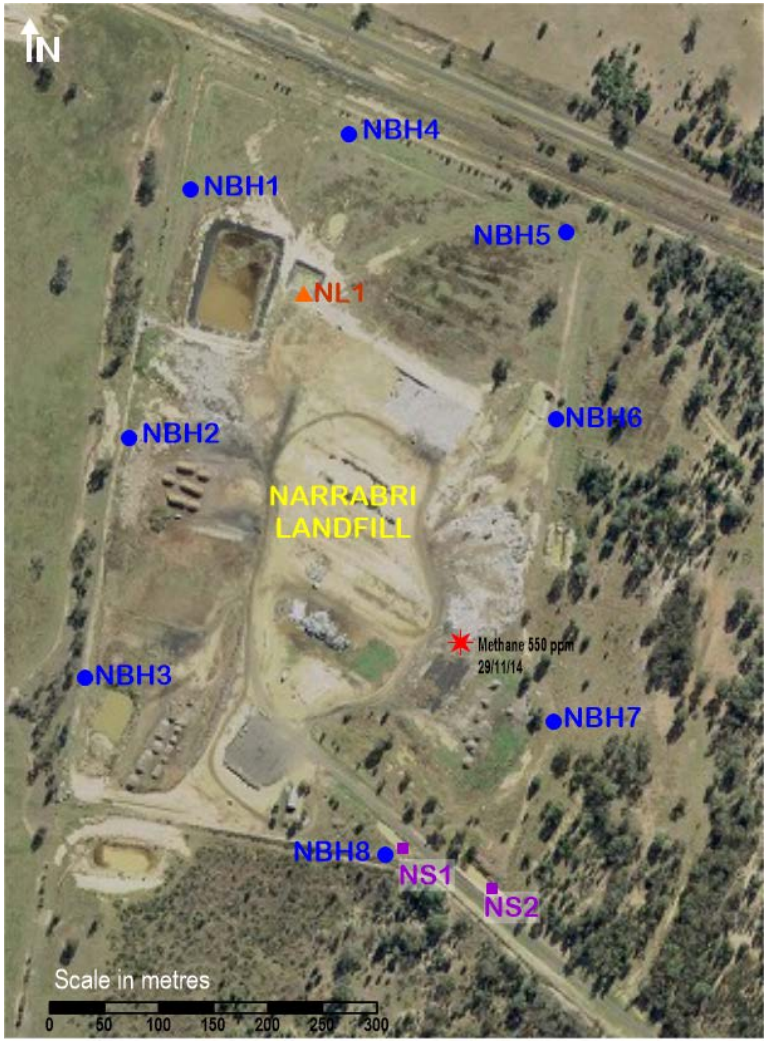
Narrabri Landfill

Location: Yarrie Lake Road, Narrabri NSW 2390 Environment Protection Licence Number: 12193 Activities: Waste disposal to land and waste processing
Licensee under Protection of Environment Operations Act 1997 (POEO Act): Narrabri Shire Council, PO Box 261, Narrabri NSW 22390

The internet link to Licence No. 12193 is https://apps.epa.nsw.gov.au/prpoeoapp/ViewPOEOLicence.aspx?DOCID=143907&SYSUID=1&LICID=12193
Council is required to monitor groundwater, surface water, leachate and methane at various sampling points. This document details recent results. To meet its obligation under Section 66 (6) of the POEO Act, a link to the current version of this document is available on Council's website.

Locations of the sampling points are shown on the adjacent figure. Historical names are used. NBH stands for Narrabri Bore Hole. [A bore hole is an investigative hole. When casing and screen are installed for monitoring, it is called a monitoring well.] S = Surface water; L = Leachate; Methane detection points are noted in red. Corresponding Environment Protection Authority (EPA) Identification Numbers detailed on the Licence are provided below.

EPA No. 1	NBH1 (groundwater monitoring well)
EPA No. 2	NBH2 (groundwater monitoring well)
EPA No. 3	NBH3 (groundwater monitoring well)
EPA No. 4	NBH4 (groundwater monitoring well)
EPA No. 5	NBH5 (groundwater monitoring well)
EPA No. 6	NBH6 (groundwater monitoring well)
EPA No. 7	NBH7 (groundwater monitoring well)
EPA No. 8	NBH8 (groundwater monitoring well)
EPA No. 9	NS1 (surface water)
EPA No. 10	NS2 (surface water)
EPA No. 11	NL1 (leachate from lined cell)
EPA No. 12	Surface methane monitoring
EPA No. 13	Building methane monitoring



Base map: Narrabri Shire Council 2012

Monitoring results for the last four years are presented on following pages – as required in the EPA publishing requirements.

Water quality analytes are organised in the following tables according to chemical grouping to assist chemical review. [Analytes are listed on the licence in alphabetical order.] They include analytes for groundwater, surface water and landfill leachate.

Tables are organised according to field and laboratory results. Field results start with the date the sampling and field tests were undertaken. Laboratory results tables start with the date the laboratory issued the results, followed by the date by which results were placed on the Narrabri Shire Council website.

Abbreviations made in the tables are provided here in alphabetical order:

Al = Aluminium; Alk = Alkalinity measured as mg/L $CaCO_3$ equivalent; As = Arsenic; Ba = Barium; BTEX = Benzene, Toleune, Ethylbenzene, Xylene; Ca = Calcium; Cd = Cadmium; Cl = Chloride; Co = Cobalt; Cr = Chromium; Cr^{VI} = Hexavalent Chromium; Cu = Copper; DO = Dissolved Oxygen; EC = Electrical Conductivity also called conductivity; Eh = Redox Potential; Fe = Iron; Fl = Fluoride; Hg = Mercury; K = Potassium; ND = Nil detected; NR = Not required; PAH = Polynuclear aromatic hydrocarbons; Pb = Lead; Mg = Magnesium; Mn = Manganese; Na = Sodium; NH_3 = Ammonia as a measure of ammonium ions; NO_x = Nitrite + Nitrate; O&G = Oil & Grease; OC & OP = Organochlorine and Organophosphorus pesticides; SO_4 = Sulphate; SS = Total suspended solids; Temp = Temperature; TKN = Total Kjeldahl Nitrogen (organic nitrogen + ammonia); TOC = Total Organic Carbon; TP = Total Phosphorus; TPH = Total Petroleum Hydrocarbons; VOCs = Volatile organic compounds; Zn = Zinc.

