

Our Ref: 217500_LET_003.docx

18 June 2018

Lithgow City Council
PO Box 19,
180 Mort Street
Lithgow NSW 2790

Attention: Nigel Campbell, Waste & Recycling Coordinator

ENVIRONMENTAL MONITORING OF LITHGOW SOLID WASTE FACILITY

Geolyse has completed biannual groundwater and accumulated landfill gas monitoring at Lithgow Solid Waste Facility, located off Geordie Street, Lithgow. The leachate monitoring point LW1 was inspected however no discharge was occurring and leachate sampling was unable to be conducted.

Groundwater Levels

Groundwater was gauged at six (6) groundwater monitoring wells across the site. Groundwater gauging data is included in **Table 1** (attached), and elevation trends are shown on **Figure 1**. No groundwater was recorded in monitoring stations MB1, MB6, MB11 and MB13. Observations were as follows:

- Depths to groundwater ranged from 3.50 metres below ground level (mbgl) at MB14, to 13.99 mbgl at MB9. Corrected groundwater elevations ranged from 897.07 metres Australian Height Datum (mAHD) at MB14, to 934.66 mAHD at MB6B.
- Inference of groundwater elevations, calculated from available survey data from installed groundwater monitoring wells indicate a flow direction to the south-west.

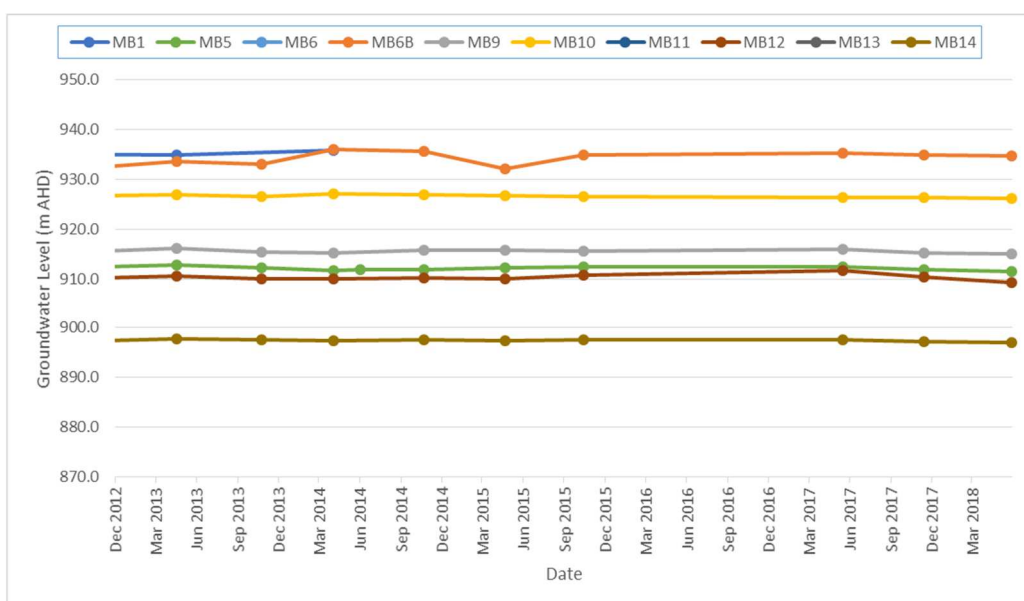


Figure 1: Lithgow Solid Waste Facility – Groundwater Elevations

Groundwater Quality

Groundwater samples were able to be collected from wells MB5, MB6B, MB9, MB10, MB12 and MB14. Samples were couriered to SGS Laboratories in Alexandria, NSW, who are NATA accredited to perform the scheduled analysis. Results of analysis are included in **Table 2** (attached), and laboratory certificates have also been appended to this letter.

Groundwater quality has been assessed by comparison to criteria (where available) adopted from Australian and New Zealand Environment and Conservation Council (ANZECC) Agriculture and Resource Management Council of Australia and New Zealand (ARMCANZ) *Australian and New Zealand Guidelines for Fresh and Marine Water Quality 2000 – Primary Industries: Water quality for irrigation and general water use*.

- Laboratory measured pH ranged from 4.6 at MB12 to 6.8 at MB14. pH of groundwater at MB9 (pH of 5.8) and MB12 was below the guideline range considered suitable for pumping, irrigation and stock watering (6.0 to 8.5 pH units).
- Electrical conductivity (EC) ranged from 430 $\mu\text{S}/\text{cm}$ at piezometer MB9 to 1,300 $\mu\text{S}/\text{cm}$ at piezometer MB5.
- Total dissolved solids (TDS) ranged from 220 mg/L at MB9 to 720 mg/L at MB5. TDS concentrations were below the livestock watering 'loss of production' tolerance limit for the most susceptible livestock category, poultry (3,000 mg/L – ANZECC & ARMCANZ, 2000).
- The chemical oxygen demand (COD) of groundwater samples ranged from below the laboratory limit of reporting (LOR) of 10 mg/L at MB9 and MB14, to 19 mg/L at MB10.
- Total alkalinity in groundwater ranged from 19 mg/L at MB12 to 360 mg/L at MB6B. Alkalinity of groundwater at MB6B was above the guideline hardness value for potential fouling of waters (350 mg/L).
- Groundwater chloride concentrations ranged from 32 mg/L at MB14 to 260 mg/L at MB5. All concentrations were below the guideline value for protection of moderately sensitive crops (350 mg/L).
- Fluoride concentrations in groundwater were all below the laboratory LOR of 0.1 mg/L. All concentrations were below the guideline value of 1 mg/L for long term irrigation use (up to 100 years).
- Sulfate concentrations in groundwater ranged from 10 mg/L at MB10 to 95 mg/L at MB12.
- Calcium concentrations ranged from 21 mg/L at MB9 to 92 mg/L at MB14.
- Magnesium concentrations ranged from 13 mg/L at MB9 and MB10, to 62 mg/L at MB6B.
- Potassium concentrations ranged from 9.5 mg/L at MB12 and MB14, to 59 mg/L at MB5.
- Concentrations of sodium ranged from 18 mg/L at MB14, to 100 mg/L at MB5. Sodium concentrations were below the guideline level for irrigation to moderately sensitive crops (<230 mg/L).
- Ammonia concentrations in groundwater ranged from 0.2 mgN/L at MB14 to 13 mgN/L at MB5.
- Nitrate concentrations ranged from below the laboratory LOR of 0.005 mgN/L at MB6B, MB9, MB12 and MB14, to 0.30 mgN/L at MB5.
- Phosphorus concentrations in groundwater ranged from below the laboratory LOR of 0.02 mg/L at MB12 to 0.08 mg/L at MB6B. Phosphorus concentrations at MB5, MB6B and MB9 were above the guideline value of 0.05 mg/L for long term irrigation use (up to 100 years).





- Aluminium concentrations ranged from below the laboratory LOR of 5 µg/L at all monitoring wells with the exception of MB12, which recorded a concentration of 990 µg/L. Aluminium concentrations in groundwater were below the long-term (up to 100 years) irrigation guideline concentration of 5,000 µg/L.
- Chromium and hexavalent chromium concentrations were below the respective laboratory LORs of 1 µg/L and 0.004 mg/L at all groundwater monitoring locations. All concentrations were lower than the long-term (up to 100 years) irrigation guideline concentration of 200 µg/L.
- Iron concentrations ranged from below the laboratory LOR of 5 µg/L at MB14 to 37,000 µg/L at MB12. Iron concentrations at MB6B, MB9, MB10 and MB12 exceeded the long-term (up to 100 years) irrigation guideline concentration of 200 µg/L.
- Manganese concentrations ranged from 71 µg/L at MB14 to 3,300 µg/L at MB6B. Manganese concentrations at all locations excluding MB14 exceeded the long-term (up to 100 years) irrigation guideline concentration of 200 µg/L.
- Total phenols were below the laboratory LOR of 0.01 mg/L at all groundwater monitoring points.
- Total organic carbon (TOC) in groundwater ranged from 2.6 mg/L at MB9 to 7.6 mg/L at MB5.
- Organochlorine pesticides and organophosphorus pesticides were below respective laboratory LORs at all groundwater monitoring points.
- Total petroleum hydrocarbons (TPH) and total recoverable hydrocarbons (TRH) were below respective laboratory LORs at all groundwater monitoring points for all fractions.

