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 Enquiries to: Emma Smith

Date: 12th December 2013

To: Marc Morris
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Re: Lethbridge West Water Monitoring, May 2013

Dear Marc,

EcOz Environmental Services (EcOz) have conducted groundwater and surface water monitoring at the Lethbridge West mine site both during mining and after completion of mining. Survey dates and water monitoring activities are provided in Table 1. To our knowledge, pre-mining sampling data is not available.

Groundwater bore locations and surface water sites are shown in Figure 1. Groundwater bores are up to 25 m deep and comprise 50 mm diameter PVC casing which is slotted along most of its length. Groundwater bores are located within the mined area and also surrounding the mined area. Bores 1A and 1B are located next to each other, where 1A is deeper than 1B.

The camp water supply bore was also sampled. This bore is located away from the mined area in a different hydrogeological environment on the elevated sandstone upland area.

Surface water sampling was limited given there are no permanent freshwater bodies in the area and nearby tidal inlets are regularly flushed with seawater and testing their water quality would not be representative of any impacts from mining unless sampled immediately after rainfall and run-off.

Table 1. Water monitoring survey dates and activities

Context	Survey Dates	Monitoring Undertaken	Comments
During mining	30 July 2010	Groundwater sampling: Bores 1A, 1B, 3, 5, 6, 8, Camp water supply	Bore 2 is damaged and could not be sampled
	3-5 January 2011	Groundwater sampling: Bores 1A, 3, 4, 5, 6, 8, Camp water supply	Bore 2 is damaged and could not be sampled
		Surface Water sampling: Sites 1, 2	Site 1 is in tidal inlet and Site 2 only has water in wet season
After mining	16-17 May 2013	Groundwater sampling: 1B, 2, 3, 4, 5, 6, 8, Camp water supply	No permanent surface water bodies receiving run-off from mined area – no surface water samples collected Bore 2 re-instated and could be sampled

Sampling Methods

Groundwater and surface water sampling followed the *EcOz Standard Operating Procedure: Groundwater Sampling* and *EcOz Standard Operating Procedure: Surface Water Sampling* respectively (see Appendix A and Appendix B). These procedures comply with the NT Department of Mines and Energy *Methodology for the Sampling of Groundwaters* (DME 2009), Australian Standards on Water Quality Sampling – Part 1 *Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples* (AS/NZS 5667.1:1998) and Australian Standard on Water Quality Sampling – Part 11 *Guidance on sampling of groundwater* (AN/NZS 5667.11:1998).

Samples were analysed by NATA accredited ALS Laboratories (all laboratory QA/QC reports, chain of custody forms and certificates of analysis supplied separately via email).

Results

Field and laboratory results from May 2013 are provided in Tables 2 and 3. The full suite of results have been entered into a database (excel spreadsheet) provided separately (via email) along with this report.

Results are assessed against the ANZECC 2000 *Australian and New Zealand Guidelines for Fresh and Marine Water Quality* (95% species protection level in freshwater).

Overall, results show little impact on water quality due to mining. Chromium, copper and zinc were slightly elevated during mining. However, all post-mining metals concentrations were below the ANZECC 2000 guidelines. Standing water levels also, appear un-impacted given that all groundwater levels were within 3 m of the surface regardless of whether they are within or near to the cleared mined area (4, 5, 8) or distant from mining (1A, 1B, 2, 3, 6).

Electrical conductivity (EC) and Total Dissolved Solids (TDS) show the influence of seawater ingress with saline EC levels ($EC > 10\,000\ \mu\text{S}/\text{cm}$) in bores 1B, 3, 4, 6 and 2 and brackish EC levels ($EC < 10\,000\ \mu\text{S}/\text{cm}$) in bores 1A, 5 and 8.

pH in both groundwater and surface water is around neutral; ranging between 5.0 and 8.0.

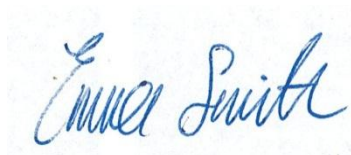
The camp water supply is fresh and has low EC and TDS; although levels appear to be slightly increasing as time goes on and the aquifer is pumped. Given that operations have now ceased, the aquifer will likely return to pre-extraction levels following the 2013/14 wet season. Copper and zinc levels in the camp bore were occasionally slightly elevated above the ANZECC 2000 guidelines.

Surface water results measured during the wet season in January 2011 indicated no impact on the nearby drainage line (Site 2) east of the mining area, with all metals concentrations below ANZECC 2000 guidelines. The nearby tidal inlet (Site 1) recorded slightly elevated copper and zinc, although this is expected to have returned to natural seawater levels with tidal flushing over the dry season in the absence of surface water run-off.

Conclusions

The water quality of groundwater and surface water at Lethbridge West does not appear impacted as a result of mining. It is not considered necessary to conduct any further groundwater or surface water sample collection.

