

DRAFT

Appendix D

Geochemistry Tables & Contaminant Limits

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Appendix D1 Geochemistry Tables

Monitoring_Zone	Field_ID	Well	Sampled_Date_Time	UNIT	Physio-Chemical Parameters															Major Ions																								
					Total Dissolved Solids		pH (Lab)		Total Petroleum Hydrocarbons		Total Recoverable Hydrocarbons		Total BTEX	Aluminium (Filtered)	Arsenic (Filtered)	Boron (Filtered)	Cadmium (Filtered)	Chromium	Cobalt	Copper (Filtered)	Iron (Filtered)	Lead (Filtered)	Manganese	Mercury	Molybdenum	Nickel (Filtered)	Selenium	Silver	Uranium (Filtered)	Vanadium	Zinc	Electrical Conductivity	Total Alkalinity	Ammonia Nitrate (as Nitrate)	Nitrite (as Nitrite)	Total Phosphate	Chloride	Calcium	Fluoride (as F ⁻)	Magnesium	Potassium	Sodium	Sulphide (as SO ₄ ²⁻)	
					mg/L	mg/L	2	0.01	10	20	100	1																															0.005	0.001
Joe Joe Formation	C914001S	C914001S	26/02/2016	LOR	8900	7	<10	-	-	-	<0.005	0.001	2	<0.0001	<0.001	<1	<0.001	7.7	<0.001	0.99	<0.00005	<1	0.001	<1	<0.15	3	<1	<0.005	15000	210	0.26	<0.005	<0.005	<0.01	7000	870	0.3	430	120	3700	<0.5	1600		
Joe Joe Formation	C914001S	C914001S	20/04/2016	LOR	13000	7	<10	-	-	-	<0.005	0.002	2.1	<0.0001	<0.001	<1	<0.001	9.2	<0.001	1	<0.00005	<1	0.001	<1	<0.5	3	<1	<0.005	21000	220	0.006	0.2	0.012	0.01	7200	880	0.3	430	110	3800	<0.5	1500		
Joe Joe Formation	C914001S	C914001S	8/07/2016	LOR	13000	6.7	<10	-	-	-	<0.005	0.002	2.1	<0.0001	<0.001	<1	0.002	8.8	<0.001	0.9	<0.00005	<1	0.002	2	0.18	2	<1	0.006	21000	210	0.28	<0.005	<0.005	0.01	4200	840	<0.5	420	130	44000	<0.5	1500		
Joe Joe Formation	C914001S	C914001S	25/11/2016	LOR	13000	6.8	<20	<20	<125	<3	0.006	0.002	2	<0.0001	<0.001	<1	0.006	9.9	<0.001	0.88	<0.00005	<1	0.002	<1	<0.5	3	4	0.15	21000	210	0.28	0.006	<0.005	<0.01	7300	860	<0.5	430	120	3800	<0.5	1500		
Joe Joe Formation	C914001S	C914001S	22/04/2017	LOR	12000	6.8	<20	<20	<125	<3	0.006	0.002	2	<0.0001	<0.001	<1	0.006	7.1	<0.001	0.94	<0.00005	<1	<0.001	<5000	<0.25	2	<1	<0.005	20000	190	0.34	<0.005	<0.005	<0.01	6900	850	<0.5	430	130	3900	<0.5	1500		

