaken using the AusRivAS modelling programme to compare collected data against reference sites within the region and provide a level of macroinvertebrate community condition for each site. Data were analysed using the AusRivAS Queensland-Autumn-Western Regional- Edge and Run models. For a full description of how these models function please refer to the *AusRivAS Predictive Modelling Software Version 3.1 Users Manual (2004)* and the *AusRivAS Macroinvertebrate Bioassessment Predictive Modelling Manual (2000).* The results of these models provide an indication of the level of biological impairment experienced at the targeted sites. The Observed/Expected (O/E) score (50%) provides a measure of biological impairment for each habitat within a site. The O/E score (50%) indicates the number of collected taxa that were predicted (expected) to occur with equal to or greater than 50% probability. Each O/E score (50%) occurs within the range of one of five Bands (X, A, B, C or D). The Band provides the description of biological impairment. The habitat that provides the lowest O/E score (50%) (e.g. the most biologically impaired) for a site provides the level of biological impairment for that particular site. This provides a conservative approach to management.

The levels of biological impairment a site can be categorised as include:

- **Band X:** Indicates the site is richer than reference sites within the region. This means that more families were found than expected and can suggest that the site is either a potential biodiversity “hotspot” or has mild organic enrichment.
- **Band A:** Infers the site is similar to reference sites. Suggesting that the site is similar to the determined natural state of creeks in the region.
- **Band B:** Indicates the site is significantly impacted. Fewer families were collected than were predicted to occur. This suggests there is potential mild impact to water quality and/or sampled habitat.
- **Band C:** Indicates the site is severely impacted. Many families were not collected that were predicted to occur. Severely impacted water quality and/or habitat are present that has resulted in a loss of families.
- **Band D:** Indicates the site is impoverished. This infers that very few families were collected, indicating that the site is highly degraded with very poor water and/or habitat quality.

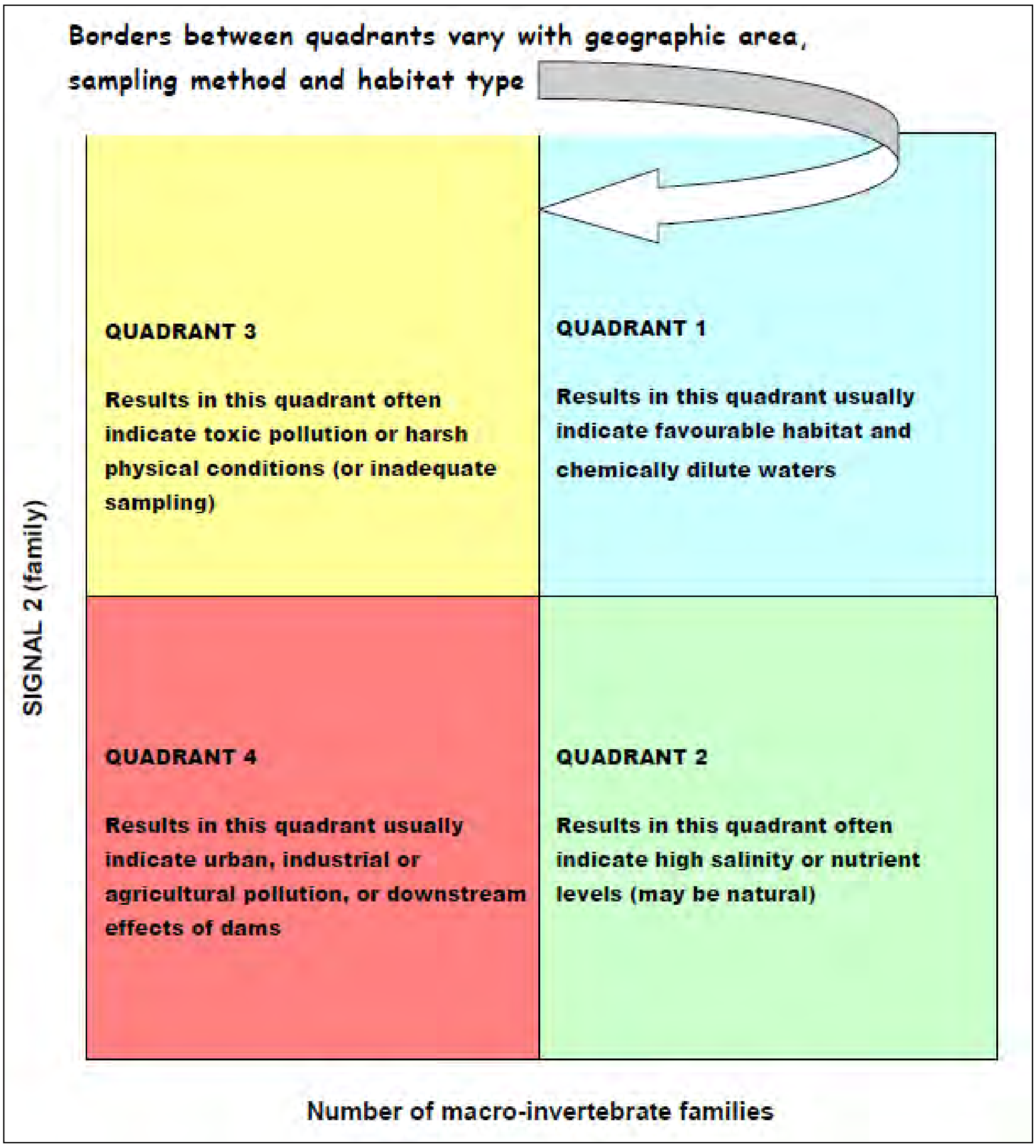

Figure 2: SIGNAL 2 Bi-plot quadrants

2.2.7 Fish Communities

Fish communities were surveyed using a combination of backpack electrofishing, baited traps, seine nets, tangle nets and dip nets dependent on habitat type (e.g. deep pool, shallow run, etc.).

Backpack electrofishing (using a Smith-Root LR-24) was the preferred sampling technique (Table 2). Baited traps were employed at each site to target both fish and crustaceans. This included replicate samples of collapsible box traps (2mm mesh) and opera house traps (1.5" mesh) at each site. Table 2 outlines the fishing techniques and effort utilised at each particular site during the field assessment.

Fish collected were counted, identified, measured (to determine life history stage) and photographed. A general assessment of fish health was also noted for each surveyed site. Any specimens unable to be identified within the field were euthanised and brought back to the C&R laboratory (as voucher specimens) for identification.

Freshwater fish surveys were conducted in accordance with methods developed for the Northern Australian Freshwater Fish Atlas project (NAFF 2007, a collaboration between the National Centre for Tropical Wetland Research and Griffith University) and in accordance with the *Australian Code of Electrofishing Practice 1997*.

Data Analysis

Species richness, total abundance, abundance of listed aquatic species, abundance of exotic species, and abundance of each life history stage present (e.g. juvenile, intermediate or adult) were determined for each assessed site.

2.2.8 TURTLE COMMUNITIES

A turtle survey was conducted to identify any turtle species that may be present within the project site. Turtle communities at each site were assessed via visual surveys and baited cathedral traps dependent on habitat targeted and access (e.g. depth, macrophyte beds, etc.). However, the shallow nature of the majority of sites meant cathedral traps could only be utilised at W1 with one being deployed for a total of 15hrs. As the water was clear and relatively shallow at most sites, walk through visual surveys were employed to target freshwater turtles potentially inhabiting the area.

Turtles are also regularly seen during electrofishing surveys for fish communities. When noticed, the electrofisher was shut down to prevent injury to the animal. The turtle was then caught for identification purposes, and subsequently released.

Captured turtles were measured, identified to a species level and photographed. All results were tabulated for species presence and abundance at each sampling site.

All turtle surveys were conducted under Animal Ethics Approval No. CA 2016-02-942.

2.2.9 OTHER AQUATIC VERTEBRATES

The potential presence of other aquatic vertebrates in the region was assessed through the completion of database searches, specifically the Commonwealth's *Protected Matters Search Tool* and the Queensland Government's *Wildlife Online* database.

However, by undertaking the methods outlined for fish and turtle surveys, any other aquatic vertebrates observed inhabiting the area were noted with presence/absence data recorded.

Table 2: Fishing settings and effort employed at each site

	Date	Habitat sampled	Average Depth	Method	Fishing Settings			Total Effort
WB	25/04/2018	Shallow runs with deeper erosional banks and woody debris	0.75m	Baited box traps	2 deployed	2mm mesh		33 hrs
				Baited opera traps	2 deployed	1" mesh		33 hrs
				Backpack Electrofisher	240V	60Hz	25% Duty	487 secs
W1	25/04/2018	Deep pools with some shallower runs and backwater	>1m	Baited box traps	2 deployed	2mm mesh		31 hrs
				Baited opera traps	3 deployed	1" mesh		46.5 hrs
				Tangle net	1 deployed	1.5" mesh x 10m		1.5 hrs
				Backpack Electrofisher	240V	60Hz	25% Duty	205 secs
W2	24/04/2018	Shallow and deep riffles and runs with an some backwater	1m	Baited box traps	2 deployed	2mm mesh		31 hrs
				Baited opera traps	2 deployed	1" mesh		31 hrs
				Backpack Electrofisher	260V	60Hz	25% Duty	298 secs
W3	23/04/2018	Shallow runs and riffles and deeper riffles with deep undercut banks	1m	Baited box traps	3 deployed	2mm mesh		48 hrs
				Baited opera traps	3 deployed	1" mesh		48 hrs
				Tangle net	1 deployed	1.5" mesh x 10m		2 hrs
				Backpack Electrofisher	200V	60Hz	25% Duty	430 secs
E1	24/04/2018	Shallow run and small riffle, extensive backwater	0.75m	Baited box traps	2 deployed	2mm mesh		35 hrs
				Baited opera traps	2 deployed	1" mesh		35 hrs
				Backpack Electrofisher	200V	60Hz	25% Duty	415 secs
E2	24/04/2018	Isolated pool with only base flow remaining	0.5m	Baited box traps	3 deployed	2mm mesh		48 hrs
				Baited opera traps	3 deployed	1" mesh		48 hrs
				Backpack Electrofisher	360V	60Hz	25% Duty	248 secs

3. RESULTS

3.1 HABITAT ASSESSMENT

Field surveys were undertaken at the end of April 2018, at the end of the 2017-2018 wet season, and approximately six weeks after a significant rainfall event/flows, to allow aquatic flora and fauna assemblages to be at peak family richness.

Above ground flows were still present in Copperfield River, while East Creek was reduced to a series of pools connected by subsurface flows at the time of sampling. The study is considered to have adequately determined aquatic habitats that occur within the project site, including:

- Run;
- Riffle;
- Deep pool;
- Shallow pool;
- Undercut/eroded bank;
- Bedrock; and
- Complex woody debris (Table 3).

Table 3 outlines the sampling sites and portrays their status at time of sampling.

3.1.1 HABITAT CONDITION

The AusRivAS habitat condition assessment was determined for each sample site and the results are presented in Figure 3. These results indicate that the majority of sites were in a similar condition (good), with only E1 observed in moderate condition. This is a direct result of the relatively uniform flowing habitats, displaying riffles and runs within Copperfield River at time of sampling (Table 3). E1 scored slightly less because of the lack of flows and subsequent reduced diversity of habitats (Table 3).

Table 3: Site descriptions, sampling limitations and site pictures

Site	Upstream view	Downstream view	Description
WB			WB incorporated a long, shallow run habitat with a deep pool associated with a large fallen tree and other woody debris. There was also a large backwater pool that contained a large amount of leaf litter. The water was relatively clear with an average depth of 0.75m. The substrate was comprised of sand and gravel. The riparian vegetation was dominated by Acacia and Melaleuca, with aquatic vegetation limited to sedges. Exposed roots, sedges and trailing vegetation provided structurally complex habitat along the banks. ***Limitations*** **–** The shallow nature and high flows limited the effectiveness of nets and traps.
W1			W1 consisted of a deep turbid pool with some shallow run sections and backwater also present. Structural complexity was provided by exposed roots, some trailing vegetation and bedrock. The riparian vegetation was dominated by Melaleuca, with minimal aquatic vegetation noted. The substrate was dominated by sand and bedrock with an average depth of >1m. ***Limitations*** **–** The depth of water and turbidity limited the ability to utilise electrofishing at this site.

Site	Upstream view	Downstream view	Description
W2			This site consisted of one large straight run section with bedrock and woody debris creating some riffles. The water was relatively turbid and an average depth of ~1m. No aquatic vegetation was noted at this site. The riparian vegetation was again dominated by Melaleuca and the substrate dominated by coarse sand. ***Limitations*** – Turbidity limited the ability to utilise electrofishing at this site while the flows limited the use of nets.
E1			E1 was situated at the downstream end of East Creek immediately prior the confluence with Copperfield Creek. This site is to act as a reference site for flows at downstream sites to provide an indication of the influence flows from East Creek may have on downstream environments. The site was a large pool on a bend, with significant amounts of trailing vegetation. The water clarity at the site was good although the depth of water along the erosional restricted vision. The riparian zone was dominated by Melaleuca and Forest Blue Gums. Little erosion and moderate sediment deposition were noted. The substrate was dominated by sand. ***Limitations*** – The depth of the water along the erosional bank limited the ability to electrofish.

Site	Upstream view	Downstream view	Description
E2			This site was one long straight run habitat with a shallow backwater section and exposed roots providing some structural complexity. The substrate was dominated by sand. The aquatic vegetation community was limited to intermittent sedges along the banks. The riparian vegetation was again dominated by Melaleuca and Acacia. ***Limitations*** **–** Flow was too strong to utilise nets. However, all other sampling techniques were performed effectively.
W3			W3 provided the most diverse range of habitats including substantial riffle zones, shallow pools, runs and deeper pools. The site is located downstream of all historic mining operations at the main access road crossing. The substrate was dominated by sand, cobble and bedrock. The water was relatively clear, although it was opaque in deeper sections. The riparian vegetation was dominated by Melaleuca. ***Limitations*** **–** Sampling of deeper waters (>1.2m) was limited to traps as water was too deep and flowing too fast for electrofishing and nets.

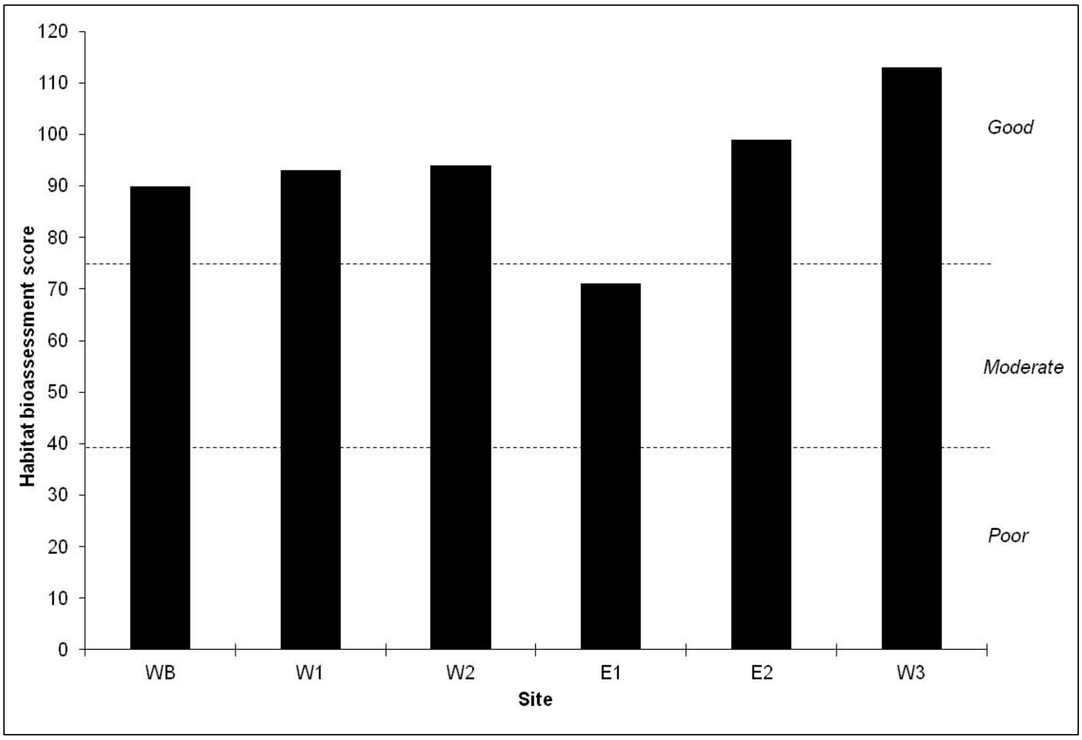

Figure 3: Habitat condition observed at each site

3.2 WATER QUALITY

In-situ water quality results displayed a relatively well mixed system with stable electrical conductivity, pH and dissolved oxygen across all sample sites (Table 4). The variability observed within the temperature data is simply a product of time of sampling during each day (e.g. morning or afternoon; Table 4).

Table 4: In-situ water quality results

Site	Temperature (ºC)	Electrical conductivity (µS/cm)	pH (pH units)	Dissolved oxygen (%Saturation)
WB	23.23	107	7.75	N/A
W1	20.99	113	7.75	91.7
W2	25.67	108	7.81	100.9
E1	22.5	116	7.78	105.9
E2	22.2	112	7.9	100.9
W3	25.00	115	7.63	99.2

3.3 MACROINVERTEBRATE COMMUNITIES

3.3.1 TAXONOMIC RICHNESS

Fifty one (51) different macroinvertebrate taxa were collected during the field survey compared to 41 in 2012, 39 in 2011, 35 in 2010 and 33 in 2009 (Genex 2015; refer to raw macroinvertebrate data in Appendix 1). As no guideline values are available for Gulf Rivers, the Central Coast Guideline Values (QWQG, 2009) were adopted as these are the most relevant in terms of the nature of flows within the targeted watercourses. Therefore, these guidelines simply provide guidance on the results, not definitive conclusions.

The majority of bed habitats were greater than the 20th percentile value set by the Queensland Water Quality Guidelines (QWQG) (2009), with only E2 recorded below this guideline value (Figure 4). All sites were well below the 80th percentile guideline value (Figure 4). The bed habitat at E2 was almost entirely comprised of sand with only a minor amount of cobble and gravel. This lack of structural complexity may have influenced the results.

Edge habitats at only W1 and E1 were compliant with the QWQG (2009) 20th percentile value (Figure 5). All other sites were non-compliant. Such results usually suggest a lack of diversity within the edge habitat. However, as these guideline values are not developed for this region it may simply be a regional trend. Edge habitats were predominantly exposed roots with a large amount of scouring associated with the relatively large and consistent flows experienced six weeks prior. This scouring may have reduced the diversity of fauna able to inhabit the areas.

Edge habitats are generally more structurally diverse and exhibit higher rates of primary production compared to bed habitats, resulting in greater diversity of macroinvertebrate communities than bed habitats (Choy *et al.,* 2002). This was the case in the current study. However, the presence of riffles within the bed habitats at most sites limited the overall differences in taxonomic richness between habitat types.

