Helping You Protect Your Environment

ENVIRONMENTAL MONITORING URALLA LANDFILL

ANNUAL REPORT

17 October 2019 to 16 October 2020

for Uralla Shire Council

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1. INTRODUCTION

This is the annual report required under Environment Protection Licence (EPL) No. 5899 for the Uralla Landfill. It concerns the annual reporting period 17 October 2019 to 16 October 2020. Tabled environmental monitoring results and a brief review are provided.

2. LICENCE REQUIREMENTS

The Uralla Landfill licence states:

Annual monitoring report

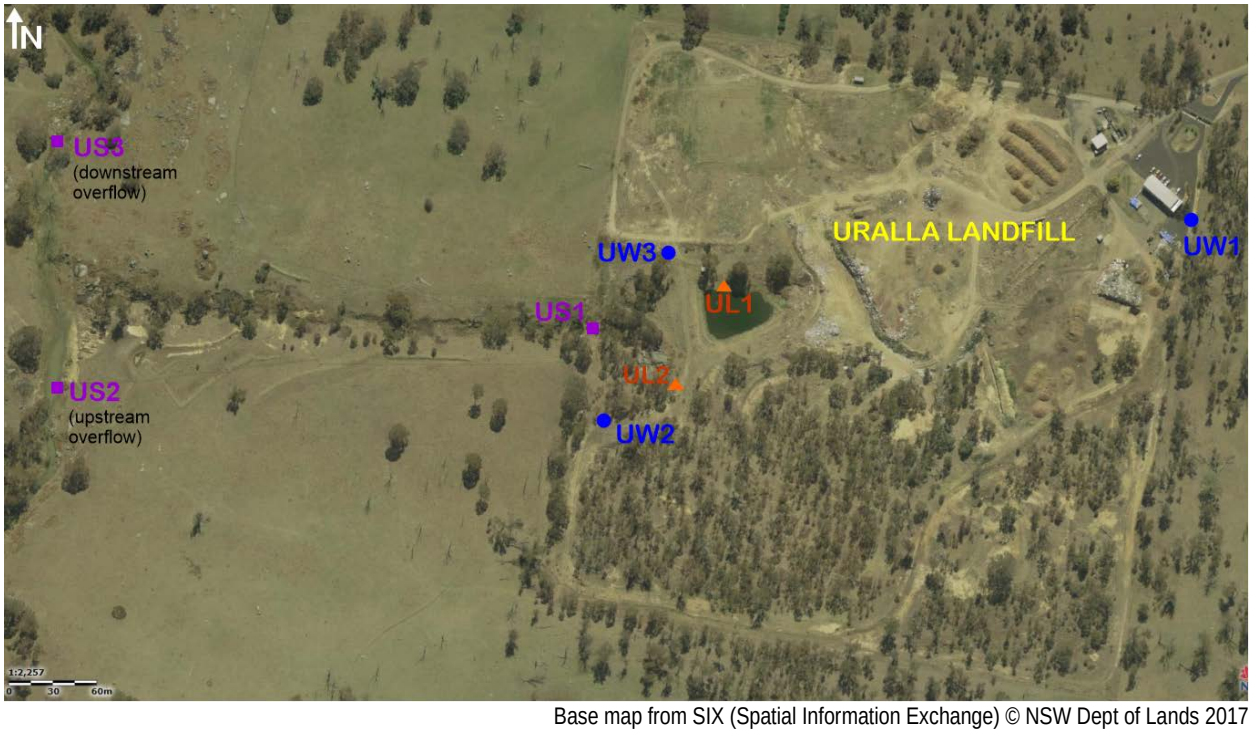
R1.8 The Licensee must provide with the Annual Return a report that:

- *a) Demonstrates that surface water monitoring and groundwater results have been assessed after each monitoring event to determine the occurrence of groundwater pollution and off-site surface water pollution;*
- *b) Demonstrates that landfill gas monitoring results have been assessed after each monitoring event to determine the need for action to prevent gas emissions and gas accumulation; and*
- *c) Provides details of action taken in response to the assessments undertaken in a) and b).*

3. SAMPLING LOCATIONS

Sampling locations specified in the Environment Protection Licence 5899 for groundwater, surface water and leachate at the Uralla Landfill are shown on Figure 1.