Accumulated Landfill Gas Monitoring

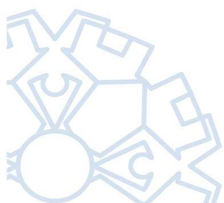
Gas concentrations in buildings and sheds within the required monitoring distance of 250 metres of filled areas were all below the respective threshold concentration of 1.25 % (v/v) during the monthly monitoring rounds conducted in February 2018 to May 2018.

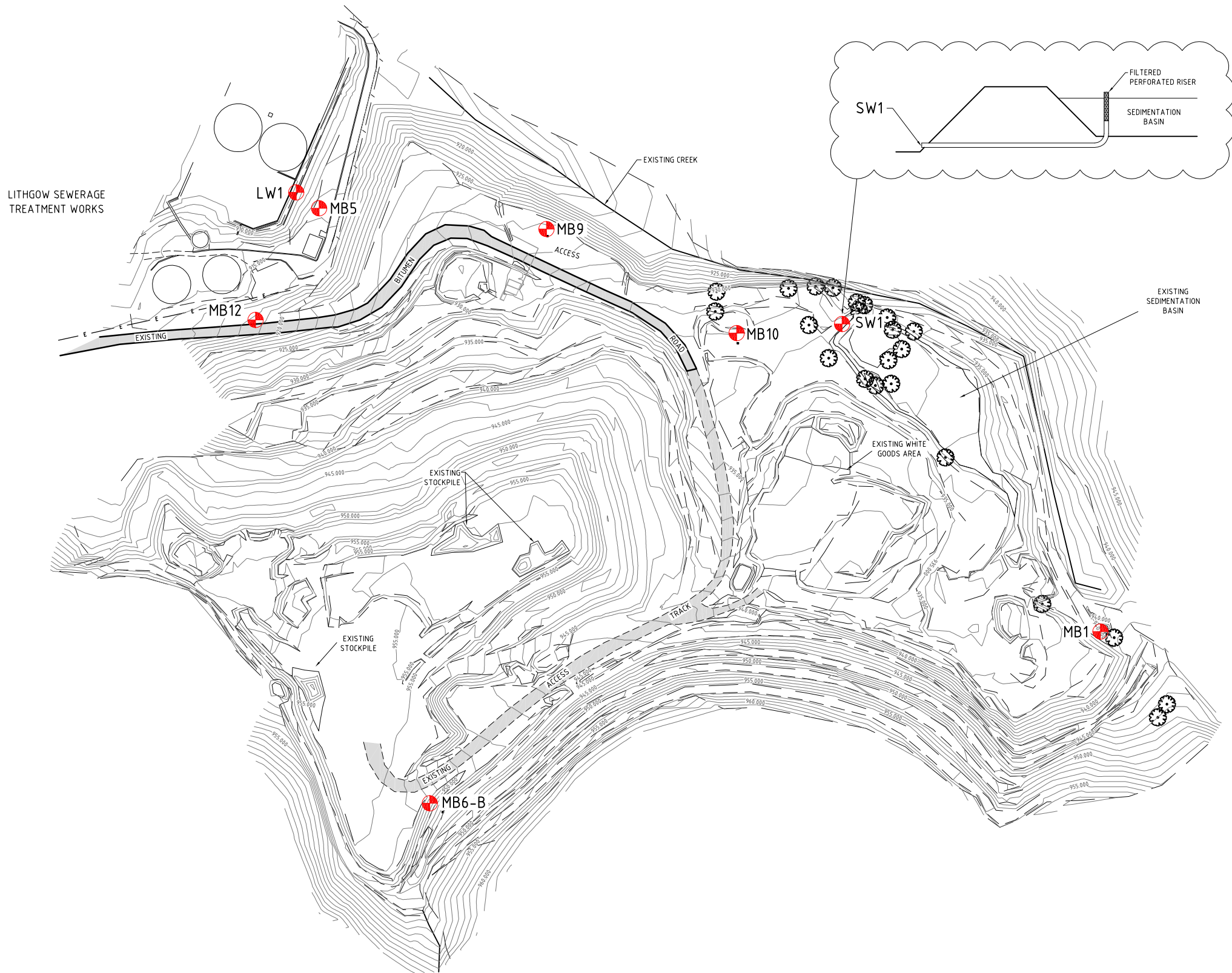
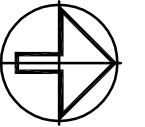
The next routine monitoring for groundwater and leachate is scheduled for November 2018. Surface water monitoring is required to take place any calendar month when a surface water discharge is recorded. Please do not hesitate to contact us with any questions or comments you may have regarding this report.

Yours faithfully
Geolyse Pty Ltd

BRENDAN STUART
Environmental Scientist

No. of Attachments – 4: Environmental Monitoring Point Locations
Table 1 – Groundwater Level Measurements
Table 2 – Results of Laboratory Analyses – May 2018
Table 3 – Accumulated Landfill Gas Monitoring
SGS Laboratories Analytical Reports – May 2018





EPA MONITORING POINTS		
EPA ID No.	LOCATION	TYPE
1	MB1	GROUNDWATER
2	MB5	GROUNDWATER
3	MB6-B	GROUNDWATER
4	MB9	GROUNDWATER
5	MB10	GROUNDWATER
6	SW1	AMBIENT WATER
7	MB12	GROUNDWATER
8	MB14	GROUNDWATER
9	LW1	LEACHATE
10		LANDFILL GAS

- NOTES:
- THIS PLAN IS PREPARED FROM A FIELD SURVEY FOR THE PURPOSE OF DESIGNING NEW CONSTRUCTIONS ON THE LAND AND SHOULD NOT BE USED FOR ANY OTHER PURPOSE.
 - VISIBLE SERVICES HAVE BEEN LOCATED ONLY. PRIOR TO ANY DEMOLITION, EXCAVATION OR CONSTRUCTION ON THE SITE, THE RELEVANT AUTHORITIES SHOULD BE CONTACTED FOR LOCATION OF FURTHER UNDERGROUND SERVICES AND DETAILED LOCATIONS OF ALL SERVICES.
 - CONTOUR INTERVAL 1m.
 - THESE NOTES ARE AN INTEGRAL PART OF THIS PLAN.