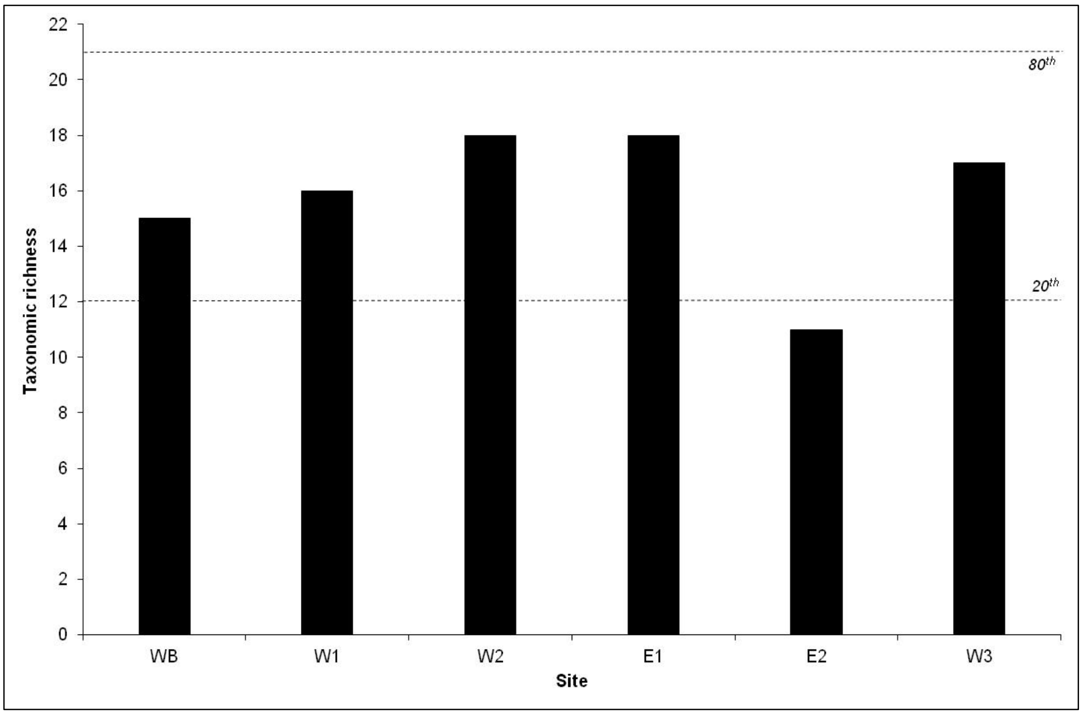

Figure 4: Taxonomic richness within the bed habitats at all sites compared to the QWQG (2009) Central Queensland guideline values

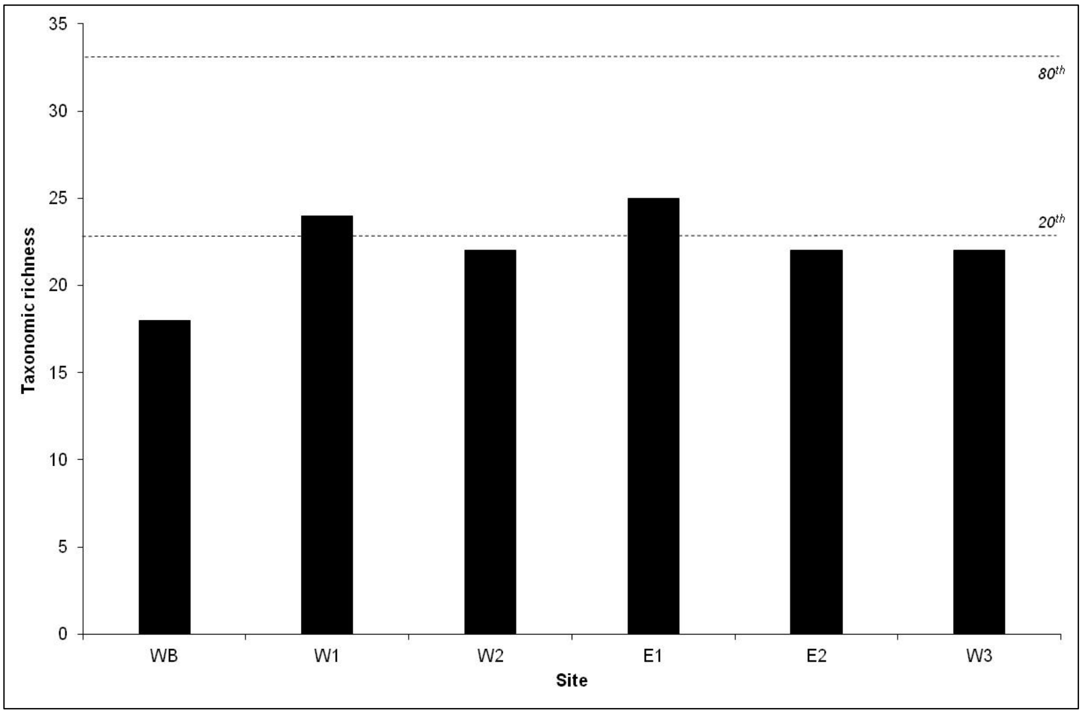

Figure 5: Taxonomic richness within the edge habitats at all sites compared to the QWQG (2009) Central Queensland guideline values

3.3.2 PET RICHNESS

All sites recorded PET richness within the bed habitat well above the 20th percentile guideline value and often equal to the 80th percentile guideline value for Central Queensland (Figure 6). Similar trends were observed in the edge habitat at each site (Figure 7). These PET richness results suggest that either the communities are in excellent condition, or the guideline values are not relevant to the region.

Interestingly, the far afield downstream site (W3) recorded the highest levels of PET richness of any site in both habitats. This is likely a result of the variety of habitats observed at the site and extensive riffle zones encountered.

Seven of the nine PET families identified occurring within the receiving environment are allocated SIGNAL Grades of ≥5, with these seven families accounting for over 70% of PET individuals recorded. Therefore, the PET richness results also suggest that the macroinvertebrate communities within the receiving environment are comprised of a high number of taxa that are sensitive to environmental change. As the PET richness values recorded at downstream sites are similar to those recorded at upstream sites it is suggested that historic mining operations have had little residual effect on the concentrations of sensitive organisms inhabiting the various reaches of the receiving environment or an overarching disturbance is influencing the results from all sites. Comparison with raw historic data, if available, may provide further insight on these results.

Note; an Odonata family with a SIGNAL Grade of 10 was recorded in the edge habitat at several sites including downstream sites (refer to raw data in Appendix 1).

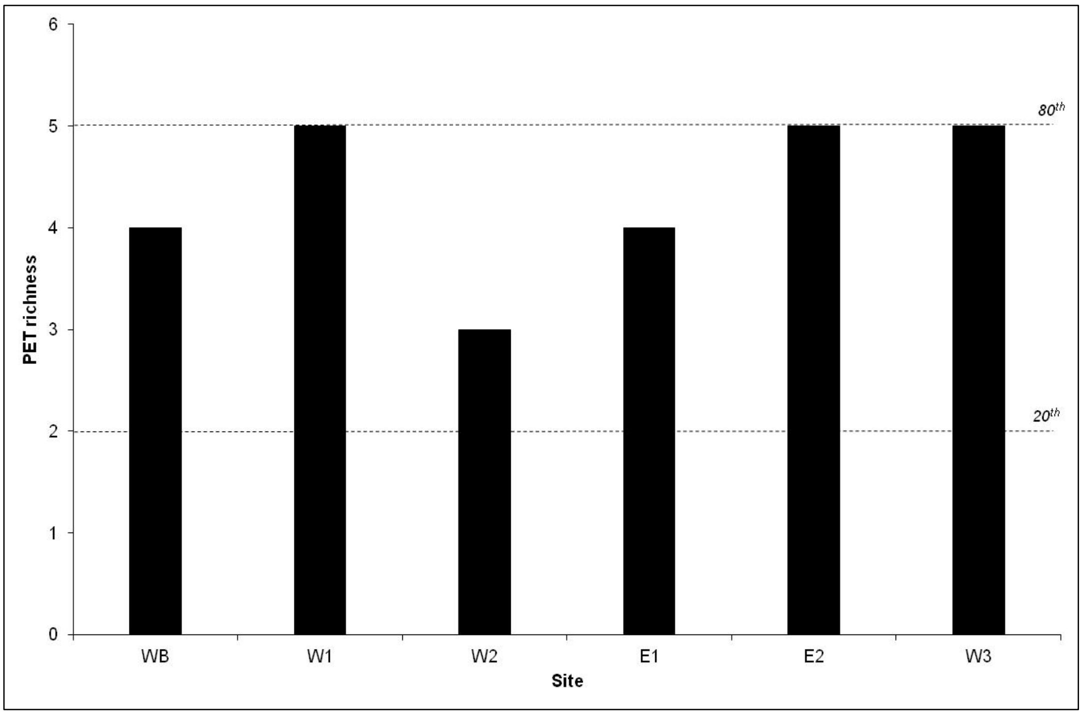

Figure 6: PET richness within the bed habitats at all sites compared to the QWQG (2009) Central Queensland guideline values

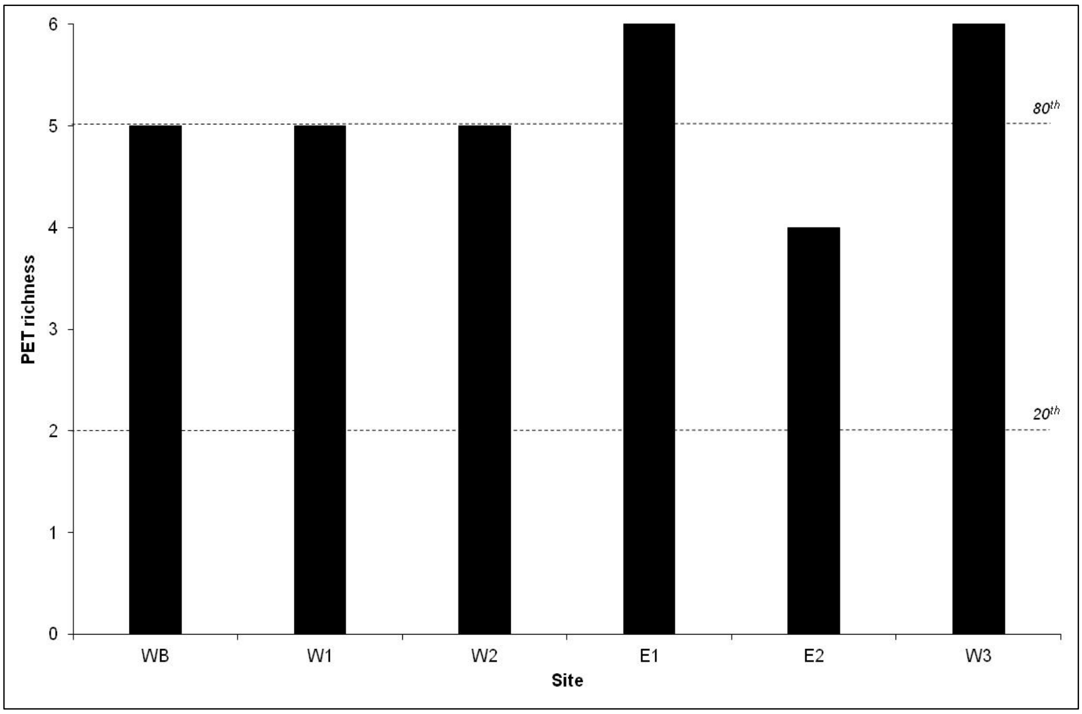

Figure 7: PET richness within the edge habitats at all sites compared to the QWQG (2009) Central Queensland guideline values

3.3.3 SIGNAL 2/FAMILY BI-PLOTS

SIGNAL 2/Family bi-plots provide an indication of the major environmental and anthropogenic factors influencing the structure (both diversity and tolerance) of the macroinvertebrate communities occurring at a particular site. For this assessment interim quadrant boundaries for edge and bed habitats were drawn from the QWQG (2009) 20th percentile values for taxonomic richness and SIGNAL Index Values allocated to the Central Queensland region.

Figure 8 shows that only E2 was outside quadrant one within the bed habitat. E2 occupied quadrant 3 suggesting the site is experiencing toxic pollution or harsh environmental conditions (Chessman 2003a). Water quality results for the system show lower concentrations at E2 than E1 for all parameters tested. All parameters from E2 were compliant with the default ANZECC & ARMCANZ (2000) WQOs for 95% Species Protection Level, except for dissolved aluminium. Concentrations at E2, 0.46mg/L, are not outside the range experienced in the system naturally where the 80th percentile at WB is 0.56mg/L (Pers. Comm. AECOM). Therefore the quadrant position of E2 is likely a result of the harsh environmental conditions experienced throughout the region naturally. The sites bed habitat was primarily made up of one extensive run habitat with a sandy substrate. The lack of habitat complexity and the high flow rates with the potential to shift the substrate are the likely contributing factors influencing this result.

Figure 9 shows that both upstream and downstream sites fall into quadrant three for the edge habitat. Again, this is likely the result of the higher flow rates experienced in the previous month (flooding flows were received in early March 2018) limiting the ability for some families to utilise the habitat with the potential for increased scouring. Since the results are wide spread across the study area (including upstream; WB) they are not likely a result of activities associated with the Kidston Gold Mine.

The sensitivity scores displayed in Figure 8 and Figure 9 provide further evidence of the highly sensitive communities inhabiting the area, as discussed with the PET richness results (refer to Section 3.3.2).

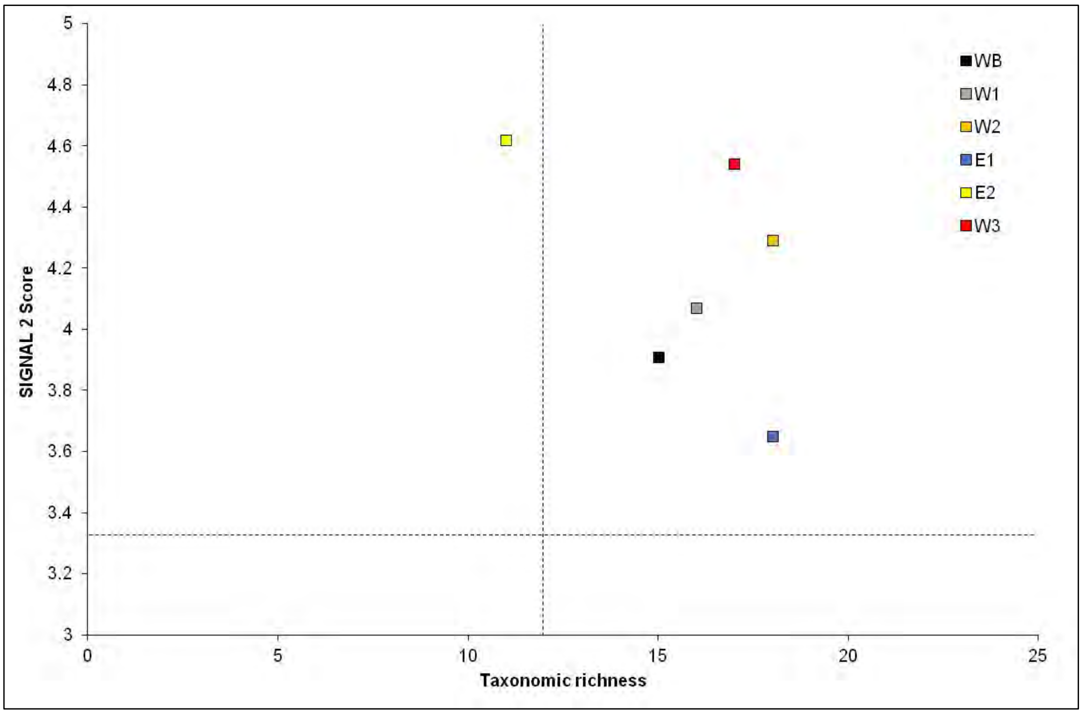

Figure 8: SIGNAL 2 Bi-plot displaying the bed results from each site compared against guideline values from the Central Queensland region (QWQG, 2009)

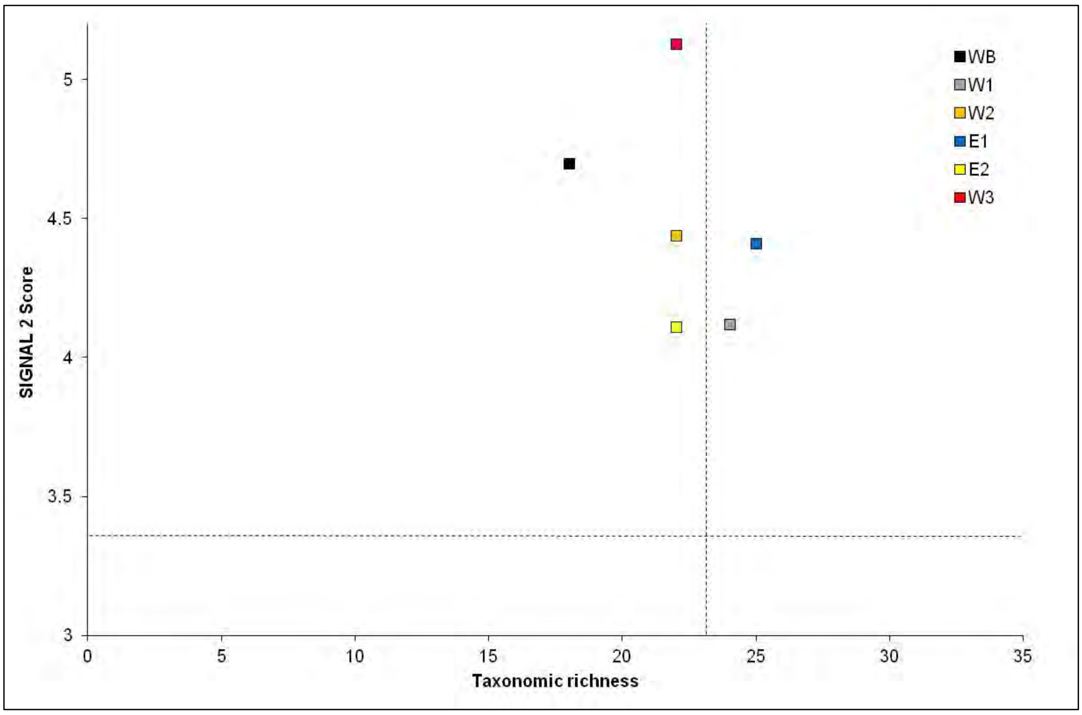

Figure 9: SIGNAL 2 Bi-plot displaying the edge results from each site compared against guideline values from the Central Queensland region (QWQG, 2009)

3.3.4 AUSRIVAS MODELLING

AusRivAS modelling of the macroinvertebrate data indicates that the bed habitat at all sites was more biologically impaired than edge habitats (Table 5). The Band for all sites within the bed habitat was evaluated to be B, while the Band for various edge habitats (at W1, W2, E1 and E2) in the edge habitat was an A (Table 5). The Band provides the description of the level of biological impairment with:

- Band A classed as *similar to reference sites*; and,
- Band B classed as *significantly impaired*.

These results are consistent with PET and taxonomic richness data which indicated that the bed habitat at all sites were the least favourable for macroinvertebrate communities. Genex (2015) REMP Assessment suggests that historic sampling found all sites to be allocated as a Band A, but provides no actual data to compare these results.

Table 5: Observed taxa results for each habitat at each site with greater than 50% probability of occurrence

	Number of families collected (50%)		O/E score (50%)		O/E SIGNAL score (50%)		Band	
Site	Edge	Bed	Edge	Bed	Edge	Bed	Edge	Bed
WB	12	10	0.80	0.60	1.13	0.89	B	B
W1	14	11	0.85	0.66	0.99	1.04	A	B
W2	13	11	0.86	0.66	0.98	1.02	A	B
E1	15	9	0.96	0.54	0.96	0.90	A	B
E2	14	9	0.93	0.54	0.94	1.06	A	B
W3	12	12	0.80	0.72	1.06	1.00	B	B

The O/E SIGNAL score (50%) results show that within both habitats the observed SIGNAL scores (with >50% probability of occurring) were generally similar to those expected (a value of 1.00 signifies the scores are equal) and sometimes better (i.e. a value >1.00; Table 5). Note; the macroinvertebrate assemblages inhabiting both habitats at W3 (the downstream site) were comprised of as sensitive or more sensitive families than the reference sites utilised by the model. This is likely a result of the diversity of structure/habitats identified at this site.

The bandwidth in Table 6 shows the upper O/E score (50%) for each Band allocated. When compared against the results in Table 5 it can be seen that the majority of bed habitats occurred within the middle of Band C (range 0.78 – 0.36).

Table 6: Overall site results and macroinvertebrate taxa information relevant to each site

Site	Overall site assessment Band	Upper O/E score for the allocated Band	Number of taxa predicted to occur (with >50% probability) but not collected	Most sensitive taxa recorded (including SIGNAL grade)
WB	B (bed habitat)	0.78	10	Hydracarina & Leptoceridae (S.G. – 6)
W1	B (bed habitat)	0.78	9	Leptophlebiidae (S.G. – 8)
W2	B (bed habitat)	0.78	9	Leptophlebiidae (S.G. – 8)
E1	B (bed habitat)	0.78	11	Hydracarina & Leptoceridae (S.G. – 6)
E2	B (bed habitat)	0.78	11	Philopotamidae (S.G. – 8)
W3	B (bed habitat)	0.78	8	Philopotamidae (S.G. – 8)

The number of families and/or sub-families expected with over 50% probability of occurring and not collected at the sites ranged from 8 to 11 (Table 6). The families and/or sub-families missing from the bed habitats at most sites were comprised of both sensitive (S.G. ≥5) and tolerant (S.G. <5) taxa. The highest sensitivity taxa, based on SIGNAL grades, collected within the bed habitat at any site were Leptophlebiidae and Philopotamidae with a SIGNAL grade of 8 collected at all sites downstream of historic mining operations (Table 6).

These AusRivAS results suggest that all watercourses within the project site are influenced by an overarching disturbance as both background and downstream sites are in similar condition.

3.3.5 Baited Traps

Three larger freshwater decapod species were caught using baited traps. These included one species of freshwater yabby, a species of freshwater prawn and a species of freshwater crab. Table 7 indicates the sites from which these invertebrates were recorded and their abundance.