Yours sincerely,



Emma Smith

Senior Environmental Scientist

EcOz Environmental Services

References

- DME 2009, *Methodology for the Sampling of Groundwaters*, Advisory Note, 2009. Northern Territory Department of Mines and Energy (DME), NT Government, Darwin.
- Australian/New Zealand Standard on Water Quality Sampling - Part 1: *Guidance on the design of sampling programs, sampling techniques and the preservation and handling of samples* (AS/NZS 5667.1:1998), Standards Australia, New South Wales.
- Australian/New Zealand Standard on Water Quality Sampling – Part 11: *Guidance on sampling of groundwater* (AS/NZS 5667.11:1998), Standards Australia, New South Wales.
- ANZECC & AMRCANZ 2000, *Australian Guidelines for Water Quality Monitoring and Reporting*, National Water Quality Management Strategy Paper No 7, Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), Canberra.
- ANZECC & AMRCANZ 2000, *Australian and New Zealand Guidelines for Fresh and Marine Water Quality*, National Water Quality Management Strategy Paper No 4, Australian and New Zealand Environment and Conservation Council (ANZECC) and Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ), Canberra.

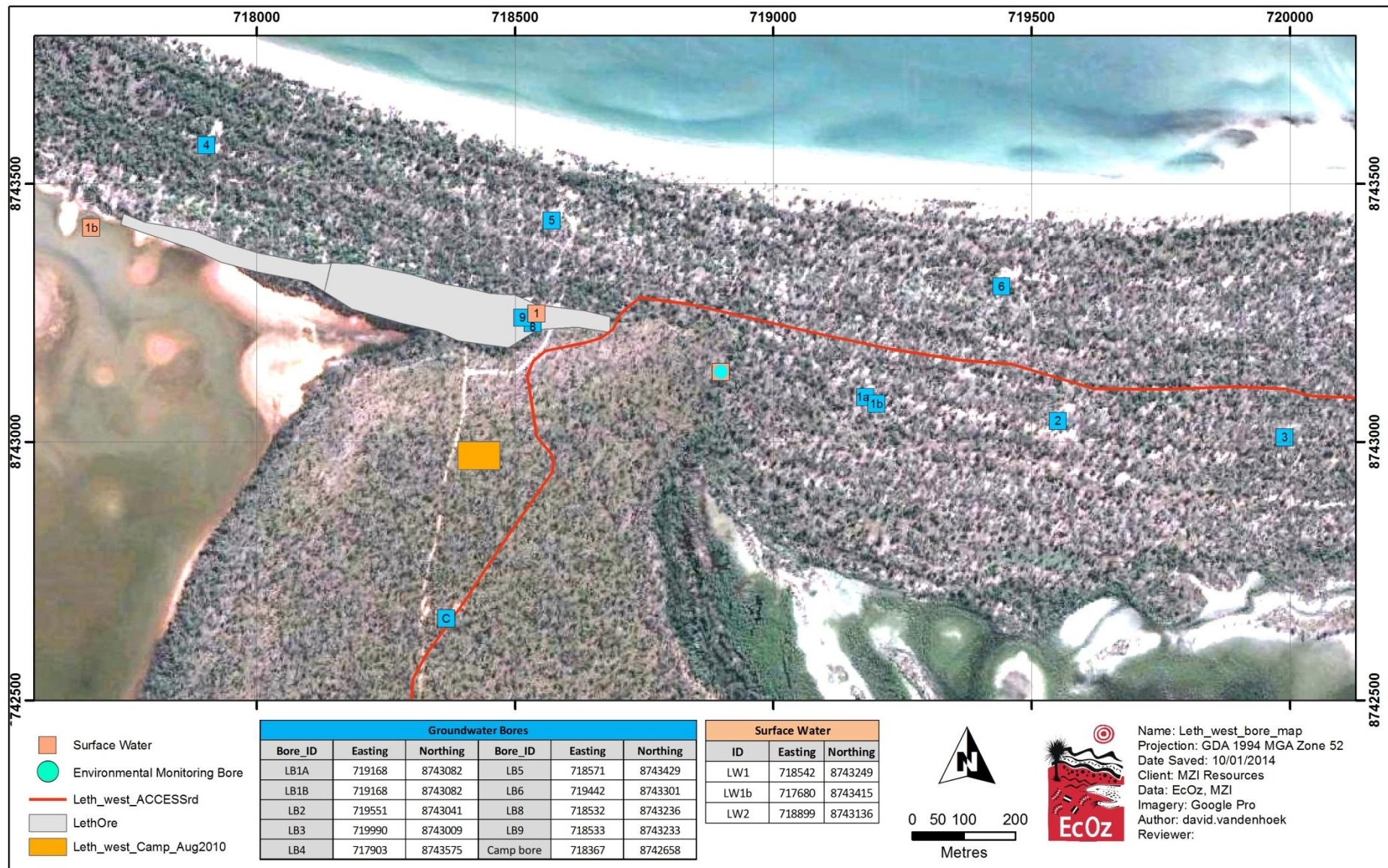


Figure 1. Map of groundwater bores and surface water sites

Table 2. Physical parameters, major anions and cations

Site ID	Date	SWL	Temp	pH	EC	TDS	Bicarbonate Alkalinity as CaCO3	Carbonate Alkalinity as CaCO3	Hydroxide Alkalinity as CaCO3	Total Alkalinity as CaCO3	Sulfate as SO4	Chloride	Calcium	Magnesium	Potassium	Sodium
		mbgl	°C	pH units	µS/cm	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ANZECC Guideline - 95% Species Protection Freshwater		-	-	6-8	-	-	-	-	-	-	-	-	-	-	-	-
Groundwater																
LW_G 1A	30/07/2010	1.62	28.6	7.4	-	1420	425	<1	<1	425	1	725	94	68	22	411
