

Our Ref: 217501_LET_002.docx

4 March 2019

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

Attention: Nigel Campbell, Waste & Recycling Coordinator

ENVIRONMENTAL MONITORING OF PORTLAND WASTE DISPOSAL DEPOT

Geolyse has completed annual groundwater monitoring at Portland Waste Disposal Depot, located off the Portland Cullen Bullen Road, approximately 2 km north of Portland, NSW.

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**. Observations were as follows:

- Depths to groundwater ranged from 0.05 metres below ground level (mbgl) at MP9, to 20.61 mbgl at MP5. Corrected groundwater elevations ranged from 904.85 metres Australian Height Datum (mAHD) at MP9, to 917.39 mAHD at MP5.
- Inference of groundwater elevations, calculated from available survey data from installed groundwater monitoring wells, indicates a flow direction to the north-west.

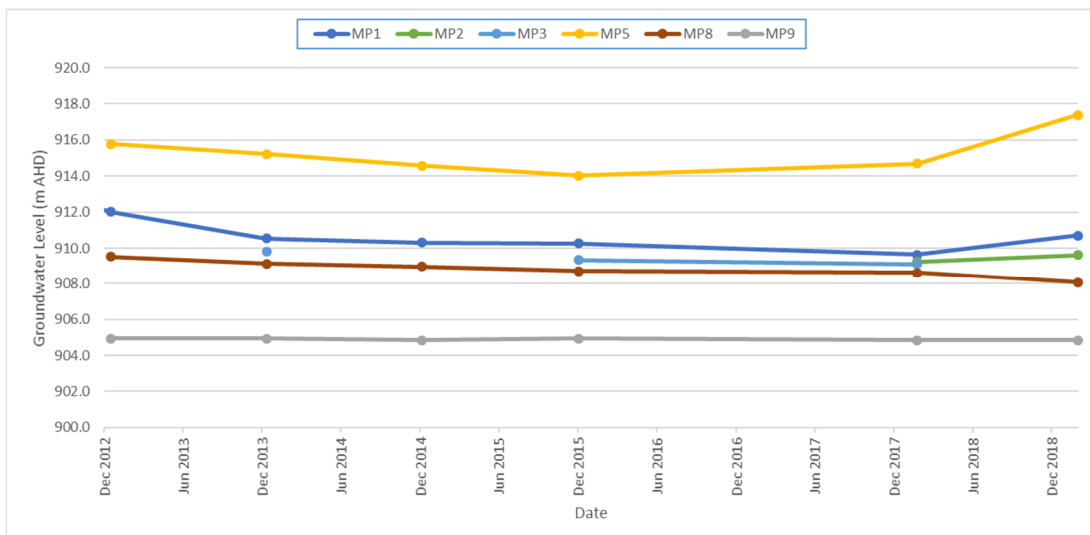
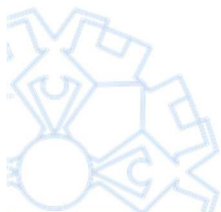


