154 Peisley Street
PO Box 1963
ORANGE NSW 2800

02 6393 5000
02 6393 5050

orange@geolyse.com
geolyse.com

Our Ref: 217500_LET_001.docx

6 December 2017

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

ENVIRONMENTAL MONITORING OF LITHGOW SOLID WASTE FACILITY

Geolyse has completed biannual groundwater, leachate and accumulated landfill gas monitoring at Lithgow Solid Waste Facility, located off Geordie Street, Lithgow.

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 3.29 metres below ground level (mbgl) at MB14, to 13.84 mbgl at MB9. Corrected groundwater elevations ranged from 897.28 metres Australian Height Datum (mAHD) at MB14, to 934.89 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.

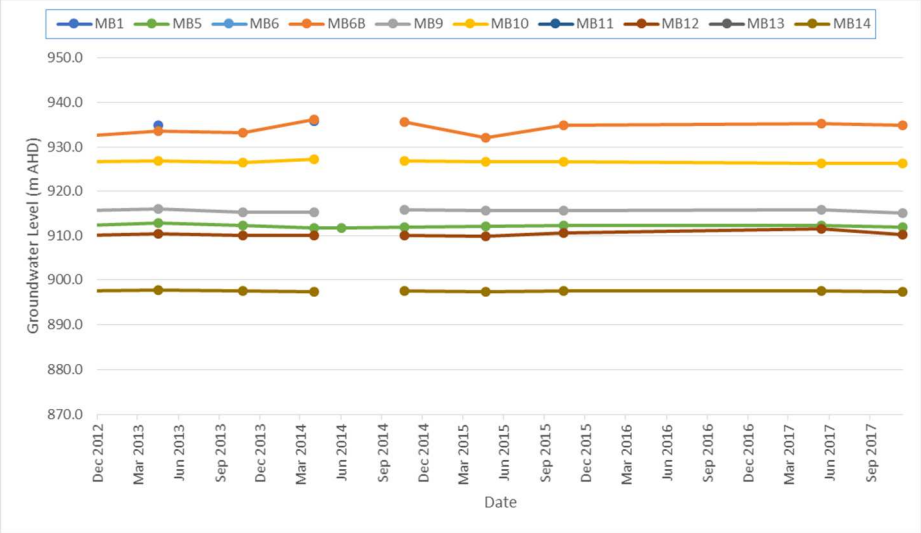


Figure 1: Lithgow Solid Waste Facility – Groundwater Elevations

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 4.0 at MB12 to 6.6 at MB10. Groundwater at 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 490 µS/cm at piezometer MB9 to 1,200 µS/cm at piezometer MB10.
- Total dissolved solids (TDS) ranged from 230 mg/L at MB9 to 730 mg/L at MB12. TDS concentrations were below the livestock watering 'loss of production' tolerance limit for the most susceptible livestock category, poultry (3000 mg/L – ANZECC & ARMCANZ, 2000).
- The chemical oxygen demand (COD) of groundwater samples ranged from 14 mg/L at MB14 to 60 mg/L at MB10.
- Total alkalinity in groundwater ranged from less than the laboratory limit of reporting (LOR) of 5 mg/L at MB10 to 370 mg/L at MB10.Groundwater at MB10 was above the guideline hardness value for potential fouling of waters (350 mg/L).
- Groundwater chloride concentrations ranged from 33 mg/L at MB14 to 260 mg/L at MB12. All concentrations were below the guideline value for protection of moderately sensitive crops (350 mg/L).
- Fluoride concentrations in groundwater ranged from below the laboratory LOR of 0.1 mg/L at MB5, MB9 and MB10, to 0.14 mg/L at MB12. 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 7.5mg/L at MB10 to 110 mg/L at MB12.
- Calcium concentrations ranged from 27 mg/L at MB12 to 99 mg/L at MB14.
- Magnesium concentrations ranged from 13 mg/L at MB9 to 54 mg/L at MB6B.
- Potassium concentrations ranged from 9 mg/L at MB14 to 55 mg/L at MB5.
- Concentrations of sodium ranged from 16 mg/L at MB14, to 94 mg/L at MB12. Sodium concentrations were below the guideline level for irrigation to moderately sensitive crops (<230 mg/L).
- Ammonia concentrations in groundwater ranged from 0.24 mgN/L at MB14 to 18 mgN/L at MB10.
- Nitrate concentrations ranged from below the laboratory LOR of 0.005 mgN/L at MB6B, MB9, MB12 and MB14, to 6.2 mgN/L at MB5.

- Phosphorus concentrations in groundwater ranged from below the laboratory LOR of 0.02 mg/L at MB5, MB10, MB12 and MB14, to 0.28 mg/L at MB9. Phosphorus concentrations at 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 4,300 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 MB6B and MB14, to 28,000 µg/L at MB12. Iron concentrations at MB9 and MB12 exceeded the long-term (up to 100 years) irrigation guideline concentration of 200 µg/L.
- Manganese concentrations ranged from 77 µg/L at MB14 to 3,400 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 7.1 mg/L at MB14 to 26 mg/L at MB10.
- 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 with the exception of MB12, which recorded TPH at 180 µg/L (C_6-C_9 fraction) and TRH at 200 µg/L (C_6-C_{10} fraction).

Leachate Quality

A leachate sample was able to be collected from monitoring point LW1. 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.