Measures:

mg/L = milligram per litre (equivalent to ppm); µS/cm = microSiemens per centimetre; mV = millivolts; ºC= degrees Celsius; ppm = parts per million.

Choice of water quality analytes:

Some analytes are tested because they give a general understanding of groundwater, surface water and leachate quality. The concentrations are usually greater in leachate than in groundwater and surface water. A simple comparison can tell us if landfill leachate may have escaped into groundwater or surface water. However, groundwater has particular characteristics that need to be taken into account so that false conclusions are not made. For example, groundwater may have naturally high salt levels due to the clay strata in which it resides. EC is an indicator of salt levels. The EC of the Narrabri Landfill groundwater is a case in point. The high EC levels (Table 1) in wells NBH4, NBH5, and NBH8 are not due to landfill leachate. Their borelogs show they are in silty clay, and no other analytes indicate there is leachate contamination.

Other analytes give us more specific information about the possible presence of landfill leachate in groundwater and surface water. Even with these we must carefully consider if their increased concentrations are definitely due to landfill leachate and are not from some other source.

- Nitrogen compounds indicate biodegradation of the plant and animal waste in our solid waste. They may also be due to fertilizer use on nearby properties. A general rule of thumb is that total nitrogen (TKN + NO_x) should be <5 mg/L.
- Iron and manganese above 10 mg/L is an indicator that landfill leachate may be present in groundwater. However, these groundwater analytes may have increased due to leaching of iron and manganese from the soil after excessive rainfall or flood water infiltration.
- Organic analytes such as BTEX compounds are most likely to indicate landfill leachate, especially if they haven't been detected before.

So it is important to monitor on a regular basis to note changes in water quality and to judicially review the results. Increases in groundwater and surface water analyte concentrations due to landfill leachate intrusion are often at least three to four times the previous concentrations.

Comments on water quality monitoring results: Groundwater in wells NBH2, NBH3, NBH5, NHB6 and NBH7 are contaminated with nitrogen compounds, which are derived from biodegradable waste such as green waste, food waste and animal waste. Leachate is now being collected from a leachate collection tank and is more concentrated than when collected from the leachate pond where it was diluted by rainwater. The groundwater qualities of neighbours' bores were tested in March 2019 and all results show the bore waters are fit for purpose.

Table 1a: Groundwater quality - field parameters, analytes and depth (Monitoring wells NBH1, NBH2, NBH3)

Sampling date	Frequency required by licence	DO	EC	pH	Eh	Temp	D	RL	Alk
Measure		mg/L	µS/cm	1-14	mV	ºC	m	m	mg/L
NBH1	Six monthly								
22/06/19		1.09	1501	7.32	+120	21.5	9.37	204.88	600
21/11/19		2.12	1515	7.76	+117	25.6	9.34	204.91	600
29/05/20		1.18	1567	7.66	+115	22.5	9.33	204.92	613
08/12/20		2.41	1431	7.76	+68	22.6	9.33	204.92	607
30/06/21		1.04	1441	7.44	+89	22.3	9.37	204.88	615
11/12/21		1.80	1487	7.50	+84	22.4	9.31	204.94	627
14/07/22		0.94	1481	7.41	+62	21.7	9.27	204.98	633
08/12/22		2.75	1415	7.61	+137	22.5	9.23	205.02	583
20/07/23		3.86	1454	7.61	+115	22.1	9.19	205.06	650
NBH2	Six monthly								
21/06/19		1.99	16898	7.52	+137	22.6	9.51	205.92	4500
21/11/19		0.62	20305	7.93	+121	26.3	9.54	205.89	4600
29/05/20		8.21	18900	8.59	+66	23.6	9.62	205.81	4100
09/12/20		0.45	19468	8.03	+77	24.3	9.69	205.74	4400
18/08/21		0.73	19018	7.90	+23	21.1	9.71	205.72	4650
11/12/21		0.50	18748	7.86	-2	23.9	9.70	205.73	4600
14/07/22		0.68	18525	7.97	+58	22.1	9.65	205.78	4600
08/12/22		5.58	17203	7.97	+77	24.8	9.48	205.95	4200
20/07/23		1.12	18248	7.82	+74	21.9	9.37	206.06	3900
NBH3	Six monthly								
21/06/19		4.66	16850	6.63	+154	21.5	9.92	205.63	1340
21/11/19		5.23	14553	7.20	+147	24.9	9.94	205.61	1350
29/05/20		4.38	14280	7.19	+101	22.5	10.02	205.53	1364
09/12/20		5.17	12690	7.29	+93	22.7	10.05	205.50	1260
18/08/21		4.75	12458	7.14	+66	19.4	10.08	205.47	1278
10/12/21		4.67	11450	7.22	+96	22.9	10.05	205.50	1180
14/07/22		3.97	15368	7.11	+115	20.6	10.05	205.50	1400
08/12/22		3.78	31000	7.34	+121	25.2	9.85	205.70	1780
20/07/23		3.72	23950	7.27	+109	22.7	9.81	205.74	1640

Table 1b: Groundwater quality - field parameters, analytes and depth (Monitoring wells NBH4, NBH5, NBH6)