- LEGEND:
- EXISTING TOP OF BANK
 - EXISTING BOTTOM OF BANK
 - EXISTING TRACK
 - EXISTING ELECTRICITY
 - EXISTING FENCE
 - EXISTING VEGETATION
 - EXISTING ACCESS ROAD

SCALE 1:1500(A1)
0 10 20 40 60 80 100
0 10 20 40 60 80 100
SCALE 1:3000(A3)

**GEOLYSE**
ORANGE
orange@geolyse.com
www.geolyse.com

154 PEISLEY STREET
P.O. BOX 1963
ORANGE, NSW 2800
Ph. (02) 6393 5000
Fx. (02) 6393 5050

No	DATE	DRAFTING CHECK	PM CHECK	DETAILS
A	27/06/11	LP	AB	WORKING DRAFT
B	28/09/11	LP	AB	EPL VARIATION

PROJECT

LITHGOW SOLID WASTE FACILITY
LANDFILL ENVIRONMENTAL
MANAGEMENT PLAN

FILE REFERENCE: 0:\Projects\211109\04\1\Cad\Lithgow\211109_04_EV01-EV09.dwg

APPROVAL AUTHORITY

ENVIRONMENTAL PROTECTION AUTHORITY
EPL : 6004

CLIENT


CITY OF LITHGOW COUNCIL

DRAWING

ENVIRONMENTAL MONITORING
POINTS

PROJECT NUMBER: 211109 DRAWING NUMBER: 01B_EV04 REV. B

SOURCE: CRAVEN, ELLISTON & HAYES (LITHGOW) PTY. LTD. (DRAWING No. E668-10, DATED 19/04/2010)



TABLE 1: LITHGOW SOLID WASTE FACILITY - GROUNDWATER LEVEL RESULTS

Ground Water Levels: 13-Nov-17

Piezometer Details:

	Ground Elev (mAHD)	Stickup (m)	Elevation Top PVC (mAHD)	Date	Measured (m)	GWL (mAHD)	Well Depth (m)	Well Base (mAHD)	Water Column (m)
MB1	939.790	0.86	940.650	13/11/2017	NMWL	-	6.5	934.15	nil
MB5	914.940	0.80	915.740	13/11/2017	3.80	911.94	9.8	905.94	6.00
MB6	945.820	0.85	946.670	13/11/2017	NMWL	-	-	-	nil
MB6B	946.290	0.75	947.040	13/11/2017	12.15	934.89	19.3	927.74	7.15
MB9	928.260	0.69	928.950	13/11/2017	13.84	915.11	17.1	911.85	3.26
MB10	932.180	0.73	932.910	13/11/2017	6.63	926.28	13.7	919.21	7.07
MB11	915.010	0.67	915.680	13/11/2017	NMWL	-	17.9	897.82	nil
MB12	918.330	0.76	919.090	13/11/2017	8.70	910.39	22.3	896.84	13.55
MB13	914.980	0.70	915.680	13/11/2017	NMWL	-	39.4	876.28	nil
MB14	899.790	0.78	900.570	13/11/2017	3.29	897.28	17.7	882.87	14.41

Definitions:

- Stickup: Height of piezometer pipe above ground surface.
- Ground Elev: Actual elevation of ground at the piezometer relative to an arbitrary datum. All ground elevations are measured to the same datum, hence Piezo GWLs are relative to each other.
- GWL: Actual elevation of groundwater at the piezometer relative to an arbitrary datum.
- Measured: Depth of groundwater measured from the top of the piezometer pipe.

Date	MB1		MB5		MB6		MB6B		MB9		MB10		MB11		MB12		MB13		MB14	
	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)
25-Oct-11	NMWL		3.20	912.54	NMWL		9.92	937.12	12.62	916.33	5.77	927.14	NMWL		8.69	910.40	NMWL		2.80	897.77
8-Feb-12	5.85	934.80	3.26	912.48	NMWL		4.68	942.36	12.71	916.24	5.83	927.08	6.87	908.81	8.77	910.32	6.89	908.79	NMWL	
15-Mar-12	3.11	937.54	2.29	913.45	NMWL		7.82	939.22	11.56	917.39	5.51	927.40	6.08	909.60	7.95	911.14	6.11	909.57	2.64	897.93
24-Apr-12	NMWL		2.55	913.19	NMWL		7.47	939.57	12.10	916.85	5.78	927.13	NMWL		8.24	910.85	NMWL		2.67	897.90
31-May-12	5.55	935.10	3.07	912.67	NMWL		9.71	937.33	12.73	916.22	6.04	926.87	NMWL		8.43	910.66	NMWL		2.64	897.93
30-Oct-12	NMWL		3.29	912.45	NMWL		14.64	932.40	13.33	915.62	6.19	926.72	6.83	908.85	8.90	910.19	6.87	908.81	3.11	897.46
17-Apr-13	5.81	934.84	2.87	912.87	NMWL		13.55	933.49	12.80	916.15	6.10	926.81	NMWL		8.50	910.59	NMWL		2.91	897.66
23-Oct-13	NMWL		3.44	912.30	NMWL		13.97	933.07	13.60	915.35	6.35	926.56	NMWL		9.01	910.08	NMWL		3.09	897.48
2-Apr-14	4.90	935.75	3.98	911.76	NMWL		11.00	936.04	13.66	915.29	5.75	927.16	NMWL		9.04	910.05	NMWL		3.20	897.37
2-Jun-14	NMWL		3.96	911.78	NMWL		NMWL		NMWL		NMWL		NMWL		NMWL		NMWL		NMWL	
21-Oct-14	NMWL		3.81	911.93	NMWL		11.41	935.63	13.13	915.82	6.01	926.90	NMWL		8.89	910.20	NMWL		2.97	897.60
21-Apr-15	NMWL		3.56	912.18	NMWL		14.98	932.06	13.19	915.76	6.26	926.65	NMWL		9.06	910.03	NMWL		3.27	897.30
13-Oct-15	NMWL		3.34	912.40	NMWL		12.18	934.86	13.30	915.65	6.30	926.61	NMWL		8.35	910.74	NMWL		3.06	897.51
15-May-17	6.36		3.37	912.38	NMWL		11.88	935.16	13.09	915.86	6.58	926.34	NMWL		7.45	911.64	NMWL		3.05	897.52
13-Nov-17	NMWL		3.80	911.94	NMWL		12.15	934.89	13.84	915.11	6.63	926.28	NMWL		8.70	910.39	NMWL		3.29	897.28
29-May-18	NMWL		4.19	911.55	NMWL		12.38	934.66	13.99	914.96	6.83	926.08	NMWL		9.84	909.25	NMWL		3.50	897.07