Leachate 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 was neutral, recorded at 7.0. pH was within the guideline range of 6.0 to 8.5 pH units for pumping, irrigation and stock watering.
- Total alkalinity was recorded at 220 mg/L, which was below the guideline hardness value for potential fouling of waters (350 mg/L).
- The recorded chloride concentration was 230 mg/L, and below the guideline value for protection of moderately sensitive crops (350 mg/L).
- The fluoride concentration of leachate was 0.12 mg/L, below the guideline value of 1 mg/L for long term irrigation use (up to 100 years).

- The leachate sulphate concentration was recorded to be 23 mg/L.
- Calcium in leachate was recorded to be 74 mg/L.
- Magnesium in leachate was recorded to be 27 mg/L.
- Potassium in leachate was recorded to be 44 mg/L.
- Sodium in leachate was recorded to be 110 mg/L. Sodium concentrations were below the guideline level for irrigation to moderately sensitive crops (230 mg/L).
- Total organic carbon (TOC) was recorded at 20 mg/L.
- The ammonia concentration of leachate was recorded to be 0.49 mgN/L.
- The nitrate concentration of leachate was recorded to be 0.57 mgN/L.
- Iron in leachate was recorded to be 18 µg/L, and below the long term (up to 100 years) irrigation guideline concentration of 200 µg/L.
- Manganese in leachate was recorded to be 990 µg/L, and above the long term (up to 100 years) irrigation guideline concentration of 200 µg/L.
- Phenolic compounds in leachate were below the laboratory LOR of 0.01 mg/L.

Accumulated Landfill Gas Monitoring

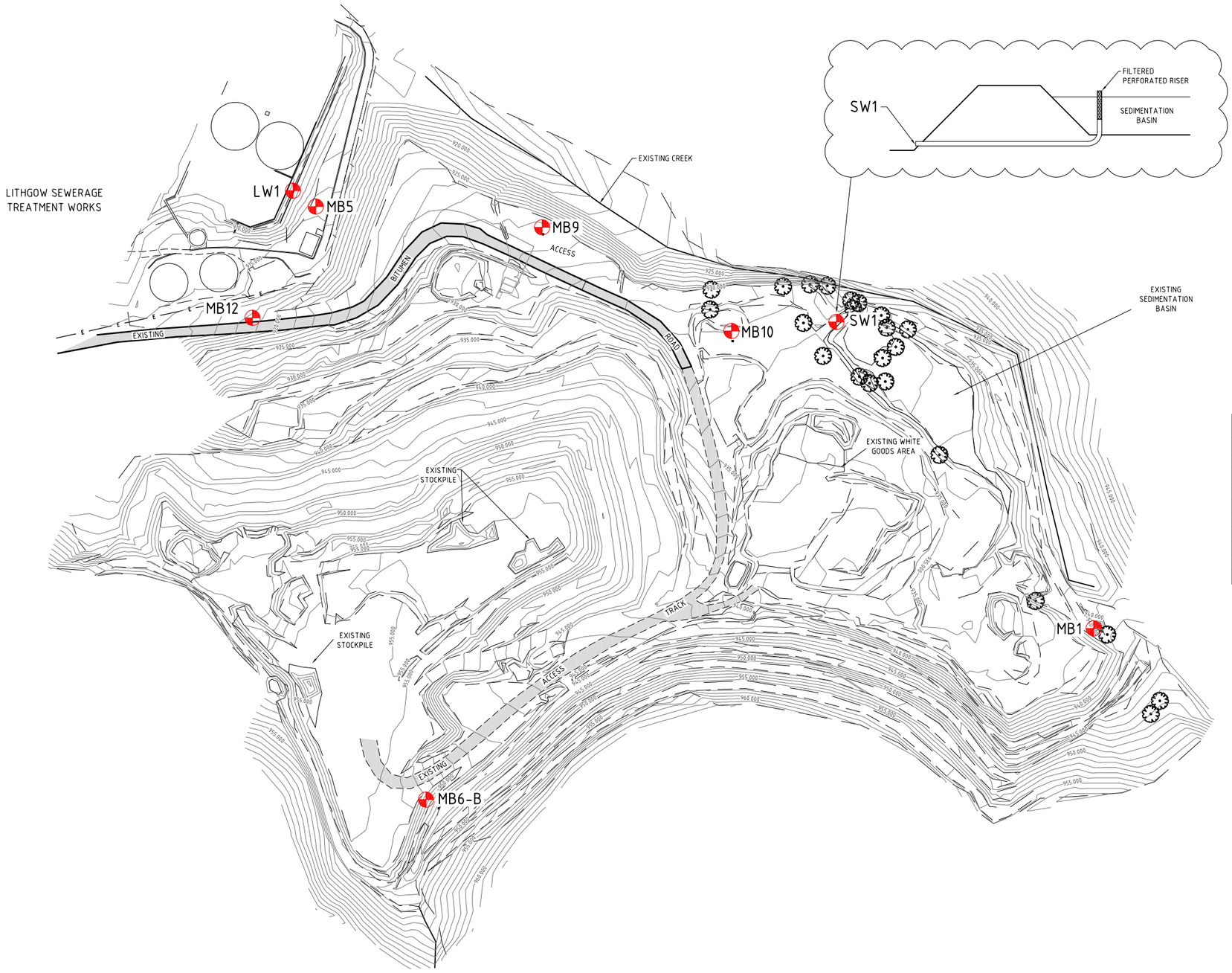
Gas concentrations in buildings and sheds within the required monitoring distance of 250 metres of filled areas were all below the respective threshold concentration of 1.25 % (v/v) during the monthly monitoring rounds conducted in July to October 2017.