Sampling date	Frequency required by licence	DO	EC	pH	Eh	Temp	D	RL	Alk
Measure		mg/L	µS/cm	1-14	mV	ºC	m	m	mg/L
NBH4	Six monthly								
22/06/19		2.46	4830	7.38	+125	21.5	8.78	205.14	1167
21/11/19		2.14	4420	7.68	+102	26.3	8.73	205.19	1187
29/05/20		2.66	4640	7.71	+110	22.7	8.72	205.20	1167
09/12/20		3.92	4693	7.91	+112	23.0	8.71	205.21	1167
30/06/21		2.58	4735	7.66	+98	24.1	8.73	205.19	1187
11/12/21		3.14	4720	7.66	+70	23.7	8.62	205.30	1173
15/07/22		2.96	4708	7.53	+88	19.8	8.66	205.26	1167
08/12/22		3.97	4778	7.57	+147	23.3	8.54	205.38	1167
19/07/23		4.90	4810	7.62	+96	22.3	8.51	205.41	1153
NBH5	Six monthly								
22/06/19		4.83	10073	7.13	+168	22.7	8.28	205.83	960
22/11/19		4.77	9793	7.25	+107	25.1	8.28	205.83	920
30/05/20		4.47	10078	7.45	+92	22.9	8.24	205.87	985
08/12/20		5.30	9963	7.56	+94	23.4	8.26	205.85	984
30/06/21		5.05	10178	7.38	+102	25.6	8.22	205.89	959
11/12/21		5.03	10270	7.41	+79	23.3	8.18	205.93	993
15/07/22		4.94	10230	7.39	+97	21.8	8.21	205.90	993
08/12/22		7.66	10623	7.34	+130	23.2	8.09	206.02	1013
19/07/23		6.82	10285	7.37	+111	22.5	8.08	206.03	1007
NBH6	Six monthly								
22/06/19		4.57	12765	7.41	+122	22.7	7.89	206.45	2540
22/11/19		3.97	14220	7.68	+107	24.6	7.97	206.37	2750
30/05/20		3.32	14540	8.01	+29	22.8	7.92	206.42	3080
08/12/20		3.37	14025	8.04	+82	25.5	7.93	206.41	3020
30/06/21		4.29	13890	8.05	+88	25.5	7.89	206.45	3150
10/12/21		3.96	13543	8.00	+89	23.4	7.83	206.51	3300
15/07/22		4.17	12510	8.05	+82	22.7	7.83	206.51	5200
08/12/22		7.07	12828	8.01	+92	23.4	7.56	206.78	3300
19/07/23		5.41	11923	8.06	+91	21.7	7.64	206.70	3330

Table 1c: Groundwater quality - field parameters, analytes and depth (Monitoring wells NBH7, NBH8)

Sampling date	Frequency required by licence	DO	EC	pH	Eh	Temp	D	RL	Alk	
Measure		mg/L	µS/cm	1-14	mV	ºC	m	m	mg/L	
NBH7	Quarterly									
05/03/19		0.84	705	6.10	+155	28.8	4.65	209.99	93	
22/06/19		0.88	653	5.73	+143	23.0	4.41	209.77	67	
30/09/19		1.74	655	5.98	+86	22.3	4.47	209.71	67	
22/11/19		3.14	589	5.81	+168	25.0	4.70	209.48	67	
13/02/20		6.07	705	6.61	+123	26.1	4.05	210.13	70	
30/05/20		2.50	525	6.76	-25	21.9	4.02	210.16	153	
02/10/20		0.18	685	6.71	-128	22.6	4.10	210.08	300	
08/12/20		0.81	954	6.95	-95	25.8	4.23	209.95	467	
21/02/21		2.66	637	6.50	+63	24.3	4.10	210.08	150	
30/06/21		5.06	536	7.16	+152	24.7	3.78	210.40	83	
20/09/21		6.20	502	6.62	+104	19.8	3.66	210.52	110	
10/12/21		5.71	397	8.23	+133	23.1	2.43	211.75	70	
20/03/22		0.78	515	6.02	+105	24.5	3.38	210.80	97	
15/07/22		2.86	488	6.99	+109	21.8	3.62	210.56	113	
28/09/22		4.27	419	6.53	+167	19.6	2.84	211.34	80	
11/12/22		5.16	484	6.51	+127	23.0	1.75	212.43	70	
19/03/23		4.19	437	6.44	+129	26.1	2.84	211.34	80	
20/07/23		3.23	469	6.70	+124	19.6	2.99	211.19	117	
NBH8	Six monthly									
23/06/19		6.07	5740	6.98	+120	22.1	8.73	206.20	480	EC 23/06/19 NBH8 was corrected 15 July 19. Incorrect was 1447.
21/11/19		0.88	5700	6.71	+120	25.0	8.83	206.10	483	
29/05/20		1.12	5505	6.76	+84	23.1	8.86	206.07	477	
08/12/20		5.44	5685	7.28	+90	21.4	8.94	205.99	487	
30/06/21		1.13	5793	6.88	-18	25.1	8.96	205.97	487	
10/12/21		4.73	5620	7.15	+97	21.9	8.95	205.98	470	
14/07/22		1.34	5595	6.70	+106	20.9	8.89	206.04	493	
08/12/22		4.78	5465	7.08	+96	21.5	8.85	206.08	473	
19/07/23		6.17	5273	6.92	+145	21.1	8.86	206.07	473	

Table 2a: Groundwater quality – laboratory analytes (Monitoring wells NBH1, NBH2)