TABLE 2: LITHGOW SOLID WASTE FACILITY - RESULTS OF LABORATORY ANALYSIS
MAY 2018

GROUNDWATER



				Sample ID	MB5	MB6-B	MB9	MB10	MB12	MB14
				Sample Date	29/05/2018	29/05/2018	29/05/2018	29/05/2018	29/05/2018	29/05/2018
Group	Analyte	LOR	Units	Criteria	PS	PS	PS	PS	PS	PS
Physical Parameters	pH (Lab)	0	No unit	6.0 - 8.5	6.1	6.2	5.8	6.6	4.6	6.8
	Electrical Conductivity (Lab)	2	µS/cm	4478	1300	1200	430	510	950	690
	Chemical Oxygen Demand	10	mg/L	-	18	17	< 10	19	18	< 10
	Total Dissolved Solids	10	mg/L	-	720	710	220	240	660	390
Alkalinity	Bicarbonate Alkalinity as CaCO3	5	mg/L	-	290	360	130	160	19	290
	Total Alkalinity as CaCO3	5	mg/L	350	290	360	130	160	19	290
Anions	Chloride	1	mg/L	350	260	200	52	55	230	32
	Fluoride	0.1	mg/L	1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Sulfate (SO4)	1	mg/L	-	16	33	19	10	95	39
Cations	Calcium (Ca)	0.2	mg/L	1000	81	73	21	31	31	92
	Magnesium (Mg)	0.1	mg/L	-	26	62	13	13	22	28
	Potassium (K)	0.1	mg/L	-	59	16	9.8	15	9.5	9.5
	Sodium (Na)	0.5	mg/L	230	100	66	28	31	73	18
Forms of Carbon	Total Organic Carbon	0.2	mg/L	-	7.6	5.6	2.6	7.1	5.3	4.2
Nutrients	Ammonia (NH3) as N	0.01	mg/L	-	13	1.1	2.6	9.3	3.3	0.2
	Nitrate (NO3) as N	0.005	mg/L	-	0.3	< 0.005	< 0.005	0.081	< 0.005	< 0.005
	Total Phosphorus	0.02	mg/L	0.05	0.06	0.08	0.07	0.04	< 0.02	0.02
Trace Metals	Hexavalent Chromium (Cr-VI)	0.004	mg/L	0.1	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004
	Chromium (Cr)	1	µg/L	-	< 1	< 1	< 1	< 1	< 1	< 1
	Aluminium (Al)	5	µg/L	5000	< 5	< 5	< 5	< 5	990	< 5
	Iron (Fe)	5	µg/L	200	200	1100	11000	450	37000	< 5
	Manganese (Mn)	1	µg/L	200	830	3300	1300	260	1900	71
Phenolics	Total Phenols	0.01	mg/L	-	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01	< 0.01
OC Pesticides	Aldrin	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Alpha BHC	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Alpha Chlordane	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Alpha Endosulfan	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Beta BHC	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Beta Endosulfan	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Delta BHC	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Dieldrin	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Endosulfan sulphate	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Endrin	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Endrin aldehyde	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Endrin ketone	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Heptachlor	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Heptachlor epoxide	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Hexachlorobenzene (HCB)	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Lindane (gamma BHC)	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Methoxychlor	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	p,p'-DDD	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	p,p'-DDE	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	p,p'-DDT	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	o,p'-DDD	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	o,p'-DDT	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	o,p'-DDE	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Gamma Chlordane	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	trans-Nonachlor	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Isodrin	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
	Mirex	0.1	µg/L	-	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
OP Pesticides	Azinphos-methyl	0.2	µg/L	-	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Bromophos Ethyl	0.2	µg/L	-	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Chlorpyrifos (Chlorpyrifos Ethyl)	0.2	µg/L	-	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Diazinon (Dimpylate)	0.5	µg/L	-	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
	Dichlorvos	0.5	µg/L	-	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
	Dimethoate	0.5	µg/L	-	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
	Ethion	0.2	µg/L	-	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Fenitrothion	0.2	µg/L	-	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Malathion	0.2	µg/L	-	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Parathion-ethyl (Parathion)	0.2	µg/L	-	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2	< 0.2
	Methidathion	0.5	µg/L	-	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
	Total Petroleum Hydrocarbons	TRH C6-C9	40	µg/L	-	< 40	< 40	< 40	< 40	< 40
	TRH C10-C14	50	µg/L	-	< 50	< 50	< 50	< 50	< 50	
	TRH C15-C28	200	µg/L	-	< 200	< 200	< 200	< 200	< 200	
	TRH C29-C36	200	µg/L	-	< 200	< 200	< 200	< 200	< 200	
	TRH C10-C36	450	µg/L	-	< 450	< 450	< 450	< 450	< 450	
	TRH C37-C40	200	µg/L	-	< 200	< 200	< 200	< 200	< 200	
Total Recoverable Hydrocarbons	TRH C6-C10	50	µg/L	-	< 50	< 50	< 50	< 50	< 50	< 50
	TRH C6-C10 minus BTEX (F1)	50	µg/L	-	< 50	< 50	< 50	< 50	< 50	< 50
	TRH >C10-C16 (F2)	60	µg/L	-	< 60	< 60	< 60	< 60	< 60	< 60
	TRH >C16-C34 (F3)	500	µg/L	-	< 500	< 500	< 500	< 500	< 500	< 500
	TRH >C34-C40 (F4)	500	µg/L	-	< 500	< 500	< 500	< 500	< 500	< 500
	TRH C10-C40	650	µg/L	-	< 650	< 650	< 650	< 650	< 650	< 650
BTEXN Analytes	Benzene (F0)	0.5	µg/L	-	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5

mg/L milligrams per litre
µg/L micrograms per litre
µS/cm microsiemens per centimetre
LOR limit of reporting
PS primary sample
Criteria Criteria adopted from Australian and New Zealand Environment and Conservation Council (ANZECC) Agriculture and Resource

Management Council of Australia and New Zealand (ARMCANZ) Australian and New Zealand Guidelines for Fresh and Marine Water Quality - 'Primary Industries: Water quality for irrigation and general water use', 2000, and/or

'Concentration Limits' in Section L2.4 of NSW EPA Environment Protection Licence 6004

within criteria
criteria exceeded

TABLE 3: LITHGOW SOLID WASTE FACILITY - ACCUMULATED LANDFILL GAS MONITORING
METHANE (as %, v/v)



		Date	24/07/2017	17/08/2017	7/09/2017	5/10/2017	14/11/2017	5/12/2017	16/01/2018	16/02/2018	23/03/2018	27/04/2018	29/05/2018
Location	LOR	Units											
Site Shed	0.005	%	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Weighbridge	0.005	%	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Office (STP)	0.005	%	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Green Shed (STP)	0.005	%	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005
Pump Room (STP)	0.005	%	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005	< 0.005

LOR limit of reporting

CLIENT DETAILS

Contact **Brendan Stuart**
 Client **GEOLYSE PTY LIMITED**
 Address **PO BOX 1963
 NSW 2800**

Telephone **61 2 68841525**
 Facsimile **(Not specified)**
 Email **bstuart@geolyse.com**

Project **217500 - Lithgow SWF**
 Order Number **(Not specified)**
 Samples **6**

LABORATORY DETAILS

Manager **Huong Crawford**
 Laboratory **SGS Alexandria Environmental**
 Address **Unit 16, 33 Maddox St
 Alexandria NSW 2015**

Telephone **+61 2 8594 0400**
 Facsimile **+61 2 8594 0499**
 Email **au.environmental.sydney@sgs.com**

SGS Reference **SE179808 R0**
 Date Received **31 May 2018**
 Date Reported **07 Jun 2018**

COMMENTS

Accredited for compliance with ISO/IEC 17025 - Testing. NATA accredited laboratory 2562(4354).

SIGNATORIES



Akheeque Beniamen
 Chemist



Dong Liang
 Metals/Inorganics Team Leader



Kamrul Ahsan
 Senior Chemist



Ly Kim Ha
 Organic Section Head



Teresa Nguyen
 Organic Chemist

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	SE179808.001 Water 29 May 2018 MB10	SE179808.002 Water 29 May 2018 MB12	SE179808.003 Water 29 May 2018 MB14	SE179808.004 Water 29 May 2018 MB5
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Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 31/5/2018

TRH C6-C10	µg/L	50	<50	<50	<50	<50
TRH C6-C9	µg/L	40	<40	<40	<40	<40

Surrogates

Dibromofluoromethane (Surrogate)	%	-	120	106	110	121
d4-1,2-dichloroethane (Surrogate)	%	-	106	112	114	114
d8-toluene (Surrogate)	%	-	107	110	122	108
Bromofluorobenzene (Surrogate)	%	-	88	85	88	89

VPF F Bands

Benzene (F0)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50	<50	<50

TRH (Total Recoverable Hydrocarbons) in Water Method: AN403 Tested: 4/6/2018

TRH C10-C14	µg/L	50	<50	<50	<50	<50
TRH C15-C28	µg/L	200	<200	<200	<200	<200
TRH C29-C36	µg/L	200	<200	<200	<200	<200
TRH C37-C40	µg/L	200	<200	<200	<200	<200
TRH C10-C36	µg/L	450	<450	<450	<450	<450
TRH C10-C40	µg/L	650	<650	<650	<650	<650

TRH F Bands

TRH >C10-C16	µg/L	60	<60	<60	<60	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500	<500	<500