The next routine monitoring for groundwater and leachate is scheduled for May 2018. 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 – October 2017
SGS Laboratories Analytical Reports – October 2017



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:

1. 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.
2. 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.
3. CONTOUR INTERVAL 1m.
4. 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
154 PEISLEY STREET
P.O. BOX 1963
ORANGE, NSW 2800
orange@geolyse.com
www.geolyse.com
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: O:\Projects\211109\Out\Cad\Lithgow\211109_01B_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)

GEOLYSE

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.

	MB1		MB5		MB6		MB6B		MB9		MB10		MB11		MB12		MB13		MB14	
Date	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

TABLE 2: LITHGOW SOLID WASTE FACILITY - RESULTS OF LABORATORY ANALYSIS **LEACHATE & GROUNDWATER**
NOVEMBER 2017

GEOLYSE

				Sample ID	LW1	MB5	MB6-B	MB9	MB10	MB12	MB14
				Sample Date	14/11/2017	14/11/2017	14/11/2017	14/11/2017	14/11/2017	14/11/2017	14/11/2017
Group	**Analyte**	**LOR**	**Units**	**Criteria**	PS	PS	PS	PS	PS	PS	PS
Physical Parameters	pH (Lab)	0	No unit	6.0 - 8.5	**7**	**6.2**	**6.2**	**6**	**6.6**	**4**	**6.6**
	Electrical Conductivity (Lab)	2	µS/cm	4478	-	**1200**	**1200**	**490**	**1200**	**1100**	**760**
	Chemical Oxygen Demand	10	mg/L	-	-	**17**	**27**	**35**	**60**	**19**	**14**
	Total Dissolved Solids	10	mg/L	-	-	**630**	**690**	**230**	**570**	**730**	**370**
Alkalinity	Bicarbonate Alkalinity as CaCO3	5	mg/L	-	**220**	**270**	**320**	**150**	**370**	< 5	**310**
	Total Alkalinity as CaCO3	5	mg/L	350	**220**	**270**	**320**	**150**	**370**	< 5	**310**
Anions	Chloride	1	mg/L	350	**230**	**170**	**180**	**48**	**150**	**260**	**33**
	Fluoride	0.1	mg/L	1	**0.12**	< 0.1	**0.14**	< 0.1	< 0.1	**0.14**	**0.11**
	Sulfate (SO4)	1	mg/L	-	**23**	**25**	**34**	**15**	**7.5**	**110**	**43**
Cations	Calcium (Ca)	0.2	mg/L	1000	**74**	**72**	**71**	**27**	**76**	**27**	**99**
	Magnesium (Mg)	0.1	mg/L	-	**27**	**23**	**54**	**13**	**25**	**21**	**29**
	Potassium (K)	0.1	mg/L	-	**44**	**55**	**16**	**14**	**26**	**10**	**9**
	Sodium (Na)	0.5	mg/L	230	**110**	**92**	**69**	**25**	**91**	**94**	**16**
Forms of Carbon	Total Organic Carbon	0.2	mg/L	-	**20**	**9.6**	**11**	**7.7**	**26**	**11**	**7.1**
Nutrients	Ammonia (NH3) as N	0.01	mg/L	-	**0.49**	**4.9**	**1**	**4.7**	**18**	**5.7**	**0.24**
	Nitrate (NO3) as N	0.005	mg/L	-	**0.57**	**6.2**	< 0.005	< 0.005	**0.15**	< 0.005	< 0.005
	Total Phosphorus	0.02	mg/L	0.05	-	< 0.02	**0.13**	**0.28**	< 0.02	< 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
	Aluminium (Al)	5	µg/L	5000	-	< 5	< 5	< 5	< 5	**4300**	< 5
	Chromium (Cr)	1	µg/L	-	-	< 1	< 1	< 1	< 1	< 1	< 1
	Iron (Fe)	5	µg/L	200	**18**	**14**	< 5	**3700**	**28**	**28000**	< 5
	Manganese (Mn)	1	µg/L	200	**990**	**660**	**3400**	**1900**	**500**	**1400**	**77**
Phenolics	Total Phenols	0.01	mg/L	-	< 0.01	< 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	**180**	< 40
	TRH C10-C14	50	µg/L	-	-	< 50	< 50	< 50	< 50	< 50	< 50
	TRH C15-C28	200	µg/L	-	-	< 200	< 200	< 200	< 200	< 200	< 200
	TRH C29-C36	200	µg/L	-	-	< 200	< 200	< 200	< 200	< 200	< 200
	TRH C10-C36	450	µg/L	-	-	< 450	< 450	< 450	< 450	< 450	< 450
	TRH C37-C40	200	µg/L	-	-	< 200	< 200	< 200	< 200	< 200	< 200
Total Recoverable Hydrocarbons	TRH C6-C10	50	µg/L	-	-	< 50	< 50	< 50	< 50	**200**	< 50
	TRH C6-C10 minus BTEX (F1)	50	µg/L	-	-	< 50	< 50	< 50	< 50	**200**	< 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
	within criteria
	criteria exceeded

ANALYTICAL REPORT

Accreditation No. 2562

CLIENT DETAILS		LABORATORY DETAILS	
Contact	Brendan Stuart	Manager	Huong Crawford
Client	GEOLYSE PTY LIMITED	Laboratory	SGS Alexandria Environmental
Address	PO BOX 1963 NSW 2800	Address	Unit 16, 33 Maddox St Alexandria NSW 2015
Telephone	61 2 68841525	Telephone	+61 2 8594 0400
Facsimile	(Not specified)	Facsimile	+61 2 8594 0499
Email	bstuart@geolyse.com	Email	au.environmental.sydney@sgs.com
Project	**217500 - Lithgow SWF**	SGS Reference	**SE172657 R0**
Order Number	(Not specified)	Date Received	15 Nov 2017
Samples	7	Date Reported	24 Nov 2017