Unlike the other two species, the freshwater crab had limited range within the study area and was only found at W2 (Table 7). It is unclear why this species was not wider spread within the project site (Table 7).

Table 7: Invertebrate species caught in baited traps

Site	*Cherax quadricarinatus* (Redclaw)	*Macrobrachium australiense* (Freshwater prawn)	*Austrothelphusa transversa* (Freshwater crab)
WB	23	2	
W1	9		
W2	20		2
E1			
E2	4	4	
W3	11	5	

3.3.6 Summary

Despite the AusRivAS modelling determining the assemblages are significantly impacted, the relatively high percentage of sensitive macroinvertebrates inhabiting the receiving environment across the project site suggests the targeted watercourses (East Creek and Copperfield River) are in relatively good condition. This corresponds to past findings which have also suggested the macroinvertebrate communities inhabiting Copperfield River are in good condition (Genex, 2015).

None of the species of macroinvertebrates identified during field assessments, database searches, literature reviews, are listed under the EPBC Act or the NC Act.

3.4 Fish Communities

3.4.1 Species Richness

Seven (7) species of freshwater fish were identified within the project site during the field survey, including:

- Checkered Rainbowfish (*Melanotaenia splendida inornata*);
- Northern Trout Gudgeon (*Mogurnda mogurnda*);
- Hyrtl's Tandan (*Neosuluris hyrtlii*);
- Spangled Perch (*Leioptherapon unicolor*);
- Sooty Grunter (*Hepthaestus fuliginosus*);
- Bony Bream (*Nematolosa erebi*); and
- Barred Grunter (*Amniataba percoides*).

No species listed under the EPBC Act or the NC Act were found during the field surveys.

W3 was the most diverse site recording a total of six species, closely followed by W1 with five species (Figure 10). W3 displayed the greatest diversity of habitats compared to all other sites and was also one of the only sites where all fish sampling procedures could be conducted.

W2 and E1 recorded the lowest diversity, with only three species of freshwater fish found at both sites (Figure 10). W2 and E1 both displayed relatively uniform habitats throughout their reaches, potentially a controlling factor on the results.

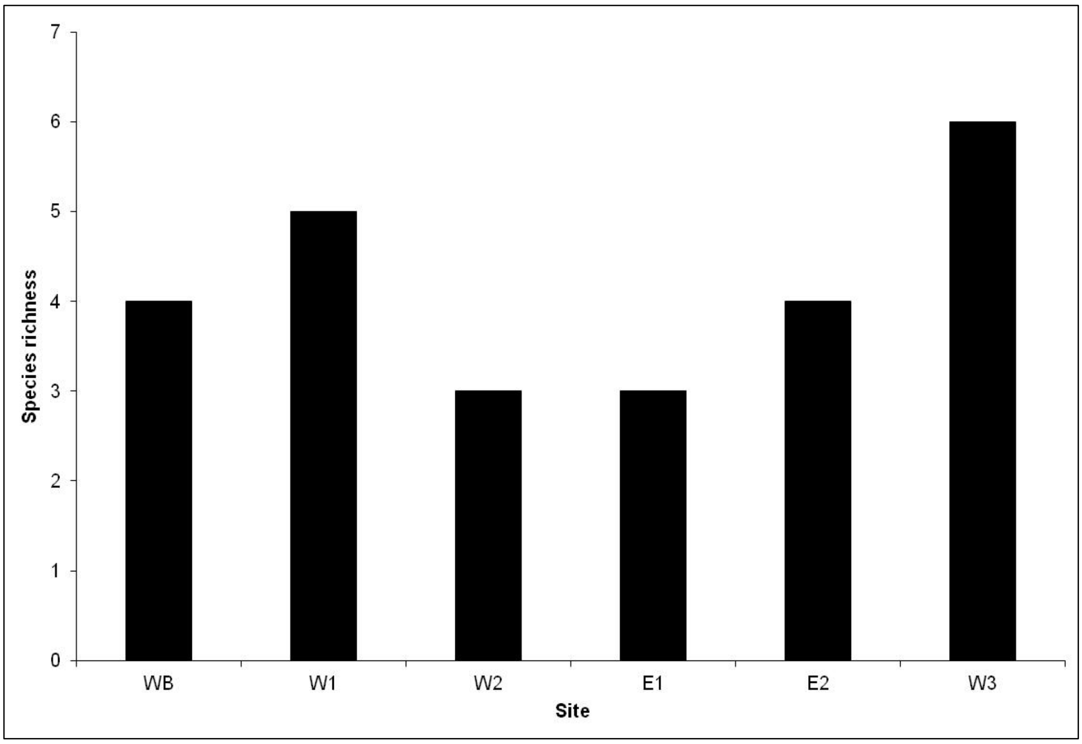

Figure 10: Fish species richness at each site

3.4.2 TOTAL ABUNDANCE

Similar to species richness, W3 recorded the highest total abundance and, despite being relatively species poor for the system, E1 recorded the second highest abundance (Figure 11). W2 was the least abundant. However, this site was difficult to survey with turbid, flowing waters and slippery bedrock (refer to Table 3).

Please refer to Appendix 1 for all the raw fish data collected in April 2018.

3.4.3 REGIONAL CONTEXT

Several of the fish species identified during the field survey are known to occur in the greater Copperfield River catchment (Wildlife Online, 2018; Appendix 2). An additional three species have previously been recorded within the system but were not found during the current study, including:

- Blackbanded gudgeon (*Oxyeleotris selheimi*);
- Sleepy cod (*Oxyeleotris lineolata*); and
- Hardy head (*Craterocephalus stercusmuscarum*).

No fish species listed under the EPBC Act or the NC Act occur within the project site or surrounding areas.

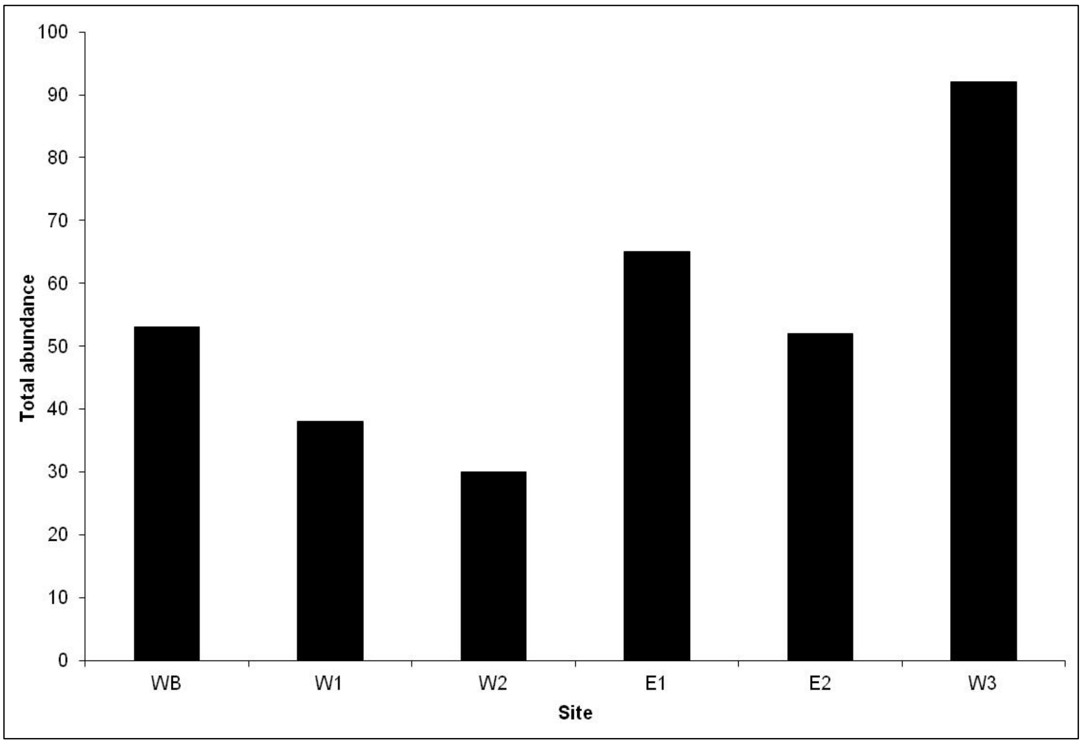

Figure 11: Total fish abundance at each site

3.5 AQUATIC FLORA

Only two species of macrophytes were recorded inhabiting the Copperfield River and East Creek (both sedges), Rice Sedge (*Cyperus difformis*) and *Cyperus species.* The reduced species assemblage is possibly a response to the ephemeral nature of the watercourses combined with high flow rates. Rice sedge is an emergent macrophyte that quickly establishes within shallow waters, allowing it to successfully inhabit flowing watercourse sites (Sainty & Jacobs, 2003).

No aquatic Weeds of National Significance (WONS) or aquatic weeds as classified under State legislation, were observed. Further, none of the aquatic flora species identified within the project site are listed under the EPBC Act or the NC Act.

3.6 TURTLE COMMUNITY AND OTHER AQUATIC VERTEBRATES

3.6.1 TURTLE COMMUNITIES PRESENT

No freshwater turtles were caught or observed within the Copperfield River or East Creek during the field studies. However, there is anecdotal evidence that the common Krefft's Turtle (*Emydura Macquari Krefftii*) possibly inhabits farm dams and more permanent waterholes within the area (i.e. conversation with local residents).

3.6.2 OTHER AQUATIC VERTEBRATES

Database searches identified the potential for the Freshwater Crocodile (*Crocodylus johnstoni*) to inhabit the area. While they were not found during field surveys of the Copperfield River or East Creek the species was observed inhabiting the Einasleigh River upstream of the confluence with the Copperfield River. Therefore, it is highly likely that the species utilises the lower reaches of the Copperfield River with the potential to push further upstream during flow events. There has been anecdotal evidence of Freshwater Crocodiles inhabiting the Copperfield River and Copperfield Dam in the past (i.e. conversations with local residents). This species is listed as Least Concern under the *Nature Conservation Act (1994)*.

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APPENDIX 1 – RAW MACROINVERTEBRATE AND FISH DATA

Table A1.1: Raw macroinvertebrate data during the April 2018 sampling round

Order	Family/sub-family	AusRivAS Code	SIGNAL Grade	WB		W1		W2		E1		E2		W3	
				Bed	Edge	Bed	Edge	Bed	Edge	Bed	Edge	Bed	Edge	Bed	Edge
Nematoda		II999999	3											2	
Oligochaeta		LO999999	2	2				2				4		1	
Gastropoda	Planorbidae	KG079999	2					1			1				
Cladocera	Cladocera	OG999999	5.5		1										
Copepoda	Copepoda	OJ999999	5.5				1				1				
Ostracoda	Ostracoda	OH999999	5.5		1	1				1					1
Decapoda	Atyidae	OT019999	3										1		5
	Parastacidae	OV019999	4						1						3
Acarina	Hydracarina	MM999999	6	7	13	39	25	23	27	22	19	14	30	16	20
Coleoptera	Dytiscidae	QC099999	2		5		7	5	9	8	4	2	5	12	8
	Hydrophilidae	QC119999	2							11	2				1
	Hydrochidae	QCAO9999	4		3		3				15				
	Elmidae	QC349999	7			1		1							1
	Hydraenidae	QC139999	3		1		2		1					1	
	Haliplidae	QC069999	2				1	1		2	5				
	Staphylinidae	QC189999	3												1
Diptera	Unidentified	QDZZ9999	3	1	1			1		1					
	Chironomidae														
	Chironominae	QDAJ9999	3	20	11	10	5	9	11	1	3	4	7	2	2
	Tanypodiinae	QDAE9999	4	1			2		1	3	1		1		1
	Orthocladiinae	QDAF9999	4	5	1	1		1					1	3	
	Podonominae	QDAD9999	6	3				1	1						
	Ceratopogonidae	QD099999	4	1	1	1		1	2	4	1	2		4	1
	Simuliidae	QD109999	5						1					22	
	Tabanidae	QD239999	3			1				1				2	
	Muscidae	QD899999	1	6		17		3		3		9		15	
	Culicidae	QD079999	1										2		

Order	Family/sub-family	AusRivAS Code	SIGNAL Grade	WB		W1		W2		E1		E2		W3	
				Bed	Edge	Bed	Edge	Bed	Edge	Bed	Edge	Bed	Edge	Bed	Edge
Ephemeroptera	Baetidae	QE029999	5	15	23	26	23	7	10	20	10	58	18	47	39
	Caenidae	QE089999	4	41	7	41	12	22	26	24	16	15	7	25	8
	Leptophlebiidae	QE069999	8		1	1		4	1			3		3	1
Hemiptera	Micronectidae	N/A	2	3		7	9		1	6			1		
	Corixidae	QH659999	2			1	3								
	Gerridae	QH579999	4				3		1		2		1		3
	Nepidae	QH619999	3										1		
	Notonectidae	QH679999	1		1		3				1				1
	Pleidae	QH689999	2								6		1		
	Veliidae	QH569999	3				2		3	1	1		4		
	Belastomatidae	QH629999	1										1		
Odonata	Gomphidae	QO139999	5	1	8	2	9	3	1				5		1
	Corduliidae	QO169999	5				2								
	Libellulidae	QO179999	4		1		10		4	12	15		3		2
	Austrocorduliidae	QO279999	10						2		6		1		1
	Platycnemidae	QO049999	4				1				4		2		
	Coenagrionidae	QO029999	2				7		6		12		3		
	Isostictidae	QO039999	3				3		1		1				
Trichoptera	Leptoceridae	QT259999	6	1	10	2	10	2	3	1	10		1		3
	Calocidae	QT189999	9		3		4		3		4		2		63
	Ecnomidae	QT089999	4	3		1		1		1					
	Helicophidae	QT199999	10				1				1				
	Philopotamidae	QT049999	8									4		33	1
	Hydropsychidae	QT069999	6								1	7		15	
Lepidoptera	Crambidae	QL999999	2											1	

Table A1.2: Raw fish data collected during the April 2018 sampling round

Species	WB	W1	W2	E1	E2	W3
Melanotaenia splendida inornata	26	26	22	53	26	53
Mogurnda mogurnda	14	1		2	11	4
Neosuluris hyrtlii	9		2		1	1
Leioptherapon unicolor	4	9	6	10	14	31
Hepthaestus fuliginosus		1				
Nematolosa erebi		1				1
Amniataba percoides						2

APPENDIX 2 – SEARCH RESULTS

Australian Government
Department of the Environment and Energy

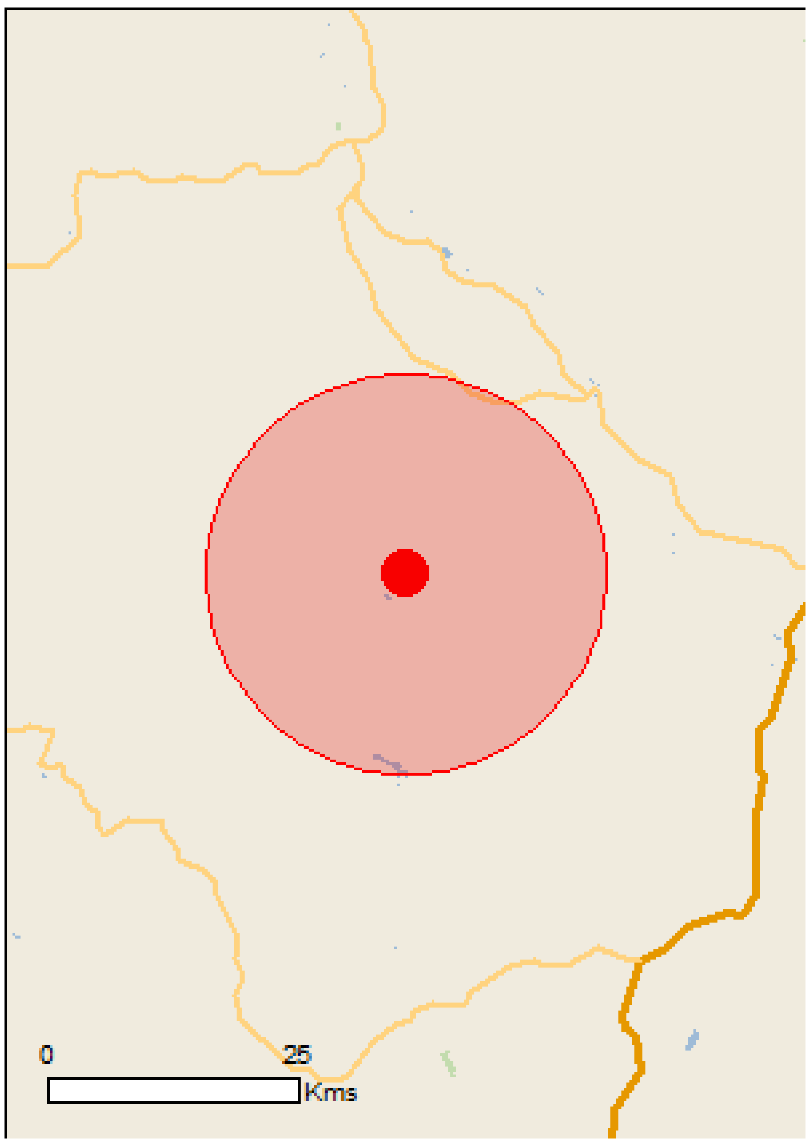
EPBC Act Protected Matters Report

This report provides general guidance on matters of national environmental significance and other matters protected by the EPBC Act in the area you have selected.

Information on the coverage of this report and qualifications on data supporting this report are contained in the caveat at the end of the report.

Information is available about Environment Assessments and the EPBC Act including significance guidelines, forms and application process details.

Report created: 20/05/18 20:03:30



This map may contain data which are ©Commonwealth of Australia (Geoscience Australia), ©PSMA 2010

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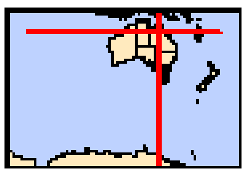

Summary

Matters of National Environmental Significance

This part of the report summarises the matters of national environmental significance that may occur in, or may relate to, the area you nominated. Further information is available in the detail part of the report, which can be accessed by scrolling or following the links below. If you are proposing to undertake an activity that may have a significant impact on one or more matters of national environmental significance then you should consider the Administrative Guidelines on Significance.

World Heritage Properties:	None
National Heritage Places:	None
Wetlands of International Importance:	None
Great Barrier Reef Marine Park:	None
Commonwealth Marine Area:	None
Listed Threatened Ecological Communities:	None
Listed Threatened Species:	17
Listed Migratory Species:	12

Other Matters Protected by the EPBC Act

This part of the report summarises other matters protected under the Act that may relate to the area you nominated. Approval may be required for a proposed activity that significantly affects the environment on Commonwealth land, when the action is outside the Commonwealth land, or the environment anywhere when the action is taken on Commonwealth land. Approval may also be required for the Commonwealth or Commonwealth agencies proposing to take an action that is likely to have a significant impact on the environment anywhere.

The EPBC Act protects the environment on Commonwealth land, the environment from the actions taken on Commonwealth land, and the environment from actions taken by Commonwealth agencies. As heritage values of a place are part of the 'environment', these aspects of the EPBC Act protect the Commonwealth Heritage values of a Commonwealth Heritage place. Information on the new heritage laws can be found at http://www.environment.gov.au/heritage

A permit may be required for activities in or on a Commonwealth area that may affect a member of a listed threatened species or ecological community, a member of a listed migratory species, whales and other cetaceans, or a member of a listed marine species.

Commonwealth Land:	None
Commonwealth Heritage Places:	None
Listed Marine Species:	19
Whales and Other Cetaceans:	None
Critical Habitats:	None
Commonwealth Reserves Terrestrial:	None
Commonwealth Reserves Marine:	None

Extra Information

This part of the report provides information that may also be relevant to the area you have nominated.