OC Pesticides in Water Method: AN420 Tested: 4/6/2018

Hexachlorobenzene (HCB)	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Alpha BHC	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Lindane (gamma BHC)	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Aldrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Beta BHC	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Delta BHC	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Heptachlor epoxide	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDE	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Alpha Endosulfan	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Gamma Chlordane	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Alpha Chlordane	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
trans-Nonachlor	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDE	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Dieldrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Endrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDD	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
o,p'-DDT	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Beta Endosulfan	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDD	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
p,p'-DDT	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Endosulfan sulphate	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Endrin aldehyde	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Methoxychlor	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Endrin ketone	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Isodrin	µg/L	0.1	<0.1	<0.1	<0.1	<0.1
Mirex	µg/L	0.1	<0.1	<0.1	<0.1	<0.1

Parameter	Units	LOR	Sample Number	SE179808.001	SE179808.002	SE179808.003	SE179808.004
			Sample Matrix	Water	Water	Water	Water
			Sample Date	29 May 2018	29 May 2018	29 May 2018	29 May 2018
			Sample Name	MB10	MB12	MB14	MB5

OC Pesticides in Water Method: AN420 Tested: 4/6/2018 (continued)

Surrogates

Tetrachloro-m-xylene (TCMX) (Surrogate)	%	-	97	87	100	94
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OP Pesticides in Water Method: AN420 Tested: 4/6/2018

Dichlorvos	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Dimethoate	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Diazinon (Dimpylate)	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Fenitrothion	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Malathion	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Parathion-ethyl (Parathion)	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Bromophos Ethyl	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Methidathion	µg/L	0.5	<0.5	<0.5	<0.5	<0.5
Ethion	µg/L	0.2	<0.2	<0.2	<0.2	<0.2
Azinphos-methyl	µg/L	0.2	<0.2	<0.2	<0.2	<0.2

Surrogates

2-fluorobiphenyl (Surrogate)	%	-	64	64	66	56
d14-p-terphenyl (Surrogate)	%	-	80	80	78	72

Total Phenolics in Water Method: AN289 Tested: 1/6/2018

Total Phenols	mg/L	0.01	<0.01	<0.01	<0.01	<0.01
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pH in water Method: AN101 Tested: 31/5/2018

pH**	No unit	-	6.6	4.6	6.8	6.1
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Conductivity and TDS by Calculation - Water Method: AN106 Tested: 31/5/2018

Conductivity @ 25 C	µS/cm	2	510	950	690	1300
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Parameter	Units	LOR	Sample Number	SE179808.001	SE179808.002	SE179808.003	SE179808.004
			Sample Matrix	Water	Water	Water	Water
			Sample Date	29 May 2018	29 May 2018	29 May 2018	29 May 2018
			Sample Name	MB10	MB12	MB14	MB5

Forms of Carbon Method: AN190 Tested: 1/6/2018

Total Organic Carbon as NPOC	mg/L	0.2	7.1	5.3	4.2	7.6
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Alkalinity Method: AN135 Tested: 31/5/2018

Bicarbonate Alkalinity as CaCO ₃	mg/L	5	160	19	290	290
Total Alkalinity as CaCO ₃	mg/L	5	160	19	290	290

Anions by Ion Chromatography in Water Method: AN245 Tested: 1/6/2018

Chloride	mg/L	1	55	230	32	260
Sulfate, SO ₄	mg/L	1	10	95	39	16
Fluoride	mg/L	0.1	<0.10	<0.10	<0.10	<0.10
Nitrate Nitrogen, NO ₃ -N	mg/L	0.005	0.081	<0.005	<0.005	0.30

Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: AN291 Tested: 1/6/2018

Ammonia Nitrogen, NH ₃ as N	mg/L	0.01	9.3	3.3	0.20	13
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Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 4/6/2018

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	0.04	<0.02	0.02	0.06
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COD in Water Method: AN179/AN181 Tested: 6/6/2018

Chemical Oxygen Demand	mg/L	10	19	18	<10	18
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Parameter	Units	LOR
Sample Number	SE179808.001	SE179808.002
Sample Matrix	Water	Water
Sample Date	29 May 2018	29 May 2018
Sample Name	MB10	MB12
		MB14
		MB5

Hexavalent Chromium in water by Discrete Analyser Method: AN283 Tested: 1/6/2018

Hexavalent Chromium, Cr6+	mg/L	0.004	<0.004	<0.004	<0.004	<0.004
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Total Dissolved Solids (TDS) in water Method: AN113 Tested: 4/6/2018

Total Dissolved Solids Dried at 175-185°C	mg/L	10	240	660	390	720
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Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 4/6/2018

Calcium, Ca	mg/L	0.2	31	31	92	81
Magnesium, Mg	mg/L	0.1	13	22	28	26
Potassium, K	mg/L	0.1	15	9.5	9.5	59
Sodium, Na	mg/L	0.5	31	73	18	100

Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 4/6/2018

Aluminium, Al	µg/L	5	<5	990	<5	<5
Chromium, Cr	µg/L	1	<1	<1	<1	<1
Iron, Fe	µg/L	5	450	37000	<5	200
Manganese, Mn	µg/L	1	260	1900	71	830

		Sample Number	SE179808.005	SE179808.006
		Sample Matrix	Water	Water
		Sample Date	29 May 2018	29 May 2018
		Sample Name	MB6-B	MB9
Parameter	Units	LOR		

Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 31/5/2018

TRH C6-C10	µg/L	50	<50	<50
TRH C6-C9	µg/L	40	<40	<40

Surrogates

Dibromofluoromethane (Surrogate)	%	-	112	107
d4-1,2-dichloroethane (Surrogate)	%	-	114	104
d8-toluene (Surrogate)	%	-	112	93
Bromofluorobenzene (Surrogate)	%	-	87	80

VPF F Bands

Benzene (F0)	µg/L	0.5	<0.5	<0.5
TRH C6-C10 minus BTEX (F1)	µg/L	50	<50	<50

TRH (Total Recoverable Hydrocarbons) in Water Method: AN403 Tested: 4/6/2018

TRH C10-C14	µg/L	50	<50	<50
TRH C15-C28	µg/L	200	<200	<200
TRH C29-C36	µg/L	200	<200	<200
TRH C37-C40	µg/L	200	<200	<200
TRH C10-C36	µg/L	450	<450	<450
TRH C10-C40	µg/L	650	<650	<650

TRH F Bands

TRH >C10-C16	µg/L	60	<60	<60
TRH >C16-C34 (F3)	µg/L	500	<500	<500
TRH >C34-C40 (F4)	µg/L	500	<500	<500

OC Pesticides in Water Method: AN420 Tested: 4/6/2018

Hexachlorobenzene (HCB)	µg/L	0.1	<0.1	<0.1
Alpha BHC	µg/L	0.1	<0.1	<0.1
Lindane (gamma BHC)	µg/L	0.1	<0.1	<0.1
Heptachlor	µg/L	0.1	<0.1	<0.1
Aldrin	µg/L	0.1	<0.1	<0.1
Beta BHC	µg/L	0.1	<0.1	<0.1
Delta BHC	µg/L	0.1	<0.1	<0.1
Heptachlor epoxide	µg/L	0.1	<0.1	<0.1
o,p'-DDE	µg/L	0.1	<0.1	<0.1
Alpha Endosulfan	µg/L	0.1	<0.1	<0.1
Gamma Chlordane	µg/L	0.1	<0.1	<0.1
Alpha Chlordane	µg/L	0.1	<0.1	<0.1
trans-Nonachlor	µg/L	0.1	<0.1	<0.1
p,p'-DDE	µg/L	0.1	<0.1	<0.1
Dieldrin	µg/L	0.1	<0.1	<0.1
Endrin	µg/L	0.1	<0.1	<0.1
o,p'-DDD	µg/L	0.1	<0.1	<0.1
o,p'-DDT	µg/L	0.1	<0.1	<0.1
Beta Endosulfan	µg/L	0.1	<0.1	<0.1
p,p'-DDD	µg/L	0.1	<0.1	<0.1
p,p'-DDT	µg/L	0.1	<0.1	<0.1
Endosulfan sulphate	µg/L	0.1	<0.1	<0.1
Endrin aldehyde	µg/L	0.1	<0.1	<0.1
Methoxychlor	µg/L	0.1	<0.1	<0.1
Endrin ketone	µg/L	0.1	<0.1	<0.1
Isodrin	µg/L	0.1	<0.1	<0.1
Mirex	µg/L	0.1	<0.1	<0.1