Received from laboratory	Accessible on Council website by		SO_4	Cl	Ca	Mg	Na	K	As	Cd	Cr	Pb	Zn	Mn	Fe	NH_3	NO_x	TKN	TN	TOC	Total Phenols	OC& OP pesticides	BTEX compounds and/or VOCS
		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	mg/L	mg/L as N	mg/L as N	mg/L as N	mg/L as N	mg/L	mg/L	mg/L	mg/L
NBH1																					Annually	Annually	BTEX – Annually
10/07/19	30/07/19		<1	140	<1	<1	416	12	0.006	<0.0001	<0.001	<0.001	0.010	<0.001	<0.05	<0.01	0.02	<0.1	<0.1	5	<0.05	ND	ND
03/12/19	23/12/19		1	144	<1	1	373	11	0.008	<0.0001	<0.001	<0.001	<0.005	<0.001	<0.05	<0.01	0.02	0.2	0.2	5	NR	NR	NR
09/05/20	29/06/20		<1	107	<1	1	366	11	0.006	<0.0001	<0.001	<0.001	<0.005	<0.001	<0.05	0.04	0.04	0.1	0.1	8	<0.05	ND	ND
22/12/20	14/01/21		<1	149	<1	<1	362	11	0.006	<0.0001	<0.001	<0.001	0.011	<0.001	<0.05	<0.01	0.03	0.1	0.1	10	NR	NR	NR
15/07/21	04/08/21		<1	144	<1	1	365	11	0.006	<0.0001	0.001	0.001	0.024	0.002	<0.05	0.01	<0.01	<0.1	<0.1	3	<0.05	ND	ND
31/12/21	21/01/22		<1	135	<1	<1	362	10	0.006	<0.0001	<0.001	<0.001	<0.005	<0.001	<0.05	0.01	0.04	<0.1	<0.1	6	NR	NR	NR
27/01/22	16/08/22		<1	143	<1	1	348	10	0.006	<0.0001	<0.001	0.001	0.021	0.001	<0.05	<0.01	0.02	<0.1	<0.1	13	<0.05	ND	ND
29/12/22	23/01/23		<1	127	<1	1	377	12	0.006	<0.0001	<0.001	<0.001	<0.005	<0.001	<0.05	<0.01	0.08	<0.1	<0.1	3	NR	NR	NR
04/08/23	24/08/23		1	134	<1	1	343	10	0.006	<0.0001	<0.001	<0.001	0.008	<0.001	<0.05	<0.01	0.19	<0.1	0.2	3	<0.05	ND	ND
NBH2																					Annually	Annually	VOCs – Six monthly
10/07/19	30/07/19		715	4640	4	84	5230	142	0.018	<0.0005	<0.005	0.052	0.025	0.016	<0.05	<0.01	2.74	3.1	5.8	121	<0.05	ND	0.009 Tetrachloroethene 0.007 cis-1.2-Dichloroethene
03/12/19	23/12/19		741	4850	2	86	5540	153	0.023	<0.0005	<0.005	0.009	<0.025	0.015	<0.05	<0.01	2.28	2.9	5.2	69	NR	NR	0.009 Tetrachloroethene 0.007 cis-1.2-Dichloroethene
09/06/20	29/06/20		722	4320	2	75	5090	137	0.020	<0.0005	<0.005	0.047	<0.025	0.022	<0.05	0.06	2.41	2.9	5.3	92	<0.05	ND	ND
22/12/20	14/01/21		753	5030	<1	83	5220	140	0.022	<0.0005	<0.005	0.008	<0.025	0.019	<0.05	<0.01	1.86	2.6	4.5	95	NR	NR	0.008 Tetrachloroethene 0.005 cis-1.2-Dichloroethene
31/08/21	20/09/21		736	4780	<1	74	4660	132	0.022	<0.0001	0.002	0.005	0.019	0.018	<0.05	<0.01	1.59	2.6	4.2	73	<0.05	ND	ND
31/12/21	21/01/22		690	4530	<1	77	4930	128	0.016	<0.0005	<0.005	<0.005	<0.025	0.008	<0.05	0.02	1.66	1.8	3.5	98	NR	NR	0.006 Tetrachloroethene
27/01/22	16/08/22		797	4320	1	77	4950	132	0.023	<0.0001	<0.005	0.006	<0.025	0.016	<0.05	<0.01	1.51	2.7	4.2	107	<0.05	ND	ND
29/12/22	23/01/23		797	3900	1	75	5010	130	0.024	<0.0001	<0.001	0.002	0.008	0.012	<0.05	<0.01	2.26	3.0	5.3	64	NR	NR	NR
04/08/23	24/08/23		1170	4330	<1	76	4740	129	0.019	<0.0001	0.002	0.001	0.006	0.023	<0.05	<0.01	48.3	5.4	53.7	78	<0.05	ND	ND

Table 2b: Groundwater quality – laboratory analytes (Monitoring wells NBH3, NBH4)