Figure 1: Sampling locations



Base map from SIX (Spatial Information Exchange) © NSW Dept of Lands 2017

Surface water sampling points:
EPA No. 1 - US1; EPA No. 10 - US2 - Upstream leachate overflow sampling point; EPA No. 11 – US3 - Downstream leachate overflow sampling point
Groundwater monitoring wells:
EPA No. 4 - UW1; EPA No. 5 - UW2; EPA No. 6 - UW3
Leachate:
EPA No. 2 - UL2 (leachate overflow); EPA No. 3 - Leachate volume discharge to irrigation area; EPA No. 7 - UL1 (leachate quality)
Methane: EPA No. 8 - Surface methane; EPA No. 9 - Building methane (as defined in NSW EPA 2016).

4. PUBLICATION OF MONITORING DATA

As required by the Environment Protection Authority (EPA) all monitoring data are provided on the Uralla Shire website - as an updated monitoring file:

https://www.uralla.nsw.gov.au/Council-Services/Waste-Recycling/Pollution-Incident-Response-Monitoring-Data-Uralla-Landfill

5. ASSESSMENT OF METHANE

Methane monitoring was conducted as per licence requirements. The following excerpts from the results tables of the quarterly environmental report demonstrate that the results were provided in an assessable form.

Table 1: Surface methane detections – Uralla Landfill

Date	Sampling location	ppm by vol in air	% CH4 by volume in air	% LEL (Lower Explosive Limit)
	Note:	500ppm CH_4 by vol in air	= 0.05% = CH_4 by vol in air	1% LEL
15/02/20	nil detects on surface; nil eastern vent			
17/06/20	nil detects on surface; 680 ppm eastern vent			
03/09/20	nil detects on surface; nil eastern vent			
16/10/20	nil detects on surface; 1220 ppm eastern vent			

Notes:

1. 100% LEL for methane (CH4) = 5% CH4 by volume in air (50,000 ppm by volume in air). Methane may explode in confined spaces or ignite in open spaces if ignited when CH4 is 5% to 15% by volume in air. Oxygen levels should never fall below 18% by volume in air (180,000 ppm by volume in air) and carbon dioxide levels should not exceed 0.5% by volume in air (5000 ppm by volume in air) for an 8 hour working day (Gendebien et al., 1992:282-284).
2. NSW EPA (2016, p.33) surface methane monitoring threshold for investigation & corrective action = 0.05% CH4 by volume in air = 500 ppm by volume in air = 1% LEL
3. NSW EPA (2016, p.35) surface methane monitoring notification promptly to EPA if concentration ≥ 1 % CH_4 by volume in air = 10,000 ppm by volume in air = 20% LEL. Plan for further investigation or remediation to EPA within 14 days.
4. Leachate vent internally is technically not a surface gas monitoring point. It is tested for OH&S.

Table 2: Recycling & transfer shed methane detections – Uralla Landfill

Date	Sampling location	ppm by vol in air	% CH4 by volume in air	% LEL (Lower Explosive Limit)
	Note:	12,500ppm CH_4 by vol in air	= 1.25% = CH_4 by vol in air	25% LEL
15/02/20	Nil methane detected recycling & transfer sheds.			
17/06/20	Nil methane detected recycling & transfer sheds.			
03/09/20	Nil methane detected recycling & transfer sheds.			
16/10/20	Nil methane detected recycling & transfer sheds.			

Note: NSW EPA (2016, p.35) methane accumulation reportable to EPA within 24 hours threshold in buildings = 1.0% CH4 by volume in air = 10,000 ppm by volume in air = 20% LEL.

5.1 Response actions – methane monitoring

If there are methane detections, Council is advised verbally soon after the detection.

No surface or building methane detections were made in this annual reporting year. However, Council is advised of the readings in the gas vents in the last two constructed cells - from an occupational health and safety perspective.

6. ASSESSMENT OF WATERS

Surface, groundwater and leachate monitoring was conducted for the analytes listed and according to the sampling frequency in the licence. Field parameter forms and laboratory results, sampling methodology and quality assurance measures were detailed in the quarterly reports to Council. Tables of historical results since sampling commenced at the landfill are also provided in these reports.

