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Withyhedge Landfill Site

2020 Annual Review

Condition 4.2.2 Section a) of Environmental Permit EPR/MP3330WP (with reference to EPR/GP3630HT/V002)

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1. Introduction

1.1 Background

- 1.1.1 Resources Management (UK) Limited currently operates the Withyhedge Landfill Site (the Site) at Bowling Farm, Rudbaxton, approximately 5.5 km north of Haverfordwest in Pembrokeshire. The site is a non-hazardous landfill that covers approximately 53 ha and is managed in two phases, Phase1 and Phase 2, which are subdivided into 18 individual cells.
- 1.1.2 This report has been prepared internally within the Potter Group of companies and summarises the environmental monitoring carried out at Withyhedge Landfill Site from 1st January 2020 to 31st December 2020, in accordance with Condition 4.2.2 Part a) of Environmental Permit (the Permit) EPR/GP3630HT/V002, variation EPR/MP3330WP/T001.
- 1.1.3 All groundwater, surface water, leachate and gas monitoring has been undertaken in accordance with Schedule 3 of the current permit and all data has been previously submitted to Natural Resources Wales (NRW) in accordance with the timescales specified within Schedule 4 of the permit. Selected data will be referenced where relevant in this report.
- 1.1.4 An up-to-date plan of the site showing the locations of the current monitoring points is being prepared at the beginning at present and will be available in the middle of February.
- 1.1.5 A Hydrogeological Risk Assessment (HRA) Review was undertaken in 2018 in accordance with condition 3.1.6 of the permit and submitted to NRW in November 2018 under document Report Ref:3933/R/001/01. Amendments were then undertaken on this HRA for final submission in November 2019 under document Report Ref:3933/R/001/02.

2. Review of Surface Water

2.1 Surface Water Quality

- 2.1.1 Surface water run-off from restored phases at the site is channelled into a sequence of lagoons. These lagoon systems discharge into Rudbaxton Water, which is the closest watercourse to the site, and which flows along the northern perimeter of Phase 1 and Phase 2 in a westerly then south westerly direction. Rudbaxton Water later joins the Western Cleddau River, approximately 2 km southwest of the site.
- 2.1.2 Surface water quality monitoring is currently undertaken at lagoon discharge point D1, north of Phase 1. Monitoring points D2 and D3 are associated with the Phase 2 lagoons which have not yet been fully completed and are allowing no discharge.
- 2.1.3 Rudbaxton Water is monitored monthly at points SP1, SP3, SP5, SP6 and SP7 in accordance with Table S4.10 of the current permit; these monitoring points do not have specified compliance limits. All surface water monitoring points are listed in Table 1 below.

Table 1: Surface Water Monitoring Points

Monitoring Point	Description
SP1	Rudbaxton Water, upstream of site.
SP3	Surface water lagoon, beneath TP10 and SP1, upstream of Phase 1.
SP5	Rudbaxton Water, mid-stream of Phase 1 and WH/D1 but upstream of Phase 2.
SP6	Surface water inlet to lagoon servicing WH/D2 mid/downstream.
SP7	Rudbaxton Water, downstream of site.
D1	Formerly referred to as WH/L out, located at the outfall of the Phase 1 surface water lagoon system to Rudbaxton Water.
D2	Phase 2 Surface Water Lagoon A – no discharge.
D3	Phase 2 Surface Water Lagoon B – no discharge.
EFD	Effluent discharge from the MRF, flowing into a soakaway.
SWD	Discharge from MRF yard to ditch on eastern side of the site.

2.2 Surface Water Quality Results

2.2.1 The surface water quality data for D1 is summarised in Table 3 and compared with the limits specified in Table S4.3 of the permit. The permitted limits are shown below in Table 2.

Monitoring Points	Determinant	Concentration (mg/l)
D1 (D2 and D3 – no data)	Ammoniacal Nitrogen	0.5
	Chloride	250
	Biological Oxygen Demand	17
	Chemical Oxygen Demand	150
	Total Suspended Solids	30
	pH	6 to 9 pH units

2.2.2 One sample from D1 failed the compliance limit for suspended solids. No other compliance limits were exceeded during the review period at monitoring point D1, with pH, ammonia, COD, BOD, and chloride all below permitted threshold levels. For the remaining surface water monitoring points, the results of the surface water quality data have been compared to data collected upstream of the site and to applicable Environmental Quality Standards (EQS).