Received from laboratory	Accessible on Council website by		SO_4	Cl	Ca	Mg	Na	K	As	Cd	Cr	Pb	Zn	Mn	Fe	NH_3	NO_x	TKN	TN	TOC	Total Phenols	OC& OP pesticides	BTEX compounds and/or VOCS
		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	mg/L	mg/L as N	mg/L as N	mg/L as N	mg/L as N	mg/L	mg/L	mg/L	mg/L
NBH3																					Annually	Annually	BTEX – Annually
10/07/19	30/07/19		634	4730	10	149	3730	75	0.004	<0.0001	0.002	0.002	0.055	0.001	<0.05	<0.01	20.6	1.7	22.3	27	<0.05	ND	ND
03/12/19	23/12/19		527	4350	6	113	3290	67	0.004	<0.0001	<0.001	0.002	0.056	0.002	<0.05	0.04	17.8	2.0	19.8	2	NR	NR	NR
09/06/20	29/06/20		535	4090	5	104	3110	61	0.003	<0.0001	0.001	0.002	0.040	0.002	<0.05	<0.01	17.0	2.0	19.0	12	<0.05	ND	ND
22/12/20	14/01/21		430	3970	4	93	2900	59	0.003	<0.0001	0.002	0.001	0.052	0.002	<0.05	<0.01	12.3	1.4	13.7	10	NR	NR	NR
31/08/21	20/09/21		403	3790	4	82	2590	54	0.003	<0.0001	0.002	0.002	0.123	0.001	<0.05	<0.01	10.5	1.2	11.7	4	<0.05	ND	ND
31/12/21	21/01/22		334	3370	4	72	2540	51	0.003	<0.0001	0.002	0.001	0.083	<0.001	<0.05	<0.01	8.79	0.4	9.2	13	NR	NR	NR
27/01/22	16/08/22		644	4730	7	135	3450	68	0.003	<0.0001	0.002	0.002	0.098	0.003	<0.05	<0.01	20.0	1.4	21.4	27	<0.05	ND	ND
29/12/22	23/01/23		2200	9290	9	454	7910	122	<0.005	<0.0005	<0.005	<0.005	0.046	<0.005	0.10	<0.01	286.0	2.5	288.0	20	NR	NR	NR
04/08/23	24/08/23		2040	7260	7	372	6400	105	<0.005	<0.0005	<0.005	<0.005	0.030	<0.005	0.09	<0.01	436.0	59.3	495.0	39	<0.05	ND	ND
NBH4																					Annually	Annually	BTEX – Annually
10/07/19	30/07/19		21	897	1	5	1120	34	0.005	<0.0001	<0.001	0.002	0.024	0.007	<0.05	<0.01	0.23	<0.1	0.2	17	<0.05	ND	ND
03/12/19	23/12/19		27	907	1	5	1070	33	0.006	<0.0001	<0.001	0.001	0.016	0.005	<0.05	<0.01	0.21	<0.1	0.2	<2	NR	NR	NR
09/06/20	29/06/20		28	910	1	5	1090	33	0.005	<0.0001	<0.001	0.002	0.011	0.007	<0.05	<0.01	0.22	<0.1	0.2	11	<0.05	ND	ND
22/12/20	14/01/21		28	979	1	5	1110	33	0.005	<0.0001	0.002	0.004	0.029	0.013	0.22	<0.01	0.22	0.1	0.3	7	NR	NR	NR
15/07/21	04/08/21		26	970	1	5	1040	31	0.005	<0.0001	0.001	0.001	0.034	0.003	<0.05	<0.01	0.21	0.1	0.3	4	<0.05	ND	ND
31/12/21	21/01/22		27	917	2	5	1120	32	0.005	<0.0001	<0.001	0.001	0.009	0.002	<0.05	<0.01	0.23	<0.1	0.2	13	NR	NR	NR
27/01/22	16/08/22		26	955	1	5	1040	32	0.005	<0.0001	<0.001	<0.001	0.024	0.002	<0.05	<0.01	0.23	<0.1	0.2	19	<0.05	ND	ND
29/12/22	23/01/23		27	912	1	6	1190	34	0.005	<0.0001	<0.001	0.002	0.022	0.003	<0.05	<0.01	0.23	<0.1	0.2	<2	NR	NR	NR
04/08/23	24/08/23		26	975	1	5	1100	33	0.005	<0.0001	<0.001	<0.001	0.007	0.002	<0.05	<0.01	0.24	<0.1	0.2	7	<0.05	ND	ND

Table 2c: Groundwater quality – laboratory analytes (Monitoring wells NBH5, NBH6)