COMMENTS

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

SIGNATORIES

Akheeqar Beniameen
Chemist

Dong Liang
Metals/Inorganics Team Leader

Huong Crawford
Production Manager

Kamrul Ahsan
Senior Chemist

Ly Kim Ha
Organic Section Head

Shane McDermott
Inorganic/Metals Chemist

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	SE172657.001 Water 14 Nov 2017 LW1	SE172657.002 Water 14 Nov 2017 MB10	SE172657.003 Water 14 Nov 2017 MB12	SE172657.004 Water 14 Nov 2017 MB14
Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 24/11/2017							
TRH C6-C10	µg/L	50		-	<50	**200**	<50
TRH C6-C9	µg/L	40		-	<40	**180**	<40
Surrogates							
Dibromofluoromethane (Surrogate)	%	-		-	**94**	**100**	**106**
d4-1,2-dichloroethane (Surrogate)	%	-		-	**98**	**107**	**110**
d8-toluene (Surrogate)	%	-		-	**90**	**99**	**102**
Bromofluorobenzene (Surrogate)	%	-		-	**90**	**102**	**105**
VPH F Bands							
Benzene (F0)	µg/L	0.5		-	<0.5	<0.5	<0.5
TRH C6-C10 minus BTEX (F1)	µg/L	50		-	<50	**200**	<50
TRH (Total Recoverable Hydrocarbons) in Water Method: AN403 Tested: 20/11/2017							
TRH C10-C14	µg/L	50		-	<50	<50	<50
TRH C15-C28	µg/L	200		-	<200	<200	<200
TRH C29-C36	µg/L	200		-	<200	<200	<200
TRH C37-C40	µg/L	200		-	<200	<200	<200
TRH C10-C36	µg/L	450		-	<450	<450	<450
TRH C10-C40	µg/L	650		-	<650	<650	<650
TRH F Bands							
TRH >C10-C16 (F2)	µg/L	60		-	<60	<60	<60
TRH >C16-C34 (F3)	µg/L	500		-	<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500		-	<500	<500	<500
OC Pesticides in Water Method: AN420 Tested: 23/11/2017							
Hexachlorobenzene (HCB)	µg/L	0.1		-	<0.1	<0.1	<0.1
Alpha BHC	µg/L	0.1		-	<0.1	<0.1	<0.1
Lindane (gamma BHC)	µg/L	0.1		-	<0.1	<0.1	<0.1
Heptachlor	µg/L	0.1		-	<0.1	<0.1	<0.1
Aldrin	µg/L	0.1		-	<0.1	<0.1	<0.1
Beta BHC	µg/L	0.1		-	<0.1	<0.1	<0.1
Delta BHC	µg/L	0.1		-	<0.1	<0.1	<0.1
Heptachlor epoxide	µg/L	0.1		-	<0.1	<0.1	<0.1
o,p'-DDE	µg/L	0.1		-	<0.1	<0.1	<0.1
Alpha Endosulfan	µg/L	0.1		-	<0.1	<0.1	<0.1
Gamma Chlordane	µg/L	0.1		-	<0.1	<0.1	<0.1
Alpha Chlordane	µg/L	0.1		-	<0.1	<0.1	<0.1
trans-Nonachlor	µg/L	0.1		-	<0.1	<0.1	<0.1
p,p'-DDE	µg/L	0.1		-	<0.1	<0.1	<0.1
Dieldrin	µg/L	0.1		-	<0.1	<0.1	<0.1
Endrin	µg/L	0.1		-	<0.1	<0.1	<0.1
o,p'-DDD	µg/L	0.1		-	<0.1	<0.1	<0.1
o,p'-DDT	µg/L	0.1		-	<0.1	<0.1	<0.1
Beta Endosulfan	µg/L	0.1		-	<0.1	<0.1	<0.1
p,p'-DDD	µg/L	0.1		-	<0.1	<0.1	<0.1
p,p'-DDT	µg/L	0.1		-	<0.1	<0.1	<0.1
Endosulfan sulphate	µg/L	0.1		-	<0.1	<0.1	<0.1
Endrin aldehyde	µg/L	0.1		-	<0.1	<0.1	<0.1
Methoxychlor	µg/L	0.1		-	<0.1	<0.1	<0.1
Endrin ketone	µg/L	0.1		-	<0.1	<0.1	<0.1
Isodrin	µg/L	0.1		-	<0.1	<0.1	<0.1
Mirex	µg/L	0.1		-	<0.1	<0.1	<0.1