Figure 1: Portland Waste Disposal Depot – Groundwater Elevations

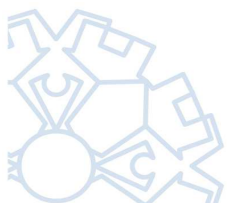


Groundwater Quality

Groundwater samples were able to be collected from wells MP1, MP2, MP5, MP8 and MP9. 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 5.4 at MP2 to 7.5 at MP5 and MP9. Groundwater at MP2 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 1,600 $\mu\text{S}/\text{cm}$ at piezometer MP2 to 3,400 $\mu\text{S}/\text{cm}$ at piezometer MP1. Corresponding total dissolved solid (TDS) concentrations (respectively 1,072 mg/L to 2,278 mg/L) identifies the surface water did not exceed the livestock watering 'loss of production' TDS tolerance limit for the most sensitive livestock category, poultry (3,000 mg/L, ANZECC & ARMCANZ, 2000).
- Total alkalinity in groundwater ranged from 14 mg/L at MP2 to 580 mg/L at MP8. Groundwater alkalinity at MP5, MP8 and MP9 was above the guideline hardness value for potential fouling of waters (350 mg/L).
- Groundwater chloride concentrations ranged from 92 mg/L at MP5 to 570 mg/L at MP1. The chloride concentration recorded at MP1 exceeded the guideline value for protection of moderately sensitive crops (350 mg/L).
- Fluoride concentrations in groundwater ranged from 0.13 mg/L at MP1, to 0.24 mg/L at MP5. 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 240 mg/L at MP2 to 1,200 mg/L at MP9.
- Calcium concentrations ranged from 59 mg/L at MP2 to 340 mg/L at MP8.
- Magnesium concentrations ranged from 51 mg/L at MP2 to 210 mg/L at MP9.
- Potassium concentrations ranged from 6.6 mg/L at MP9 to 130 mg/L at MP1.
- Concentrations of sodium ranged from 93 mg/L at MP5, to 270 mg/L at MP1. The sodium concentration of groundwater recorded at MP1 exceeded the guideline level for irrigation to moderately sensitive crops (<230 mg/L).
- Total organic carbon (TOC) in groundwater ranged from 1.5 mg/L at MP9 to 100 mg/L at MP1.
- Ammonia concentrations in groundwater ranged from 0.05 mgN/L at MP5 to 1.30 mgN/L at MP2.
- Nitrate concentrations ranged from below the laboratory limit of reporting (LOR) of 0.005 mgN/L at MP8 and MP9, to 57 mgN/L at MP2.
- Iron concentrations ranged from below the laboratory LOR of 0.005 mg/L at MP5, MP8 and MP9, to 14 mg/L at MP1. The iron concentration recorded in the groundwater sample collected from MP1 exceeded the long-term (up to 100 years) irrigation guideline concentration of 0.2 mg/L.





- Manganese concentrations ranged from 0.011 mg/L at MP9 to 4.7 mg/L at MP8. Manganese concentrations at all locations with the exception of MP9 exceeded the long-term (up to 100 years) irrigation guideline concentration of 0.2 mg/L.
- Total phenols were below the laboratory LOR of 0.01 mg/L at all groundwater monitoring points.
- Organochlorine pesticides were below respective laboratory LORs at all groundwater monitoring points.

Surface Water Discharge Monitoring

The surface water monitoring point SW1 was inspected in January 2019. No discharge was occurring at the time of inspection, and no evidence of discharge(s) having occurred prior was apparent.

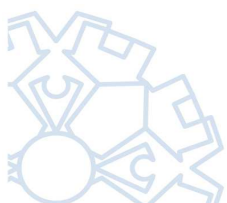
The next routine monitoring for groundwater is scheduled for January 2020. Surface water monitoring is required to take place any calendar month when a surface water discharge is recorded at an interval of not less than once every 6 months.

Please do not hesitate to contact us with any questions or comments you may have regarding this report.