Excerpts from the results tables of the environmental monitoring reports follow. They provide the results for this annual reporting year. They demonstrate that the results were provided in an assessable form to determine the occurrence of groundwater pollution and off-site surface water pollution. This year's leachate results and Australian water quality guideline values are also provided as a comparison for the surface water and groundwater.

6.1 Groundwater results

Table 3: Results - Groundwater monitoring well UW1

	Field analytes					*Water levels*		*Carbon*		
	DO	EC	pH	Eh	Temp	D	RL	Alk	Free CO_2	CO_2 + Alk
Measure	mg/L	µS/cm	1-14	mV	°C	m	m	mg/L	mg/L	mg/L
Reporting Limit	0.01	1	0.01	1	0.1	0.01	0.01	1	1	1
15/02/20						18.88	84.23			
17/06/20	2.75	1699	6.90	+143	18.3	18.98	84.13	267	117	84
03/09/20						18.95	84.16			
16/10/20	3.18	1695	6.84	+179	20.7	18.91	84.20	283	109	85

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Eh = redox potential; Temp = Temperature; D = Depth to water from top of internal well casing; RL = water level converted to Reduced Level relative to 100 m BMG (top of PVC casing RL = 103.111m); Alk = Alkalinity measured as mg/L $CaCO_3$ equivalent; Free CO_2 = Free Carbon Dioxide; Unfiltered C of (CO_2 + Alk) = 12/44 CO_2 + 12/61 Alk; NR = Not required.
Note: Approximate Grid Coordinates for UW1: E 354250; N 6607900.

Table 4: Results - Groundwater monitoring well UW2

UW2	*Field analytes*					*Water levels*		*Carbon*				*Laboratory leachate indicator analytes*							
	DO	EC	pH	Eh	Temp	D	RL	Alk	Free CO_2	CO_2 + Alk	TOC	SO_4	Cl	As	Mn	Fe	NO_X	TKN	TotN
Measure	mg/L	µS/cm	1-14	mV	°C	m	m	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	as N mg/L	as N mg/L	mg/L
Reporting Limit	0.01	1	0.01	1	0.1	0.01	0.01	1	1	1	1	1	1	0.1	0.01	0.01	0.01	0.01	0.1
15/02/20						9.76	78.10												
17/06/20	0.43	1681	7.21	+105	16.2	9.71	78.15	653	153	170	9	22	224	0.006	0.044	<0.05	0.03	0.8	0.8
03/09/20						9.65	78.21												
16/10/20	0.24	1689	7.02	+174	18.1	9.60	78.26	707	158	182	15	22	232	0.006	0.054	0.05	0.02	1.0	1.0

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Eh = redox potential; Temp = Temperature; D = Depth to water from top of internal well casing; RL = water level converted to Reduced Level relative to 100m BMG (top of PVC casing RL = 87.862 m); Alk = Alkalinity measured as mg/L $CaCO_3$ equivalent; Free CO_2 = Free Carbon Dioxide; Unfiltered C of (Alk + CO_2) = 12/61 Alk + 12/44 CO_2; TOC = Total Organic Carbon; SO_4 = Sulphate; Cl = Chloride; As = Arsenic; Mn = Manganese; Fe = Iron; Bold = non-filtered; NO_X = Nitrite + Nitrate; TKN = Total Kjeldahl Nitrogen; TotN = Total Nitrogen. Bold = non-filtered.
Note: Approximate Grid Coordinates for UW2: E 353850; N 6607750.

Table 5: Results - Groundwater monitoring well UW3 – Field parameters and carbon

UW3	*Field analytes*					*Water levels*		*Carbon*			
	DO	EC	pH	Eh	Temp	D	RL	Alk	Free CO_2	CO_2 + Alk	TOC
Measure	mg/L	µS/cm	1-14	mV	°C	m	m	mg/L	mg/L	mg/L	mg/L
Reporting Limit	0.01	1	0.01	1	0.1	0.01	0.01	1	1	1	1
15/02/20	0.57	2213	6.34	+171	17.9	9.96	80.67	680	469	262	10
17/06/20	0.26	2206	6.61	+159	15.8	10.06	80.57	687	440	255	25
03/09/20	0.29	2230	6.40	+147	13.7	10.02	80.61	587	337	207	41
16/10/20	0.34	2189	6.39	+139	18.5	9.98	80.65	620	469	250	14

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Eh = redox potential; Temp = Temperature; D = Depth to water from top of internal well casing; RL = water level converted to Reduced Level relative to 100m BMG (top of PVC casing RL = 90.627m); Alk = Alkalinity measured as mg/L $CaCO_3$ equivalent; Free CO_2 = Free Carbon Dioxide; Unfiltered C of (Alk + CO_2) = 12/61 Alk + 12/44 CO_2; TOC = Total Organic Carbon; Bold = non-filtered.
Note: Approximate Grid Coordinates for UW3: E 353887; N 6607875.