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	SE172657.001 Water 14 Nov 2017 LW1	SE172657.002 Water 14 Nov 2017 MB10	SE172657.003 Water 14 Nov 2017 MB12	SE172657.004 Water 14 Nov 2017 MB14
OC Pesticides in Water Method: AN420 Tested: 23/11/2017 (continued)							
Surrogates							
Tetrachloro-m-xylene (TCMX) (Surrogate)	%	-	-		**54**	**68**	**63**
OP Pesticides in Water Method: AN420 Tested: 22/11/2017							
Dichlorvos	µg/L	0.5	-		<0.5	<0.5	<0.5
Dimethoate	µg/L	0.5	-		<0.5	<0.5	<0.5
Diazinon (Dimpylate)	µg/L	0.5	-		<0.5	<0.5	<0.5
Fenitrothion	µg/L	0.2	-		<0.2	<0.2	<0.2
Malathion	µg/L	0.2	-		<0.2	<0.2	<0.2
Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	-		<0.2	<0.2	<0.2
Parathion-ethyl (Parathion)	µg/L	0.2	-		<0.2	<0.2	<0.2
Bromophos Ethyl	µg/L	0.2	-		<0.2	<0.2	<0.2
Methidathion	µg/L	0.5	-		<0.5	<0.5	<0.5
Ethion	µg/L	0.2	-		<0.2	<0.2	<0.2
Azinphos-methyl	µg/L	0.2	-		<0.2	<0.2	<0.2
Surrogates							
2-fluorobiphenyl (Surrogate)	%	-	-		**60**	**80**	**70**
d14-p-terphenyl (Surrogate)	%	-	-		**82**	**100**	**90**
Total Phenolics in Water Method: AN289 Tested: 20/11/2017							
Total Phenols	mg/L	0.01	<0.01		<0.01	<0.01	<0.01
pH in water Method: AN101 Tested: 16/11/2017							
pH**	No unit	-	**7.0**		**6.6**	**4.0**	**6.6**
Conductivity and TDS by Calculation - Water Method: AN106 Tested: 16/11/2017							
Conductivity @ 25 C	µS/cm	2	-		**1200**	**1100**	**760**

Parameter	Units	LOR	Sample Number: SE172657.001 Sample Matrix: Water Sample Date: 14 Nov 2017 Sample Name: LW1	SE172657.002 Water 14 Nov 2017 MB10	SE172657.003 Water 14 Nov 2017 MB12	SE172657.004 Water 14 Nov 2017 MB14
Forms of Carbon Method: AN190 Tested: 20/11/2017						
Total Organic Carbon as NPOC	mg/L	0.2	**20**	**26**	**11**	**7.1**
Alkalinity Method: AN135 Tested: 17/11/2017						
Bicarbonate Alkalinity as CaCO3	mg/L	5	**220**	**370**	<5	**310**
Total Alkalinity as CaCO3	mg/L	5	**220**	**370**	<5	**310**
Anions by Ion Chromatography in Water Method: AN245 Tested: 20/11/2017						
Chloride	mg/L	1	**230**	**150**	**260**	**33**
Sulfate, SO4	mg/L	1	**23**	**7.5**	**110**	**43**
Fluoride	mg/L	0.1	**0.12**	<0.10	**0.14**	**0.11**
Nitrate Nitrogen, NO3-N	mg/L	0.005	**0.57**	**0.15**	<0.005	<0.005
Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: AN291 Tested: 17/11/2017						
Ammonia Nitrogen, NH_3 as N	mg/L	0.01	**0.49**	**18**	**5.7**	**0.24**
Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 21/11/2017						
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	-	<0.02	<0.02	<0.02
COD in Water Method: AN179/AN181 Tested: 20/11/2017						
Chemical Oxygen Demand	mg/L	10	-	**60**	**19**	**14**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	SE172657.001 Water 14 Nov 2017 LW1	SE172657.002 Water 14 Nov 2017 MB10	SE172657.003 Water 14 Nov 2017 MB12	SE172657.004 Water 14 Nov 2017 MB14
Hexavalent Chromium in water by Discrete Analyser Method: AN283 Tested: 23/11/2017							
Hexavalent Chromium, Cr6+	mg/L	0.004		-	<0.004	<0.004	<0.004
Total Dissolved Solids (TDS) in water Method: AN113 Tested: 20/11/2017							
Total Dissolved Solids Dried at 175-185°C	mg/L	10		-	**570**	**730**	**370**
Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 21/11/2017							
Calcium, Ca	mg/L	0.2		**74**	**76**	**27**	**99**
Magnesium, Mg	mg/L	0.1		**27**	**25**	**21**	**29**
Potassium, K	mg/L	0.1		**44**	**26**	**10**	**9.0**
Sodium, Na	mg/L	0.5		**110**	**91**	**94**	**16**
Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 20/11/2017							
Aluminium, Al	µg/L	5		-	<5	**4300**	<5
Chromium, Cr	µg/L	1		-	<1	<1	<1
Iron, Fe	µg/L	5		**18**	**28**	**28000**	<5
Manganese, Mn	µg/L	1		**990**	**500**	**1400**	**77**