State and Territory Reserves:	1
Regional Forest Agreements:	None
Invasive Species:	16
Nationally Important Wetlands:	None
Key Ecological Features (Marine)	None

Details

Matters of National Environmental Significance

Listed Threatened Species		[Resource Information]
Name	Status	Type of Presence
Birds		
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Erythrotriorchis radiatus Red Goshawk [942]	Vulnerable	Species or species habitat likely to occur within area
Erythrura gouldiae Gouldian Finch [413]	Endangered	Species or species habitat likely to occur within area
Poephila cincta cincta Southern Black-throated Finch [64447]	Endangered	Species or species habitat likely to occur within area
Rostratula australis Australian Painted Snipe [77037]	Endangered	Species or species habitat may occur within area
Tyto novaehollandiae kimberli Masked Owl (northern) [26048]	Vulnerable	Species or species habitat may occur within area
Mammals		
Dasyurus hallucatus Northern Quoll, Digul [Gogo-Yimidir], Wijingadda [Dambimangari], Wiminji [Martu] [331]	Endangered	Species or species habitat may occur within area
Macroderma gigas Ghost Bat [174]	Vulnerable	Species or species habitat likely to occur within area
Mesembriomys gouldii rattoides Black-footed Tree-rat (north Queensland), Shaggy Rabbit-rat [87620]	Vulnerable	Species or species habitat may occur within area
Petauroides volans Greater Glider [254]	Vulnerable	Species or species habitat may occur within area
Phascolarctos cinereus (combined populations of Qld, NSW and the ACT) Koala (combined populations of Queensland, New South Wales and the Australian Capital Territory) [85104]	Vulnerable	Species or species habitat may occur within area
Rhinolophus robertsi Large-eared Horseshoe Bat, Greater Large-eared Horseshoe Bat [87639]	Vulnerable	Species or species habitat likely to occur within area

Name	Status	Type of Presence
Saccolaimus saccolaimus nudicluniatus		
Bare-rumped Sheath-tailed Bat, Bare-rumped Sheathtail Bat [66889]	Vulnerable	Species or species habitat may occur within area
Plants		
Cajanus mareebensis		
[8635]	Endangered	Species or species habitat likely to occur within area
Cycas cairnsiana		
a cycad [5780]	Vulnerable	Species or species habitat likely to occur within area
Dichanthium setosum		
bluegrass [14159]	Vulnerable	Species or species habitat likely to occur within area
Reptiles		
Egernia rugosa		
Yakka Skink [1420]	Vulnerable	Species or species habitat may occur within area

Listed Migratory Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Migratory Marine Birds		
Apus pacificus		
Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Migratory Terrestrial Species		
Cuculus optatus		
Oriental Cuckoo, Horsfield's Cuckoo [86651]		Species or species habitat may occur within area
Hirundo rustica		
Barn Swallow [662]		Species or species habitat may occur within area
Motacilla cinerea		
Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava		
Yellow Wagtail [644]		Species or species habitat may occur within area
Migratory Wetlands Species		
Actitis hypoleucos		
Common Sandpiper [59309]		Species or species habitat may occur within area
Calidris acuminata		
Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea		
Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos		
Pectoral Sandpiper [858]		Species or species habitat may occur within area
Gallinago hardwickii		
Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area
Pandion haliaetus		
Osprey [952]		Species or species habitat likely to occur

Name	Threatened	Type of Presence
		within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area

Other Matters Protected by the EPBC Act

Listed Marine Species [Resource Information]

* Species is listed under a different scientific name on the EPBC Act - Threatened Species list.

Name	Threatened	Type of Presence
Birds		
Actitis hypoleucos Common Sandpiper [59309]		Species or species habitat may occur within area
Anseranas semipalmata Magpie Goose [978]		Species or species habitat may occur within area
Apus pacificus Fork-tailed Swift [678]		Species or species habitat likely to occur within area
Ardea alba Great Egret, White Egret [59541]		Species or species habitat likely to occur within area
Ardea ibis Cattle Egret [59542]		Species or species habitat may occur within area
Calidris acuminata Sharp-tailed Sandpiper [874]		Species or species habitat may occur within area
Calidris ferruginea Curlew Sandpiper [856]	Critically Endangered	Species or species habitat may occur within area
Calidris melanotos Pectoral Sandpiper [858]		Species or species habitat may occur within area
Cuculus saturatus Oriental Cuckoo, Himalayan Cuckoo [710]		Species or species habitat may occur within area
Gallinago hardwickii Latham's Snipe, Japanese Snipe [863]		Species or species habitat may occur within area

Name	Threatened	Type of Presence
Haliaeetus leucogaster White-bellied Sea-Eagle [943]		Species or species habitat likely to occur within area
Hirundo rustica Barn Swallow [662]		Species or species habitat may occur within area
Merops ornatus Rainbow Bee-eater [670]		Species or species habitat may occur within area
Motacilla cinerea Grey Wagtail [642]		Species or species habitat may occur within area
Motacilla flava Yellow Wagtail [644]		Species or species habitat may occur within area
Pandion haliaetus Osprey [952]		Species or species habitat likely to occur within area
Rostratula benghalensis (sensu lato) Painted Snipe [889]	Endangered*	Species or species habitat may occur within area
Tringa nebularia Common Greenshank, Greenshank [832]		Species or species habitat may occur within area
Reptiles		
Crocodylus johnstoni Freshwater Crocodile, Johnston's Crocodile, Johnston's River Crocodile [1773]		Species or species habitat may occur within area

Extra Information

State and Territory Reserves [Resource Information]

Name	State
Newcastle Range-The Oaks	QLD

Invasive Species [Resource Information]

Weeds reported here are the 20 species of national significance (WoNS), along with other introduced plants that are considered by the States and Territories to pose a particularly significant threat to biodiversity. The following feral animals are reported: Goat, Red Fox, Cat, Rabbit, Pig, Water Buffalo and Cane Toad. Maps from Landscape Health Project, National Land and Water Resouces Audit, 2001.

Name	Status	Type of Presence
Birds		
Columba livia Rock Pigeon, Rock Dove, Domestic Pigeon [803]		Species or species habitat likely to occur within area
Passer domesticus House Sparrow [405]		Species or species habitat likely to occur within area

Name	Status	Type of Presence
Streptopelia chinensis		
Spotted Turtle-Dove [780]		Species or species habitat likely to occur within area
Frogs		
Rhinella marina		
Cane Toad [83218]		Species or species habitat known to occur within area
Mammals		
Bos taurus		
Domestic Cattle [16]		Species or species habitat likely to occur within area
Canis lupus familiaris		
Domestic Dog [82654]		Species or species habitat likely to occur within area
Equus caballus		
Horse [5]		Species or species habitat likely to occur within area
Felis catus		
Cat, House Cat, Domestic Cat [19]		Species or species habitat likely to occur within area
Oryctolagus cuniculus		
Rabbit, European Rabbit [128]		Species or species habitat likely to occur within area
Rattus rattus		
Black Rat, Ship Rat [84]		Species or species habitat likely to occur within area
Sus scrofa		
Pig [6]		Species or species habitat likely to occur within area
Plants		
Acacia nilotica subsp. indica		
Prickly Acacia [6196]		Species or species habitat may occur within area
Cryptostegia grandiflora		
Rubber Vine, Rubbervine, India Rubber Vine, India Rubbervine, Palay Rubbervine, Purple Allamanda [18913]		Species or species habitat likely to occur within area
Lantana camara		
Lantana, Common Lantana, Kamara Lantana, Large-leaf Lantana, Pink Flowered Lantana, Red Flowered Lantana, Red-Flowered Sage, White Sage, Wild Sage [10892]		Species or species habitat likely to occur within area
Parkinsonia aculeata		
Parkinsonia, Jerusalem Thorn, Jelly Bean Tree, Horse Bean [12301]		Species or species habitat likely to occur within area
Parthenium hysterophorus		
Parthenium Weed, Bitter Weed, Carrot Grass, False Ragweed [19566]		Species or species habitat likely to occur within area

Caveat

The information presented in this report has been provided by a range of data sources as acknowledged at the end of the report.

This report is designed to assist in identifying the locations of places which may be relevant in determining obligations under the Environment Protection and Biodiversity Conservation Act 1999. It holds mapped locations of World and National Heritage properties, Wetlands of International and National Importance, Commonwealth and State/Territory reserves, listed threatened, migratory and marine species and listed threatened ecological communities. Mapping of Commonwealth land is not complete at this stage. Maps have been collated from a range of sources at various resolutions.

Not all species listed under the EPBC Act have been mapped (see below) and therefore a report is a general guide only. Where available data supports mapping, the type of presence that can be determined from the data is indicated in general terms. People using this information in making a referral may need to consider the qualifications below and may need to seek and consider other information sources.

For threatened ecological communities where the distribution is well known, maps are derived from recovery plans, State vegetation maps, remote sensing imagery and other sources. Where threatened ecological community distributions are less well known, existing vegetation maps and point location data are used to produce indicative distribution maps.

Threatened, migratory and marine species distributions have been derived through a variety of methods. Where distributions are well known and if time permits, maps are derived using either thematic spatial data (i.e. vegetation, soils, geology, elevation, aspect, terrain, etc) together with point locations and described habitat; or environmental modelling (MAXENT or BIOCLIM habitat modelling) using point locations and environmental data layers.

Where very little information is available for species or large number of maps are required in a short time-frame, maps are derived either from 0.04 or 0.02 decimal degree cells; by an automated process using polygon capture techniques (static two kilometre grid cells, alpha-hull and convex hull); or captured manually or by using topographic features (national park boundaries, islands, etc). In the early stages of the distribution mapping process (1999-early 2000s) distributions were defined by degree blocks, 100K or 250K map sheets to rapidly create distribution maps. More reliable distribution mapping methods are used to update these distributions as time permits.

Only selected species covered by the following provisions of the EPBC Act have been mapped:

- migratory and
- marine

The following species and ecological communities have not been mapped and do not appear in reports produced from this database:

- threatened species listed as extinct or considered as vagrants
- some species and ecological communities that have only recently been listed
- some terrestrial species that overfly the Commonwealth marine area
- migratory species that are very widespread, vagrant, or only occur in small numbers

The following groups have been mapped, but may not cover the complete distribution of the species:

- non-threatened seabirds which have only been mapped for recorded breeding sites
- seals which have only been mapped for breeding sites near the Australian continent

Such breeding sites may be important for the protection of the Commonwealth Marine environment.

Coordinates

-18.8828 144.1488

Acknowledgements

This database has been compiled from a range of data sources. The department acknowledges the following custodians who have contributed valuable data and advice:

-Office of Environment and Heritage, New South Wales
-Department of Environment and Primary Industries, Victoria
-Department of Primary Industries, Parks, Water and Environment, Tasmania
-Department of Environment, Water and Natural Resources, South Australia
-Department of Land and Resource Management, Northern Territory
-Department of Environmental and Heritage Protection, Queensland
-Department of Parks and Wildlife, Western Australia
-Environment and Planning Directorate, ACT
-Birdlife Australia
-Australian Bird and Bat Banding Scheme
-Australian National Wildlife Collection
-Natural history museums of Australia
-Museum Victoria
-Australian Museum
-South Australian Museum
-Queensland Museum
-Online Zoological Collections of Australian Museums
-Queensland Herbarium
-National Herbarium of NSW
-Royal Botanic Gardens and National Herbarium of Victoria
-Tasmanian Herbarium
-State Herbarium of South Australia
-Northern Territory Herbarium
-Western Australian Herbarium
-Australian National Herbarium, Canberra
-University of New England
-Ocean Biogeographic Information System
-Australian Government, Department of Defence
Forestry Corporation, NSW
-Geoscience Australia
-CSIRO
-Australian Tropical Herbarium, Cairns
-eBird Australia
-Australian Government – Australian Antarctic Data Centre
-Museum and Art Gallery of the Northern Territory
-Australian Government National Environmental Science Program
-Australian Institute of Marine Science
-Reef Life Survey Australia
-American Museum of Natural History
-Queen Victoria Museum and Art Gallery, Inveresk, Tasmania
-Tasmanian Museum and Art Gallery, Hobart, Tasmania
-Other groups and individuals

The Department is extremely grateful to the many organisations and individuals who provided expert advice and information on numerous draft distributions.

Please feel free to provide feedback via the Contact Us page.

Department of the Environment
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Queensland Government

Wildlife Online Extract

Search Criteria: Species List for a Specified Point
Species: All
Type: All
Status: All
Records: All
Date: All
Latitude: -18.8722
Longitude: 144.1550
Distance: 20
Email: matt@candrconsulting.com.au
Date submitted: Sunday 20 May 2018 21:22:03
Date extracted: Sunday 20 May 2018 21:30:02

The number of records retrieved = 355

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	amphibians	Bufonidae	*Rhinella marina*	cane toad	Y			1
animals	birds	Acanthizidae	*Gerygone olivacea*	white-throated gerygone		C		2
animals	birds	Acanthizidae	*Smicrornis brevirostris*	weebill		C		2
animals	birds	Accipitridae	*Milvus migrans*	black kite		C		4
animals	birds	Accipitridae	*Hieraaetus morphnoides*	little eagle		C		1
animals	birds	Accipitridae	*Haliastur sphenurus*	whistling kite		C		2
animals	birds	Accipitridae	*Aquila audax*	wedge-tailed eagle		C		1
animals	birds	Alaudidae	*Mirafra javanica*	Horsfield's bushlark		C		1
animals	birds	Anatidae	*Anas superciliosa*	Pacific black duck		C		3
animals	birds	Anhingidae	*Anhinga novaehollandiae*	Australasian darter		C		2
animals	birds	Ardeidae	*Ardea alba modesta*	eastern great egret		C		2
animals	birds	Ardeidae	*Egretta novaehollandiae*	white-faced heron		C		7
animals	birds	Artamidae	*Cracticus nigrogularis*	pied butcherbird		C		12
animals	birds	Artamidae	*Strepera graculina*	pied currawong		C		2
animals	birds	Artamidae	*Cracticus tibicen*	Australian magpie		C		19
animals	birds	Artamidae	*Artamus cinereus*	black-faced woodswallow		C		5
animals	birds	Artamidae	*Cracticus torquatus*	grey butcherbird		C		4
animals	birds	Cacatuidae	*Eolophus roseicapilla*	galah		C		16
animals	birds	Campephagidae	*Coracina novaehollandiae*	black-faced cuckoo-shrike		C		7
animals	birds	Campephagidae	*Coracina papuensis*	white-bellied cuckoo-shrike		C		3
animals	birds	Campephagidae	*Lalage tricolor*	white-winged triller		C		2
animals	birds	Casuariidae	*Dromaius novaehollandiae*	emu		C		1
animals	birds	Charadriidae	*Vanellus miles miles*	masked lapwing (northern subspecies)		C		3
animals	birds	Charadriidae	*Vanellus miles*	masked lapwing		C		1
animals	birds	Charadriidae	*Elseyornis melanops*	black-fronted dotterel		C		1
animals	birds	Climacteridae	*Climacteris picumnus*	brown treecreeper		C		5
animals	birds	Columbidae	*Geophaps scripta*	squatter pigeon		C		1
animals	birds	Columbidae	*Geopelia striata*	peaceful dove		C		4
animals	birds	Columbidae	*Ocyphaps lophotes*	crested pigeon		C		5
animals	birds	Coraciidae	*Eurystomus orientalis*	dollarbird		C		3
animals	birds	Corcoracidae	*Struthidea cinerea*	apostlebird		C		6
animals	birds	Corvidae	*Corvus sp.*					5
animals	birds	Corvidae	*Corvus orru*	Torresian crow		C		5
animals	birds	Cuculidae	*Eudynamys orientalis*	eastern koel		C		1
animals	birds	Estrildidae	*Poephila cincta atropygialis*	black-throated finch (black-rumped subspecies)		C		2
animals	birds	Estrildidae	*Poephila cincta cincta*	black-throated finch (white-rumped subspecies)		E	E	1
animals	birds	Estrildidae	*Taeniopygia bichenovii*	double-barred finch		C		2
animals	birds	Falconidae	*Falco cenchroides*	nankeen kestrel		C		3
animals	birds	Falconidae	*Falco berigora*	brown falcon		C		2
animals	birds	Falconidae	*Falco longipennis*	Australian hobby		C		1
animals	birds	Gruidae	*Grus antigone*	sarus crane		C		1
animals	birds	Gruidae	*Grus rubicunda*	brolga		C		2
animals	birds	Halcyonidae	*Todiramphus macleayii*	forest kingfisher		C		1
animals	birds	Halcyonidae	*Todiramphus pyrrhopygius*	red-backed kingfisher		C		1

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animals	birds	Halcyonidae	*Todiramphus sanctus*	sacred kingfisher		C		2
animals	birds	Halcyonidae	*Dacelo novaeguineae*	laughing kookaburra		C		7
animals	birds	Halcyonidae	*Dacelo leachii*	blue-winged kookaburra		C		4
animals	birds	Maluridae	*Malurus melanocephalus*	red-backed fairy-wren		C		2
animals	birds	Meliphagidae	*Plectorhyncha lanceolata*	striped honeyeater		C		3
animals	birds	Meliphagidae	*Melithreptus albogularis*	white-throated honeyeater		C		4
animals	birds	Meliphagidae	*Philemon citreogularis*	little friarbird		C		3
animals	birds	Meliphagidae	*Manorina melanocephala*	noisy miner		C		1
animals	birds	Meliphagidae	*Philemon corniculatus*	noisy friarbird		C		1
animals	birds	Meliphagidae	*Lichmera indistincta*	brown honeyeater		C		2
animals	birds	Meliphagidae	*Entomyzon cyanotis*	blue-faced honeyeater		C		6
animals	birds	Meropidae	*Merops ornatus*	rainbow bee-eater		C		6
animals	birds	Monarchidae	*Grallina cyanoleuca*	magpie-lark		C		8
animals	birds	Monarchidae	*Myiagra rubecula*	leaden flycatcher		C		1
animals	birds	Nectariniidae	*Dicaeum hirundinaceum*	mistletoebird		C		1
animals	birds	Neosittidae	*Daphoenositta chrysoptera*	varied sittella		C		1
animals	birds	Otididae	*Ardeotis australis*	Australian bustard		C		2
animals	birds	Pachycephalidae	*Pachycephala rufiventris*	rufous whistler		C		4
animals	birds	Pardalotidae	*Pardalotus striatus*	striated pardalote		C		7
animals	birds	Petroicidae	*Microeca fascinans*	jacky winter		C		2
animals	birds	Phalacrocoracidae	*Phalacrocorax sulcirostris*	little black cormorant		C		2
animals	birds	Phalacrocoracidae	*Microcarbo melanoleucos*	little pied cormorant		C		2
animals	birds	Podicipedidae	*Tachybaptus novaehollandiae*	Australasian grebe		C		1
animals	birds	Pomatostomidae	*Pomatostomus temporalis*	grey-crowned babbler		C		4
animals	birds	Psittacidae	*Trichoglossus haematodus moluccanus*	rainbow lorikeet		C		6
animals	birds	Psittacidae	*Platycercus adscitus adscitus*	pale-headed rosella (northern form)		C		4
animals	birds	Psittacidae	*Aprosmictus erythropterus*	red-winged parrot		C		1
animals	birds	Psittacidae	*Platycercus adscitus*	pale-headed rosella		C		2
animals	birds	Ptilonorhynchidae	*Ptilonorhynchus nuchalis*	great bowerbird		C		2
animals	birds	Rallidae	*Gallinula tenebrosa*	dusky moorhen		C		1
animals	birds	Rallidae	*Fulica atra*	Eurasian coot		C		1
animals	birds	Rhipiduridae	*Rhipidura leucophrys*	willie wagtail		C		5
animals	birds	Rhipiduridae	*Rhipidura albiscapa*	grey fantail		C		1
animals	birds	Threskiornithidae	*Platalea flavipes*	yellow-billed spoonbill		C		1
animals	birds	Threskiornithidae	*Threskiornis spinicollis*	straw-necked ibis		C		2
animals	mammals	Bovidae	*Bos taurus*	European cattle	Y			1
animals	mammals	Canidae	*Canis lupus dingo*	dingo				1
animals	mammals	Suidae	*Sus scrofa*	pig	Y			1
animals	ray-finned fishes	Atherinidae	*Craterocephalus stercusmuscarum*	flyspecked hardyhead				1
animals	ray-finned fishes	Clupeidae	*Nematalosa erebi*	bony bream				1
animals	ray-finned fishes	Eleotridae	*Oxyeleotris lineolata*	sleepy cod				1
animals	ray-finned fishes	Eleotridae	*Oxyeleotris selheimi*	blackbanded gudgeon				1
animals	ray-finned fishes	Melanotaeniidae	*Melanotaenia splendida inornata*	checkered rainbowfish				2
animals	ray-finned fishes	Terapontidae	*Leiopotherapon unicolor*	spangled perch				2
animals	ray-finned fishes	Terapontidae	*Hephaestus fuliginosus*	sooty grunter				1
animals	ray-finned fishes	Terapontidae	*Amniataba percoides*	barred grunter				1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
animals	reptiles	Crocodylidae	*Crocodylus johnstoni*	Australian freshwater crocodile		C		1
animals	reptiles	Elapidae	*Acanthophis praelongus*	northern death adder		C		1
animals	reptiles	Scincidae	*Carlia pectoralis sensu lato*			C		1
animals	reptiles	Scincidae	*Morethia taeniopleura*	fire-tailed skink		C		1
animals	reptiles	Scincidae	*Cryptoblepharus virgatus sensu lato*			C		1
animals	uncertain	Indeterminate	*Indeterminate*	Unknown or Code Pending		C		1
plants	conifers	Cupressaceae	*Callitris intratropica*	coast cypress pine		C		1/1
plants	cycads	Cycadaceae	*Cycas cairnsiana*			V	V	5/5
plants	ferns	Adiantaceae	*Cheilanthes brownii*			C		2/2
plants	ferns	Adiantaceae	*Paraceterach muelleri*			C		1/1
plants	ferns	Marsileaceae	*Marsilea exarata*	sway-back nardoo		C		1/1
plants	higher dicots	Acanthaceae	*Rostellularia adscendens subsp. glaucoviolacea*			C		1/1
plants	higher dicots	Acanthaceae	*Rostellularia adscendens*			C		1/1
plants	higher dicots	Amaranthaceae	*Gomphrena lanata*			C		1/1
plants	higher dicots	Amaranthaceae	*Ptilotus capensis*			C		1/1
plants	higher dicots	Amaranthaceae	*Achyranthes aspera*			C		1/1
plants	higher dicots	Amaranthaceae	*Amaranthus interruptus*			C		1/1
plants	higher dicots	Anacardiaceae	*Pleiogynium timorense*	Burdekin plum		C		1/1
plants	higher dicots	Araliaceae	*Trachymene bivestita var. bivestita*			C		2/2
plants	higher dicots	Asteraceae	*Pterocaulon serrulatum var. serrulatum*			C		1/1
plants	higher dicots	Asteraceae	*Bidens subalternans var. simulans*		Y			1/1
plants	higher dicots	Asteraceae	*Centipeda minima subsp. minima*			C		1/1
plants	higher dicots	Asteraceae	*Acanthospermum hispidum*	star burr	Y			1/1
plants	higher dicots	Asteraceae	*Olearia xerophila*			C		1/1
plants	higher dicots	Asteraceae	*Cyanthillium cinereum*			C		1/1
plants	higher dicots	Bignoniaceae	*Dolichandrone alternifolia*			C		1/1
plants	higher dicots	Burseraceae	*Canarium australianum var. glabrum*			C		1/1
plants	higher dicots	Byttneriaceae	*Waltheria indica*			C		1/1
plants	higher dicots	Caesalpiniaceae	*Labichea nitida*			C		1/1
plants	higher dicots	Caesalpiniaceae	*Senna magnifolia*			C		1/1
plants	higher dicots	Caesalpiniaceae	*Lysiphyllum hookeri*	Queensland ebony		C		1/1
plants	higher dicots	Caryophyllaceae	*Polycarpaea spirostylis*			C		1/1
plants	higher dicots	Casuarinaceae	*Casuarina cunninghamiana*			C		1/1
plants	higher dicots	Cleomaceae	*Cleome viscosa*	tick-weed		C		1/1
plants	higher dicots	Cochlospermaceae	*Cochlospermum gregorii*			C		1/1
plants	higher dicots	Combretaceae	*Terminalia aridicola subsp. aridicola*			C		1/1
plants	higher dicots	Cucurbitaceae	*Cucumis queenslandicus*			C		1/1
plants	higher dicots	Dilleniaceae	*Hibbertia stelligera*			C		1/1
plants	higher dicots	Ebenaceae	*Diospyros humilis*	small-leaved ebony		C		1/1
plants	higher dicots	Erythroxylaceae	*Erythroxylum ellipticum*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia tannensis subsp. eremophila*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia macdonaldii var. macdonaldii*			C		1/1
plants	higher dicots	Euphorbiaceae	*Microstachys chamaelea*			C		1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia dallachyana*			C		1/1
plants	higher dicots	Euphorbiaceae	*Ricinus communis*	castor oil bush	Y			1/1
plants	higher dicots	Euphorbiaceae	*Euphorbia schultzii var. schultzii*			C		1/1