Parameter	Sample Number	SE179808.005	SE179808.006
	Sample Matrix	Water	Water
	Sample Date	29 May 2018	29 May 2018
	Sample Name	MB6-B	MB9
	Units	LOR	

OC Pesticides in Water Method: AN420 Tested: 4/6/2018 (continued)

Surrogates

Tetrachloro-m-xylene (TCMX) (Surrogate)	%	-	108	93
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OP Pesticides in Water Method: AN420 Tested: 4/6/2018

Dichlorvos	µg/L	0.5	<0.5	<0.5
Dimethoate	µg/L	0.5	<0.5	<0.5
Diazinon (Dimpylate)	µg/L	0.5	<0.5	<0.5
Fenitrothion	µg/L	0.2	<0.2	<0.2
Malathion	µg/L	0.2	<0.2	<0.2
Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	<0.2	<0.2
Parathion-ethyl (Parathion)	µg/L	0.2	<0.2	<0.2
Bromophos Ethyl	µg/L	0.2	<0.2	<0.2
Methidathion	µg/L	0.5	<0.5	<0.5
Ethion	µg/L	0.2	<0.2	<0.2
Azinphos-methyl	µg/L	0.2	<0.2	<0.2

Surrogates

2-fluorobiphenyl (Surrogate)	%	-	62	60
d14-p-terphenyl (Surrogate)	%	-	76	70

Total Phenolics in Water Method: AN289 Tested: 7/6/2018

Total Phenols	mg/L	0.01	<0.01	<0.01
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pH in water Method: AN101 Tested: 31/5/2018

pH**	No unit	-	6.2	5.8
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Conductivity and TDS by Calculation - Water Method: AN106 Tested: 31/5/2018

Conductivity @ 25 C	µS/cm	2	1200	430
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	Sample Number	SE179808.005	SE179808.006
	Sample Matrix	Water	Water
	Sample Date	29 May 2018	29 May 2018
	Sample Name	MB6-B	MB9
Parameter	Units	LOR	

Forms of Carbon Method: AN190 Tested: 1/6/2018

Total Organic Carbon as NPOC	mg/L	0.2	5.6	2.6
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Alkalinity Method: AN135 Tested: 31/5/2018

Bicarbonate Alkalinity as CaCO ₃	mg/L	5	360	130
Total Alkalinity as CaCO ₃	mg/L	5	360	130

Anions by Ion Chromatography in Water Method: AN245 Tested: 1/6/2018

Chloride	mg/L	1	200	52
Sulfate, SO ₄	mg/L	1	33	19
Fluoride	mg/L	0.1	<0.10	<0.10
Nitrate Nitrogen, NO ₃ -N	mg/L	0.005	<0.005	<0.005

Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: AN291 Tested: 1/6/2018

Ammonia Nitrogen, NH ₃ as N	mg/L	0.01	1.1	2.6
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Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 4/6/2018

Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	0.08	0.07
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COD in Water Method: AN179/AN181 Tested: 6/6/2018

Chemical Oxygen Demand	mg/L	10	17	<10
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	Sample Number	SE179808.005	SE179808.006
	Sample Matrix	Water	Water
	Sample Date	29 May 2018	29 May 2018
	Sample Name	MB6-B	MB9
Parameter	Units	LOR	

Hexavalent Chromium in water by Discrete Analyser Method: AN283 Tested: 1/6/2018

Hexavalent Chromium, Cr6+	mg/L	0.004	<0.004	<0.004
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Total Dissolved Solids (TDS) in water Method: AN113 Tested: 4/6/2018

Total Dissolved Solids Dried at 175-185°C	mg/L	10	710	220
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Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 4/6/2018

Calcium, Ca	mg/L	0.2	73	21
Magnesium, Mg	mg/L	0.1	62	13
Potassium, K	mg/L	0.1	16	9.8
Sodium, Na	mg/L	0.5	66	28

Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 4/6/2018

Aluminium, Al	µg/L	5	<5	<5
Chromium, Cr	µg/L	1	<1	<1
Iron, Fe	µg/L	5	1100	11000
Manganese, Mn	µg/L	1	3300	1300

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA', the results are less than the LOR and thus the RPD is not applicable.

Alkalinity Method: ME-(AU)-[ENV]AN135

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Bicarbonate Alkalinity as CaCO ₃	LB149089	mg/L	5	<5	0%	NA
Total Alkalinity as CaCO ₃	LB149089	mg/L	5	<5	0%	104%

Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: ME-(AU)-[ENV]AN291

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Ammonia Nitrogen, NH ₃ as N	LB149170	mg/L	0.01	<0.01	1 - 3%	101%

Anions by Ion Chromatography in Water Method: ME-(AU)-[ENV]AN245

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride	LB149162	mg/L	1	<0.05	2%	93%
Sulfate, SO ₄	LB149162	mg/L	1	<1.0	0 - 2%	93%
Fluoride	LB149162	mg/L	0.1	<0.10	0%	88%
Nitrate Nitrogen, NO ₃ -N	LB149162	mg/L	0.005	<0.005	0%	97%

COD in Water Method: ME-(AU)-[ENV]AN179/AN181

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chemical Oxygen Demand	LB149431	mg/L	10	<10	7 - 11%	106%

Conductivity and TDS by Calculation - Water Method: ME-(AU)-[ENV]AN106

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB149088	µS/cm	2	<2	1%	102%

Forms of Carbon Method: ME-(AU)-[ENV]AN190

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Organic Carbon as NPOC	LB149145	mg/L	0.2	<0.2	1%	108%	106%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Hexavalent Chromium in water by Discrete Analyser Method: ME-(AU)-[ENV]AN283

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Hexavalent Chromium, Cr6+	LB149116	mg/L	0.004	<0.004	0%	102%

Metals in Water (Dissolved) by ICPOES Method: ME-(AU)-[ENV]AN320

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Calcium, Ca	LB149240	mg/L	0.2	<0.2	0 - 3%	102%	97%
Magnesium, Mg	LB149240	mg/L	0.1	<0.1		100%	
Potassium, K	LB149240	mg/L	0.1	<0.1	0%	100%	
Sodium, Na	LB149240	mg/L	0.5	<0.5	2%	109%	81%