Parameter	Units	LOR	Sample Number Sample Matrix Sample Date Sample Name	SE172657.005 Water 14 Nov 2017 MB5	SE172657.006 Water 14 Nov 2017 MB6-B	SE172657.007 Water 14 Nov 2017 MB9
Volatile Petroleum Hydrocarbons in Water Method: AN433 Tested: 22/11/2017						
TRH C6-C10	µg/L	50		<50	<50	<50
TRH C6-C9	µg/L	40		<40	<40	<40
Surrogates						
Dibromofluoromethane (Surrogate)	%	-		**97**	**100**	**94**
d4-1,2-dichloroethane (Surrogate)	%	-		**102**	**108**	**102**
d8-toluene (Surrogate)	%	-		**96**	**95**	**91**
Bromofluorobenzene (Surrogate)	%	-		**95**	**100**	**97**
VPH F Bands						
Benzene (F0)	µg/L	0.5		<0.5	<0.5	<0.5
TRH C6-C10 minus BTEX (F1)	µg/L	50		<50	<50	<50
TRH (Total Recoverable Hydrocarbons) in Water Method: AN403 Tested: 20/11/2017						
TRH C10-C14	µg/L	50		<50	<50	<50
TRH C15-C28	µg/L	200		<200	<200	<200
TRH C29-C36	µg/L	200		<200	<200	<200
TRH C37-C40	µg/L	200		<200	<200	<200
TRH C10-C36	µg/L	450		<450	<450	<450
TRH C10-C40	µg/L	650		<650	<650	<650
TRH F Bands						
TRH >C10-C16 (F2)	µg/L	60		<60	<60	<60
TRH >C16-C34 (F3)	µg/L	500		<500	<500	<500
TRH >C34-C40 (F4)	µg/L	500		<500	<500	<500
OC Pesticides in Water Method: AN420 Tested: 20/11/2017						
Hexachlorobenzene (HCB)	µg/L	0.1		<0.1	<0.1	<0.1
Alpha BHC	µg/L	0.1		<0.1	<0.1	<0.1
Lindane (gamma BHC)	µg/L	0.1		<0.1	<0.1	<0.1
Heptachlor	µg/L	0.1		<0.1	<0.1	<0.1
Aldrin	µg/L	0.1		<0.1	<0.1	<0.1
Beta BHC	µg/L	0.1		<0.1	<0.1	<0.1
Delta BHC	µg/L	0.1		<0.1	<0.1	<0.1
Heptachlor epoxide	µg/L	0.1		<0.1	<0.1	<0.1
o,p'-DDE	µg/L	0.1		<0.1	<0.1	<0.1
Alpha Endosulfan	µg/L	0.1		<0.1	<0.1	<0.1
Gamma Chlordane	µg/L	0.1		<0.1	<0.1	<0.1
Alpha Chlordane	µg/L	0.1		<0.1	<0.1	<0.1
trans-Nonachlor	µg/L	0.1		<0.1	<0.1	<0.1
p,p'-DDE	µg/L	0.1		<0.1	<0.1	<0.1
Dieldrin	µg/L	0.1		<0.1	<0.1	<0.1
Endrin	µg/L	0.1		<0.1	<0.1	<0.1
o,p'-DDD	µg/L	0.1		<0.1	<0.1	<0.1
o,p'-DDT	µg/L	0.1		<0.1	<0.1	<0.1
Beta Endosulfan	µg/L	0.1		<0.1	<0.1	<0.1
p,p'-DDD	µg/L	0.1		<0.1	<0.1	<0.1
p,p'-DDT	µg/L	0.1		<0.1	<0.1	<0.1
Endosulfan sulphate	µg/L	0.1		<0.1	<0.1	<0.1
Endrin aldehyde	µg/L	0.1		<0.1	<0.1	<0.1
Methoxychlor	µg/L	0.1		<0.1	<0.1	<0.1
Endrin ketone	µg/L	0.1		<0.1	<0.1	<0.1
Isodrin	µg/L	0.1		<0.1	<0.1	<0.1
Mirex	µg/L	0.1		<0.1	<0.1	<0.1

Parameter	Units	LOR	Sample Number: SE172657.005 Sample Matrix: Water Sample Date: 14 Nov 2017 Sample Name: MB5	SE172657.006 Water 14 Nov 2017 MB6-B	SE172657.007 Water 14 Nov 2017 MB9
OC Pesticides in Water Method: AN420 Tested: 20/11/2017 (continued)					
Surrogates					
Tetrachloro-m-xylene (TCMX) (Surrogate)	%	-	**63**	**65**	**65**
OP Pesticides in Water Method: AN420 Tested: 20/11/2017					
Dichlorvos	µg/L	0.5	<0.5	<0.5	<0.5
Dimethoate	µg/L	0.5	<0.5	<0.5	<0.5
Diazinon (Dimpylate)	µg/L	0.5	<0.5	<0.5	<0.5
Fenitrothion	µg/L	0.2	<0.2	<0.2	<0.2
Malathion	µg/L	0.2	<0.2	<0.2	<0.2
Chlorpyrifos (Chlorpyrifos Ethyl)	µg/L	0.2	<0.2	<0.2	<0.2
Parathion-ethyl (Parathion)	µg/L	0.2	<0.2	<0.2	<0.2
Bromophos Ethyl	µg/L	0.2	<0.2	<0.2	<0.2
Methidathion	µg/L	0.5	<0.5	<0.5	<0.5
Ethion	µg/L	0.2	<0.2	<0.2	<0.2
Azinphos-methyl	µg/L	0.2	<0.2	<0.2	<0.2
Surrogates					
2-fluorobiphenyl (Surrogate)	%	-	**74**	**74**	**80**
d14-p-terphenyl (Surrogate)	%	-	**100**	**94**	**106**
Total Phenolics in Water Method: AN289 Tested: 21/11/2017					
Total Phenols	mg/L	0.01	<0.01	<0.01	<0.01
pH in water Method: AN101 Tested: 16/11/2017					
pH**	No unit	-	**6.2**	**6.2**	**6.0**
Conductivity and TDS by Calculation - Water Method: AN106 Tested: 16/11/2017					
Conductivity @ 25 C	µS/cm	2	**1200**	**1200**	**490**