Received from laboratory	Accessible on Council website by		SO_4	Cl	Ca	Mg	Na	K	As	Cd	Cr	Pb	Zn	Mn	Fe	NH_3	NO_x	TKN	TN	TOC	Total Phenols	OC& OP pesticides	BTEX compounds and/or VOCS
		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	mg/L	mg/L as N	mg/L as N	mg/L as N	mg/L as N	mg/L	mg/L	mg/L	mg/L
NBH5																					Annually	Annually	BTEX – Annually
10/07/19	30/07/19		87	2870	16	45	2250	71	0.004	<0.0001	<0.001	0.002	0.029	0.019	0.08	<0.01	3.65	0.4	4.0	23	<0.05	ND	ND
03/12/19	23/12/19		89	2880	15	40	2140	67	0.004	<0.0001	<0.001	<0.001	0.040	0.001	<0.05	<0.01	3.77	0.3	4.1	9	NR	NR	NR
09/06/20	29/06/20		96	2930	15	40	2150	66	0.004	<0.0001	<0.001	0.001	0.026	0.002	<0.05	<0.01	3.98	1.0	5.0	16	<0.05	ND	ND
22/12/20	14/01/21		91	3200	14	44	2210	69	0.004	<0.0001	<0.001	0.002	0.031	0.008	<0.05	<0.01	4.17	0.4	4.6	12	NR	NR	NR
15/07/21	04/08/21		96	3150	15	44	2180	69	0.003	<0.0001	<0.001	<0.001	0.038	<0.001	<0.05	<0.01	4.06	0.6	4.7	13	<0.05	ND	ND
31/12/21	21/01/22		98	3190	16	47	2350	71	0.004	<0.0001	<0.001	<0.001	0.025	<0.001	<0.05	<0.01	4.54	0.2	4.7	20	NR	NR	NR
27/01/22	16/08/22		107	3400	15	48	2230	70	0.004	<0.0001	<0.001	<0.001	0.032	<0.001	<0.05	<0.01	4.41	0.6	5.0	26	<0.05	ND	ND
29/12/22	23/01/23		94	3340	20	56	2570	80	0.004	<0.0001	<0.001	<0.001	0.034	<0.001	<0.05	<0.01	4.83	0.3	5.1	13	NR	NR	NR
04/08/23	24/08/23		99	3360	19	52	2350	71	0.004	<0.0001	<0.001	<0.001	0.018	0.030	<0.05	0.14	4.86	0.3	5.2	15	<0.05	ND	ND
NBH6																					Annually	Annually	BTEX – Annually
22/12/17	15/01/18		128	4150	26	54	3230	93	0.002	<0.0001	0.005	0.002	0.022	<0.001	<0.05	0.03	8.76	0.9	9.7	17	NR	NR	NR
30/08/18	19/09/18		148	3550	20	46	3260	96	0.004	<0.0001	0.004	0.002	0.018	0.002	<0.05	0.03	9.59	<0.5	9.6	35	<0.05	ND	VOCs ND
18/12/18	11/01/19		117	3880	20	47	3630	101	0.004	<0.0001	0.005	0.005	0.019	0.007	0.17	0.03	8.76	0.3	9.1	3	NR	NR	NR
10/07/19	30/07/19		141	3520	20	52	4070	116	0.004	<0.0001	0.005	0.005	0.022	0.002	<0.05	<0.01	5.84	0.4	6.2	41	<0.05	ND	ND
03/12/19	23/12/19		115	3700	13	39	3390	96	0.005	<0.0001	0.004	0.003	0.020	0.002	<0.05	<0.01	7.71	0.5	8.2	65	NR	NR	NR
09/06/20	29/06/20		152	3620	10	32	3020	84	0.004	<0.0001	0.004	0.001	0.012	0.001	<0.05	<0.01	7.60	0.9	8.5	32	<0.05	ND	ND
22/12/20	14/01/21		155	3760	9	38	3620	100	0.006	<0.0001	0.006	0.001	0.015	<0.001	<0.05	0.04	7.69	0.8	8.5	<10	NR	NR	NR
15/07/21	04/08/21		157	3520	8	33	3300	93	0.006	<0.0001	0.005	<0.001	0.012	<0.001	<0.05	0.02	7.11	1.1	8.2	23	<0.05	ND	ND
31/12/21	21/01/22		147	3320	8	34	3590	96	0.008	<0.0001	0.006	<0.001	0.013	<0.001	<0.05	<0.01	7.05	0.7	7.8	38	NR	NR	NR
27/01/22	16/08/22		148	3200	7	31	3260	90	0.007	<0.0001	0.005	0.002	0.019	<0.001	<0.05	<0.01	6.63	0.9	7.5	8	0.20	ND	ND
29/12/22	23/01/23		131	3020	9	33	3450	95	0.009	<0.0001	0.002	<0.001	0.013	0.001	<0.05	<0.01	6.91	0.6	7.5	10	NR	NR	NR
04/08/23	24/08/23		133	2600	6	27	3090	86	0.010	<0.0001	0.004	0.001	0.009	0.002	<0.05	<0.01	6.55	0.9	7.4	42	<0.05	ND	ND

Table 2d: Groundwater quality – laboratory analytes (Monitoring wells NBH7, NBH8)