OC Pesticides in Water Method: ME-(AU)-[ENV]AN420

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Hexachlorobenzene (HCB)	LB149221	µg/L	0.1	<0.1	NA
Alpha BHC	LB149221	µg/L	0.1	<0.1	NA
Lindane (gamma BHC)	LB149221	µg/L	0.1	<0.1	NA
Heptachlor	LB149221	µg/L	0.1	<0.1	77%
Aldrin	LB149221	µg/L	0.1	<0.1	78%
Beta BHC	LB149221	µg/L	0.1	<0.1	NA
Delta BHC	LB149221	µg/L	0.1	<0.1	75%
Heptachlor epoxide	LB149221	µg/L	0.1	<0.1	NA
o,p'-DDE	LB149221	µg/L	0.1	<0.1	NA
Alpha Endosulfan	LB149221	µg/L	0.1	<0.1	NA
Gamma Chlordane	LB149221	µg/L	0.1	<0.1	NA
Alpha Chlordane	LB149221	µg/L	0.1	<0.1	NA
trans-Nonachlor	LB149221	µg/L	0.1	<0.1	NA
p,p'-DDE	LB149221	µg/L	0.1	<0.1	NA
Dieldrin	LB149221	µg/L	0.1	<0.1	82%
Endrin	LB149221	µg/L	0.1	<0.1	116%
o,p'-DDD	LB149221	µg/L	0.1	<0.1	NA
o,p'-DDT	LB149221	µg/L	0.1	<0.1	NA
Beta Endosulfan	LB149221	µg/L	0.1	<0.1	NA
p,p'-DDD	LB149221	µg/L	0.1	<0.1	NA
p,p'-DDT	LB149221	µg/L	0.1	<0.1	78%
Endosulfan sulphate	LB149221	µg/L	0.1	<0.1	NA
Endrin aldehyde	LB149221	µg/L	0.1	<0.1	NA
Methoxychlor	LB149221	µg/L	0.1	<0.1	NA
Endrin ketone	LB149221	µg/L	0.1	<0.1	NA
Isodrin	LB149221	µg/L	0.1	<0.1	NA
Mirex	LB149221	µg/L	0.1	<0.1	NA

Surrogates

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Tetrachloro-m-xylene (TCMX) (Surrogate)	LB149221	%	-	80%	85%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

OP Pesticides in Water Method: ME-(AU)-[ENV]AN420

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Dichlorvos	LB149221	µg/L	0.5	<0.5	87%
Dimethoate	LB149221	µg/L	0.5	<0.5	NA
Diazinon (Dimpylate)	LB149221	µg/L	0.5	<0.5	93%
Fenitrothion	LB149221	µg/L	0.2	<0.2	NA
Malathion	LB149221	µg/L	0.2	<0.2	NA
Chlorpyrifos (Chlorpyrifos Ethyl)	LB149221	µg/L	0.2	<0.2	83%
Parathion-ethyl (Parathion)	LB149221	µg/L	0.2	<0.2	NA
Bromophos Ethyl	LB149221	µg/L	0.2	<0.2	NA
Methidathion	LB149221	µg/L	0.5	<0.5	NA
Ethion	LB149221	µg/L	0.2	<0.2	89%
Azinphos-methyl	LB149221	µg/L	0.2	<0.2	NA

Surrogates

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
2-fluorobiphenyl (Surrogate)	LB149221	%	-	68%	70%
d14-p-terphenyl (Surrogate)	LB149221	%	-	86%	84%

pH in water Method: ME-(AU)-[ENV]AN101

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery
pH**	LB149088	No unit	-	0 - 1%	100%

Total Dissolved Solids (TDS) in water Method: ME-(AU)-[ENV]AN113

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Dissolved Solids Dried at 175-185°C	LB149292	mg/L	10	<10	3 - 6%	96%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Total Phenolics in Water Method: ME-(AU)-[ENV]AN289

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Phenols	LB149111	mg/L	0.01	<0.01	0%	100%	96%
	LB149495	mg/L	0.01	<0.01	0%	96%	100%

Total Phosphorus by Kjeldahl Digestion DA in Water Method: ME-(AU)-[ENV]AN279/AN293(Sydney only)

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB149222	mg/L	0.02	<0.02	3%	105%

Trace Metals (Dissolved) in Water by ICPMS Method: ME-(AU)-[ENV]AN318

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Aluminium, Al	LB149207	µg/L	5	<5	2%	111%	109%
Chromium, Cr	LB149207	µg/L	1	<1	0 - 24%	115%	
Iron, Fe	LB149207	µg/L	5	<5	19%	116%	
Manganese, Mn	LB149207	µg/L	1	<1		108%	209%

TRH (Total Recoverable Hydrocarbons) in Water Method: ME-(AU)-[ENV]AN403

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
TRH C10-C14	LB149221	µg/L	50	<50	NVL	79%
TRH C15-C28	LB149221	µg/L	200	<200	NVL	94%
TRH C29-C36	LB149221	µg/L	200	<200	NVL	106%
TRH C37-C40	LB149221	µg/L	200	<200	NVL	NA
TRH C10-C36	LB149221	µg/L	450	<450	NVL	NA
TRH C10-C40	LB149221	µg/L	650	<650	NVL	NA

TRH F Bands

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
TRH >C10-C16	LB149221	µg/L	60	<60	NVL	89%
TRH >C16-C34 (F3)	LB149221	µg/L	500	<500	NVL	96%
TRH >C34-C40 (F4)	LB149221	µg/L	500	<500	NVL	115%

MB blank results are compared to the Limit of Reporting

LCS and MS spike recoveries are measured as the percentage of analyte recovered from the sample compared the the amount of analyte spiked into the sample.

DUP and MSD relative percent differences are measured against their original counterpart samples according to the formula : *the absolute difference of the two results divided by the average of the two results as a percentage*. Where the DUP RPD is 'NA' , the results are less than the LOR and thus the RPD is not applicable.

Volatile Petroleum Hydrocarbons in Water Method: ME-(AU)-[ENV]AN433

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
TRH C6-C10	LB149098	µg/L	50	<50	0%	96%	75%
TRH C6-C9	LB149098	µg/L	40	<40	0%	91%	70%

Surrogates

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Dibromofluoromethane (Surrogate)	LB149098	%	-	106%	4%	89%	88%
d4-1,2-dichloroethane (Surrogate)	LB149098	%	-	106%	3%	92%	101%
d8-toluene (Surrogate)	LB149098	%	-	105%	0%	97%	107%
Bromofluorobenzene (Surrogate)	LB149098	%	-	86%	10%	106%	100%

VPH F Bands

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Benzene (F0)	LB149098	µg/L	0.5	<0.5	0%	NA	NA
TRH C6-C10 minus BTEX (F1)	LB149098	µg/L	50	<50	0%	94%	67%