Table 6: Results - Groundwater monitoring well UW3 – Laboratory analytes

UW3	*Ions and metals*									*Nutrients*		
	SO_4	Cl	Ca	Mg	Na	K	As	Mn	Fe	NO_X	TKN	TotN
Measure	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	as N mg/L	as N mg/L	mg/L
Reporting Limit	1	1	1	1	1	1	0.1	0.01	0.01	0.01	0.01	0.1
15/02/20	109	378	170	148	118	14	0.053	0.019	<0.05	12.7	2.8	15.5
17/06/20	118	376	162	139	101	12	0.047	0.017	<0.05	11.2	1.0	12.2
03/09/20	164	365	179	160	108	13	0.052	0.019	<0.05	10.4	2.1	12.5
16/10/20	165	375	175	150	107	13	0.057	0.020	<0.05	9.14	2.0	11.1

Abbreviations: SO4 = Sulphate; Cl = Chloride; Ca = Calcium; Mg = Magnesium; Na = Sodium; K = Potassium; As = Arsenic; Mn = Manganese; Fe = Iron; Bold = non-filtered; NOX = Nitrite + Nitrate; TKN = Total Kjeldahl Nitrogen; TotN = Total Nitrogen.

6.2 Surface water results

Table 7: Field analytes, water level, nutrients, carbon – Surface water sampling point US1

US1	*Field analytes*					*Carbon*				*Water depth*	*Flow*
	DO	EC	pH	Eh	Temp	Alk	Free CO_2	CO_2 + Alk	TOC	D	VFR
Measure	mg/L	µS/cm	1-14	mV	°C	mg/L	mg/L	mg/L	mg/L	m	kL/ day
Reporting Limit	0.01	1	0.01	1	0.1	1	1	1	1	0.01	0.01
05/10/19	No	flow									
15/02/20	3.03	2256	7.28	-71	23.0	533	132	141	30	0.002	2.59
16/10/20	0.86	1966	7.28	-177	18.9	536	120	138	23	0.003	2.59

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Eh = Redox Potential; Temp = Temperature; Alk = Alkalinity measured as mg/L $CaCO_3$ equivalent; Free CO_2 = Free Carbon Dioxide; Unfiltered C of (Alk + CO_2) = 12/61 Alk + 12/44 CO_2; TOC = Total Organic Carbon; Bold = unfiltered; NT = Not tested; D = Approximate depth of water at sampling point; VFR = Volumetric Flow Rate.

Table 8: Laboratory analytes, suspended solids, geochemical, metals, VOCs – Surface water US1

US1	*Laboratory analytes – geochemical, metals, nutrients*															
	SS	SO_4	Cl	As	Cd	Cr	Cu	Pb	Mn	Ni	Zn	Fe	NO_X	TKN	TotN	TotP
Measure	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	as N mg/L	as N mg/L	mg/L	mg/L
Reporting Limit	1	1	1	0.001	0.001	0.001	0.001	0.001	0.01	0.001	0.001	0.01	0.01	0.1	0.1	0.01
05/10/19	No	flow														
15/02/20	31	122	412	0.003	<0.0001	0.002	0.002	<0.001	5.67	0.016	0.010	4.73	0.01	3.4	3.4	0.23
16/10/20	58	46	469	0.002	<0.0001	<0.001	0.001	<0.001	2.00	0.012	0.010	2.46	<0.01	2.6	2.6	0.10

Abbreviations: SS = Suspended solids; SO_4 = Sulphate; Cl = Chloride; As = Arsenic; Cd = Cadmium; Cr = Total Chromium; Cu = Copper; Pb = Lead; Mn = Manganese; Ni = Nickel; Zn = Zinc; Fe = Iron ; NT = Not tested; Bold = unfiltered; NO_X = Nitrite + Nitrate; TKN = Total Kjeldahl Nitrogen (organic nitrogen and ammonia); Tot N = Total Nitrogen; Tot P = Total Phosphorus.