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plants	higher dicots	Fabaceae	*Zornia*			C		1/1
plants	higher dicots	Fabaceae	*Clitoria ternatea*	butterfly pea	Y			1/1
plants	higher dicots	Fabaceae	*Tephrosia varians*			C		1/1
plants	higher dicots	Fabaceae	*Desmodium muelleri*			C		1/1
plants	higher dicots	Fabaceae	*Indigofera colutea*	sticky indigo		C		1/1
plants	higher dicots	Fabaceae	*Indigofera hirsuta*	hairy indigo		C		1/1
plants	higher dicots	Fabaceae	*Sesbania cannabina*			C		1
plants	higher dicots	Fabaceae	*Cajanus acutifolius*			C		3/3
plants	higher dicots	Fabaceae	*Stylosanthes scabra*		Y			1/1
plants	higher dicots	Fabaceae	*Crotalaria verrucosa*			C		1/1
plants	higher dicots	Fabaceae	*Indigofera brevidens*			C		1/1
plants	higher dicots	Fabaceae	*Indigofera linifolia*			C		1/1
plants	higher dicots	Fabaceae	*Indigofera pratensis*			C		1/1
plants	higher dicots	Fabaceae	*Tephrosia macrostachya*			C		1/1
plants	higher dicots	Fabaceae	*Crotalaria laburnifolia*		Y			1/1
plants	higher dicots	Fabaceae	*Tephrosia astragaloides*			C		1/1
plants	higher dicots	Fabaceae	*Tephrosia gaudium-solis*			C		3/3
plants	higher dicots	Fabaceae	*Aphyllodium biarticulatum*			C		2/2
plants	higher dicots	Fabaceae	*Gastrolobium grandiflorum*			C		1/1
plants	higher dicots	Fabaceae	*Tephrosia filipes forma vestita*			C		1/1
plants	higher dicots	Fabaceae	*Zornia muriculata subsp. angustata*			C		1/1
plants	higher dicots	Fabaceae	*Crotalaria aridicola subsp. aridicola*			C		1/1
plants	higher dicots	Fabaceae	*Indigofera australis subsp. australis*			C		1/1
plants	higher dicots	Fabaceae	*Phyllodium pulchellum var. pulchellum*			C		1/1
plants	higher dicots	Fabaceae	*Zornia muelleriana subsp. muelleriana*			C		1/1
plants	higher dicots	Fabaceae	*Tephrosia sp. (Cobbold Gorge B.S.Wannan 1167)*			C		1/1
plants	higher dicots	Fabaceae	*Tephrosia sp. (Georgetown G.N.Batianoff+ 900402H)*			C		2/2
plants	higher dicots	Fabaceae	*Crotalaria novae-hollandiae subsp. novae-hollandiae*			C		1/1
plants	higher dicots	Fabaceae	*Tephrosia sp. (Copperfield River P.I.Forster PIF14768)*			C		1/1
plants	higher dicots	Goodeniaceae	*Goodenia armitiana*			C		3/3
plants	higher dicots	Goodeniaceae	*Goodenia grandiflora*			C		1/1
plants	higher dicots	Goodeniaceae	*Goodenia effusa*			C		2/2
plants	higher dicots	Haloragaceae	*Haloragis heterophylla*	rough raspweed		C		1
plants	higher dicots	Lentibulariaceae	*Utricularia gibba*	floating bladderwort		C		1/1
plants	higher dicots	Loranthaceae	*Amyema villiflora subsp. villiflora*			C		1/1
plants	higher dicots	Loranthaceae	*Amyema congener subsp. rotundifolia*			C		2/2
plants	higher dicots	Lythraceae	*Ammannia multiflora*	jerry-jerry		C		2/1
plants	higher dicots	Lythraceae	*Rotala mexicana*			C		1/1
plants	higher dicots	Lythraceae	*Rotala tripartita*			C		2/1
plants	higher dicots	Malvaceae	*Hibiscus meraukensis*	Merauke hibiscus		C		1/1
plants	higher dicots	Malvaceae	*Sida hackettiana*			C		1/1
plants	higher dicots	Malvaceae	*Abutilon hannii*			C		1/1
plants	higher dicots	Malvaceae	*Sida magnifica*			C		1/1
plants	higher dicots	Martyniaceae	*Martynia annua*	small-fruited devil's claw	Y			1/1
plants	higher dicots	Mimosaceae	*Acacia hemignosta*			C		1/1

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plants	higher dicots	Mimosaceae	*Acacia umbellata*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia nesophila*			C		2/2
plants	higher dicots	Mimosaceae	*Acacia lazaridis*			C		2/2
plants	higher dicots	Mimosaceae	*Acacia hammondii*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia longispicata*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia multisiliqua*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia colei var. colei*			C		1/1
plants	higher dicots	Mimosaceae	*Acacia galioides*			C		2/2
plants	higher dicots	Mimosaceae	*Acacia*			C		2/2
plants	higher dicots	Mimosaceae	*Acacia victoriae subsp. fasciaria*			C		1/1
plants	higher dicots	Molluginaceae	*Glinus oppositifolius*			C		1/1
plants	higher dicots	Molluginaceae	*Glinus lotoides*	hairy carpet weed		C		1/1
plants	higher dicots	Moraceae	*Ficus opposita*			C		1/1
plants	higher dicots	Moraceae	*Ficus rubiginosa forma rubiginosa*			C		1/1
plants	higher dicots	Myrsinaceae	*Lysimachia ovalis*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca viridiflora var. attenuata*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus camaldulensis subsp. acuta*			C		1/1
plants	higher dicots	Myrtaceae	*Lophostemon grandiflorus subsp. riparius*			C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca leucadendra*	broad-leaved tea-tree		C		1
plants	higher dicots	Myrtaceae	*Melaleuca fluviatilis*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus microneura*	Gilbert River box		C		1/1
plants	higher dicots	Myrtaceae	*Calytrix leptophylla*			C		2/2
plants	higher dicots	Myrtaceae	*Melaleuca bracteata*			C		2/1
plants	higher dicots	Myrtaceae	*Eucalyptus shirleyi*			C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus coolabah*	coolabah		C		1/1
plants	higher dicots	Myrtaceae	*Corymbia peltata*	yellowjacket		C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus camaldulensis*			C		1
plants	higher dicots	Myrtaceae	*Corymbia erythrophloia*	variable-barked bloodwood		C		1/1
plants	higher dicots	Myrtaceae	*Eucalyptus leptophleba*	Molloy red box		C		1/1
plants	higher dicots	Myrtaceae	*Melaleuca trichostachya*			C		2/2
plants	higher dicots	Nyctaginaceae	*Boerhavia pubescens*			C		1/1
plants	higher dicots	Oleaceae	*Jasminum didymum subsp. racemosum*			C		1/1
plants	higher dicots	Onagraceae	*Ludwigia octovalvis*	willow primrose		C		4/2
plants	higher dicots	Orobanchaceae	*Striga squamigera*			C		1/1
plants	higher dicots	Passifloraceae	*Passiflora aurantia var. aurantia*			C		1/1
plants	higher dicots	Pentapetaceae	*Melhania brachycarpa*			C		1/1
plants	higher dicots	Pentapetaceae	*Melhania oblongifolia*			C		1/1
plants	higher dicots	Phyllanthaceae	*Antidesma parvifolium*			C		1/1
plants	higher dicots	Phyllanthaceae	*Flueggea virosa subsp. melanthesoides*			C		1/1
plants	higher dicots	Phyllanthaceae	*Phyllanthus hebecarpus*			C		1/1
plants	higher dicots	Phyllanthaceae	*Margaritaria dubium-traceyi*			C		1/1
plants	higher dicots	Phyllanthaceae	*Breynia oblongifolia*			C		1/1
plants	higher dicots	Phyllanthaceae	*Phyllanthus collinus*			C		2/2
plants	higher dicots	Phyllanthaceae	*Phyllanthus virgatus*			C		2/2
plants	higher dicots	Picrodendraceae	*Petalostigma pubescens*	quinine tree		C		1/1
plants	higher dicots	Polygonaceae	*Persicaria barbata*			C		2/1

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plants	higher dicots	Polygonaceae	*Persicaria subsessilis*	hairy knotweed		C		1/1
plants	higher dicots	Portulacaceae	*Portulaca*			C		1/1
plants	higher dicots	Portulacaceae	*Portulaca filifolia*			C		1/1
plants	higher dicots	Proteaceae	*Grevillea pteridifolia*	golden parrot tree		C		1/1
plants	higher dicots	Proteaceae	*Grevillea glauca*	bushy's clothes peg		C		1/1
plants	higher dicots	Proteaceae	*Hakea arborescens*			C		1/1
plants	higher dicots	Proteaceae	*Grevillea mimosoides*			C		1/1
plants	higher dicots	Putranjivaceae	*Drypetes deplanchei*	grey boxwood		C		1/1
plants	higher dicots	Rhamnaceae	*Alphitonia excelsa*	soap tree		C		2/2
plants	higher dicots	Rubiaceae	*Pavetta granitica*			C		1/1
plants	higher dicots	Rubiaceae	*Larsenaikia ochreata*			C		1/1
plants	higher dicots	Rubiaceae	*Dentella repens*	dentella		C		1/1
plants	higher dicots	Rubiaceae	*Spermacoce cristulata*			C		1/1
plants	higher dicots	Rubiaceae	*Spermacoce brachystema*			C		2/2
plants	higher dicots	Rubiaceae	*Coelospermum reticulatum*			C		1/1
plants	higher dicots	Rubiaceae	*Psychotria daphnoides var. angustifolia*			C		1/1
plants	higher dicots	Rubiaceae	*Oldenlandia mitrasacmoides subsp. nigricans*			C		1/1
plants	higher dicots	Rutaceae	*Geijera salicifolia*	brush wilga		C		1/1
plants	higher dicots	Salicaceae	*Homalium brachybotrys*			C		1/1
plants	higher dicots	Santalaceae	*Exocarpos latifolius*			C		1/1
plants	higher dicots	Santalaceae	*Santalum lanceolatum*			C		1/1
plants	higher dicots	Sapindaceae	*Dodonaea lanceolata var. subsessilifolia*			C		1/1
plants	higher dicots	Sapindaceae	*Dodonaea dodecandra*			C		1/1
plants	higher dicots	Sapotaceae	*Sersalisia sericea*			C		1/1
plants	higher dicots	Sparrmanniaceae	*Triumfetta pentandra*		Y			1/1
plants	higher dicots	Sparrmanniaceae	*Grewia retusifolia*			C		1/1
plants	higher dicots	Sparrmanniaceae	*Grewia mesomischa*			C		1/1
plants	higher dicots	Sparrmanniaceae	*Corchorus*			C		1/1
plants	higher dicots	Sparrmanniaceae	*Triumfetta micracantha*			C		1/1
plants	higher dicots	Sterculiaceae	*Brachychiton chillagoensis*			C		1/1
plants	higher dicots	Sterculiaceae	*Brachychiton diversifolius subsp. orientalis*			C		1/1
plants	higher dicots	Ulmaceae	*Celtis paniculata*	native celtis		C		1/1
plants	higher dicots	Ulmaceae	*Trema tomentosa*			C		1/1
plants	higher dicots	Viscaceae	*Notothixos cornifolius*	kurrajong mistletoe		C		1/1
plants	higher dicots	Vitaceae	*Cayratia trifolia*			C		1/1
plants	higher dicots	Vitaceae	*Cissus cardiophylla*			C		1/1
plants	lower dicots	Apocynaceae	*Tylophora erecta*			C		2/2
plants	lower dicots	Apocynaceae	*Alyxia spicata*			C		1/1
plants	lower dicots	Apocynaceae	*Parsonsia lanceolata*	northern silkpod		C		1/1
plants	lower dicots	Apocynaceae	*Marsdenia microlepis*			C		1/1
plants	lower dicots	Apocynaceae	*Carissa lanceolata*			C		1/1
plants	lower dicots	Apocynaceae	*Cynanchum viminale subsp. brunonianum*			C		1/1
plants	lower dicots	Aristolochiaceae	*Aristolochia pubera var. pubera*			C		1/1
plants	lower dicots	Boraginaceae	*Heliotropium peninsulare*			C		1/1
plants	lower dicots	Boraginaceae	*Heliotropium cunninghamii*			C		3/3
plants	lower dicots	Boraginaceae	*Trichodesma zeylanicum var. zeylanicum*			C		1/1

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	lower dicots	Boraginaceae	*Heliotropium collinum*			C		2/2
plants	lower dicots	Convolvulaceae	*Polymeria*			C		1/1
plants	lower dicots	Convolvulaceae	*Jacquemontia sp. (Fairview R.W.Johnson 4026)*			C		2/2
plants	lower dicots	Convolvulaceae	*Jacquemontia paniculata var. tomentosa*			C		1/1
plants	lower dicots	Convolvulaceae	*Evolvulus alsinoides var. decumbens*			C		1/1
plants	lower dicots	Convolvulaceae	*Evolvulus alsinoides var. sericeus*			C		1/1
plants	lower dicots	Convolvulaceae	*Ipomoea polymorpha*			C		1/1
plants	lower dicots	Convolvulaceae	*Ipomoea costata*			C		1/1
plants	lower dicots	Convolvulaceae	*Bonamia media*			C		1/1
plants	lower dicots	Hernandiaceae	*Gyrocarpus americanus*			C		1/1
plants	lower dicots	Lamiaceae	*Anisomeles lappa*			C		1/1
plants	lower dicots	Lamiaceae	*Premna acuminata*			C		1/1
plants	lower dicots	Lamiaceae	*Ocimum caryophyllinum*			C		1/1
plants	lower dicots	Lauraceae	*Cassytha filiformis*	dodder laurel		C		1/1
plants	lower dicots	Linderniaceae	*Lindernia lobelioides*			C		1/1
plants	lower dicots	Menyanthaceae	*Nymphoides indica*	water snowflake		C		1/1
plants	lower dicots	Solanaceae	*Solanum crebrispinum*			C		1/1
plants	monocots	Commelinaceae	*Commelina ensifolia*	scurvy grass		C		1/1
plants	monocots	Commelinaceae	*Aneilema siliculosum*			C		1/1
plants	monocots	Cyperaceae	*Cyperus distans*			C		1/1
plants	monocots	Cyperaceae	*Scleria brownii*			C		3/3
plants	monocots	Cyperaceae	*Fuirena ciliaris*			C		1
plants	monocots	Cyperaceae	*Baumea rubiginosa*	soft twigrush		C		1
plants	monocots	Cyperaceae	*Cyperus difformis*	rice sedge		C		1/1
plants	monocots	Cyperaceae	*Cyperus exaltatus*	tall flatsedge		C		1
plants	monocots	Cyperaceae	*Cyperus javanicus*			C		1/1
plants	monocots	Cyperaceae	*Cyperus brevifolius*	Mullumbimby couch	Y			2/1
plants	monocots	Cyperaceae	*Cyperus polystachyos*			C		3/1
plants	monocots	Cyperaceae	*Eleocharis geniculata*			C		1
plants	monocots	Cyperaceae	*Fimbristylis dichotoma*	common fringe-rush		C		2/1
plants	monocots	Cyperaceae	*Fimbristylis littoralis*			C		1/1
plants	monocots	Cyperaceae	*Lipocarpha microcephala*			C		1
plants	monocots	Cyperaceae	*Schoenoplectiella mucronata*			C		1/1
plants	monocots	Cyperaceae	*Cyperus conicus var. conicus*			C		1/1
plants	monocots	Cyperaceae	*Cyperus dietrichiae var. dietrichiae*			C		1/1
plants	monocots	Cyperaceae	*Cyperus conicus*			C		1/1
plants	monocots	Cyperaceae	*Cyperus iria*			C		1/1
plants	monocots	Cyperaceae	*Cyperus haspan*			C		1
plants	monocots	Laxmanniaceae	*Lomandra decomposita*			C		1/1
plants	monocots	Laxmanniaceae	*Thysanotus banksii*			C		1/1
plants	monocots	Orchidaceae	*Cymbidium canaliculatum*			C		1/1
plants	monocots	Poaceae	*Melinis repens*	red natal grass	Y			1/1
plants	monocots	Poaceae	*Sarga plumosum*			C		1/1
plants	monocots	Poaceae	*Aristida spuria*			C		1/1
plants	monocots	Poaceae	*Cynodon dactylon*		Y			2
plants	monocots	Poaceae	*Eriachne ciliata*			C		2/2

Kingdom	Class	Family	Scientific Name	Common Name	I	Q	A	Records
plants	monocots	Poaceae	*Leersia hexandra*	swamp rice grass		C		1
plants	monocots	Poaceae	*Themeda avenacea*			C		1/1
plants	monocots	Poaceae	*Aristida pruinosa*			C		2/2
plants	monocots	Poaceae	*Eragrostis fallax*			C		1/1
plants	monocots	Poaceae	*Thellungia advena*	coolibah grass		C		1/1
plants	monocots	Poaceae	*Echinochloa colona*	awnless barnyard grass	Y			2
plants	monocots	Poaceae	*Ectrosia gulliveri*			C		1/1
plants	monocots	Poaceae	*Eragrostis sororia*			C		1/1
plants	monocots	Poaceae	*Perotis clarksonii*			C		1/1
plants	monocots	Poaceae	*Sacciolepis indica*	Indian cupscale grass		C		1
plants	monocots	Poaceae	*Eragrostis speciosa*			C		1/1
plants	monocots	Poaceae	*Oxychloris scariosa*	winged chloris		C		1/1
plants	monocots	Poaceae	*Paspalidium gracile*	slender panic		C		1/1
plants	monocots	Poaceae	*Tragus australianus*	small burr grass		C		1/1
plants	monocots	Poaceae	*Bothriochloa pertusa*		Y			1/1
plants	monocots	Poaceae	*Eragrostis schultzii*			C		1/1
plants	monocots	Poaceae	*Triodia stenostachya*			C		2/2
plants	monocots	Poaceae	*Urochloa holosericea*			C		2/2
plants	monocots	Poaceae	*Cymbopogon bombycinus*	silky oilgrass		C		2/2
plants	monocots	Poaceae	*Digitaria breviglumis*			C		1/1
plants	monocots	Poaceae	*Heteropogon contortus*	black speargrass		C		1/1
plants	monocots	Poaceae	*Aristida inaequiglumis*			C		1/1
plants	monocots	Poaceae	*Enneapogon lindleyanus*			C		1/1
plants	monocots	Poaceae	*Enneapogon polyphyllus*	leafy nineawn		C		3/3
plants	monocots	Poaceae	*Paspalum scrobiculatum*	ditch millet		C		1
plants	monocots	Poaceae	*Dactyloctenium radulans*	button grass		C		1/1
plants	monocots	Poaceae	*Eragrostis spartinoides*			C		1/1
plants	monocots	Poaceae	*Enneapogon robustissimus*			C		1/1
plants	monocots	Poaceae	*Aristida calycina var. praealta*			C		1/1
plants	monocots	Poaceae	*Eragrostiella bifaria var. bifaria*			C		2/2
plants	monocots	Poaceae	*Panicum seminudum var. cairnsianum*			C		2/2
plants	monocots	Poaceae	*Eriachne pallescens var. pallescens*			C		1/1
plants	monocots	Poaceae	*Aristida queenslandica var. dissimilis*			C		1/1
plants	monocots	Poaceae	*Aristida jerichoensis var. subspinulifera*			C		1/1
plants	monocots	Typhaceae	*Typha domingensis*			C		2
plants	monocots	Xanthorrhoeaceae	*Xanthorrhoea johnsonii*			C		1/1

CODES

I - Y indicates that the taxon is introduced to Queensland and has naturalised.