Monitoring_Zone	Field_ID	Well	Sampled_Date_Time	Physico-Chemical Parameters		Total Petroleum Hydrocarbons		Total Recoverable Hydrocarbons		Total BTEX	Aluminium (Filtered)	Arsenic (Filtered)	Boron (Filtered)	Cadmium (Filtered)	Chromium Cobalt (FIR Copper (F) Iron (F) Lead (F) Manganese (F) Mercury (F) Molybdenum (F) Nickel (F) Selenium (F) Silver (F) Uranium (F) Vanadium (F) Zinc (F))	Physico-Chemical Parameters										Major Ions																	
				Total Dissolved Solids	pH (Lab)	mg/L	µg/L	mg/L	µg/L							mg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	µg/L	mg/L	µg/L		
Tertiary	C9180121	9180121S	28/04/2014	2570	7.8 >20	<20	<100	<1	<0.01	<0.01	<0.001	0.005	0.0001	0.001	<0.001	<1	<0.001	0.37	0.001	0.029	<0.001	<1	0.002	<10	<1	<1	<10	0.089	3950	58	-	-	-	<0.01	1060	34	0.1	48	10	6.5	0.2	99	
Tertiary	C9180121	9180121S	28/05/2014	2330	6.53 >20	<20	<100	<1	<0.01	<0.01	<0.001	0.005	0.0001	0.001	<0.001	<1	<0.001	0.18	0.001	0.032	<0.001	<1	0.003	<10	<1	<1	<10	0.202	3590	43	-	-	<0.01	1020	35	0.1	51	9	64	<0.1	95		
Tertiary	C9180121	9180121S	30/07/2014	2200	6.7 >400	<20	<400	<3	<0.005	<0.005	<0.001	0.005	0.0002	<0.001	<1	<0.001	0.24	0.003	0.017	<0.001	<1	0.002	<3	<0.05	<0.5	<5	0.2	3700	36	0.012	0.055	<0.005	<0.02	1100	35	0.1	49	15	590	<0.5	96		
Tertiary	C9180121	9180121S	28/09/2014	2300	6.8 >40	<50	<650	<3	<0.005	0.006	<0.003	0.006	0.0002	<0.001	<1	<0.001	0.19	<0.001	0.019	<0.0005	<1	0.002	<3	<0.15	<0.5	<5	0.099	3800	42	<0.005	<0.005	<0.005	<0.02	1100	35	0.1	50	16	500	<0.5	99		
Tertiary	C9180121	9180121S	22/11/2014	2300	6.6 >40	<50	<400	<3	<0.005	0.005	<0.003	0.005	0.0002	<0.001	<1	<0.001	0.38	0.001	0.019	<0.0005	<1	0.002	<3	<0.05	<0.5	<5	0.19	3800	40	<0.005	<0.005	<0.005	<0.02	1100	36	0.1	49	15	500	<0.1	85		
Tertiary	C9180121	9180121S	8/02/2015	2300	6.7 >40	<50	<400	<3	<0.005	<0.005	<0.003	0.005	0.0002	<0.001	<1	<0.001	0.35	0.001	0.017	<0.0005	<1	0.002	<3	<0.05	<0.5	<5	0.12	3800	57	<0.009	<0.005	<0.005	<0.02	1100	37	0.1	51	16	540	<0.5	100		
Tertiary	C9180121	9180121S	28/03/2015	2300	6.8 >40	<50	<400	<3	<0.005	<0.005	<0.003	0.005	0.0002	<0.001	<1	<0.001	0.34	0.002	0.016	<0.0005	<1	0.002	<3	<0.05	<0.5	<5	0.4	3800	54	<0.009	<0.005	<0.005	<0.02	1100	35	0.1	50	14	540	<0.5	98		
Tertiary	C9180121	9180121S	31/05/2015	2300	6.8 >10	<20	<400	<3	<0.005	<0.005	<0.001	0.005	0.0002	<0.001	<1	<0.001	0.15	0.002	0.019	<0.001	<1	0.002	<3	<0.05	<0.5	<5	3.2	3900	47	0.008	0.11	<0.005	<0.01	1200	36	0.2	51	14	550	<0.5	97		
Tertiary	C9180121	9180121S	19/07/2015	2200	6.6 >10	<20	<400	<3	<0.005	<0.005	<0.001	0.005	0.0001	<0.001	<1	<0.001	0.079	0.002	0.018	<0.001	<1	0.002	<3	<0.05	<0.5	<5	1.8	3700	37	0.017	0.23	<0.005	0.03	1100	33	0.1	45	14	580	<0.5	98		
Tertiary	C9180121	9180121S	14/09/2015	2200	6.7 >10	<20	<400	<3	<0.005	<0.005	<0.001	0.005	0.0002	<0.001	<1	<0.001	0.22	0.001	0.019	<0.0005	<1	0.002	<3	<0.05	<0.5	<5	2.7	3700	40	0.01	0.11	<0.005	<0.01	1200	34	0.1	48	14	480	<0.5	97		
Tertiary	C9180121	9180121S	28/09/2015	2200	6.5 >10	<20	<400	<3	<0.005	<0.005	<0.001	0.005	0.0002	<0.001	<1	<0.001	0.095	0.002	0.018	<0.0005	<1	0.002	<3	<0.05	<0.5	<5	0.87	3600	35	<0.005	0.28	<0.005	<0.01	1100	35	0.1	49	15	540	<0.5	92		
Tertiary	C9180121	9180121S	19/04/2016	2200	6.6 >10	<20	<400	<3	<0.005	<0.005	<0.001	0.005	0.0001	<0.001	<1	<0.001	0.097	0.001	0.015	<0.0005	<1	0.002	<3	<0.05	<0.5	<5	0.78	3700	39	<0.005	0.14	<0.005	<0.01	1000	35	0.1	49	14	540	<0.5	91		