2.2.3 The highest ammoniacal nitrogen reading was recorded at SP6 in July 2020 (0.89 mg/l). A reading of 0.52 mg/l was recorded at monitoring point SP3 in November. All other off-site readings were less than 0.5 mg/l. The highest ammoniacal nitrogen reading at D1 was 0.45 mg/l.

2.2.4 There have been a number of low pH readings for SP6 over the past twelve months with recorded levels of 4, 3.2, 3.3, 3.3, and 4.3 in July, August, September, October and November, respectively. All other on- and off-site sample points remained within the EQS and permit compliance limits (6 to 9 pH units). pH readings from the D1 monitoring point showed a pH range of 6.8 to 8.

2.2.5 There were a number of suspended solids readings above 50 mg/l over the last 12 months. These was a result of 58.4mg/l in SP3 in July, a result of 148mg/l in SP5 in August, and results of 102 mg/l, 55.2mg/l and 86.8mg/l in SP6 in July, October and November, respectively.

- 2.2.6 Concentrations of other substances did not change significantly up and down stream of the site. The data collected over the 2020 period indicates that the site had no observable impact on surface water quality on- or off-site.

Table 3: Surface Water Quality Results

Determinand	Units	D1 Compliance Limit	Relevant EQS	SP1 (Upstream)		SP3 (Upstream)		SP5 (Midstream)		SP6 (Mid/downstream)		SP7 (Downstream)		D1	
				Mean	Max	Mean	Max	Mean	Max	Mean	Max	Mean	Max	Mean	Max
pH	pH Units	>6 <9	6 to 9	7.2	7.6	7.3	7.5	7.3	7.6	5.6	7.6	7.1	8	7.4	8
Conductivity	$\mu\text{S.cm}^{-1}$		2500*	197.6	242	195.1	243	224.3	335	628.2	1341	187.2	286	306.1	334
Total Suspended Solids	mg.l^{-1}	30		13.5	43.6	17.6	58.4	28.5	148	32.9	102	12.1	26.4	19.7	43.2
Ammonia	$\text{mg.l}^{-1}\text{N}$	0.5		0.17	0.33	0.16	0.52	0.1	0.19	0.41	0.89	0.15	0.39	0.11	0.45
Chloride	mg.l^{-1}	250	250	26.7	29.6	27	29.8	23.83	28.4	28.32	39.2	26.3	29.7	26.5	31.3
Dissolved Oxygen	$\text{mg.l}^{-1}\text{O}_2$			9.7	11.1	9.6	11.3	9.72	10.6	9.79	10.8	10	10.6	9.9	10.8
BOD	$\text{mg.l}^{-1}\text{O}_2$	17		1.6	3.1	1.84	4.7	2.99	13.9	1.87	4.3	1.7	3.3	2.2	4.8
COD	$\text{mg.l}^{-1}\text{O}_2$	150		20.3	56	21.4	54	24.5	65	24.62	88	25.4	62	23.9	64
Cadmium	mg.l^{-1}		0.0005*	<0.00008	<0.00008	<0.00008	<0.00008	<0.00008	0.000098	0.012	0.026	<0.00008	0.00035	<0.00008	<0.00008
Nickel	mg.l^{-1}		0.004#	0.002	0.004	0.002	0.0033	0.0025	0.0043	0.57	1.43	0.003	0.005	0.21	0.863
Mercury	mg.l^{-1}		0.00007	<0.00050	0.00066	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050	<0.00050
Mecoprop	mg.l^{-1}		0.018#	<0.0001	<0.1	<0.0001	<0.1	<0.00010	<0.1	<0.0001	<0.0001	<0.0001	<0.1	<0.0001	<0.0001
Ortho-Phosphate	mg.l^{-1}			0.19	0.58	0.3	0.61	0.46	1.7	0.54	1.7	0.73	1.9	0.45	1

Unless stated all EQS standards are taken from the Agency guidance document 'Freshwaters specific pollutants and operational environmental quality standards (EQS)'.

*Drinking Water Standard.

#The EQS used for Nickel and Mecoprop is the Annual Average EQS.

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3. Review of Groundwater

3.1 Groundwater Monitoring Points

- 3.1.1 Groundwater level monitoring is undertaken at 22 perimeter boreholes on a monthly basis in accordance with Table S4.11 of the permit. The existing groundwater monitoring points are listed in Table 4 below. New boreholes have been drilled during the 2020 period. Data has been collected from these boreholes but is not included in this annual review as the data sets are incomplete.