Q - Indicates the Queensland conservation status of each taxon under the *Nature Conservation Act 1992.* The codes are Extinct in the Wild (PE), Endangered (E), Vulnerable (V), Near Threatened (NT), Least Concern (C) or Not Protected ( ).

A - Indicates the Australian conservation status of each taxon under the *Environment Protection and Biodiversity Conservation Act 1999.* The values of EPBC are Conservation Dependent (CD), Critically Endangered (CE), Endangered (E), Extinct (EX), Extinct in the Wild (XW) and Vulnerable (V).

Records – The first number indicates the total number of records of the taxon for the record option selected (i.e. All, Confirmed or Specimens). This number is output as 99999 if it equals or exceeds this value. The second number located after the / indicates the number of specimen records for the taxon. This number is output as 999 if it equals or exceeds this value.

Appendix F

DTA - May 2018

DTA OF POTENTIAL RELEASE WATER FROM THE KIDSTON PUMPED STORAGE HYDRO PROJECT

BRISBANE | PERTH | SINGAPORE | PAPUA NEW GUINEA

PREPARED FOR AECOM

AEC1701

—

JUNE 2018

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EXECUTIVE SUMMARY

This Direct Toxicity Assessment (DTA) aimed to determine effluent release rates for the Kidston pumped storage Hydro project in the slightly to moderately disturbed Gilbert Basin.

Waters from Wises Pit and Eldridge Pit at the former Kidston gold mine were mixed to produce a representative composite sample of the proposed discharge into the Copperfield River. Ecotoxicity testing was performed by the NATA accredited laboratories at Ecotox Services Australasia (ESA) on the composite water sample using Copperfield River water as diluent.

The following sub-chronic to chronic toxicity tests were selected for this DTA and satisfied the minimum data requirement of ANZECC & ARMCANZ (2000):

- 96hr growth inhabitation of the freshwater duckweed *Lemna aequinoctialis* based on OECD method 221 (OECD, 2006)
- 72hr microalgal growth inhibition (cell yield) test using the freshwater alga *Chlorella vulgaris* (based on US EPA method 1003.0, (US EPA, 2002))
- 96hr population growth toxicity test using *Hydra viridissima* (based on Riethmuller et al. (2003))
- Fish embryonic development and post-hatch survival toxicity test using the rainbowfish *Melanotaenia splendida splendida* (based on US EPA (2002))
- 7 day reproductive impairment toxicity test using the freshwater cladoceran *Ceriodaphnia cf dubia* (based on US EPA (2002) and Bailey et al. (2000))

The results obtained from these ecotoxicity tests were used to create a species sensitivity distribution (SSD) to predict the concentrations that would protect specified percentages of species in the receiving Copperfield River ecosystem. Trigger values (TVs) were derived using the BurrliOZ software package (Campbell et al., 2000), provided as part of ANZECC and ARMCANZ (2000) package. BurrliOZ fits a log-

logistic distribution to estimate the concentrations of discharges such that a given percentage of species will be protected. The TV for the protection of 95 % of the receiving ecosystem species corresponded to a concentration of 10 % of the composite pit sample tested. This corresponded to a safe dilution factor of 9.

Based on the outcomes of this DTA, it is recommended that the proposed discharge water (composed of a mixture of Eldridge and Wises pit water) be diluted at least 10 times to achieve a minimum protection level of 95% of species in the receiving Copperfield River.

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Glossary of Terms and Acronyms

The following glossary is based on that provided by *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (ANZECC and ARMCANZ 2000) and Environment Canada (1999) except where otherwise indicated.

Chronic toxicity – A biological response to exposure to a toxicant that takes a prolonged period to appear and persists for a prolonged period. The term can be used to define either the exposure of an aquatic species or its response to an exposure (effect). The ANZECC & ARMCANZ (2000) define chronic exposure as being greater than 96 hours duration for multi-celled organisms and being equal to or greater than 72 hours duration for single-celled organisms.

Control (control treatment) – In toxicity tests, the control is that treatment in which the test organisms are not subjected to the test substance. The control is used as a standard comparison, to check that the outcome of the experiment is a reflection of the test conditions and not some unknown factor.

Direct toxicity assessment (DTA) – The use of toxicity tests to determine the acute and/or chronic toxicity of effluents and other mixtures of potential toxicants.

EC – Electrical Conductivity, which is an estimate of the amount of total dissolved salts (TDS).

EC_{10} – The concentration of a chemical that is estimated to cause a response in 10% of the test organisms or causes the mean response of the organisms to differ from the control by 10%. The EC10 is usually expressed as a time-dependent value, e.g. 24-hour EC_{10} is the concentration estimated to cause an effect on 10% of the test organisms after 24 hours of exposure.

EC_{50} – The concentration of chemical that is estimated to cause a response in 50% of the test organisms or causes the mean response of the organisms to differ from the control by 50%. The EC50 is usually expressed as a time-dependent value, e.g. 24-hour EC_{50} is the concentration estimated to be cause an effect on 50% of the test organisms after 24 hours of exposure.

Endpoint – The biological response of test organisms in toxicity tests that is measured (e.g. lethality, immobilisation).

ESA – Ecotox Services Australasia.

Ecosystem trigger values – These are the concentration (or loads) of the key performance indicators measured for the ecosystem, below which there exists a low risk that adverse biological (ecological) effects will occur. They indicate a risk of impact if exceeded and should 'trigger' some action, either further ecosystem-specific investigations or implementation of management/remedial actions.

Goodness of Fit – A statistical measure of how well a set of observations fit the predicted pattern of a probability distribution function.

ICp – The concentration that inhibits an endpoint by 'p' percent (e.g. the $IC50_{(reprod)}$ is the concentration that inhibits reproduction by 50%). It represents a point estimate of a concentration of test material that causes a designated percent inhibition (p) compared to the control. The ICp is usually expressed as a time-dependent value, e.g. 24-hour IC_{50} is the concentration estimated to cause an effect on 50% of the test organisms after 24 hours of exposure.

LC_{50} – The concentration of material in water that is estimated to be lethal to 50% of the test organisms. The LC_{50} is usually expressed as a time-dependent value, e.g. 24-hour or 96-hour LC_{50}, the concentration estimated to be lethal to 50% of the test organisms after 24 or 96 hours of exposure.

Level of protection – The ANZECC & ARMCANZ (2000) provide three levels of protection depending on the current status of the ecosystem being considered. The levels are (1) high conservation ecosystems where the default is to protect 99% of species (i.e. PC_{99} values apply), (2) slightly to moderately modified ecosystems where the default is to protect 95% of species (i.e. PC_{95} values apply) and (3) highly modified ecosystems where the default is to protect between 80 to 90% of species (i.e. PC_{80} to PC_{90} values apply).

LOEC – The lowest observed concentration of a toxicant used in a toxicity test that has a statistically significant ($P \leq 0.05$) adverse effect on the exposed population of test organisms compared with the controls. This is estimated by hypothesis-based statistical methods and is therefore not a point estimate.

Mixing zones – An explicitly defined area around a discharge point where discharge concentrations may exceed guideline values and therefore result in certain environmental values not being protected. The size of the mixing zone is site specific.

NATA – National Association of Testing Authorities.

NOEC – The highest observed concentration of a toxicant used in a toxicity test that does not exert a statistically significant adverse effect ($P > 0.05$) on the exposed population of test organisms compared to the controls. This is estimated by hypothesis based statistical methods and is therefore not a point estimate.

Protective concentrations (PC) – The concentration predicted by species sensitivity distribution methods that will protect a chosen percentage of species from experiencing toxic effects. For example, the PC_{99} should protect 99% of species in the ecosystem being considered. The toxic effects that are being prevented will depend on the type of toxicity data used to derive the PC values. Thus, if sub-lethal EC_{10} data are used to generate a PC_{95} – it will protect 95% of species from experiencing sub-lethal EC_{10} effects.

Safe dilution factors – The concentration that a chemical or discharge must be diluted by in order to meet a selected PC value. The lower the PC value the higher the dilution factor must be to protect the selected percentage of species.

Species Sensitivity Distribution (SSD) – SSD is a statistical approach for predicting the threshold concentrations of a contaminant or effluent that will protect a specific proportion of aquatic species with a predetermined level of confidence.

Sub-lethal – A biological response that is less severe than death. Examples of sub-lethal effects include inhibition of reproduction, reduction in growth, reduction in population growth, inhibition of fertilisation and inhibition of development.

Toxicity – The inherent potential or capacity of a chemical to cause adverse effects in a living organism.

Toxicity test – A test that exposes living organisms to several concentrations of a substance that is under investigation, and evaluates the organism's responses.

Trigger Value (TV) – The numerical limit for the aqueous concentration of a toxicant which if exceeded leads to further investigation or action to remediate the site or to reduce the concentration of the toxicant.

1. BACKGROUND AND OBJECTIVES

AECOM has commissioned Hydrobiology and Ecotox Services Australia Pty Ltd (ESA) to perform a Direct Toxicity Assessment (DTA) of a mixture of water from Wises Pit and Eldridge Pit at Kidston which is being proposed to be discharged into the Copperfield River (Gilbert Basin, North Queensland). The major contaminants of concern identified in the effluent release were sulphate (as SO4), arsenic, zinc and nickel.

The scope of this work was to determine acceptable safe dilution factors in the Gilbert Basin which has been assessed as a slightly to moderately disturbed upland freshwater system that will achieve the prescribed level of aquatic ecosystem protection of 95% of species in the receiving environment.

The specific objectives of this study were to:

- Use the results obtained in ecotoxicity testing performed by ESA to create a species sensitivity distribution (SSD);
- Use the SSD to predict the concentrations that would protect specified percentages of species in the receiving Copperfield River ecosystem; and
- Derive safe dilution factors for protecting this ecosystem.

2. METHODS

2.1 SAMPLE COLLECTION

All water samples used for this investigation were collected by the AECOM aquatic ecology team in April 2018. Two test water samples were provided from the Wises and Eldridge pits. Diluent water was also collected from the Copperfield River. The river sample was collected at site W2, as indicated in Figure 2-1. This point was located directly downstream of the proposed release point and represents the most likely river water quality that will mix with the proposed discharge.

2.2 WATER QUALITY

The two test waters from Eldridge and Wises pits were mixed in-house at ESA. The DTA was undertaken using this composite sample serially diluted using Copperfield River water. Both the Copperfield River and composite pit samples were characterised at Australian Laboratory Services (ALS). Parameters analysed included:

- Physico-chemical parameters
- Cations/Anions
- Metals (total and dissolved)
- Nutrients
- Cyanide

Water quality results for the composite sample and the river water sample used in this DTA are presented in Table 2-1.

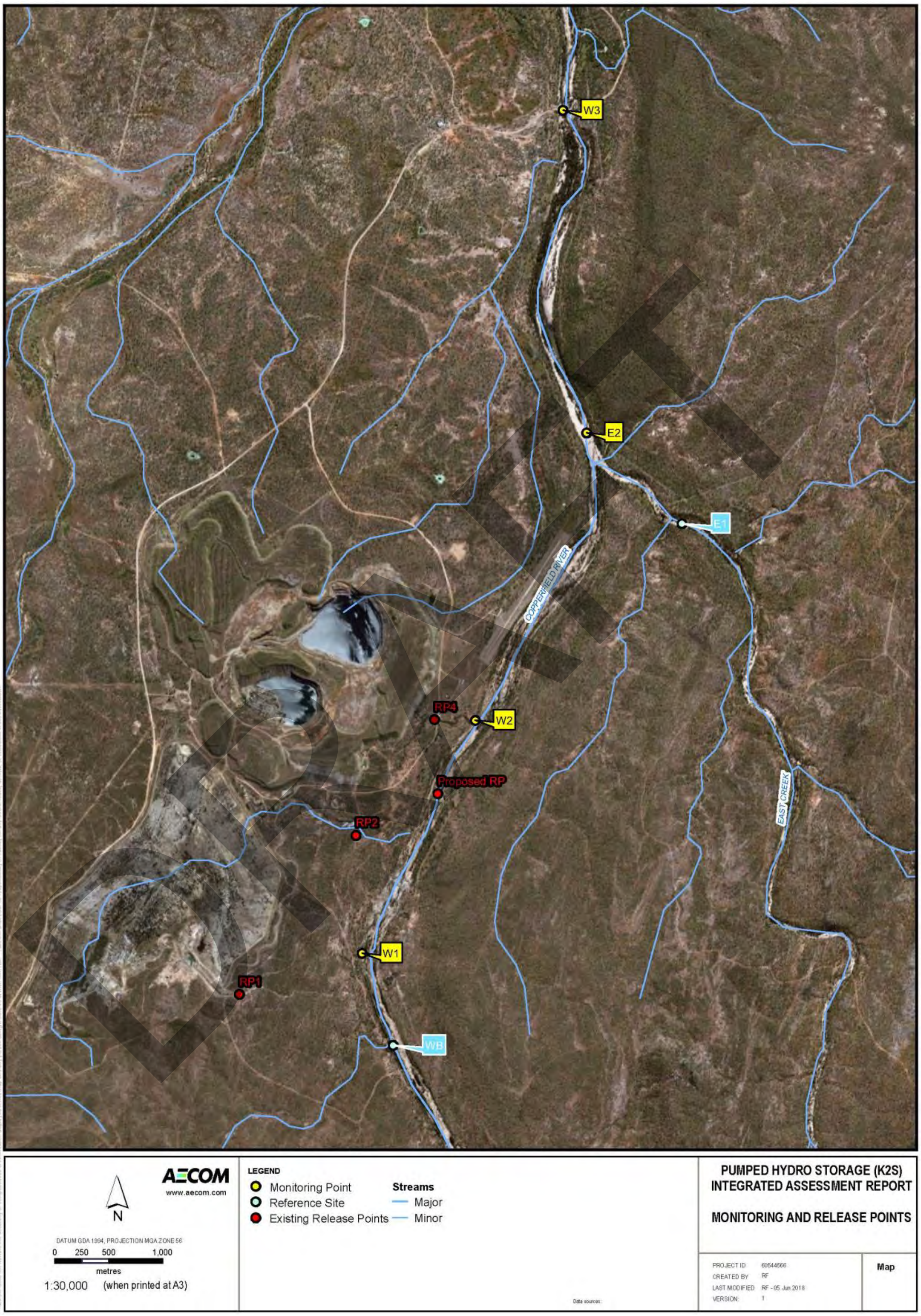


Figure 2-1 Map of river sampling locations along the Copperfield River and proposed release points

Table 2-1 Water quality results for the composite and river water samples used in the DTA

Parameter	Unit	Composite pit sample	Copperfield River sample (W2)
pH	-	7.82	7.74
EC (at 25˚C)	µS/cm	4600	98
Total Hardness (as $CaCO_3$)	mg/L	1530	27
Sodium adsorption ratio (SAR)	-	6.04	0.83
Total Alkalinity (as $CaCO_3$)	mg/L	84	43
Sulphate (SO42-)	mg/L	2630	2
Chloride	mg/L	161	6
Calcium	mg/L	410	6
Magnesium	mg/L	124	3
Sodium	mg/L	544	10
Potassium	mg/L	110	2
Fluoride	mg/L	4.9	0.1
Total Anions	meq/L	61.0	1.07
Total Cations	meq/L	57.1	1.03
Ionic Balance	%	3.25	-
Ammonia as N	mg/L	0.35	0.02
Nitrite as N	mg/L	0.01	<0.01
Nitrate as N	mg/L	0.31	0.06
Total Kjeldahl Nitrogen as N	mg/L	0.4	0.2
Total Phosphorous as P	mg/L	0.09	<0.01
Reactive Phosphorous as P	mg/L	0.04	<0.01
Aluminium	mg/L	<0.01 (D), 0.14 (T)	0.47 (D), 0.69 (T)

Parameter	Unit	Composite pit sample	Copperfield River sample (W2)
Arsenic	mg/L	0.247 (D), 0.250 (T)	<0.001 (D), <0.001 (T)
Beryllium	mg/L	<0.001 (D), <0.001 (T)	-
Barium	mg/L	0.042 (D), 0.043 (T)	-
Cadmium	mg/L	0.0012 (D), 0.0015 (T)	<0.0001 (D), <0.0001 (T)
Chromium	mg/L	<0.001 (D), <0.001 (T)	<0.001 (D), <0.001 (T)
Cobalt	mg/L	0.002 (D), 0.003 (T)	<0.001 (D), <0.001 (T)
Copper	mg/L	0.002 (D), 0.002 (T)	<0.001 (D), <0.001 (T)
Lead	mg/L	<0.001 (D), <0.001 (T)	<0.001 (D), <0.001 (T)
Manganese	mg/L	0.236 (D), 0.256 (T)	0.020 (D), 0.028 (T)
Mercury	mg/L	<0.0001 (D), <0.0001 (T)	<0.0001 (D), <0.0001 (T)
Molybdenum	mg/L	0.042 (D), 0.56 (T)	<0.001 (D), <0.001 (T)
Nickel	mg/L	0.003 (D), 0.003 (T)	<0.001 (D), <0.001 (T)
Selenium	mg/L	<0.01 (D), <0.01 (T)	<0.01 (D), <0.01 (T)
Uranium	mg/L	0.006 (D), 0.007 (T)	-
Vanadium	mg/L	<0.01 (D), <0.01 (T)	-
Zinc	mg/L	0.080 (D), 0.081 (T)	<0.005 (D), <0.005 (T)
Boron	mg/L	0.08 (D), 0.09 (T)	-
Iron	mg/L	<0.05 (D), 0.08 (T)	0.20 (D), 0.71 (T)
Free cyanide	mg/L	<0.004	<0.004
Total cyanide	mg/L	<0.004	<0.004
Cyanide (WAD)	mg/L	<0.004	<0.004

Notes: (D) denotes dissolved concentrations, (T) denotes total concentrations

2.3 ECOTOXICITY TESTING

A minimum of five tests on species from four taxonomic groups are required to enable the derivation of “safe” dilutions of discharges using an SSD approach (ANZECC & ARMCANZ, 2000). The following chronic and sub-chronic tests were selected for this DTA:

- 96hr growth inhabitation of the freshwater duckweed *Lemna aequinoctialis* based on OECD method 221 (OECD, 2006)

  Two species of macrophytes were found in the Copperfield river aquatic ecology survey performed in April 2018 (C&R Consulting, 2018). The test species *L. aequinoctialis*, is a small aquatic, flowering macrophyte commonly known as duckweed. Unlike many other evolutionary more complex plants, their small size and fast growth rates make them ideal for testing in the laboratory. This test was based on the OECD protocol method 221 (OECD, 2006). A standard number of vegetatively reproducing *lemna* plants were exposed to dilution series of the test solution over 96 hours under controlled conditions. The number of fronds was counted at the end of the test and from this, the degree of plant growth was calculated and compared with an appropriate control to determine the percentage inhibition of growth for each treatment.