Tertiary	C9180121	9180121S	6/07/2016	2200	6.5 >10	<20	<400	<3	<0.005	<0.005	<0.001	0.005	0.0001	<0.001	<1	<0.001	0.006	0.001	0.016	<0.0005	<1	0.002	<3	<0.05	<0.5	<5	0.84	3700	45	0.006	0.073	<0.005	0.01	1100	34	0.1	47	14	550	<0.5	91		
Tertiary	C9180121	9180121S	22/11/2016	2200	6.6 >20	<20	<130	<3	<0.005	<0.005	<0.001	0.005	0.0001	<0.001	<1	<0.001	<0.005	0.002	0.016	<0.0005	<1	0.002	<3	<0.05	<0.5	<5	0.12	3700	35	<0.005	0.14	<0.005	0.02	1100	37	0.1	52	15	570	<0.5	100		
Tertiary	C9180121	9180121S	19/04/2017	2200	6.3 >20	<20	<125	<3	<0.005	<0.005	<0.001	0.005	0.0001	<0.001	<1	<0.001	0.2	0.002	0.011	<0.0005	<1	0.002	<3	<0.05	<0.5	<5	0.057	3700	31	0.022	0.27	<0.005	0.01	1100	33	0.1	47	13	580	<0.5	90		
Tertiary	C025P2	C025P2	29/09/2011	8180	7.52	310	330 <100	<16	0.03	0.03	0.012	0.005	0.0001	0.001	<0.001	<1	<0.001	0.2	0.001	1.16	<0.001	<1	0.001	50 <1	<1	2	10	0.006	14000	746	0.63	0.03	<0.01	0.38	4570	107	0.8	134	79	2700	0.4	54	
Tertiary	C025P2	C025P2	7/11/2011	8660	7.07	60	60 <100	<16	0.01	0.01	0.013	<0.005	0.0001	0.001	<0.001	<1	0.002	24.5	0.001	2.19	<0.001	<1	0.001	10 <1	<1	2	10	0.006	14000	763	1.38	0.16	<0.01	0.12	3670	130	0.6	134	74	2680	<0.1	10	
Tertiary	C025P2	C025P2	25/05/2013	7780	7.73	80	70 <100	<1	<0.01	0.002	0.002	<0.005	0.0001	0.001	<0.001	<1	<0.001	4.11	<0.001	3.01	<0.001	<1	<0.001	<10	<1	<1	<10	0.006	12700	605	0.72	<0.01	<0.01	<0.01	4710	114	0.5	117	79	2780	<0.1	165	
Tertiary	C025P2	C025P2	7/05/2014	8580	6.97	20	30 <100	<1	<0.01	<0.01	0.002	<0.005	0.0001	0.001	<0.001	<1	<0.001	8.1	<0.001	3.04	<0.001	<1	2	0.001	<10	<1	<1	<10	<0.005	12300	430	-	-	-	0.05	4700	109	0.4	114	66	2700	0.1	330
Tertiary	C025P2_2	C025P2	28/05/2014	8000	7.2 >20	<20	<100	<1	<0.01	<0.01	0.001	<0.005	0.0001	0.001	<0.001	<1	<0.001	5.58	<0.001	3.12	<0.001	<1	2	0.007	<10	<1	<1	<10	0.022	12300	394	-	-	-	0.08	4650	109	0.4	112	59	2820	<0.1	416
Tertiary	C025P2	C025P2	4/08/2014	8700	7.5 >40	<30	<50	<1	<0.01	<0.01	0.001	<0.005	0.0001	0.001	<0.001	<1	0.063	<0.01	3.6	<0.001	3	0.01	<2	<0.25	<0.5	<1	<0.01	14000	410	0.24	0.008	0.005	0.08	4400	110	0.3	120	94	2600	<0.1	400		
Tertiary	C025P2_0	C025P2	26/09/2014	9000	7.4 >40	<30	<650	<3	<0.005	<0.005	<0.001	<0.005	0.0001	0.001	<0.001	<1	<0.001	1.2	<0.001	2.7	<0.0005	<1	<0.001	<1	<0.25	<0.5	<0.005	15000	380	0.28	<0.005	<0.005	0.11	4500	120	0.5	120	98	2600	<0.5	460		
Tertiary	C025P2	C025P2	29/11/2014	9000	7.2 >40	<30	<400	<3	<0.005	<0.005	<0.001	<0.005	0.0001	0.001	<0.001	<1	0.02	<0.005	2.1	<0.001	1	0.005	<1	<0.25	<0.5	<1	<0.01	16000	400	0.36	0.009	<0.005	0.12	4500	120	0.5	120	109	2700	<0.1	420		
Tertiary	C025P2_2	C025P2	7/02/2015	8400	7.4 >40	<30	<50	<1	<0.01	0.016	<0.001	<0.005	0.0001	0.001	<0.001	<1	<0.001	0.52	<0.001	1.5	<0.0005	<1	<0.001	<1	<0.25	<0.5	1.6	14000	410	0.3	<0.005	<0.005	0.04	4400	120	0.5	120	93	2900	<0.5	420		
Tertiary	C025P2_2	C025P2	26/03/2015	8700	7.4 >40	<30	<400	<3	<0.005	<0.005	<0.001	<0.005	0.0001	0.001	<0.001	<1	0.001	0.31	<0.001	2.5	<0.0005	<1	<0.001	<1	<0.25	<0.5	<0.005	15000	400	0.42	0.012	<0.005	0.19	4400	110	0.5	120	95	2900	<0.5	440		
Tertiary	C025P2_2	C025P2	28/03/2015	8800	7.7 >10	<30	<400	<3	<0.005	0.014	<0.001	<0.005	0.0001	0.001	<0.001	<1	0.002	<0.005	2.1	<0.001	1	0.005	<1	<0.25	<0.5	<1	2	0.014															