Received from laboratory	Accessible on Council website by		SO_4	Cl	Ca	Mg	Na	K	As	Cd	Cr	Pb	Zn	Mn	Fe	NH_3	NO_x	TKN	TN	TOC	Total Phenols	OC & OP pesticides	BTEX compounds and/or VOCS
		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	mg/L	mg/L as N	mg/L as N	mg/L as N	mg/L as N	mg/L	mg/L	mg/L	mg/L
NBH7																					Annually	Annually	BTEX – Annually
13/03/19	02/04/19		100	90	1	4	129	13	0.007	<0.0001	0.075	0.028	0.151	0.094	63.6	0.08	0.52	6.8	7.3	30	NR	NR	NR
10/07/19	30/07/19		94	81	<1	4	137	10	0.006	0.0003	0.036	0.021	0.059	0.053	30.0	0.08	1.23	5.1	6.3	28	<0.05	ND	ND
14/10/19	01/11/19		103	85	<1	3	119	9	0.011	<0.0001	0.065	0.038	0.266	0.093	47.9	0.03	1.26	11.1	12.4	29	NR	NR	NR
03/12/19	23/12/19		98	86	<1	2	124	7	0.016	0.0001	0.154	0.064	0.204	0.192	119	0.05	0.46	11.4	11.9	27	NR	NR	NR
26/02/20	11/03/20		68	61	1	4	103	18	0.008	<0.0001	0.061	0.072	0.100	0.111	48.6	0.16	6.60	11.6	18.2	24	NR	NR	NR
09/06/20	29/06/20		35	36	2	4	91	19	0.009	0.0001	0.054	0.048	0.103	0.139	48.3	4.57	2.99	22.5	25.5	23	<0.05	ND	ND
13/10/20	02/11/20		40	54	3	5	94	19	0.008	<0.0001	0.025	0.016	0.117	0.202	24.0	27.1	0.16	41.2	41.4	47	NR	NR	NR
22/12/20	14/01/21		14	49	4	7	126	21	0.008	<0.0001	0.012	0.004	0.014	0.053	9.43	45.7	0.01	55.6	55.6	26	NR	NR	NR
03/03/21	23/03/21		62	54	2	6	119	16	0.002	<0.0001	0.003	0.001	0.007	0.016	3.26	1.13	1.43	3.0	4.4	21	NR	NR	NR
15/07/21	04/08/21		62	50	2	5	98	17	0.004	<0.0001	0.019	0.016	0.045	0.038	16.0	0.08	3.69	6.5	10.2	17	<0.05	ND	ND
28/09/21	18/10/21		64	50	3	7	102	17	0.003	<0.0001	0.021	0.009	0.027	0.032	16.6	0.04	2.81	4.1	6.9	13	NR	NR	NR
31/12/21	21/01/22		52	37	4	7	68	14	0.002	<0.0001	0.007	0.004	0.008	0.015	5.40	0.04	2.80	1.0	3.8	<1	NR	NR	NR
31/03/22	22/04/22		55	32	3	7	78	15	0.001	<0.0001	<0.001	<0.001	0.017	<0.001	0.09	0.02	1.83	2.9	4.7	14	NR	NR	NR
27/01/22	16/08/22		61	45	2	7	93	18	0.003	<0.0001	0.024	0.009	0.023	0.038	18.7	0.01	0.64	2.1	2.7	14	<0.05	ND	ND
11/10//22	01/11/22		44	40	4	8	68	10	<0.001	<0.0001	<0.001	0.003	0.007	0.009	<0.05	<0.01	2.77	1.5	4.3	8	NR	NR	NR
29/12/22	23/01/23		40	32	5	6	60	9	0.001	<0.0001	0.004	0.002	0.006	0.008	3.12	<0.01	1.62	0.6	2.2	6	NR	NR	NR
29/03/23	20/04/23		36	41	5	8	73	12	0.001	<0.0001	0.002	0.004	0.005	0.017	1.95	<0.01	0.36	0.7	1.1	8	<0.05	ND	ND
04/08/23	24/08/23		30	37	7	8	64	10	<0.001	<0.0001	0.002	<0.001	<0.005	0.026	1.71	<0.01	0.75	1.1	1.8	7	<0.05	ND	ND
NBH8																					Annually	Annually	BTEX – Annually
10/07/19	30/07/19		29	1550	15	55	1140	18	0.002	<0.0001	<0.001	0.001	0.072	0.008	<0.05	<0.01	0.15	0.2	0.4	10	<0.05	ND	ND
03/12/19	23/12/19		28	1530	15	49	1110	17	0.002	<0.0001	<0.001	0.004	0.074	0.014	0.08	<0.01	0.16	0.3	0.5	7	NR	NR	NR
09/06/20	29/06/20		30	1570	15	49	1110	16	0.002	<0.0001	<0.001	0.002	0.082	0.012	0.07	0.01	0.12	0.2	0.3	9	<0.05	ND	ND
22/12/20	14/01/21		29	1670	14	52	1140	17	0.002	<0.0001	<0.001	0.002	0.044	0.008	0.05	0.04	0.13	0.2	0.3	7	NR	NR	NR
15/07/21	04/08/21		28	1640	15	52	1140	18	0.002	<0.0001	<0.001	0.002	0.070	0.011	0.08	0.01	0.18	0.3	0.5	5	<0.05	ND	ND
31/12/21	21/01/22		29	1570	15	51	1160	17	0.002	<0.0001	<0.001	0.003	0.057	0.010	0.12	0.15	0.37	0.3	0.7	9	NR	NR	NR
27/01/22	16/08/22		28	1620	14	51	1110	16	0.001	<0.0001	<0.001	0.003	0.104	0.007	<0.05	<0.01	0.30	0.2	0.5	12	<0.05	ND	ND
29/12/22	23/01/23		28	1560	16	56	1200	18	0.002	<0.0001	<0.001	0.003	0.062	0.013	0.05	<0.01	0.45	0.2	0.6	6	NR	NR	NR
04/08/23	24/08/23		27	1580	14	51	1130	17	0.002	<0.0001	<0.001	0.006	0.042	0.023	0.16	<0.01	0.34	0.3	0.6	5	<0.05	ND	ND

Table 3: Surface water quality

Sampling date	Frequency required by licence	EC	pH
Measure		µS/cm	1-14
NS1	Sampling only on discharge from dam required by licence		
06/12/18	no discharge – voluntary sample to assess internal, no flow quality	291	8.17
12/02/20	FLOW	126	7.44
31/03/20	FLOW	167	7.28
30/05/20	no discharge – voluntary sample to assess internal, no flow quality	200	8.10
23/03/21	FLOW	130	7.46
01/07/21	FLOW	221	6.90
10/12/21	no discharge – voluntary sample to assess internal, no flow quality	207	6.85
11/12/22	no discharge – voluntary sample to assess internal, no flow quality	226	7.97
NS2	Sampling only on discharge from dam required by licence		
06/12/18	no discharge – voluntary sample to assess internal, no flow quality	547	8.22
30/05/20	no discharge – voluntary sample to assess internal, no flow quality	398	8.33
10/12/21	no discharge – voluntary sample to assess internal, no flow quality	553	8.23
11/12/22	no discharge – voluntary sample to assess internal, no flow quality	559	7.97

Received from laboratory	Accessible on Council website by	SS	NH_3	NO_x	TKN	TN	TOC	O&G
		mg/L	mg/L as N	mg/L as N	mg/L as N	mg/L	mg/L	mg/L
NS1								
18/12/18	11/01/19	31	0.03	<0.01	1.3	1.3	11	<5
20/02/20	11/03/20	240	0.27	0.38	1.8	2.2	5	8
14/04/20	29/06/20	49	0.18	0.16	1.6	1.8	5	<5
09/06/20	29/06/20	15	0.08	0.72	0.6	1.3	5	<5
01/04/21	22/04/21	104	0.08	0.36	1.3	1.6	7	<5
15/07/21	04/08/21	14	0.21	1.04	2.2	3.2	7	5
31/12/21	21/01/22	58	0.08	0.35	1.2	1.6	7	<5
29/12/22	23/01/23	5	0.19	0.50	1.0	1.5	6	<5
NS2								
18/12/18	11/01/19	33	0.07	<0.01	1.9	1.9	20	<5
09/06/20	29/06/20	6	0.03	0.36	1.1	1.5	9	<5
31/12/21	21/01/22	13	0.05	<0.01	2.8	2.8	22	<5
29/12/22	23/01/23	6	1.06	0.14	2.9	3.0	17	<5