- 72hr microalgal growth inhibition (cell yield) test using the freshwater alga *Chlorella vulgaris* (based on US EPA method 1003.0, (US EPA, 2002))

  Chlorella vulgaris (Chlorophyceae) is a unicellular freshwater green alga. Exponentially growing cells of *C. vulgaris* were exposed to dilution series of the test toxicant over several generations under defined conditions. The test was conducted over 72 hours with cell counts undertaken at both 48 and 72 h. From these counts, cell division rates were calculated. The test solution was considered toxic when a statistically significant ($P \leq 0.05$) concentration-dependent inhibition of algal growth occurred. Development of this method is described by Franklin et al. (1998).

- 96hr population growth toxicity test using *Hydra viridissima* (based on Riethmuller et al. (2003))

  Hydra viridissima is referred to as ‘green’ hydra because of its green colouration resulting from the presence of a symbiotic green alga in the gastrodermal cells of the animal. Although the precise distribution of this species has not been mapped, it has been found in a variety of aquatic habitats in northern Australia. Asexually reproducing (budding) test hydra were exposed to a dilution series of the test toxicant for 96 hours. Observations of any changes to the hydra population (i.e. changes in the number of intact hydroids, where one hydroid equals one animal plus any attached buds) were recorded at 24 h intervals. The method is based on the hydra population growth test described by Hyne et al. (1996) and Riethmuller et al. (2003).

- Fish embryonic development and post-hatch survival toxicity test using the rainbowfish *Melanotaenia splendida splendida* (based on US EPA (2002))

  Rainbowfish were chosen as they are common in freshwater areas of the Copperfield River and other north Queensland catchments. The Copperfield River aquatic ecology survey performed in April 2018 reported the presence of checkered rainbowfish (*Melanotaenia splendida inornata*) (C&R Consulting, 2018). The methods adopted by ESA for this test were based on US EPA (2002), but adapted for use with native rainbowfish. The embryo development and post-hatch survival test method covers the first 6 days of embryonic development and 4-days post hatch period (10-day exposure period in total).

- 7 day reproductive impairment toxicity test using the freshwater cladoceran, *Ceriodaphnia* cf. *dubia* (based on US EPA (2002) and Bailey et al. (2000))

  The *Ceriodaphnia* cf. *dubia* freshwater cladoceran (water flea) is the most commonly used test organism to assess the potential harm a toxicant poses to freshwater aquatic ecosystems around the world. Cladocera species were found in the Copperfield River aquatic ecology survey performed in April 2018 (C&R Consulting, 2018), therefore this test is highly relevant to the study area. The reproductive impairment toxicity test measures chronic toxicity using less than 24 h old neonates during a three-brood (seven-day), static renewal test. The test began with asexually reproducing female freshwater cladocera (waterfleas) that were less than six hours old (i.e. neonates). These neonate females were exposed to a dilution series of the test substance, an effluent or reference toxicant under 'static-renewal' conditions. These females were transferred daily to fresh solutions of the same concentration. Each day, observations were made on the survival of each female, the number of neonates produced and neonate survival. Each female was accounted for as alive, dead or missing, rather than assuming missing animals were dead. The test was terminated when three broods were produced by each surviving control female (normally over a 5 to 7 day period). The method is based on the Ceriodaphnia Survival and Reproduction Test developed by the US EPA (2002).

All tests were performed by ESA which is a NATA endorsed toxicity testing facility.

2.4 STATISTICAL ANALYSIS

The EC_{10} (the effective concentration giving 10% reduction in the endpoint compared with the controls) was calculated by ESA using Trimmed Spearman-Karber analysis (Hamilton, Russo and Thurston, 1977), Maximum Likelihood Probit analysis (Finney, 1971) or Log-Logit Interpolations (US EPA, 2002), depending on which method was appropriate.

2.5 DERIVATION OF PROTECTIVE CONCENTRATIONS

Trigger values (TVs) were derived for the protection of aquatic freshwater species using the SSD method. The TVs were derived using the BurrliOZ software package (Campbell *et al.*, 2000), provided as part of ANZECC and ARMCANZ (2000) package. BurrliOZ fits a log-logistic distribution to estimate the concentrations of discharges such that a given percentage of species will be protected. The EC_{10} data from the DTA was input to the SSD to derive the protective concentrations. The TVs for the 80%, 90%, 95% and 99% protective concentrations were derived as per ANZECC and ARMCANZ (2000).

Safe dilution factors (i.e. the dilution needed for the discharge to have little to no effect on the receiving ecosystem) were extrapolated from the data to ensure protection of 95% of species in the aquatic ecosystem of the receiving environment.

2.6 QA/QC

Specific procedures for undertaking toxicity testing activities, procurement and culturing of test organisms, maintenance and calibration of instruments, cleaning, chain-of-custody and sample handling procedures are carried out by ESA as per their Procedures Manual. Quality assurance procedures were undertaken for all toxicity tests.

Quality assurance and quality control of all NATA accredited tests were satisfied. In the case of the *Ceriodaphnia* cf. *dubia* test (not NATA accredited), the control results were satisfactory.

3. RESULTS AND DISCUSSION

A summary of ecotoxicity testing results received from ESA is presented in Table 3-1. The most sensitive species of the testing suite was the microalgae *C. vulgaris* for which the EC_{10} was estimated at 11.8 %.

The five chronic EC_{10} data points were taken forward into the derivation of TVs for the protection of freshwater species using the BurrliOZ program by producing an SSD (Figure 3-1). The SSD was then used to derive ecosystem TVs corresponding to different levels of protection from 80 to 99% of species. These TVs are presented in Table 3-2.

The TV for the protection of 95 % of the receiving ecosystem species corresponded to a concentration of 10 % of the composite pit sample tested (Table 3-2). This result allowed the calculation of the dilution ratio that provides a 95% species protection level for the contaminant mixture proposed to be discharged to the Copperfield River. A safe dilution factor of 9 was calculated to achieve a mixing of 10% composite pit water in the river. Hydrobiology recommends using a conservative 10 times dilution of the composite pit water at the edge of the designated mixing zone in the Copperfield River.

Table 3-1 Summary of toxicity test results

Test	NOEC	LOEC	EC10 (95% confidence interval)	EC50 (95% confidence interval)
96-hr Growth inhibition of *Lemna aequinoctialis*	50%	100%	74.9%	>100%
96-hr acute toxicity test using *Hydra viridissima*	25%	50%	31.4 (25.8-34.9)%	63.9 (57.9-67.6)%
Fish embryo hatching test using *Melanotaenia splendida splendida*	100%	>100%	>100%	>100%
72-hr microalgal growth inhibition test using *Chlorella vulgaris*	6.3%	12.5%	11.8%	>100%
7-day reproduction test using *Ceriodaphnia* cf. *dubia*	25%	50%	30.9 (25.4-35.3)%	79.1 (73.3-84.3)%

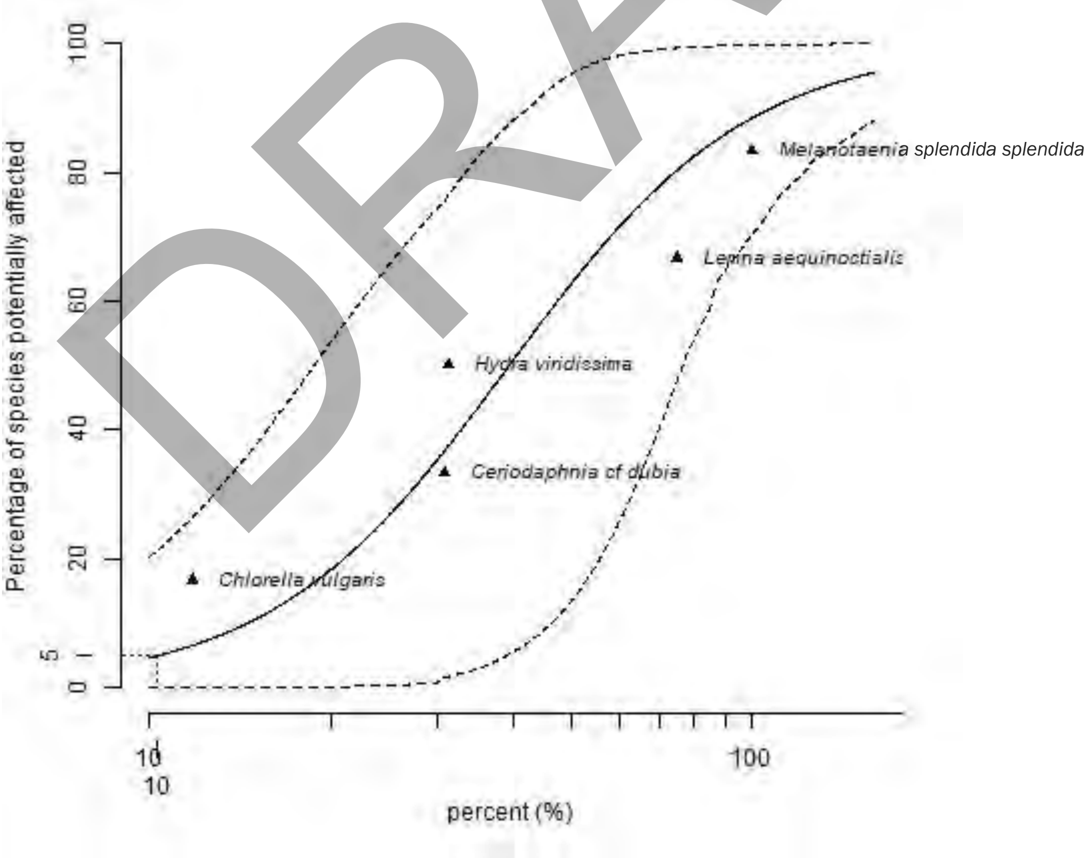


Figure 3-1 Species sensitivity distribution (SSD)

Table 3-2 Calculated safe dilution factors for each level of protection

Solution	Level of protection	Trigger value (TV) [95% confidence interval]	Safe dilution factor estimate
Composite sample Eldridge + Wises	99% species	4.9 % [2.1 – 30.5 %]	19.4
	95% species	**10 %** **[4.6 – 40.8 %]**	**9.0**
	90% species	15 % [6.6 – 48.7 %]	5.7
	80% species	21 % [10 – 55 %]	3.8

4. CONCLUSION

Based on the composite sample used in this DTA (mixture of pit water from Eldridge and Wises), it is recommended that the proposed discharge water be diluted at least 10 times to achieve a minimum protection level of 95% of species in the receiving Copperfield River.

5. REFERENCES

ANZECC & ARMCANZ (2000) 'Australian and New Zealand Guidelines for Fresh and Marine Water Quality - The Guidelines', *National Water Quality Management Strategy*, 1(4), p. 314.

Bailey, H. C. *et al.* (2000) 'Application of Ceriodaphnia cf. dubia for whole effluent toxicity tests in the Hawkesbury-Nepean watershed, New South Wales, Australia: method development and validation.', *Environmental Toxicology and Chemistry*, 19, pp. 88–93.

C&R Consulting (2018) 'Kidston pumped storage Hydro Project - Aquatic Ecology Survey Report', *report prepared by Geochemical & Hydrobiological Solutions Pty Ltd for AECOM Pty Ltd*.

Campbell, E. *et al.* (2000) *BurrliOZ: A computer program for calculating toxicant trigger values for the ANZECC and ARMCANZ water quality guidelines.* Perth, Australia.

Finney, D. J. (1971) *Probit Analysis (3rd edition)*. Cambridge. Cambridge.

Franklin, N., Australia. Environment Australia. and Australia. Supervising Scientist. (1998) 'A new tropical algal test to assess the toxicity of metals in freshwaters', *Supervising scientist report, 133.*, p. viii, 83.

Hamilton, M. A., Russo, R. C. and Thurston, R. V. (1977) 'Trimmed Spearman-Karber method for estimating median lethal concentrations in toxicity bioassays', *Environmental Science & Technology*, 11(7), pp. 714–719.

Hyne, R. V. *et al.* (1996) 'Procedures for the biological toxicity testing of mine waste waters using freshwater organisms', *Supervising scientist report 110*.

OECD (2006) 'Lemna sp. Growth Inhibition Test. Method 221. OECD Guideline for the Testing of Chemicals.', *Organisation for Economic Cooperation and Development, Paris*.

Riethmuller, N. *et al.* (2003) 'Ecotoxicological testing protocols for Australian tropical freshwater ecosystems', *Supervising Scientist Report 173, Supervising Scientist, Darwin NT*, p. 145.

US EPA (2002) 'Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms. 4th Ed.', *United States Environmental Protection Agency, Office of Water, Washington DC.*

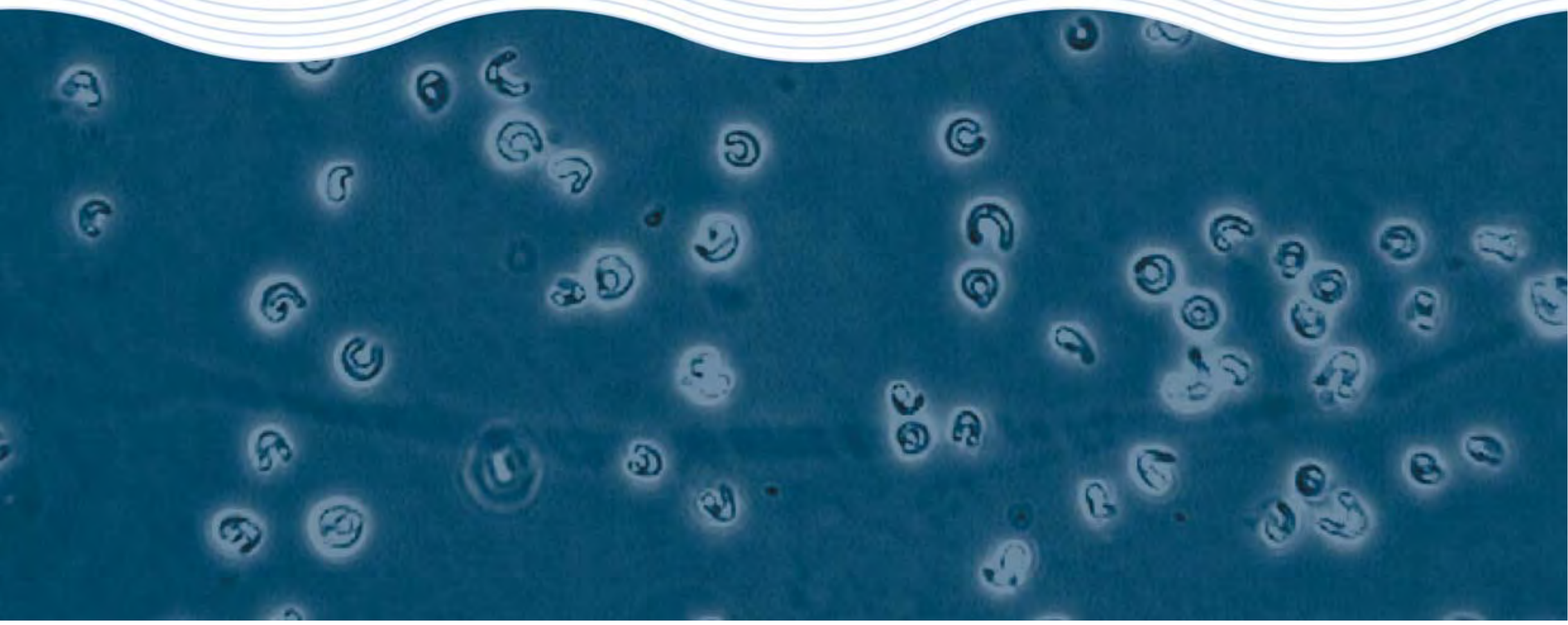
APPENDIX A. LABORATORY TOXICITY RESULTS

Ecotoxicity of a Blend of Eldridge and Wises Samples to a suite of Tropical Freshwater Test Species

Aecom

Test Report

May 2018



Toxicity Test Report: TR1552/1

Accredited for compliance with ISO/IEC 17025

Client:	Aecom PO Box 5423 Townsville QLD 4810	**ESA Job #:**	PR1552
		Date Sampled:	24 April 2018
		Date Received:	30 April 2018
Attention:	Reece Fraser	**Sampled By:**	Client
Client Ref:	60544566	**ESA Quote #:**	PR1552_02

Lab ID No.:	**Sample Name:**	**Sample Description:**
8649	Eldridge	Aqueous sample, pH 8.0, conductivity 3310 µS/cm, total ammonia <2.0mg/L. Sample received at 15 ºC in apparent good condition.
8650	Wises	Aqueous sample, pH 8.3, conductivity 5120 µS/cm, total ammonia <2.0 mg/L. Sample received at 15ºC in apparent good condition.
8651	W2	Aqueous sample, pH 8.1, conductivity 106 µS/cm, total ammonia <2.0mg/L. Sample received at 15ºC in apparent good condition.

*NATA accreditation does not cover the performance of this service

Test Performed:	Partial life-cycle toxicity test using the freshwater cladoceran *Ceriodaphnia cf dubia*
Test Protocol:	ESA SOP 102 (ESA 2016), based on USEPA (2002) and Bailey *et al.* (2000)
Test Temperature:	The test was performed at 25±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	The test solution was prepared as a mixture comprising of 10% Wises (sample 8650) and 90% Eldridge (sample 8649) as per the clients instructions. This *Mixture* was serially diluted with W2 (sample 8651) to achieve the final test concentrations. A Dilute Mineral Water (DMW-culture water) control was tested concurrently with the samples.
Source of Test Organisms:	ESA Laboratory culture
Test Initiated:	11 May 2018 at 1730h

Mixture diluted with W2 (Lab ID 8651):

Concentration (%)	**% Unaffected at 7 days (Mean ± SD)**
DMW Control	100 ± 0.0
W2 Diluent	100 ± 0.0
6.3	100 ± 0.0
12.5	100 ± 0.0
25	100 ± 0.0
50	100 ± 0.0
100	100 ± 0.0

7 day EC10 (unaffected) = >100%
7 day EC50 (unaffected) = >100%
NOEC = 100%
LOEC = >100%

Mixture diluted with W2 (Lab ID 8651):

Concentration (%)	**Number of Young (Mean ± SD)**
DMW Control	16.3 ± 1.0
W2 Diluent	12.4 ± 1.1
6.3	16.3 ± 0.7
12.5	16.8 ± 1.5
25	14.5 ± 1.4
50	10.9 ± 2.2*
100	5.2 ± 1.3*

7 day IC10 (reproduction) = 30.9 (25.4-35.3)%
7 day IC50 (reproduction) = 79.1 (73.3-84.3)%
NOEC = 25%
LOEC = 50%

* Significantly lower number of young compared with the W2 Diluent (Dunnett's Test, 1-tailed, P=0.05)

Toxicity Test Report: TR1552/1

QA/QC Parameter	Criterion	This Test	Criterion met?
DMW Control mean % unaffected	≥80.0%	100%	Yes
Control mean number of young per surviving adult	≥15.0	16.3	Yes
Reference Toxicant within cusum chart limits	192.4-242.9 mgKCl/L	209.6 mgKCl/L	Yes

Test Report Authorised by: Dr Rick Krassoi, Director on 6 June 2018

Results are based on the samples in the condition as received by ESA.

NATA Accredited Laboratory Number: 14709

Citations:

Bailey, H.C., Krassoi, R., Elphick, J.R., Mulhall, A., Hunt, P., Tedmanson, L. and Lovell, A. (2000) Application of *Ceriodaphnia cf. dubia* for whole effluent toxicity tests in the Hawkesbury-Nepean watershed, New South Wales, Australia: method development and validation. *Environmental Toxicology and Chemistry* 19:88-93.

ESA (2016) ESA SOP 102 – *Acute Toxicity Test Using Ceriodaphnia dubia.* Issue No 11. Ecotox Services Australasia, Sydney, NSW.