Yours faithfully
Geolyse Pty Ltd

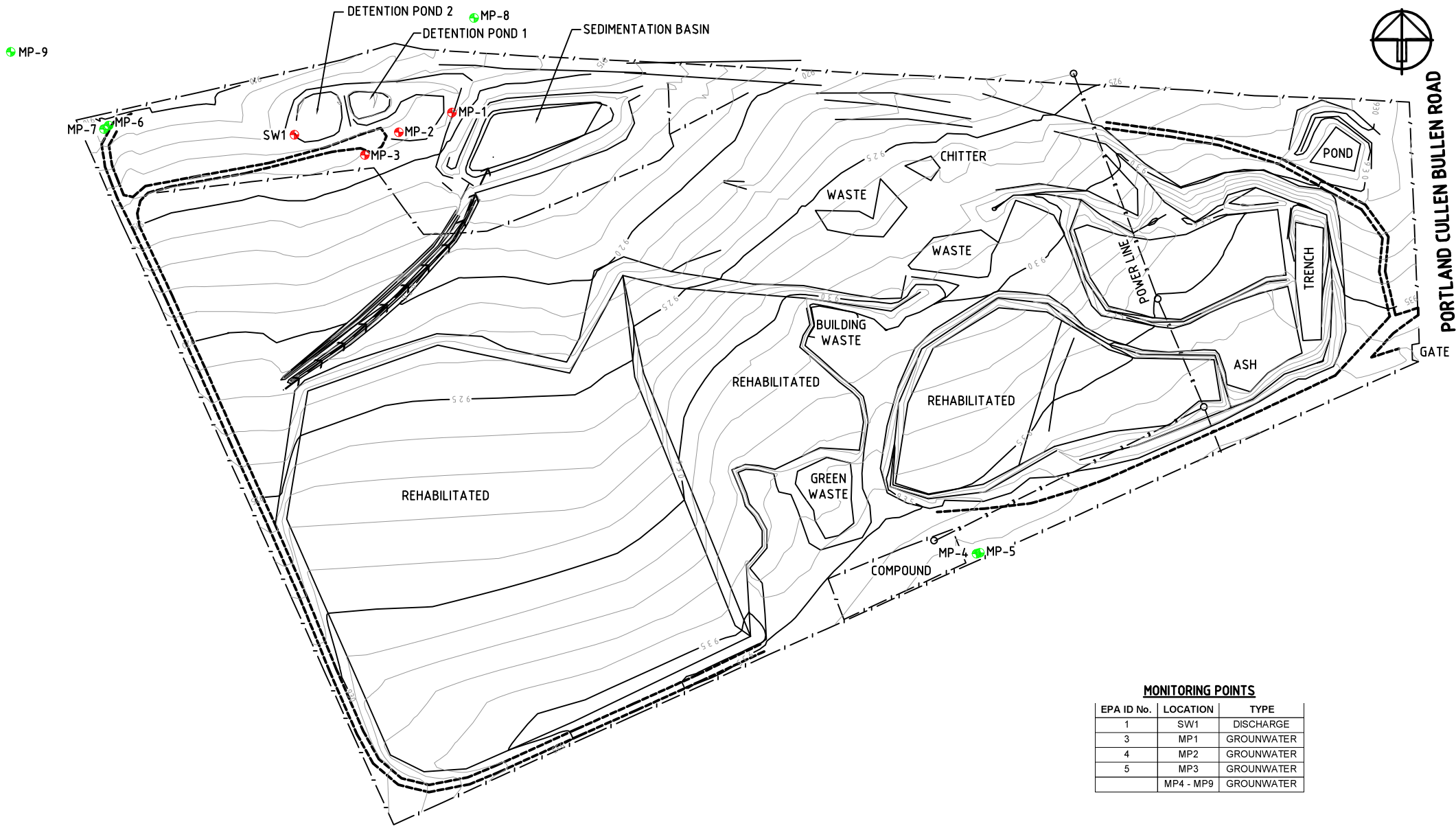
BRENDAN STUART
Environmental Scientist

No. of Attachments – 4: Environmental Monitoring Point Locations
Table 1 – Groundwater Level Measurements
Table 2 – Results of Laboratory Analyses – January 2019
SGS Laboratories Analytical Reports – January 2019





PORTLAND CULLEN BULLEN ROAD

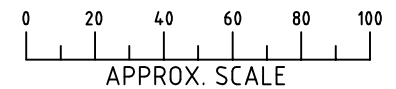


MONITORING POINTS

EPA ID No.	LOCATION	TYPE
1	SW1	DISCHARGE
3	MP1	GROUNWATER
4	MP2	GROUNWATER
5	MP3	GROUNWATER
	MP4 - MP9	GROUNWATER

LEGEND:

- + EPA MONITORING POINT
- + ADDITIONAL MONITORING POINT



ORANGE
 1st FLOOR
 28-31 SALE STREET
 P.O. BOX 1983
 ORANGE, NSW 2800
 Ph. (02) 6382 1055
 Fax. (02) 6361 8178

No	DATE	DEPART CHECK	BY CHECK	DETAILS
A	15/09/08	-	-	ISSUED TO CLIENT
B	11/05/11	LRP	AGB	ISSUED TO CLIENT
C	01/11/12	MDH	KBF	ISSUED TO CLIENT

PROJECT
 PORTLAND WASTE DISPOSAL DEPOT
 FILE REFERENCE: 0:\Projects\202334_01B_EV01.dwg

APPROVAL AUTHORITY
 ENVIRONMENTAL
 PROTECTION AUTHORITY
 EPL: 10936

CLIENT
 LITHGOW CITY
 COUNCIL
 180 MORT STREET,
 LITHGOW NSW 2790

DRAWING
 ENVIRONMENTAL
 MONITORING POINTS
 PROJECT NUMBER: 202334 DRAWING NUMBER: 01C_EV01 REV: C
 SOURCE: CRAVEN, ELLISTON & HAYES (LITHGOW) PTY.LTD.
 CONSULTING LAND, ENGINEERING AND MINING SURVEYORS