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Appendix D2 Contaminant Limits

Appendix D Contaminant Limits

Contaminant Limits (ANZECC & ARMCANZ, 2000 fresh water triggers shown for comparison; values are 95% species protection unless otherwise stated)

Alluvium

Parameter	Units	ANZECC & ARMCANZ (2000)	C14028SP Contaminant Limits	C029P1 Contaminant Limits	C027P1 Contaminant Limits	HD03A Contaminant Limits
Calcium	mg/L Ca	-	889	93	27	2.5
Magnesium	mg/L Mg	-	1,089	378.3	141.7	3
Potassium	mg/L K	-	219	427	100	22
Sodium	mg/L Na	-	9,746	7,485	1,300	181
Chloride	mg/L Cl	-	16,890	11,000	2,332	199
Sulphate	mg/L SO ₄	-	1,989	1,100	515	14
Alkalinity	mg/L CaCO ₃	-	428	2,410	565	176
Sulphide	mg/L S ₂	-	NV	2	NV	NV
Fluoride	mg/L F	-	1.8	1.8	0.9	0.5
Aluminium	µg/L Al	55	55	55	55	55
Arsenic	µg/L As	13	13(8)	13	15	13
Boron	µg/L B	370	3,478	5,700	858	370(199)
Cadmium	µg/L Cd	0.2	0.2	0.2	0.2	0.2
Chromium	µg/L Cr	1	1	1	1	1