LW_G 1B	30/07/2010	1.72	-	5.9	-	51400	86	<1	<1	86	4430	29100	691	1860	702	15200
LW_G 3	30/07/2010	2.29	28.4	7.5	-	7120	704	<1	<1	704	43	3770	121	229	97	2040
LW_G 5	30/07/2010	2.00	30.3	7.3	1930	1900	376	<1	<1	376	86	942	141	68	12	489
LW_G 6	30/07/2010	0.99	-	7.6	-	6770	660	<1	<1	660	120	3980	173	238	88	1970
LW_G 8	30/07/2010	1.89	-	7.1	6370	369	245	<1	<1	245	<1	70	91	6	<1	44
CAMP BORE	30/07/2010	-	26.5	5.6	65	33	3	<1	<1	3	<1	14	<1	<1	<1	9
LW_G 1B	4/01/2011	-	-	7.9	2510	1450	294	<1	<1	294	13	692	79	54	17	366
LW_G 3	5/01/2011	-	-	8.0	12500	9720	641	<1	<1	641	62	4480	129	256	110	2380
LW_G 4	4/01/2011	-	-	7.9	36400	28600	504	<1	<1	504	1870	15000	455	949	283	7930
LW_G 5	4/01/2011	-	-	7.7	3550	2270	320	<1	<1	320	58	1050	143	77	16	482
LW_G 6	4/01/2011	-	-	8.0	10700	8300	518	<1	<1	518	148	3650	183	232	80	1770
LW_G 8	4/01/2011	-	-	7.5	4780	3370	205	<1	<1	205	242	1520	310	43	7	687
CAMP BORE	4/01/2011	-	-	6.1	78	62	3	<1	<1	3	<1	19	<1	<1	<1	12
LW_G 1B	16/05/2013	0.77	29.8	5.8	43300	28150	162	<1	<1	162	2420	16400	470	1260	462	9800
LW_G 2	16/05/2013	1.25	30.1	7.0	10590	6890	391	<1	<1	391	402	3260	169	245	75	1890
LW_G 3	16/05/2013	1.50	29.4	7.2	11160	7320	707	<1	<1	707	65	3680	118	238	98	2170
LW_G 4	16/05/2013	1.15	29.4	7.0	33780	22140	622	<1	<1	622	1520	12500	510	978	363	7420
LW_G 5	16/05/2013	1.51	29.0	6.9	7130	4650	347	<1	<1	347	234	2470	259	156	32	1330
LW_G 6	16/05/2013	1.24	30.5	7.4	12770	8290	625	<1	<1	625	402	5120	216	366	119	2870
LW_G 8	16/05/2013	0.99	30.4	6.6	2165	1408	191	<1	<1	191	64	550	132	21	4	315
CAMP BORE	17/05/2013	-	29.8	-	213	138	<1	<1	<1	<1	<1	12	<1	<1	<1	8
Surface Water																
LW_S 1	4/01/2011	-	33.5	7.3	36000	46200	97	<1	<1	97	2010	15000	282	894	306	7590
LW_S 2	4/01/2011	-	30.1	5.9	1744	856	10	<1	<1	10	251	497	93	35	5	234