TABLE 1: PORTLAND WASTE DISPOSAL DEPOT - GROUNDWATER LEVEL RESULTS

Ground Water Levels: 30-Jan-19

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)
MP1	913.700	0.40	914.100	30/01/2019	3.40	910.70	6.0	908.09	2.61
MP2	913.600	0.20	913.800	30/01/2019	4.18	909.62	5.0	908.80	0.82
MP3	914.200	0.60	914.800	30/01/2019	NMWL	-	5.8	909.00	nil
MP5	937.200	0.80	938.000	30/01/2019	20.61	917.39	61.3	876.70	40.69
MP8	911.800	0.50	912.300	30/01/2019	4.23	908.07	21.5	890.79	17.28
MP9	903.800	1.10	904.900	30/01/2019	0.05	904.85	16.7	888.20	16.65

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.
- NMWL: No Measured Water Level
- Measured: Depth of groundwater measured from the top of the piezometer pipe.

Date	MP1		MP2		MP3		MP5		MP8		MP9	
	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)	Measured	GWL (mAHD)
1-Jun-10	4.21	909.89	NMWL		NMWL		30.20	907.80	4.48	907.82	0.00	904.90
15-Dec-10	1.23	912.87	NMWL		NMWL		27.37	910.63	3.44	908.86	-0.05	904.95
29-Jun-11	1.30	912.80	NMWL		5.65	909.15	25.67	912.33	3.62	908.68	-0.05	904.95
27-Jul-11	1.57	912.53	NMWL		NMWL		NMWL		NMWL		NMWL	
6-Dec-11	1.14	912.96	3.85	909.95	NMWL		25.40	912.60	Bore Damaged		-0.05	904.95
13-Jun-12	0.70	913.40	NMWL		4.48	910.32	NMWL		NMWL		NMWL	
16-Dec-12	2.09	912.01	NMWL		NMWL		22.22	915.78	2.77	909.53	-0.05	904.95
11-Dec-13	3.57	910.53	NMWL		4.98	909.82	22.79	915.21	3.16	909.14	-0.05	904.95
4-Dec-14	3.80	910.30	NMWL		NMWL		23.43	914.57	3.33	908.97	0.05	904.85
3-Dec-15	3.84	910.26	NMWL		5.45	909.35	23.97	914.03	3.57	908.73	-0.05	904.95
24-Jan-18	4.46	909.64	4.56	909.24	5.68	909.12	23.30	914.70	3.68	908.62	0.05	904.85
30-Jan-19	3.40	910.70	4.18	909.62	NMWL		20.61	917.39	4.23	908.07	0.05	904.85

**TABLE 2: PORTLAND WASTE DISPOSAL DEPOT - RESULTS OF LABORATORY ANALYSIS
JANUARY 2019**



Group	Analyte	LOR	Units	Criteria	Sample ID	MP-1	MP-2	MP-5	MP-8	MP-9
					Sample Date	30/01/2019	30/01/2019	30/01/2019	30/01/2019	30/01/2019
						PS	PS	PS	PS	PS
Physical Parameters	pH (Lab)	0	No unit	6.0 - 8.5		6.1	5.4	7	6.9	7.5
	Electrical Conductivity (Lab)	2	µS/cm	4478		3400	1600	1700	3000	3200
Alkalinity	Total Alkalinity as CaCO3	5	mg/L	350		140	14	470	580	550
Anions	Chloride	0.05	mg/L	350		570	230	92	300	330
	Fluoride	0.1	mg/L	1		0.13	0.22	0.24	0.18	0.19
	Sulfate (SO4)	1	mg/L	-		1100	240	470	960	1200
Cations	Calcium (Ca)	0.1	mg/L	1000		330	59	200	340	330
	Magnesium (Mg)	0.1	mg/L	-		120	51	90	160	210
	Potassium (K)	0.2	mg/L	-		130	8.8	8.5	8.3	6.6
	Sodium (Na)	0.1	mg/L	230		270	200	93	210	230
Forms of Carbon	Total Organic Carbon	0.2	mg/L	-		100	24	11	6.5	1.5
	Dissolved Organic Carbon	0.2	mg/L	-		39	16	8.9	3.1	1.4
Nutrients	Ammonia (NH3) as N	0.01	mg/L	-		0.4	1.3	0.05	0.09	0.08
	Nitrate (NO3) as N	0.005	mg/L	-		< 0.005	57	0.021	< 0.005	< 0.005
Trace Metals	Iron (Fe)	0.005	mg/L	0.2		14	0.054	< 0.005	< 0.005	< 0.005
	Manganese (Mn)	0.001	mg/L	0.2		2.4	1.2	0.72	4.7	0.011
Phenolics	Total Phenols	0.01	mg/L	-		< 0.01	< 0.01	< 0.01	< 0.01	< 0.01