6.3 Leachate results

Table 9: Field analytes, water level, VOCs, nutrients – Leachate sampling point UL1

UL1	*Field analytes*					*Carbon*				*Water depth*	*Ions*	
	DO	EC	pH	Eh	Temp	Alk	Free CO_2	CO_2 + Alk	TOC	D	SO_4	Cl
Measure	mg/L	µS/cm	1-14	mV	°C	mg/L	mg/L	mg/L	mg/L	m	mg/L	mg/L
Reporting Limit	0.01	1	0.01	1	0.1	1	1	1	1	0.01	1	1
17/06/20	1.56	4275	7.35	-79	18.4	1933	469	508	45	NA	<1	339
16/10/20	6.60	2141	8.14	+157	24.1	867	59	186	13	0.3	73	254

Abbreviations: DO = Dissolved Oxygen; EC = Electrical Conductivity also called specific conductance; Eh = Redox Potential; Temp = Temperature; Alk = Alkalinity measured as mg/L $CaCO_3$ equivalent; Free CO_2 = Free Carbon Dioxide; Unfiltered C of (Alk + CO_2) = 12/61 Alk + 12/44 CO_2; TOC = Total Organic Carbon; D = Approximate depth of water at sampling point; SO_4 = Sulphate; Cl = Chloride; NA = Not applicable – taken from end of dripping pipe.

Table 10: Laboratory analytes – geochemical, metals, phenols – Leachate UL1

UL1	*Laboratory analytes – geochemical, metals*													
	As	Cd	Cr	Cu	Ni	Pb	Zn	Mn	B	Fe	NO_X	TKN	TotN	TotP
Measure	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	as N mg/L	as N mg/L	mg/L	mg/L
Reporting Limit	0.001	0.001	0.001	0.001	0.01	0.001	0.001	0.01	0.2	0.01	0.01	0.1	0.1	0.01
17/06/20	0.060	<0.0001	0.017	0.003	0.034	<0.001	0.013	1.780	0.88	16.9	2.41	180.0	182.0	1.18
16/10/20	0.002	<0.0001	0.003	0.015	0.020	<0.001	0.014	0.663	0.59	0.48	4.41	24.8	29.2	0.06

Abbreviations: As = Arsenic; Cd = Cadmium; Cr = Total Chromium; Cu = Copper; Ni = Nickel; Pb = Lead; Zn = Zinc; Mn = Manganese; B = Boron; Fe = Iron; NO_x = Nitrite + Nitrate; TKN = Total Kjeldahl Nitrogen (organic nitrogen and ammonia); Tot N = Total Nitrogen; Tot P = Total Phosphorus. NT = Not tested; NT = Not tested; LOR = Level of Reporting; Bold = not filtered; NC = Not continuing.

Table 11: Carbon compounds – Leachate UL1

UL1	*Pesticides*	*VOC / BTEX*
Measure	mg/L	mg/L
Reporting Limit	various	various
17/06/20	ND	0.004 Benzene; 0.011 Chlorobenzene
16/10/20	ND	ND

Abbreviations: Pesticides = Organochlorine and Organophosphorus pesticides; ND = Nil detected; VOC = Volatile organic compounds; BTEX = Benzene Toluene Ethylbenzene, Xylene.

6.4 Leachate dam overflow results

There were no overflows this annual reporting year.

6.5 Water quality comparisons

Table 12 is provided as an aid for reviewing environmental health risks.