Parameter	Units	ANZECC & ARMCANZ (2000)	C14028SP Contaminant Limits	C029P1 Contaminant Limits	C027P1 Contaminant Limits	HD03A Contaminant Limits
Cobalt	µg/L Co	1.4 (low reliability freshwater)	25.7	12.9	18.5	1.4
Copper	µg/L Cu	1.4	15.4	145.2	187.3	1.4
Iron	µg/L Fe	300 (interim value from Canadian guidelines)	728	5,000	17,990	637.2
Lead	µg/L Pb	3.4	3.4	3.4	3.4	3.4
Manganese	µg/L Mn	1,900	9,423	4,230	4,540	1900(239)
Molybdenum	µg/L Mo	34 (low reliability freshwater)	34(7)	34(8)	34	34
Nickel	µg/L Ni	11	11(7)	30	34	11
Selenium	µg/L Se	11	11	11	11	11
Silver	µg/L Ag	0.05	0.05	0.05	0.05	0.05
Uranium	µg/L U	0.5 (low reliability freshwater)	85	167	0.5	0.5
Vanadium	µg/L V	6 (interim low reliability freshwater)	6	31	6	6
Zinc	µg/L Zn	8	46	318	107	8
Mercury	µg/L Hg	0.6	0.06	0.06	0.06	0.06
Ammonia	mg/L N	900	1.0	1.2	0.9	0.9(0.1)
Nitrate	mg/L N	700	0.7	0.7	0.7(0.1)	0.7
Nitrite	mg/L N	-	NV	NV	NV	NV

Parameter	Units	ANZECC & ARMCANZ (2000)	C14028SP Contaminant Limits	C029P1 Contaminant Limits	C027P1 Contaminant Limits	HD03A Contaminant Limits
T. Phosphorous	mg/L P	-	NV	0.39	0.27	0.21
Total Recoverable Hydrocarbons	ppb (C ₆ – C ₉)	-	Detect above LOR	Detect above LOR	Detect above LOR	Detect above LOR
Total Recoverable Hydrocarbons	ppb (C ₆ – C ₁₀)	-	Detect above LOR	Detect above LOR	Detect above LOR	Detect above LOR
Total Recoverable Hydrocarbons	ppb (C ₁₀ – C ₄₀)	-	Detect above LOR	Detect above LOR	Detect above LOR	Detect above LOR
BTEX	ppb	950 (benzene); 200 (p-xylene)	Detect above LOR	Detect above LOR	Detect above LOR	Detect above LOR
pH	pH units	6 - 9	6 - 9	6 - 9	6 - 9	6 - 9
Electrical Conductivity	µS/cm	-	44,890	34,000	7,300	924
Total Dissolved Solids	mg/L	-	26,890	20,272	4,442	607

Tertiary Sediments

Parameter	Units	C558P1 Contaminant Limits	Bores C025P2 and C029P2 Contaminant Limits	All other Tertiary Sediments Contaminant Limits
Calcium	mg/L Ca	81.5	126.7	37.0
Magnesium	mg/L Mg	228.4	132.7	51.7
Potassium	mg/L K	50	110	16
Sodium	mg/L Na	1,600	3,067	638
Chloride	mg/L Cl	3,420	4,837	1,200
Sulphate	mg/L SO ₄	250	467	100
Alkalinity	mg/L CaCO ₃	244	757	93
Sulphide	mg/L S ₂	NV	NV	NV
Fluoride	mg/L F	1.0	1.9	0.4
Aluminium	µg/L Al	55(29)	55	55
Arsenic	µg/L As	13	13	13
Boron	µg/L B	892	1,700	330
Cadmium	µg/L Cd	0.2	0.2	0.5
Chromium	µg/L Cr	1.0	1.0	2.5
Cobalt	µg/L Co	5.0	1.4	1.4
Copper	µg/L Cu	440	62.9	225.0
Iron	µg/L Fe	898	6,143	379