**TABLE 2: PORTLAND WASTE DISPOSAL DEPOT - RESULTS OF LABORATORY ANALYSIS
JANUARY 2019**



Group	Analyte	LOR	Units	Criteria	Sample ID	MP-1	MP-2	MP-5	MP-8	MP-9
					Sample Date	30/01/2019	30/01/2019	30/01/2019	30/01/2019	30/01/2019
					PS	PS	PS	PS	PS	PS
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

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

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 **217501 - Portland GD**
 Order Number **217501**
 Samples **5**

LABORATORY DETAILS

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 Laboratory **SGS Alexandria Environmental**
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 Alexandria NSW 2015**

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

SGS Reference **SE188720 R0**
 Date Received **01 Feb 2019**
 Date Reported **08 Feb 2019**

COMMENTS

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

SIGNATORIES



Dong Liang
 Metals/Inorganics Team Leader



Kamrul Ahsan
 Senior Chemist



Shane McDermott
 Inorganic/Metals Chemist



Teresa Nguyen
 Organic Chemist

Parameter	Units	LOR	SE188720.001	SE188720.002	SE188720.003	SE188720.004
Sample Number			SE188720.001	SE188720.002	SE188720.003	SE188720.004
Sample Matrix			Water	Water	Water	Water
Sample Date			30 Jan 2019	30 Jan 2019	30 Jan 2019	30 Jan 2019
Sample Name			MP-1	MP-2	MP-5	MP-8

pH in water Method: AN101 Tested: 5/2/2019

pH**	No unit	-	6.1	5.4	7.0	6.9
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Conductivity and TDS by Calculation - Water Method: AN106 Tested: 5/2/2019

Conductivity @ 25 C	µS/cm	2	3400	1600	1700	3000
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OC Pesticides in Water Method: AN420 Tested: 5/2/2019

Parameter	Units	LOR	SE188720.001	SE188720.002	SE188720.003	SE188720.004
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

Surrogates

Tetrachloro-m-xylene (TCMX) (Surrogate)	%	-	71	83	93	96
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Total Phenolics in Water Method: AN289 Tested: 7/2/2019

Total Phenols	mg/L	0.01	<0.01	<0.01	<0.01	<0.01
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Parameter	Units	LOR	SE188720.001	SE188720.002	SE188720.003	SE188720.004
Sample Number			SE188720.001	SE188720.002	SE188720.003	SE188720.004
Sample Matrix			Water	Water	Water	Water
Sample Date			30 Jan 2019	30 Jan 2019	30 Jan 2019	30 Jan 2019
Sample Name			MP-1	MP-2	MP-5	MP-8

Anions by Ion Chromatography in Water Method: AN245 Tested: 5/2/2019

Parameter	Units	LOR	SE188720.001	SE188720.002	SE188720.003	SE188720.004
Chloride	mg/L	0.05	570	230	92	300
Sulfate, SO4	mg/L	1	1100	240	470	960
Fluoride	mg/L	0.1	0.13	0.22	0.24	0.18
Nitrate Nitrogen, NO3-N	mg/L	0.005	<0.005	57	0.021	<0.005

Alkalinity Method: AN135 Tested: 5/2/2019

Parameter	Units	LOR	SE188720.001	SE188720.002	SE188720.003	SE188720.004
Total Alkalinity as CaCO3	mg/L	5	140	14	470	580

Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: AN291 Tested: 7/2/2019

Parameter	Units	LOR	SE188720.001	SE188720.002	SE188720.003	SE188720.004
Ammonia Nitrogen, NH ₃ as N	mg/L	0.01	0.40	1.3	0.05	0.09

Forms of Carbon Method: AN190 Tested: 5/2/2019

Parameter	Units	LOR	SE188720.001	SE188720.002	SE188720.003	SE188720.004
Total Organic Carbon as NPOC	mg/L	0.2	100	24	11	6.5
Dissolved Organic Carbon as NPOC (passing 0.45um filter)	mg/L	0.2	39	16	8.9	3.1

Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 7/2/2019

Parameter	Units	LOR	SE188720.001	SE188720.002	SE188720.003	SE188720.004
Calcium, Ca	mg/L	0.1	330	59	200	340
Magnesium, Mg	mg/L	0.1	120	51	90	160
Potassium, K	mg/L	0.2	130	8.8	8.5	8.3
Sodium, Na	mg/L	0.1	270	200	93	210

Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 6/2/2019

Parameter	Units	LOR	SE188720.001	SE188720.002	SE188720.003	SE188720.004
Iron, Fe	mg/L	0.005	14	0.054	<0.005	<0.005
Manganese, Mn	mg/L	0.001	2.4	1.2	0.72	4.7

Sample Number	SE188720.005	
Sample Matrix	Water	
Sample Date	30 Jan 2019	
Sample Name	MP-9	
Parameter	Units	LOR

pH in water Method: AN101 Tested: 5/2/2019

pH**	No unit	-	7.5
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Conductivity and TDS by Calculation - Water Method: AN106 Tested: 5/2/2019

Conductivity @ 25 C	µS/cm	2	3200
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OC Pesticides in Water Method: AN420 Tested: 5/2/2019

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

Sample Number SE188720.005
 Sample Matrix Water
 Sample Date 30 Jan 2019
 Sample Name MP-9

Parameter	Units	LOR
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OC Pesticides in Water Method: AN420 Tested: 5/2/2019 (continued)

Surrogates

Tetrachloro-m-xylene (TCMX) (Surrogate)	%	-	72
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Total Phenolics in Water Method: AN289 Tested: 7/2/2019

Total Phenols	mg/L	0.01	<0.01
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Anions by Ion Chromatography in Water Method: AN245 Tested: 5/2/2019

Chloride	mg/L	0.05	330
Sulfate, SO ₄	mg/L	1	1200
Fluoride	mg/L	0.1	0.19
Nitrate Nitrogen, NO ₃ -N	mg/L	0.005	<0.005

Alkalinity Method: AN135 Tested: 5/2/2019

Total Alkalinity as CaCO ₃	mg/L	5	550
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Ammonia Nitrogen by Discrete Analyser (Aquakem) Method: AN291 Tested: 7/2/2019

Ammonia Nitrogen, NH ₃ as N	mg/L	0.01	0.08
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Forms of Carbon Method: AN190 Tested: 5/2/2019

Total Organic Carbon as NPOC	mg/L	0.2	1.5
Dissolved Organic Carbon as NPOC (passing 0.45um filter)	mg/L	0.2	1.4

Sample Number SE188720.005
 Sample Matrix Water
 Sample Date 30 Jan 2019
 Sample Name MP-9

Parameter Units LOR

Metals in Water (Dissolved) by ICPOES Method: AN320 Tested: 7/2/2019

Parameter	Units	LOR	Result
Calcium, Ca	mg/L	0.1	330
Magnesium, Mg	mg/L	0.1	210
Potassium, K	mg/L	0.2	6.6
Sodium, Na	mg/L	0.1	230

Trace Metals (Dissolved) in Water by ICPMS Method: AN318 Tested: 6/2/2019

Parameter	Units	LOR	Result
Iron, Fe	mg/L	0.005	<0.005
Manganese, Mn	mg/L	0.001	0.011

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	LCS %Recovery
Total Alkalinity as CaCO3	LB166148	mg/L	5	<5	109%