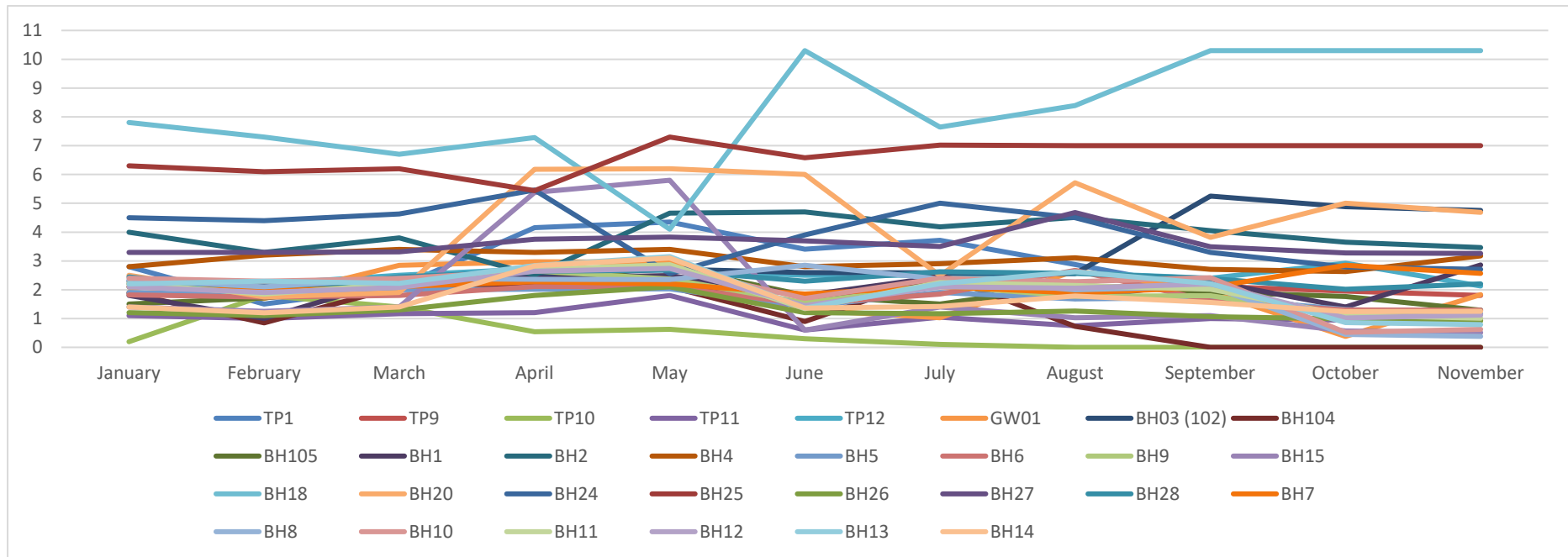
Table 4: Locations of Groundwater Monitoring Points

Monitoring Point	Location
BH15, BH18, GW01, TP1, TP10, BH26	Upgradient
BH102 (BH3), BH104, BH105, BH20, BH21, BH22, BH23	Mid-gradient
BH1, BH2, BH4, BH5, BH6, BH9, TP9, TP11, TP12	Downgradient

3.2 Groundwater Levels

- 3.2.1 Groundwater level data recorded during 2020 is presented in Figure 1. An assessment of the groundwater level with reference to the unsaturated zone beneath the site is addressed in the HRA Review which was submitted in November 2019.
- 3.2.2 Groundwater levels remained relatively stable in the majority of the perimeter boreholes around Phases 1 and 2 during the review period. The water levels reported at BH15, BH18 and BH20 between in April and June 2020 appear to be inaccurate and are expected to be recorded in error based on the otherwise stable data set at this and other data points.
- 3.2.3 Based on a review of the data, it is inferred that groundwater continues to flow in a northerly / north westerly direction towards Rudbaxton Water consistent with the groundwater flow direction identified in the HRA Review.

Figure 1: Groundwater levels reported from January to December 2020



3.3 Groundwater Quality

3.3.1 Groundwater quality is monitored at the 22 perimeter boreholes listed in Table 4. The groundwater quality data for the key pollution indicators for the 2020 review period is summarised in Table 6, 7 and 8. The specified compliance limits for individual boreholes are set out in Table S4.5 of the permit and are shown in Table 5 below.