Parameter	Units	C558P1 Contaminant Limits	Bores C025P2 and C029P2 Contaminant Limits	All other Tertiary Sediments Contaminant Limits
Lead	µg/L Pb	3.4	3.4	3.4(2.9)
Manganese	µg/L Mn	1,900(381)	3,442	1,900
Molybdenum	µg/L Mo	34	3	34
Nickel	µg/L Ni	50	10	14
Selenium	µg/L Se	11	11	11
Silver	µg/L Ag	0.05	0.05	0.05
Uranium	µg/L U	2	2	0.5
Vanadium	µg/L V	19	10	6
Zinc	µg/L Zn	172	22	3,070
Mercury	µg/L Hg	0.06	0.06	0.06
Ammonia	mg/L N	0.8	1.6	0.9
Nitrate	mg/L N	0.6	0.1	0.7
Nitrite	mg/L N	NV	NV	NV
T. Phosphorous	mg/L P	0.13	0.39	0.42
Total Recoverable Hydrocarbons	ppb (C ₆ – C ₉)	Detect above LOR	Detect above LOR	Detect above LOR
Total Recoverable Hydrocarbons	ppb (C ₆ – C ₁₀)	Detect above LOR	Detect above LOR	Detect above LOR
Total Recoverable Hydrocarbons	ppb (C ₁₀ – C ₄₀)	Detect above LOR	Detect above LOR	Detect above LOR

Parameter	Units	C558P1 Contaminant Limits	Bores C025P2 and C029P2 Contaminant Limits	All other Tertiary Sediments Contaminant Limits
BTEX	ppb	Detect above LOR	Detect above LOR	Detect above LOR
pH	pH units	6 - 9	6 - 9	6 - 9
Electrical Conductivity	µS/cm	9,584	14,600	3,700
Total Dissolved Solids	mg/L	5,784	9,000	2,500

Clematis Sandstone

Parameter	Units	Bores HD03A and C14021SP Contaminant Limits	All other Clematis Sandstone Bores Contaminant Limits
Calcium	mg/L Ca	5.2	6.6
Magnesium	mg/L Mg	11.0	9.7
Potassium	mg/L K	19	17
Sodium	mg/L Na	143	126
Chloride	mg/L Cl	158	130
Sulphate	mg/L SO ₄	21	11
Alkalinity	mg/L CaCO ₃	140	125
Sulphide	mg/L S ₂	NV	NV
Fluoride	mg/L F	0.3	0.5

Parameter	Units	Bores HD03A and C14021SP Contaminant Limits	All other Clematis Sandstone Bores Contaminant Limits
Aluminium	µg/L Al	24	24
Arsenic	µg/L As	14	13
Boron	µg/L B	130	140
Cadmium	µg/L Cd	NV	NV
Chromium	µg/L Cr	NV	NV
Cobalt	µg/L Co	4	4
Copper	µg/L Cu	19.8	55.3
Iron	µg/L Fe	632	80
Lead	µg/L Pb	NV	NV
Manganese	µg/L Mn	447	153
Molybdenum	µg/L Mo	NV	NV
Nickel	µg/L Ni	18	18
Selenium	µg/L Se	NV	NV
Silver	µg/L Ag	NV	NV
Uranium	µg/L U	NV	NV
Vanadium	µg/L V	NV	NV
Zinc	µg/L Zn	88	695
Mercury	µg/L Hg	NV	NV

Parameter	Units	Bores HD03A and C14021SP Contaminant Limits	All other Clematis Sandstone Bores Contaminant Limits
Ammonia	mg/L N	0.2	0.6
Nitrate	mg/L N	0.3	0.8
Nitrite	mg/L N	NV	NV
T. Phosphorous	mg/L P	0.12	0.24
Total Recoverable Hydrocarbons	ppb (C ₆ – C ₉)	Detect above LOR	Detect above LOR
Total Recoverable Hydrocarbons	ppb (C ₆ – C ₁₀)	Detect above LOR	Detect above LOR
Total Recoverable Hydrocarbons	ppb (C ₁₀ – C ₄₀)	Detect above LOR	Detect above LOR