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

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery
Ammonia Nitrogen, NH ₃ as N	LB166327	mg/L	0.01	<0.01	96%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Chloride	LB166068	mg/L	0.05	<0.05	0%	99%
Sulfate, SO ₄	LB166068	mg/L	1	<1.0	0%	99%
Fluoride	LB166068	mg/L	0.1	<0.10		93%
Nitrate Nitrogen, NO ₃ -N	LB166068	mg/L	0.005	<0.005	1%	99%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Conductivity @ 25 C	LB166099	µS/cm	2	<2	0%	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	LB166062	mg/L	0.2	<0.2	1 - 5%	108%	109%
Dissolved Organic Carbon as NPOC (passing 0.45µm filter)	LB166062	mg/L	0.2	<0.2		NA	

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

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery	MS %Recovery
Calcium, Ca	LB166345	mg/L	0.1	<0.1	95%	108%
Magnesium, Mg	LB166345	mg/L	0.1	<0.1	100%	97%
Potassium, K	LB166345	mg/L	0.2	<0.2	96%	
Sodium, Na	LB166345	mg/L	0.1	<0.1	90%	95%

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.

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Hexachlorobenzene (HCB)	LB166065	µg/L	0.1	<0.1	0%	NA
Alpha BHC	LB166065	µg/L	0.1	<0.1	0%	NA
Lindane (gamma BHC)	LB166065	µg/L	0.1	<0.1	0%	NA
Heptachlor	LB166065	µg/L	0.1	<0.1	0%	90%
Aldrin	LB166065	µg/L	0.1	<0.1	0%	77%
Beta BHC	LB166065	µg/L	0.1	<0.1	0%	NA
Delta BHC	LB166065	µg/L	0.1	<0.1	0%	113%
Heptachlor epoxide	LB166065	µg/L	0.1	<0.1	0%	NA
o,p'-DDE	LB166065	µg/L	0.1	<0.1	0%	NA
Alpha Endosulfan	LB166065	µg/L	0.1	<0.1	0%	NA
Gamma Chlordane	LB166065	µg/L	0.1	<0.1	0%	NA
Alpha Chlordane	LB166065	µg/L	0.1	<0.1	0%	NA
trans-Nonachlor	LB166065	µg/L	0.1	<0.1	0%	NA
p,p'-DDE	LB166065	µg/L	0.1	<0.1	0%	NA
Dieldrin	LB166065	µg/L	0.1	<0.1	0%	103%
Endrin	LB166065	µg/L	0.1	<0.1	0%	101%
o,p'-DDD	LB166065	µg/L	0.1	<0.1	0%	NA
o,p'-DDT	LB166065	µg/L	0.1	<0.1	0%	NA
Beta Endosulfan	LB166065	µg/L	0.1	<0.1	0%	NA
p,p'-DDD	LB166065	µg/L	0.1	<0.1	0%	NA
p,p'-DDT	LB166065	µg/L	0.1	<0.1	0%	100%
Endosulfan sulphate	LB166065	µg/L	0.1	<0.1	0%	NA
Endrin aldehyde	LB166065	µg/L	0.1	<0.1	0%	NA
Methoxychlor	LB166065	µg/L	0.1	<0.1	0%	NA
Endrin ketone	LB166065	µg/L	0.1	<0.1	0%	NA
Isodrin	LB166065	µg/L	0.1	<0.1	0%	NA
Mirex	LB166065	µg/L	0.1	<0.1	0%	NA

Surrogates

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery
Tetrachloro-m-xylene (TCMX) (Surrogate)	LB166065	%	-	59%	16%	63%

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.

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

Parameter	QC Reference	Units	LOR	DUP %RPD	LCS %Recovery
pH**	LB166099	No unit	-	0%	99%

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

Parameter	QC Reference	Units	LOR	MB	DUP %RPD	LCS %Recovery	MS %Recovery
Total Phenols	LB166328	mg/L	0.01	<0.01	0%	96%	93%

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

Parameter	QC Reference	Units	LOR	MB	LCS %Recovery	MS %Recovery
Iron, Fe	LB166200	mg/L	0.005	<0.005	104%	-120%
Manganese, Mn	LB166200	mg/L	0.001	<0.001	99%	65%

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.
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
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
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.

METHOD

METHODOLOGY SUMMARY

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).
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:

- 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>

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