*Table 12: Environmental health warning limits for **surface waters** - some landfill analytes*

Analyte	***Reason for Inclusion***	***Aquatic*** 1	***Human*** 2	***Irrigation*** 3	***Livestock*** 4
Temperature	Biodegradation of waste increases temperature. Temp + EC have successfully defined a leachate plume (Scrudato & Pagano, 1994).	>80%ile <20%ile	NR	NR	NR
pH	varies from acidic to alkaline as waste decomposition progresses (Andreottola & Cannas, 1992:72). But pH levels in groundwater are often naturally low.	6.5 to 8.0 (2000); 6.5 – 9.0 (1992)	6.5 to 8.5 (A)	>6 limits corrosion of pipes	NR
Electric Conductivity (EC)	a general indicator that summarises the general trend of major cation and anion concentrations.	30 -350 µS/cm (2000); ≤1500 µS/cm (1992)	>1875 µS/cm (unpalatable)	varies, e.g., ≤1,000µS/cm carrots	≥3582 µS/cm analyse for specific ions which may affect
Alkalinity	Measures acid-neutralising capacity, a solution's ability to buffer, that is stop pH changing. Often high in leachate, but some groundwaters can also have high alkalinity.	NR	NR	NR	NR
Boron	High mobility in clay. Good tracer. Found in leachate (Bagchi, 1994:52). Found in fireproofing agents, preservatives, antiseptics, glass, enamels, cosmetics, cements, carpets, soaps, powders and ointments. Some crops are intolerant to boron (ANZECC, 1992:5-13).	≤0.37 mg/L	≤4.0 mg/L	≤0.5 mg/L (long term)	≤5mg/L
Bromine	Recently found to be a good leachate indicator (Baker, 1993). Used in bleaches; dyes; pharmaceuticals; pesticides; solvents for waxes, greases and oils; additives for motor oil and fuels; and used in photograph development.	NR	NR	NR	NR
Ammonium ions	From decaying plants and animals. May be high in leachate (Hancock & Phillips, 1992:22). Toxic to fish (ANZECC, 1992:2-30).	Table 8.3.7 ≤0.18 mg/L as N for pH 9.0; ≤0.9 mg/L as N pH 8.0; ≤2.18 mg/L pH 7.0.	≤0.04 mg/L as N (A – corrosion of copper pipes)	Nitrogen ≤5 mg/L (long term; 25-125 mg/L (short term – up to 20 years)	NR
Nitrate	From final stage of plant and animal decomposition or fertilisers. May be high in leachate (Canter *et. al*, 1997:6). Toxic to infants and livestock (ANZECC, 1992:4-10,5-23).	(Table 3.3.2 eutro - NO_x as N ≤0.015 mg/L; TN ≤0.25 mg/L; Table 3.4.1 Toxic ≤0.158 NO_x as N	≤11.3 mg/L as N (2011) for up to 3 month bottle fed babies. Others ≤22.6 mg/L as N.	As for ammonia	≤ 90 mg/L as N; Nitrite ≤9 mg/L as N
Phosphorus	Csuros (1994:228-229) explains that phosphorus occurs in animal, plant and mineral kingdoms. Its discharge to streams may stimulate growth of photosynthetic organisms especially if it is the nutrient whose low values are limiting the primary productivity of the water.	Total P ≤0.02 mg/L	NR	≤0.05 mg/L (long term to prevent clogging equipment; ≤0.8-12 mg/L (short term)	NR
Iron and manganese	High iron concentrations affect plant growth and high manganese concentrations clog irrigation equipment and are toxic to plants (ANZECC, 1992:5-15, 5-16).	Fe NR (2000), ≤1 mg/L (1992), Mn≤1.9mg/L	Fe 0.3 mg/L (A) Mn 0.1 mg/L (A), Health 0.5 mg/L	Fe & Mn 0.2 mg/L long term, 10 mg/L short term	not sufficiently toxic (2000); ≤17 mg/L for dairy cattle (1992)
VOCs	Good indicators of man-made pollutants found in landfill leachate (USEPA, 1991:51075). Toxic and carcinogenic to animals and humans.	varies for different compounds	varies for different compounds	NR	NR

Table 12 continued:

Analyte	***Reason for Inclusion***	***Aquatic*** 1	***Human*** 2	***Irrigation*** 3	***Livestock*** 4
Arsenic	Found in cattle dip soils; toxic, possibly carcinogenic (Manahan, 1990:150), toxic to livestock in high concentrations (ANZECC, 1992:5-25)	≤0.024 mg/L (III) form; ≤0.05 aquaculture	≤0.01 mg/L	≤0.1 mg/L long term; ≤2 mg/L short term	0.5 to 5 mg/L tolerated
Cadmium	Causes high blood pressure, kidney damage, destroys testicular tissue and red blood cells, toxic to aquatic biota (Manahan, 1990:150), toxic and carcinogenic to livestock (ANZECC, 1992:5-26)	≤0.0002 mg/L	≤0.002 mg/L	≤0.01 mg/L long term; ≤0.05 mg/L short term	≤0.01 mg/L
Chromium	Cr^{+6} is possibly carcinogenic and is toxic to humans (anaemia, kidney disease, nervous system) (Manahan, 1990:150), reduces crop yield (ANZECC, 1992:5-14).	≤0.001 mg/L for Cr^{+6}	≤0.05 mg/L (Cr^{+6})	≤0.1 mg/L long term; ≤1 mg/L short term	≤1 mg/L
Copper	Essential in small concentrations for plant growth and animals (ANZECC, 1992:5-15&5-27). Toxic to sensitive plants and animals and bioaccumulated.	0.0014 mg/L	≤2 mg/L (Health) ≤1 mg/L (A)	≤0.2 mg/L long term; ≤5 mg/L short term	<0.4 mg/L sheep, <1 mg/L cattle; <5 mg/L pigs and poultry
Lead	Wildlife destruction (Manahan, 1990:151), reduces plant growth (ANZECC, 1992:5-16). Decreases human intelligence, growth (Csuros, 1994:210).	≤0.0034 mg/L	≤0.01 mg/L	≤2 mg/L long term; ≤5 mg/L short term	≤0.1 mg/L
Mercury	Very toxic to humans - numbness, deafness, loss of muscle control (Csuros, 1994:212); toxic to fish (ANZECC, 1992:2-38).	NR (2000); ≤0.0001 mg/L (1992)	≤0.001 mg/L	≤0.002 mg/L	≤0.002mg/L
Selenium	Toxic to cattle, fish and humans (Manahan, 1990:151) Used in electronics, glass, ceramics, pigments, rubber (Csuros, 1994:213).	≤0.005 mg/L	≤0.01 mg/L	≤0.02 mg/L long term; ≤0.05 mg/L short term	≤0.02 mg/L
Zinc	Found both naturally (weathering & erosion) and from anthropogenic sources (ANZECC, 1992:2-42). Zinc coating used to protect iron, steel and brass; used in dry batteries, construction materials, printing processes (Csuros, 1994:215). One of seven analytes with greatest percentage increase from 71 unlined landfills in North Carolina, USA (Borden and Yanoschak, 1990:269). Also found by CodyHart in landfill ponds and leachate.	≤0.008 mg/L	≤3 mg/L (A)	≤2 mg/L long term; ≤5 mg/L short term	≤20 mg/L

1. from Tables 3.3.1, 3.3.2, 3.3.3 - Default trigger values for aquatic ecosystems in upland rivers of south-east Australia that are slightly-moderately disturbed; and Table 3.4.1 trigger values for toxicants 95% level aquatic ecosystem protection in *'Australian and New Zealand Guidelines for Fresh and Marine Water Quality'*, ANZECC & ARMCANZ 2000.
2. from *'Australian Drinking Water Guidelines 6'* NHMRC & NRMMC 2011. <http://www.nhmrc.gov.au/guidelines/publications/eh52/>.
3. from Tables 4.2.5, 4.2.10, 4.2.11, 4.2.14 and 4.2.15 *'Australian and New Zealand Guidelines for Fresh and Marine Water Quality'*, ANZECC & ARMCANZ 2000.
4. from page 4.3-3 – 4.3-5 *'Australian and New Zealand Guidelines for Fresh and Marine Water Quality'*, ANZECC & ARMCANZ 2000.
NR - No recommendation
(A) aesthetic guideline rather than an environmental health guideline
(1992) refers to 1992 edition of the *'Australian and New Zealand Guidelines for Fresh and Marine Water Quality'*.

6.6 Response actions – groundwater, surface water, leachate

Groundwater, surface water and leachate were sampled in the frequency required on the EPL, and results were assessed against the historical non-contaminated results for that well or sampling point, and other ones on-site, in the light of literature references, and from CodyHart knowledge of other groundwater and surface water contamination events.

Comments on water that follow are from the latest report, October 2020, for each sampling point to Council. They are typical of comments for other sampling events this annual reporting year.