USEPA (2002) *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms.4th Ed.* United States Environmental Protection Agency, Office of Water, Washington DC.

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Toxicity Test Report: TR1552/2

Performed in compliance with ISO/IEC 17025

Client:	Aecom PO Box 5423 Townsville QLD 4810	**ESA Job #:** **Date Sampled:** **Date Received:**	PR1552 24 April 2018 30 April 2018
Attention:	Reece Fraser	**Sampled By:**	Client
Client Ref:	60544566	**ESA Quote #:**	PR1552_02

Lab ID No.:	**Sample Name:**	**Sample Description:**
8649	Eldridge	Aqueous sample, pH 8.0, conductivity 3310 µS/cm, total ammonia <2.0mg/L. Sample received at 15 ºC in apparent good condition.
8650	Wises	Aqueous sample, pH 8.3, conductivity 5120 µS/cm, total ammonia <2.0 mg/L. Sample received at 15ºC in apparent good condition.
8651	W2	Aqueous sample, pH 8.1, conductivity 106 µS/cm, total ammonia <2.0mg/L. Sample received at 15ºC in apparent good condition.

Test Performed:	96-hr Growth inhibition of the freshwater aquatic duckweed *Lemna aequinoctialis*
Test Protocol:	ESA SOP 112 (ESA 2016), based on ASTM (2012)
Test Temperature:	The test was performed at 29±2°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	The test solution was prepared as a mixture comprising of 10% Wises (sample 8650) and 90% Eldridge (sample 8649) as per the clients instructions. This *Mixture* was serially diluted with W2 (sample 8651) to achieve the final test concentrations. A CAAC control was tested concurrently with the samples..
Source of Test Organisms:	ESA Laboratory culture
Test Initiated:	11 May 2018 at 1700h

Mixture diluted with W2 (Lab ID 8651):

Concentration (%)	**Specific Growth Rate (Mean ± SD)**
CAAC Control	0.33 ± 0.03
W2 Diluent	0.33 ± 0.03
6.3	0.33 ± 0.02
12.5	0.32 ± 0.03
25	0.34 ± 0.02
50	0.33 ± 0.01
100	0.27 ± 0.05

96-h IC10 = 74.9%
96-h IC50 = >100%
NOEC = 50%
LOEC = 100%

Vacant

* Significantly lower growth rate compared with the W2 Diluent (Dunnett's Test, 1-tailed, P=0.05)

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Toxicity Test Report: TR1552/2

QA/QC Parameter	Criterion	This Test	Criterion met?
CAAC Control Specific Growth rate	>0.231	0.33	Yes
Reference Toxicant within cusum chart limits	5.6-58.6mg Mg/L	13.8 mg Mg/L	Yes

Test Report Authorised by: Dr Rick Krassoi, Director on 6 June 2018

Results are based on the samples in the condition as received by ESA.
This document shall not be reproduced except in full.

Citations:

ESA (2016) *SOP 112 – Duckweed Growth Inhibition Test.* Issue No. 7. Ecotox Services Australasia, Sydney NSW

OECD (2006) *Lemna sp*. Growth Inhibition Test. Method 221. OECD Guideline for the Testing of Chemicals. Organisation for Economic Cooperation and Development, Paris

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Toxicity Test Report: TR1552/3

Performed in compliance with ISO/IEC 17025

Client:	Aecom PO Box 5423 Townsville QLD 4810	**ESA Job #:** **Date Sampled:** **Date Received:**	PR1552 24 April 2018 30 April 2018
Attention:	Reece Fraser	**Sampled By:**	Client
Client Ref:	60544566	**ESA Quote #:**	PR1552_02

Lab ID No.:	Sample Name:	Sample Description:
8649	Eldridge	Aqueous sample, pH 8.0, conductivity 3310 µS/cm, total ammonia <2.0mg/L. Sample received at 15 ºC in apparent good condition.
8650	Wises	Aqueous sample, pH 8.3, conductivity 5120 µS/cm, total ammonia <2.0 mg/L. Sample received at 15ºC in apparent good condition.
8651	W2	Aqueous sample, pH 8.1, conductivity 106 µS/cm, total ammonia <2.0mg/L. Sample received at 15ºC in apparent good condition.

Test Performed:	96-hr acute toxicity test using the freshwater hydra *hydra viridissima*
Test Protocol:	ESA SOP 125 (2016), based on Riethmuller et al. (2003)
Test Temperature:	The test was performed at 28±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	The test solution was prepared as a mixture comprising of 10% Wises (sample 8650) and 90% Eldridge (sample 8649) as per the clients instructions. This *Mixture* was serially diluted with W2 (sample 8651) to achieve the final test concentrations. A LC control (culture water) was tested concurrently with the samples.
Source of Test Organisms:	ESA Laboratory culture
Test Initiated:	11 May 2018 at 1530h

Mixture diluted with W2 (Lab ID 8651):

Concentration (%)	Population Growth Rate (Mean ± SD)
LC Control	0.37 ± 0.02
W2 Diluent	0.36 ± 0.02
6.3	0.36 ± 0.02
12.5	0.36 ± 0.02
25	0.35 ± 0.01
50	0.25 ±0.02*
100	0.00 ± 0.00

96-h IC10 = 31.4 (25.8-34.9)%
96-h IC50 = 63.9 (57.9-67.6)%
NOEC = 25%
LOEC = 50%

Vacant

* Significantly lower growth rate compared with the W2 Diluent (Dunnett's Test, 1-tailed, P=0.05)

Toxicity Test Report: TR1552/3

QA/QC Parameter	Criterion	This Test	Criterion met?
LC Control mean population growth rate	≥0.259	0.37	Yes
Reference Toxicant within cusum chart limits	2.61-10.30µg Cu/L	3.80µg Cu/L	Yes

Test Report Authorised by: Dr Rick Krassoi, Director on 6 June 2018

Results are based on the samples in the condition as received by ESA.

Citations:

ESA (2016) SOP 125 –*Hydra Population Growth Test.* Issue No 5. Ecotox Services Australasia, Sydney, NSW

Riethmuller N, Camilleri C, Franklin N, Hogan A, King A, Koch A, Markich SJ, Turley C and van Dam R (2003).

Green Hydra Population Growth Test. In: *Ecotoxicological testing protocols for Australian tropical freshwater ecosystems*. Supervising Scientist Report 173, Supervising Scientist, Darwin NT.

Toxicity Test Report: TR1552/4

Performed in compliance with ISO/IEC 17025

Client:	Aecom PO Box 5423 Townsville QLD 4810	**ESA Job #:** **Date Sampled:** **Date Received:**	PR1552 24 April 2018 30 April 2018
Attention:	Reece Fraser	**Sampled By:**	Client
Client Ref:	60544566	**ESA Quote #:**	PR1552_02

Lab ID No.:	**Sample Name:**	**Sample Description:**
8649	Eldridge	Aqueous sample, pH 8.0, conductivity 3310 µS/cm, total ammonia <2.0mg/L. Sample received at 15 ºC in apparent good condition.
8650	Wises	Aqueous sample, pH 8.3, conductivity 5120 µS/cm, total ammonia <2.0 mg/L. Sample received at 15ºC in apparent good condition.
8651	W2	Aqueous sample, pH 8.1, conductivity 106 µS/cm, total ammonia <2.0mg/L. Sample received at 15ºC in apparent good condition.

Test Performed:	Rainbowfish embryo hatching test using *Melanotaenia splendida splendida*
Test Protocol:	ESA SOP 126 (2016), based on USEPA (2002), but adapted for use with native rainbowfish
Test Temperature:	The test was performed at 25±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	The test solution was prepared as a mixture comprising of 10% Wises (sample 8650) and 90% Eldridge (sample 8649) as per the clients instructions. This *Mixture* was serially diluted with W2 (sample 8651) to achieve the final test concentrations. A Dilute Mineral Water (DMW) control (culture water) was tested concurrently with the samples.
Source of Test Organisms:	ESA Laboratory culture
Test Initiated:	11 May 2018 at 1830h

Mixture diluted with W2 (Lab ID 8651):

Concentration (%)	**% Unaffected (Mean ± SD)**
DMW Control	90.0 ± 11.6
W2 Diluent	95.0 ± 10.0
6.3	85.0 ± 19.2
12.5	100 ± 0.0
25	95.0 ± 10.0
50	100.0 ± 0.0
100	90.0 ± 11.6

12-d EC10 = >100 %
12-d EC50 = >100 %
NOEC = 100%
LOEC = >100%

Vacant

Toxicity Test Report: TR1552/4

QA/QC Parameter	Criterion	This Test	Criterion met?
DMW Control mean % unaffected	≥80.0%	90.0%	Yes
Reference Toxicant within cusum chart limit	14.8-106.7µg Cu/L	87.4µg Cu/L	Yes

Test Report Authorised by: Dr Rick Krassoi, Director on 6 June 2018

Results are based on the samples in the condition as received by ESA.

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Citations:

ESA (2016) *SOP 126- Rainbowfish Embryo Hatching Test*. Issue N°6. Ecotox Services Australasia, Sydney NSW

USEPA (2002) *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Freshwater Organisms.4th Ed.* United States Environmental Protection Agency, Office of Water, Washington DC.

Toxicity Test Report: TR1552/5

Performed in compliance with ISO/IEC 17025

Client:	Aecom PO Box 5423 Townsville QLD 4810	**ESA Job #:** **Date Sampled:** **Date Received:**	PR1552 24 April 2018 30 April 2018
Attention:	Reece Fraser	**Sampled By:**	Client
Client Ref:	60544566	**ESA Quote #:**	PR1552_02

Lab ID No.:	**Sample Name:**	**Sample Description:**
8649	Eldridge	Aqueous sample, pH 8.0, conductivity 3310 µS/cm, total ammonia <2.0mg/L. Sample received at 15 ºC in apparent good condition.
8650	Wises	Aqueous sample, pH 8.3, conductivity 5120 µS/cm, total ammonia <2.0 mg/L. Sample received at 15ºC in apparent good condition.
8651	W2	Aqueous sample, pH 8.1, conductivity 106 µS/cm, total ammonia <2.0mg/L. Sample received at 15ºC in apparent good condition.

Test Performed:	72-hr microalgal growth inhibition test using the green alga *Chlorella vulgaris*
Test Protocol:	ESA SOP 103 (ESA 2016), based on USEPA (2002)
Test Temperature:	The test was performed at 29±1°C.
Deviations from Protocol:	Nil
Comments on Solution Preparation:	The test solution was prepared as a mixture comprising of 10% Wises (sample 8650) and 90% Eldridge (sample 8649) as per the clients instructions. This *Mixture* was serially diluted with W2 (sample 8651) to achieve the final test concentrations. A USEPA control was tested concurrently with the samples.
Source of Test Organisms:	ESA Laboratory culture
Test Initiated:	11 May 2018 at 1730h

Mixture diluted with W2 (Lab ID 8651):

Concentration (%)	**Cell Yield $x10^4$ cells/mL (Mean ± SD)**
USEPA Control	26.0 ± 0.9
W2 Diluent	29.0 ± 2.2
6.3	27.4 ± 0.8
12.5	25.9 ± 1.2*
25	25.7 ± 1.0*
50	24.9 ± 1.4*
100	25.2 ± 1.3*

96-h IC10 = 11.8%
96-h IC50 = >100%
NOEC = 6.3%
LOEC = 12.5%

Vacant

* Significantly lower cell yield compared with the W2 Diluent (Dunnett's Test, 1-tailed, P=0.05)

Toxicity Test Report: TR1552/5

QA/QC Parameter	Criterion	This Test	Criterion met?
USEPA Control mean cell density	≥16.0x10^4 cells/mL	26.0 x10^4 cells/mL	Yes
Control coefficient of variation	<20%	7.4 %	Yes
Reference Toxicant within cusum chart limits	447-3843mg KCl/L	3465mg KCl/L	Yes

Test Report Authorised by: Dr Rick Krassoi, Director on 6 June 2018

Results are based on the samples in the condition as received by ESA.
This document shall not be reproduced except in full.

Citations:

ESA (2016) *ESA SOP 103 – Green Alga, Selenastrum capricornutum, Growth Test*. Issue No 11. Ecotox Services Australasia, Sydney, NSW.

USEPA (2002) *Short-term methods for estimating the chronic toxicity of effluents and receiving waters to freshwater organisms*. Fourth Edition. EPA-821-R-02-013. United States Environmental Protection Agency, Office of Research and Development, Washington DC, USA,

Chain-of-Custody Documentation

Datasheet ID: 601.1
Last Revised: 15 July 2014

Chain-of-Custody / Service Request Form

ecotox SERVICES AUSTRALASIA

Customer: AECOM AUSTRALIA
Ship To:
Contact Name: ROUVEN LAU
Attention:
Phone: 0450617847 Email: rouven.lau@aecom.com (please provide an email address for sample receipt notification)
Sampled by: Matthew Knott

Sample Date (day/month /year)	Sample Time	Sample Name (exactly as written on the sample vessel)	Sample Method (eg. Grab, composite etc.)	Number and Volume of Containers (eg 2 x 1L)	Tests Requested (See reverse for guidance): Algal Growth Sc	Duckweed Ltd	Hydra	Embryo Fish	chronic Cerio		Comments / Instructions
25/4/18		W2	Grab	4x4L	✓	✓	✓	✓	✓		Pilven

Comments / Instructions:

Note that testing will be delayed if an incomplete chain of custody is received

- Additional treatment of samples (i.e. spiking)
- Sub-contracted services (i.e. chemical analyses)
- Dilutions required (if different than 100% down to 6.25%)
- Sample holding time restriction (if applicable)
- Sample used for litigation (if applicable)

Note: An MSDS must be attached if Available

ESA Project Number: PR 6054566

1) Released By:	Date:	2) Received By: Claire	Date: 30/4/18	3) Released By:	Date:	4) Received By:	Date:
Of:	Time:	Of: ESA	Time: 10:15am	Of:	Time:	Of:	Time:

Note that the chain-of-custody documentation will provide definitive information on the tests to be performed.

Ecotox Services Australasia . Unit 27, 2 Chaplin Drive, Lane Cove NSW 2066 AUSTRALIA
Phone: 61 2 9420-9481 Fax 61 2 9420-9484 info@ecotox.com.au

Datasheet ID: 601.1
Last Revised: 15 July 2014

Chain-of-Custody / Service Request Form

ecotox
SERVICES AUSTRALASIA

Customer: AECOM AUSTRALIA
Contact Name: ROUVEN LAU
Phone: 0450617847 Email: rouven.lau@aecom.com (please provide an email address for sample receipt notification)
Sampled by: Matthew Knott

Ship To:
Attention:

Sample Date (day/month /year)	Sample Time	Sample Name (exactly as written on the sample vessel)	Sample Method (eg. Grab, composite etc.)	Number and Volume of Containers (eg 2 x 1L)	Tests Requested (See reverse for guidance): Algal Growth Sc	Duckweed Ltd	Hydra	Embryo Fish	Chronic Cerio		Comments / Instructions
25/4/18		Eldridge	Grab	3x4L	✓	✓	✓	✓	✓		Note: The Ecotox
25/4/18		Wises	Grab	31x4L							is to prepare a
											composite sample of
											Eldridge + Wises.
											Please contact me
											as soon as you receive
											for dilution Ratio.

Comments / Instructions:

Note that testing will be delayed if an incomplete chain of custody is received

- Additional treatment of samples (i.e. spiking)
- Sub-contracted services (i.e. chemical analyses)
- Dilutions required (if different than 100% down to 6.25%)
- Sample holding time restriction (if applicable)
- Sample used for litigation (if applicable)

Note: An MSDS must be attached if Available

ESA Project Number: PR6054566

1) Released By:	Date:	2) Received By: Claire	Date: 30/4/18	3) Released By:	Date:	4) Received By:	Date:
Of:	Time:	Of: ESA	Time: 10.15am	Of:	Time:	Of:	Time:

Note that the chain-of-custody documentation will provide definitive information on the tests to be performed.

Ecotox Services Australasia . Unit 27, 2 Chaplin Drive, Lane Cove NSW 2066 AUSTRALIA
Phone: 61 2 9420-9481 Fax 61 2 9420-9484 info@ecotox.com.au

Statistical Printouts for the 3-brood Partial Life Cycle Test with *Ceriodaphnia dubia*

Ceriodaphnia Partial Life-Cycle Test-Reproduction					
Start Date:	11/05/2018 14:30	Test ID:	PR1552/01	Sample ID:	Mixture
End Date:	18/05/2018 14:30	Lab ID:	8649, 8650	Sample Type:	AQ-Aqueous
Sample Date:	25/04/2018	Protocol:	ESA 102	Test Species:	CD-Ceriodaphnia dubia
Comments:	Mixture- 10% Wises (8560) + 90% Eldridge (8649). W2 as Diluent (8651)				

Conc-%	1	2	3	4	5	6	7	8	9	10
W2 Diluent	11.000	13.000	13.000	12.000	13.000	13.000	13.000	13.000	10.000	13.000
DMW Control	17.000	17.000	16.000	15.000	16.000	16.000	16.000	15.000	17.000	18.000
6.3	15.000	16.000	17.000	16.000	17.000	17.000	17.000	16.000	16.000	16.000
12.5	19.000	14.000	18.000	18.000	17.000	17.000	15.000	17.000	16.000	17.000
25	13.000	15.000	13.000	15.000	13.000	14.000	17.000	16.000	14.000	15.000
50	10.000	8.000	9.000	11.000	11.000	13.000	13.000	9.000	15.000	10.000
100	4.000	3.000	5.000	6.000	4.000	5.000	5.000	6.000	7.000	7.000

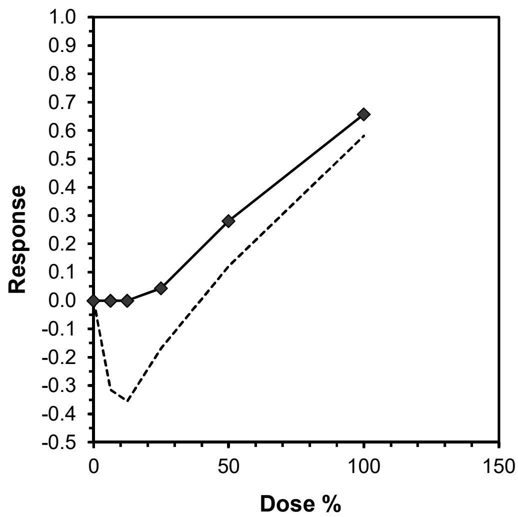
			Transform: Untransformed						1-Tailed		Isotonic	
Conc-%	Mean	N-Mean	Mean	Min	Max	CV%	N	t-Stat	Critical	MSD	Mean	N-Mean
W2 Diluent	12.400	0.7607	12.400	10.000	13.000	8.669	10	*			15.167	1.0000
DMW Control	16.300	1.0000	16.300	15.000	18.000	5.820	10					
6.3	16.300	1.0000	16.300	15.000	17.000	4.141	10	-6.135	2.287	1.454	15.167	1.0000
12.5	16.800	1.0307	16.800	14.000	19.000	8.784	10	-6.922	2.287	1.454	15.167	1.0000
25	14.500	0.8896	14.500	13.000	17.000	9.338	10	-3.304	2.287	1.454	14.500	0.9560
*50	10.900	0.6687	10.900	8.000	15.000	20.030	10	2.360	2.287	1.454	10.900	0.7187
*100	5.200	0.3190	5.200	3.000	7.000	25.318	10	11.327	2.287	1.454	5.200	0.3429

Auxiliary Tests	Statistic	Critical	Skew	Kurt
Kolmogorov D Test indicates normal distribution (p > 0.05)	0.874769	0.895	0.175717	0.519824
Bartlett's Test indicates equal variances (p = 0.04)	11.77794	15.08627		
The control means are significantly different (p = 8.59E-08)	8.602011	2.100922		

Hypothesis Test (1-tail, 0.05)	NOEC	LOEC	ChV	TU	MSDu	MSDp	MSB	MSE	F-Prob	df
Dunnett's Test	25	50	35.35534	4	1.453561	0.117223	185.1767	2.02037	4.0E-25	5, 54
Treatments vs W2 Diluent										

Linear Interpolation (200 Resamples)

Point	%	SD	95% CL		Skew
IC05	25.637	3.393	18.873	29.824	-0.2499
IC10	30.903	2.718	25.238	35.256	-0.1293
IC15	36.169	2.674	31.041	41.259	0.4592
IC20	41.435	3.084	36.262	48.246	0.8132
IC25	46.701	3.536	41.043	54.313	0.6444
IC40	65.789	3.996	55.672	72.062	-0.4693
IC50	79.094	3.001	73.324	84.287	-0.0796



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Dose-Response Plot