Table 3. Dissolved metals concentrations

Site ID	Date	Aluminium	Arsenic	Cadmium	Chromium	Copper	Iron	Lead	Manganese	Nickel	Silver	Thorium	Titanium	Uranium	Zinc	Zirconium	Mercury
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
ANZECC Guideline - 95% <i>Species Protection Freshwater</i>		0.055	0.013	0.0002	0.001	0.0014	-	0.0034	1.9	0.011	0.00005	-	-	-	0.008	-	0.0006
Groundwater																	
LW_G 1A	30/07/2010	<0.01	0.002	<0.0001	<0.001	<0.001	0.55	<0.001	0.064	<0.001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.005	<0.0001
LW_G 1B	30/07/2010	<0.50	<0.050	<0.0010	<0.010	<0.050	<0.50	<0.010	0.356	<0.050	<0.010	<0.010	<0.10	<0.010	0.104	<0.050	<0.0001
LW_G 3	30/07/2010	<0.01	0.003	<0.0001	0.011	0.003	0.34	<0.001	0.089	0.001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.005	<0.0001
LW_G 5	30/07/2010	<0.01	<0.001	<0.0001	0.004	0.001	0.21	<0.001	0.130	<0.001	<0.001	<0.001	<0.01	<0.001	0.007	<0.005	<0.0001
LW_G 6	30/07/2010	<0.01	<0.001	<0.0001	0.006	0.002	0.23	<0.001	0.052	0.001	<0.001	<0.001	<0.01	<0.001	0.012	<0.005	<0.0001
LW_G 8	30/07/2010	<0.01	0.004	<0.0001	0.002	<0.001	0.15	<0.001	0.048	<0.001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.005	<0.0001
CAMP BORE	30/07/2010	<0.01	<0.001	<0.0001	<0.001	0.033	<0.05	0.001	0.002	<0.001	<0.001	<0.001	<0.01	<0.001	0.012	<0.005	<0.0001
LW_G 1A	4/01/2011	<0.01	0.003	<0.0001	<0.001	<0.001	1.81	<0.001	0.066	<0.001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.005	<0.0001
LW_G 3	5/01/2011	<0.01	0.002	<0.0001	<0.001	0.001	2.52	<0.001	0.097	<0.001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.005	<0.0001
LW_G 4	4/01/2011	<0.01	<0.001	<0.0001	0.002	0.003	0.4	<0.001	0.199	<0.001	<0.001	<0.001	0.02	<0.001	0.011	<0.005	<0.0001
LW_G 5	4/01/2011	<0.01	<0.001	<0.0001	<0.001	<0.001	3.91	<0.001	0.131	<0.001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.005	<0.0001
LW_G 6	4/01/2011	<0.01	0.001	<0.0001	<0.001	<0.001	<0.05	<0.001	0.071	<0.001	<0.001	<0.001	<0.01	<0.001	0.006	<0.005	<0.0001
LW_G 8	4/01/2011	<0.01	0.005	<0.0001	<0.001	<0.001	4.33	<0.001	0.215	<0.001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.005	<0.0001
CAMP BORE	4/01/2011	<0.01	<0.001	<0.0001	<0.001	<0.001	<0.05	<0.001	<0.001	<0.001	<0.001	<0.001	<0.01	<0.001	<0.005	<0.005	<0.0001
LW_G 1B	16/05/2013	-	0.010	<0.0010	<0.010	<0.010	-	<0.010	-	<0.010	-	-	-	-	<0.050	-	<0.0001
LW_G 2	16/05/2013	-	0.004	<0.0001	<0.001	<0.001	-	<0.001	-	<0.001	-	-	-	-	<0.005	-	<0.0001
LW_G 3	16/05/2013	-	<0.001	<0.0001	<0.001	<0.001	-	<0.001	-	<0.001	-	-	-	-	<0.005	-	<0.0001
LW_G 4	16/05/2013	-	<0.001	<0.0001	<0.001	<0.001	-	<0.001	-	0.002	-	-	-	-	<0.005	-	<0.0001
LW_G 5	16/05/2013	-	0.008	<0.0001	<0.001	<0.001	-	<0.001	-	<0.001	-	-	-	-	<0.005	-	<0.0001
LW_G 6	16/05/2013	-	<0.001	<0.0001	<0.001	<0.001	-	<0.001	-	<0.001	-	-	-	-	<0.005	-	<0.0001
LW_G 8	16/05/2013	-	0.002	<0.0001	<0.001	<0.001	-	<0.001	-	<0.001	-	-	-	-	<0.005	-	<0.0001
CAMP BORE	17/05/2013	-	<0.001	<0.0001	<0.001	0.013	-	0.002	-	<0.001	-	-	-	-	0.007	-	<0.0001
Surface Water																	
LW_S 1	4/01/2011	0.08	0.002	<0.0001	0.004	0.004	2.48	<0.001	0.024	<0.001	<0.001	<0.001	<0.01	0.003	0.005	<0.005	<0.0001
LW_S 2	4/01/2011	0.03	0.004	<0.0001	<0.001	<0.001	2.34	<0.001	0.358	0.006	<0.001	<0.001	<0.01	<0.001	<0.005	<0.005	<0.0001

Appendix A – EcOz Standard Operating Procedure – Groundwater Sampling

Appendix B – EcOz Standard Operating Procedure – Surface Water Sampling