Table 4a: Leachate quality – field analytes, and laboratory analytes (a)

Sampling date	Frequency required by licence	DO	EC	pH	Eh	Temp	Alk	Received from laboratory	Accessible on Council website by	SO_4	Cl	Ca	Mg	Na	K	Fl	Al	As	Ba	Cd	Co	Cr	Cu	Mn	Pb	Zn	Fe
Measure		mg/L	µS/cm	1-14	mV	ºC	mg/L			mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
NL1	Annually	NR			NR	NR		NL1																			
23/06/19		1.51	16230	8.54	+54	16.1	5000	10/07/19	30/07/19	<100	2840	72	136	2660	706	0.3	9.82	0.032	0.750	0.0035	0.110	0.983	0.186	1.46	0.117	1.380	27.0
30/05/20		1.69	14570	8.76	+69	20.9	6000	09/06/20	29/06/20	<200	2350	80	98	2490	628	0.4	2.96	0.036	0.795	0.0021	0.111	0.919	0.114	1.39	0.086	1.300	22.1
09/12/20		1.83	16325	8.49	+38	30.2	4400	22/12/20	14/01/21	<50	3000	84	101	2370	725	0.3	2.88	0.033	0.667	0.0022	0.116	1.030	0.099	1.55	0.080	1.31	23.5
18/08/21		3.44	13665	9.16	+3	15.9	5200	31/08/21	20/09/21	<100	2350	4	10	240	63	0.3	1.92	0.028	0.574	0.0013	0.097	0.795	0.046	1.24	0.037	0.805	23.5
11/12/21		1.85	13255	8.78	+40	29.5	5600	31/12/21	21/01/22	<100	2470	81	109	2600	653	0.3	2.14	0.027	0.630	0.0012	0.082	0.688	0.128	1.31	0.051	1.090	20.5
15/07/22		4.62	12360	8.95	+43	19.3	6000	27/01/22	16/08/22	<100	1550	3	7	162	42	0.3	2.16	0.026	2.75	<0.0021	0.096	0.745	0.142	1.28	0.050	1.250	24.9
20/07/23		1.95	12125	8.67	+13	16.2	5000	04/08/23	24/08/23	<100	2120	78	96	2220	586	0.3	1.58	0.021	0.561	0.0011	0.076	0.562	0.169	0.997	0.046	0.525	19.4

Table 4b: Leachate quality – laboratory analytes (b)

Sampling date		Hg	Cr^{V1}	NH_3	NO_x	TKN	TN	TP	TOC	Total Phenols	OC& OP pesticides	PAH	TPH C6-C9	TPH >C10-C14	TPH >C15-C28	TPH >C29-C36	TPH >C10-C36 (sum)	VOCs
Measure	Measure	mg/L	mg/L	mg/L as N	mg/L as N	mg/L as N	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
NL1																		
23/06/19		<0.0010	<0.100	563.0	0.53	828.0	828.0	7.72	2060	<0.25	ND	ND	0.060	2.180	8.580	0.650	11.400	ND
30/05/20		<0.0010	<0.500	523.0	<2.00	904.0	904.0	8.62	1700	<0.10	ND	ND	0.050	2.130	10.600	0.920	13.600	ND
09/12/20		<0.0020	<0.100	669.0	<1.00	810.0	810.0	7.54	1850	<0.10	ND	ND	0.040	1.520	8.870	0.540	10.900	ND
18/08/21		<0.0010	<0.100	563.0	<1.00	787.0	787.0	7.42	1470	<0.10	ND	ND	<0.001	1.290	5.120	0.530	6.940	ND
11/12/21		<0.0010	<0.100	311.0	<0.50	470.0	470.0	8.74	1490	<0.20	ND	ND	<0.020	1.290	7.700	0.790	9.780	ND
15/07/22		<0.0100	<0.100	231.0	<1.00	362.0	362.0	6.86	1130	<0.05	ND	ND	<1.000	1.080	4.520	0.460	6.060	ND
20/07/23		<0.0100	<0.100	542.0	<1.00	740.0	740.0	7.67	1470	<0.10	ND	ND	<0.100	1.730	8.230	0.500	10.500	ND

Methane is a colourless, odourless gas that is flammable and explosive. It is generated approximately three months after the deposition of putrescible solid waste and once oxygen is depleted. Testing is conducted above ground surfaces to assure than none is escaping to air, and in buildings to assure against asphyxiation and explosion.

Comments on methane monitoring results: Methane has been detected occasionally on the ground surface and is remediated soon after by Council.

Table 5: Methane detections (surface or building)

Sampling date	Frequency required by licence	Detection locations	Methane (CH_4) by volume in air	Methane (CH_4) by volume in air	Methane (CH_4) as % LEL (Lower Explosive Limit)	Accessible on Council website by
Measure			ppm	%	% LEL	
Surface & building	3 monthly					
05/03/19		nil detections				02/04/19
23/06/19		nil detections				30/07/19
30/09/19		nil detections				01/11/19
22/11/19		nil detections				23/12/19
13/02/20		nil detections				11/03/20
30/05/20		nil detections				29/06/20
02/10/20		nil detections				02/11/20
09/12/20		nil detections				14/01/21
21/02/21		nil detections				23/03/21
18/08/21		nil detections				20/09/21
20/09/21		Base of leachate pipe	3,000	0.3	6.0	18/10/21
11/12/21		nil detections				21/01/22
20/03/22		nil detections				22/04/22
14&15/07/22		nil detections				16/08/22
28/09/22		nil detections				01/11/22
08/12/22		nil detections				23/01/23
19/03/23		nil detections				20/04/23
19&20/07/23		nil detections				24/08/23

Note: 500 ppm CH_4 by volume in air = 0.05% CH_4 by volume in air = 1% LEL