Parameter	Units	LOR	Sample Number: SE172657.005 Sample Matrix: Water Sample Date: 14 Nov 2017 Sample Name: MB5	SE172657.006 Water 14 Nov 2017 MB6-B	SE172657.007 Water 14 Nov 2017 MB9
Forms of Carbon Method: AN190 Tested: 20/11/2017					
Total Organic Carbon as NPOC	mg/L	0.2	**9.6**	**11**	**7.7**
Alkalinity Method: AN135 Tested: 17/11/2017					
Bicarbonate Alkalinity as CaCO3	mg/L	5	**270**	**320**	**150**
Total Alkalinity as CaCO3	mg/L	5	**270**	**320**	**150**
Anions by Ion Chromatography in Water Method: AN245 Tested: 20/11/2017					
Chloride	mg/L	1	**170**	**180**	**48**
Sulfate, SO4	mg/L	1	**25**	**34**	**15**
Fluoride	mg/L	0.1	<0.10	**0.14**	<0.10
Nitrate Nitrogen, NO3-N	mg/L	0.005	**6.2**	<0.005	<0.005
Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: AN291 Tested: 17/11/2017					
Ammonia Nitrogen, NH_3 as N	mg/L	0.01	**4.9**	**1.0**	**4.7**
Total Phosphorus by Kjeldahl Digestion DA in Water Method: AN279/AN293(Sydney only) Tested: 21/11/2017					
Total Phosphorus (Kjeldahl Digestion)	mg/L	0.02	<0.02	**0.13**	**0.28**
COD in Water Method: AN179/AN181 Tested: 17/11/2017					
Chemical Oxygen Demand	mg/L	10	**17**	**27**	**35**

Parameter	Units	LOR	Sample Number: SE172657.005 Sample Matrix: Water Sample Date: 14 Nov 2017 Sample Name: MB5	SE172657.006 Water 14 Nov 2017 MB6-B	SE172657.007 Water 14 Nov 2017 MB9
Hexavalent Chromium in water by Discrete Analyser Method: AN283 Tested: 23/11/2017					
Hexavalent Chromium, Cr6+	mg/L	0.004	<0.004	<0.004	<0.004
Total Dissolved Solids (TDS) in water Method: AN113 Tested: 17/11/2017					
Total Dissolved Solids Dried at 175-185°C	mg/L	10	**630**	**690**	**230**
Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 21/11/2017					
Calcium, Ca	mg/L	0.2	**72**	**71**	**27**
Magnesium, Mg	mg/L	0.1	**23**	**54**	**13**
Potassium, K	mg/L	0.1	**55**	**16**	**14**
Sodium, Na	mg/L	0.5	**92**	**69**	**25**
Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 20/11/2017					
Aluminium, Al	µg/L	5	<5	<5	<5
Chromium, Cr	µg/L	1	<1	<1	<1
Iron, Fe	µg/L	5	**14**	<5	**3700**
Manganese, Mn	µg/L	1	**660**	**3400**	**1900**

QC SUMMARY

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 CaCO3	LB136716	mg/L	5	<5	4%	NA
Total Alkalinity as CaCO3	LB136716	mg/L	5	<5	0 - 4%	97%

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	LB136751	mg/L	0.01	<0.01	6 - 71%	108%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride	LB136746	mg/L	1	<0.05	0 - 1%	97%
Sulfate, SO4	LB136746	mg/L	1	<1.0	1%	95%
Fluoride	LB136746	mg/L	0.1	<0.10	0%	96%
Nitrate Nitrogen, NO3-N	LB136746	mg/L	0.005	<0.005	14%	96%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chemical Oxygen Demand	LB136685	mg/L	10	<10	16%	87%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB136692	µS/cm	2	<2	1%	100%

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	LB136971	mg/L	0.2	<0.2	1%	97%	95%

QC SUMMARY

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	MS %Recovery
Hexavalent Chromium, Cr6+	LB137029	mg/L	0.004	<0.004	0%	100%	101%

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	LB136868	mg/L	0.2	<0.2	2 - 3%	95%	106%
Magnesium, Mg	LB136868	mg/L	0.1	<0.1	1 - 2%	95%	
Potassium, K	LB136868	mg/L	0.1	<0.1	2 - 6%	93%	123%
Sodium, Na	LB136868	mg/L	0.5	<0.5	1 - 6%	98%	89%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Hexachlorobenzene (HCB)	LB136731	µg/L	0.1	<0.1	0%	NA
Alpha BHC	LB136731	µg/L	0.1	<0.1	0%	NA
Lindane (gamma BHC)	LB136731	µg/L	0.1	<0.1	0%	NA
Heptachlor	LB136731	µg/L	0.1	<0.1	0%	107%
Aldrin	LB136731	µg/L	0.1	<0.1	0%	102%
Beta BHC	LB136731	µg/L	0.1	<0.1	0%	NA
Delta BHC	LB136731	µg/L	0.1	<0.1	0%	111%
Heptachlor epoxide	LB136731	µg/L	0.1	<0.1	0%	NA
o,p'-DDE	LB136731	µg/L	0.1	<0.1	0%	NA
Alpha Endosulfan	LB136731	µg/L	0.1	<0.1	0%	NA
Gamma Chlordane	LB136731	µg/L	0.1	<0.1	0%	NA
Alpha Chlordane	LB136731	µg/L	0.1	<0.1	0%	NA
trans-Nonachlor	LB136731	µg/L	0.1	<0.1	0%	NA
p,p'-DDE	LB136731	µg/L	0.1	<0.1	0%	NA
Dieldrin	LB136731	µg/L	0.1	<0.1	0%	108%
Endrin	LB136731	µg/L	0.1	<0.1	0%	116%
o,p'-DDD	LB136731	µg/L	0.1	<0.1	0%	NA
o,p'-DDT	LB136731	µg/L	0.1	<0.1	0%	NA
Beta Endosulfan	LB136731	µg/L	0.1	<0.1	0%	NA
p,p'-DDD	LB136731	µg/L	0.1	<0.1	0%	NA
p,p'-DDT	LB136731	µg/L	0.1	<0.1	0%	121%
Endosulfan sulphate	LB136731	µg/L	0.1	<0.1	0%	NA
Endrin aldehyde	LB136731	µg/L	0.1	<0.1	0%	NA
Methoxychlor	LB136731	µg/L	0.1	<0.1	0%	NA
Endrin ketone	LB136731	µg/L	0.1	<0.1	0%	NA
Isodrin	LB136731	µg/L	0.1	<0.1	0%	NA
Mirex	LB136731	µg/L	0.1	<0.1	0%	NA