METHOD

METHODOLOGY SUMMARY

AN020	Unpreserved water sample is filtered through a 0.45µm membrane filter and acidified with nitric acid similar to APHA3030B.
AN101	pH in Soil Sludge Sediment and Water: pH is measured electrometrically using a combination electrode (glass plus reference electrode) and is calibrated against 3 buffers purchased commercially. For soils, an extract with water is made at a ratio of 1:5 and the pH determined and reported on the extract. Reference APHA 4500-H+.
AN106	Conductivity and TDS by Calculation: Conductivity is measured by meter with temperature compensation and is calibrated against a standard solution of potassium chloride. Conductivity is generally reported as µmhos/cm or µS/cm @ 25°C. For soils, an extract with water is made at a ratio of 1:5 and the EC determined and reported on the extract, or calculated back to the as-received sample. Total Dissolved Salts can be estimated from conductivity using a conversion factor, which for natural waters, is in the range 0.55 to 0.75. SGS use 0.6. Reference APHA 2510 B.
AN106	Salinity may be calculated in terms of NaCl from the sample conductivity. This assumes all soluble salts present, measured by the conductivity, are present as NaCl.
AN113	Total Dissolved Solids: A well-mixed filtered sample of known volume is evaporated to dryness at 180°C and the residue weighed. Approximate methods for correlating chemical analysis with dissolved solids are available. Reference APHA 2540 C.
AN135	Alkalinity (and forms of) by Titration: The sample is titrated with standard acid to pH 8.3 (P titre) and pH 4.5 (T titre) and permanent and/or total alkalinity calculated. The results are expressed as equivalents of calcium carbonate or recalculated as bicarbonate, carbonate and hydroxide. Reference APHA 2320. Internal Reference AN135
AN181	Analysis of COD by Semi Closed Reflux: The sample is refluxed with strong acid and a known excess of oxidant. After digestion the unreacted oxidant is back titrated to determine the amount of oxidant consumed. The chemically oxidised matter is calculated in terms of oxygen equivalents. Reference APHA 5220 B.
AN190	TOC and DOC in Water: A homogenised micro portion of sample is injected into a heated reaction chamber packed with an oxidative catalyst that converts organic carbon to carbon dioxide. The CO ₂ is measured using a non-dispersive infrared detector. The process is fully automated in a commercially available analyser. If required a sugar value can be calculated from the TOC result. Reference APHA 5310 B.
AN190	Chemical oxygen demand can be calculated/estimated based on the O ₂ /C relation as 2.67*NPOC (TOC). This is an estimate only and the factor will vary with sample matrix so results should be interpreted with caution.
AN245	Anions by Ion Chromatography: A water sample is injected into an eluent stream that passes through the ion chromatographic system where the anions of interest ie Br, Cl, NO ₂ , NO ₃ and SO ₄ are separated on their relative affinities for the active sites on the column packing material. Changes to the conductivity and the UV-visible absorbance of the eluent enable identification and quantitation of the anions based on their retention time and peak height or area. APHA 4110 B
AN279/AN293(Sydney)	The sample is digested with Sulphuric acid, K ₂ SO ₄ and CuSO ₄ . All forms of phosphorus are converted into orthophosphate. The digest is cooled and placed on the discrete analyser for colorimetric analysis.
AN283	Hexavalent Chromium via Aquakem DA: Soluble hexavalent chromium forms a red/violet colour with diphenylcarbazide in acidic solution. This procedure is very sensitive and nearly specific for Cr ⁶⁺ . If total chromium is also measured the trivalent form of chromium Cr ³⁺ can be calculated from the difference (Total Cr - Cr ⁶⁺). Reference APHA3500CrB.

METHOD

METHODOLOGY SUMMARY

AN289	Analysis of Total Phenols in Soil Sediment and Water: Steam distillable phenols react with 4-aminoantipyrine at pH 7.9±0.1 in the presence of potassium ferricyanide to form a coloured antipyrine dye analysed by Discrete Analyser. Reference APHA 5530 B/D.
AN291	Ammonia in solution reacts with hypochlorite ions from Sodium Dichloroisocyanate, and salicylate in the presence of Sodium Nitroprusside to form indophenol blue and measured at 670 nm by Discrete Analyser.
AN318	Determination of elements at trace level in waters by ICP-MS technique, in accordance with USEPA 6020A.
AN320	Metals by ICP-OES: Samples are preserved with 10% nitric acid for a wide range of metals and some non-metals. This solution is measured by Inductively Coupled Plasma. Solutions are aspirated into an argon plasma at 8000-10000K and emit characteristic energy or light as a result of electron transitions through unique energy levels. The emitted light is focused onto a diffraction grating where it is separated into components.
AN320	Photomultipliers or CCDs are used to measure the light intensity at specific wavelengths. This intensity is directly proportional to concentration. Corrections are required to compensate for spectral overlap between elements. Reference APHA 3120 B.
AN403	Total Recoverable Hydrocarbons: Determination of Hydrocarbons by gas chromatography after a solvent extraction. Detection is by flame ionisation detector (FID) that produces an electronic signal in proportion to the combustible matter passing through it. Total Recoverable Hydrocarbons (TRH) are routinely reported as four alkane groupings based on the carbon chain length of the compounds: C6-C9, C10-C14, C15-C28 and C29-C36 and in recognition of the NEPM 1999 (2013), >C10-C16 (F2), >C16-C34 (F3) and >C34-C40 (F4). Where F2 is corrected for Naphthalene, the VOC data for Naphthalene is used.
AN403	Additionally, the volatile C6-C9/C6-C10 fractions may be determined by a purge and trap technique and GC/MS because of the potential for volatiles loss. Total Recoverable Hydrocarbons - Silica (TRH-Silica) follows the same method of analysis after silica gel cleanup of the solvent extract. Aliphatic/Aromatic Speciation follows the same method of analysis after fractionation of the solvent extract over silica with differential polarity of the eluent solvents.
AN403	The GC/FID method is not well suited to the analysis of refined high boiling point materials (ie lubricating oils or greases) but is particularly suited for measuring diesel, kerosene and petrol if care to control volatility is taken. This method will detect naturally occurring hydrocarbons, lipids, animal fats, phenols and PAHs if they are present at sufficient levels, dependent on the use of specific cleanup/fractionation techniques. Reference USEPA 3510B, 8015B.
AN420	SVOC Compounds: Semi-Volatile Organic Compounds (SVOCs) including OC, OP, PCB, Herbicides, PAH, Phthalates and Speciated Phenols in soils, sediments and waters are determined by GCMS/ECD technique following appropriate solvent extraction process (Based on USEPA 3500C and 8270D).
AN433	VOCs and C6-C9 Hydrocarbons by GC-MS P&T: VOC's are volatile organic compounds. The sample is presented to a gas chromatograph via a purge and trap (P&T) concentrator and autosampler and is detected with a Mass Spectrometer (MSD). Solid samples are initially extracted with methanol whilst liquid samples are processed directly. References: USEPA 5030B, 8020A, 8260.
Calculation	Free and Total Carbon Dioxide may be calculated using alkalinity forms only when the samples TDS is <500mg/L. If TDS is >500mg/L free or total carbon dioxide cannot be reported. APHA4500CO2 D.

FOOTNOTES

IS	Insufficient sample for analysis.	LOR	Limit of Reporting
LNR	Sample listed, but not received.	↑↓	Raised or Lowered Limit of Reporting
*	NATA accreditation does not cover the performance of this service.	QFH	QC result is above the upper tolerance
**	Indicative data, theoretical holding time exceeded.	QFL	QC result is below the lower tolerance
		-	The sample was not analysed for this analyte
		NVL	Not Validated

Samples analysed as received.

Solid samples expressed on a dry weight basis.

Where "Total" analyte groups are reported (for example, Total PAHs, Total OC Pesticides) the total will be calculated as the sum of the individual analytes, with those analytes that are reported as <LOR being assumed to be zero. The summed (Total) limit of reporting is calculated by summing the individual analyte LORs and dividing by two. For example, where 16 individual analytes are being summed and each has an LOR of 0.1 mg/kg, the "Totals" LOR will be 1.6 / 2 (0.8 mg/kg). Where only 2 analytes are being summed, the "Total" LOR will be the sum of those two LORs.

Some totals may not appear to add up because the total is rounded after adding up the raw values.

If reported, measurement uncertainty follow the ± sign after the analytical result and is expressed as the expanded uncertainty calculated using a coverage factor of 2, providing a level of confidence of approximately 95%, unless stated otherwise in the comments section of this report.

Results reported for samples tested under test methods with codes starting with ARS-SOP, radionuclide or gross radioactivity concentrations are expressed in becquerel (Bq) per unit of mass or volume or per wipe as stated on the report. Becquerel is the SI unit for activity and equals one nuclear transformation per second.

Note that in terms of units of radioactivity:

- 1 Bq is equivalent to 27 pCi
- 37 MBq is equivalent to 1 mCi

For results reported for samples tested under test methods with codes starting with ARS-SOP, less than (<) values indicate the detection limit for each radionuclide or parameter for the measurement system used. The respective detection limits have been calculated in accordance with ISO 11929.

The QC criteria are subject to internal review according to the SGS QAQC plan and may be provided on request or alternatively can be found here : <http://www.sgs.com.au/~media/Local/Australia/Documents/Technical%20Documents/MP-AU-ENV-QU-022%20QA%20QC%20Plan.pdf>

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