Groundwater levels in wells (piezometric levels)

Piezometric levels (groundwater level due to pressure head), in comparison to the September 2020 sampling round all rose: Well UW1 by 4 cm; UW2 by 5 cm; and UW3 by 4 cm. Since 2001, water levels have risen overall, UW1 by 5.41 m; UW2 by 2.35 m; and UW3 by 3.25 m.

Groundwater quality

- *UW1, upgradient well. Water quality in this well is tested six-monthly for only field analytes: dissolved oxygen, pH, Eh, EC, and temperature, and alkalinity and free carbon dioxide. Results are similar to previous rounds and show no sign of landfill leachate contamination.*
- *UW2, a downgradient well on the south-western side of the landfill. Water quality in this well is tested six-monthly for a broader range of analytes: field analytes as per well UW1, plus nitrogen compounds, total organic carbon, sulphate, chloride, iron, manganese, and arsenic. There is no sign of landfill leachate contamination in this well.*
- *UW3, northern downgradient well adjacent to the leachate dam wall. This well is sampled quarterly because it is contaminated with nitrate. The nitrite + nitrate (NO_x) concentration this sampling round was 9.14 mg/L as N and is representative of a continued decline in concentration since April 2013. This result is far less than the greatest NO_x concentration of 191 mg/L recorded in December 2001. The considerable overall decline is probably due to the excavation and removal of old night soil trenches and installation of leachate collection systems in the new cells. The increase in inorganic carbon since May 2012, as represented by the alkalinity and free carbon dioxide concentrations, remains as an indicator of biological breakdown.*

Surface water quality

US1 – the discharge point of an ephemeral stream from the site. The sample was collected at approximately 0.5 m north from where the flow was discharging into the small rivulet about 2 metres from the boundary fence.

At 58 mg/L, the suspended solids were slightly exceeded the ≤50 mg/L discharge quality required on many Environment Protection Licences. At 2.6 mg/L, the total nitrogen was one of its lowest concentrations to date, and the total phosphorus (0.10 mg/L) was similarly low for this sampling point. The iron concentration (2.46 mg/L) has declined, but is still too high, due to some old iron relics, such as the old night soil pan, which cannot be safely accessed with a backhoe due to protected species of peppermint gum trees alongside the pond.

Leachate quality

UL1, concentrated leachate being piped into the leachate dam.

Leachate was not discharging from the leachate pipe which drains leachate from a northern cell into the northern side of the leachate dam. The samples were therefore taken at the edge of the dam alongside the usual concentrated leachate entry point.

The field analyte results indicate a mixture of rainfall runoff water and leachate.

- *Dissolved oxygen (6.60 mg/L) was similar to that of oxygenated surface water rather than leachate.*
- *Electrical conductivity at 2141 µS/cm was considerably lower than normal.*
- *Redox potential (Eh) was positive rather than negative.*

Total nitrogen was considerably diluted, 29.2 mg/L rather than the 182 mg/L in the June 2020 sampling round. The total nitrogen greatest concentration since 1999 is 976 mg/L. This sampling round, the total nitrogen was mainly total kjeldahl nitrogen, which consists of organic nitrogen and ammonium compounds and indicates young leachate.

No pesticides were detected. No volatile organic compounds were detected. Iron (0.48 mg/L) was also diluted by the surface water runoff in the dam water.

7. ANNUAL RETURN - MONITORING SECTION

There has been full compliance with Environment Protection Licence No. 5899 conditions for methane, groundwater, surface water, and leachate monitoring conducted by CodyHart on Council behalf.

Evidence of this compliance is detailed in Section B2, 'Concentration Monitoring Summary' of the Uralla Landfill annual return, which CodyHart has completed on Uralla Shire Council behalf.

8. CONCLUSION

This report provides evidence to demonstrate that monitoring results were assessed, and actions taken if necessary during the annual reporting year 2019-2020.

Due to acceptable methane and water quality results, no response actions were required.

It is accepted that nitrate concentrations in well UW3 indicate contamination but has reduced twenty-fold from 191 mg/L as N in 2001, to 9.14 mg/L as N this October. There is no indication that this nitrate is transmitting through to the ephemeral stream sampled at US1.

There has been full compliance with the EPL 5899 Section B2 monitoring requirements during this annual reporting year.

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