Surrogates

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Tetrachloro-m-xylene (TCMX) (Surrogate)	LB136731	%	-	65%	4%	70%

QC SUMMARY

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	DUP %RPD	LCS %Recovery
Dichlorvos	LB136731	µg/L	0.5	<0.5	0%	80%
Dimethoate	LB136731	µg/L	0.5	<0.5	0%	NA
Diazinon (Dimpylate)	LB136731	µg/L	0.5	<0.5	0%	118%
Fenitrothion	LB136731	µg/L	0.2	<0.2	0%	NA
Malathion	LB136731	µg/L	0.2	<0.2	0%	NA
Chlorpyrifos (Chlorpyrifos Ethyl)	LB136731	µg/L	0.2	<0.2	0%	124%
Parathion-ethyl (Parathion)	LB136731	µg/L	0.2	<0.2	0%	NA
Bromophos Ethyl	LB136731	µg/L	0.2	<0.2	0%	NA
Methidathion	LB136731	µg/L	0.5	<0.5	0%	NA
Ethion	LB136731	µg/L	0.2	<0.2	0%	73%
Azinphos-methyl	LB136731	µg/L	0.2	<0.2	0%	NA

Surrogates

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
2-fluorobiphenyl (Surrogate)	LB136731	%	-	52%	0%	74%
d14-p-terphenyl (Surrogate)	LB136731	%	-	58%	2%	78%

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

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery
pH**	LB136692	No unit	-	1 - 3%	99%

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	LB136720	mg/L	10	<10	10%	83%

QC SUMMARY

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	LB136740	mg/L	0.01	<0.01	0%	99%	97%
	LB136841	mg/L	0.01	<0.01	0%	98%	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	MS %Recovery
Total Phosphorus (Kjeldahl Digestion)	LB136855	mg/L	0.02	<0.02	22%	108%	108%

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	LB136752	µg/L	5	<5	0 - 4%	95%	
Chromium, Cr	LB136752	µg/L	1	<1	0%	101%	100%
Iron, Fe	LB136752	µg/L	5	<5	1 - 2%	101%	93%
Manganese, Mn	LB136752	µg/L	1	<1	2%	103%	95%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
TRH C10-C14	LB136731	µg/L	50	<50	0%	104%	100%
TRH C15-C28	LB136731	µg/L	200	<200	0%	125%	128%
TRH C29-C36	LB136731	µg/L	200	<200	0%	133%	108%
TRH C37-C40	LB136731	µg/L	200	<200	0%	NA	NA
TRH C10-C36	LB136731	µg/L	450	<450	0%	NA	NA
TRH C10-C40	LB136731	µg/L	650	<650	0%	NA	NA

TRH F Bands

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
TRH >C10-C16 (F2)	LB136731	µg/L	60	<60	0%	116%	114%
TRH >C16-C34 (F3)	LB136731	µg/L	500	<500	0%	137%	127%
TRH >C34-C40 (F4)	LB136731	µg/L	500	<500	0%	130%	102%

QC SUMMARY

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	LB136927	µg/L	50	<50	0%	99%	99%
TRH C6-C9	LB136927	µg/L	40	<40	0%	93%	92%

Surrogates

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Dibromofluoromethane (Surrogate)	LB136927	%	-	92%	3 - 4%	100%	98%
d4-1,2-dichloroethane (Surrogate)	LB136927	%	-	95%	0 - 3%	102%	103%
d8-toluene (Surrogate)	LB136927	%	-	84%	9%	91%	88%
Bromofluorobenzene (Surrogate)	LB136927	%	-	89%	4 - 7%	98%	92%

VPH F Bands

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Benzene (F0)	LB136927	µg/L	0.5	<0.5	0%	NA	NA
TRH C6-C10 minus BTEX (F1)	LB136927	µg/L	50	<50	0%	99%	100%

METHOD SUMMARY

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.
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 unreduced 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 CO2 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 O2/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, NO2, NO3 and SO4 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, K2SO4 and CuSO4. 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 Cr6+. If total chromium is also measured the trivalent form of chromium Cr3+ can be calculated from the difference (Total Cr - Cr6+). Reference APHA3500CrB.
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.

METHOD SUMMARY

METHOD	METHODOLOGY SUMMARY
AN291	Ammonia in solution reacts with hypochlorite ions from Sodium Dichloroisocyanuate, 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 Recoveerable 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
		QFL	QC result is below the lower tolerance
**	Indicative data, theoretical holding time exceeded.	-	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 calcuated 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:

a. 1 Bq is equivalent to 27 pCi
b. 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