Table 5: Groundwater Quality Compliance Limits

Monitoring Point	Ammoniacal Nitrogen mg/l	Cadmium mg/l	Chloride mg/l	Mecoprop mg/l	Napthalene mg/l	Nickel mg/l	Phenol mg/l
AIGBH104	12	0.0095	250	0.0001	0.0095	0.05	0.15
AIGBH105	0.5	0.002	50	0.0001	0.0001	0.031	0.15
BH1	1.328	0.002	117	0.0001	0.00003	0.02	0.15
BH2	5.2	0.002	180	0.0001	0.00006	0.02	0.15
BH4	1.45	0.0001	64.7	0.0001	0.00001	0.02	0.15
BH5	1.18	0.001	50	0.0001	0.00046	0.02	0.15
BH20	12	0.0095	250	0.0001	0.0095	0.05	0.15
TP9	12	0.0095	250	0.0001	0.0095	0.05	0.15
TP11	12	0.0095	250	0.0001	0.0095	0.05	0.15
TP12	12	0.0095	250	0.0001	0.0095	0.05	0.15

- 3.3.2 The data has been compared against the compliance limits provided in the permit.
- 3.3.3 Concentrations of chloride, mecoprop, naphthalene, and phenol remained below the compliance limits in all boreholes throughout the review period. No breaches of compliance were recorded for ammoniacal nitrogen during the review period. However, there were elevated results recorded for cadmium in BH104 and for nickel in TP9, TP11, TP12 and BH4.
- 3.3.4 Chloride levels showed a small increase between the up, mid and downstream boreholes, but had no compliance exceedances. Phenol was typically below the level of detection, as were all naphthalene and mecoprop records.
- 3.3.5 Comparison between up, mid and downstream boreholes shows that the site is not having any discernible effect on the groundwater quality downstream.
- 3.3.6 The current monitoring and compliance assessment regime are considered sufficient to identify any adverse trend that may indicate the landfill site is having an adverse impact on groundwater quality. Proposals have been made to review the compliance limits as part of the HRA Review submitted in November 2019.

Table 6: Upgradient Groundwater Quality Summary

Determinand	Units	TP1		TP10		BH18	
		Mean	Max	Mean	Max	Mean	Max
Ammonia	mg.l ⁻¹ as N	1.13	7.9	0.04	0.16	0.21	0.35
Chloride	mg.l ⁻¹	16.53	21.4	17.08	18.2	18.5	14.4
Nickel	mg.l ⁻¹	4.01	4.3	0.266	0.0213	0.0063	0.0063
Total Phenols	mg.l ⁻¹	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cadmium	mg.l ⁻¹	0.00008	0.00008	<0.000080	<0.000080		
Mecoprop	mg.l ⁻¹	<0.0001	<0.1	<0.0001	<0.1		
Naphthalene	mg.l ⁻¹	<0.00005	<0.00005	<0.00005	<0.00005	<0.0005	<0.0005

Table 7: Mid-gradient Groundwater Quality Summary

Determinand	Units	BH104		BH105		BH1		BH2		BH20	
		Mean	Max	Mean	Max	Mean	Max	Mean	Max	Mean	Max
Ammonia	mg.l ⁻¹ as N	0.158	0.85	0.12	0.38	0.21	1.1	0.35	2.8	0.022	0.34
Chloride	mg.l ⁻¹	22.88	31.4	25.41	44.3	28.71	47.6	23.06	30.7	28.83	48.4
Nickel	mg.l ⁻¹	0.0242	0.0242	0.012	0.0221	0.0051	0.0116	0.003	0.0039	0.0104	0.0194
Total Phenols	mg.l ⁻¹	0.02	0.02	0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cadmium	mg.l ⁻¹	1.45	2.4	<0.000080	<0.000080	0.000017	0.000089	0.00013	0.00013	0.0023	0.0023
Mecoprop	mg.l ⁻¹	<0.0001	<0.000080	<0.0001	<0.1	<0.0001	<0.1	<0.0001	<0.1	<0.0001	<0.1
Naphthalene	mg.l ⁻¹	<0.00005	<0.00005	<0.0005	<0.0005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005


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Table 8: Down-gradient Groundwater Quality Summary

Determinand	Units	TP9		TP11		TP12		BH5		BH4	
		Mean	Max	Mean	Max	Mean	Max	Mean	Max	Mean	Max
Ammonia	mg.l ⁻¹ as N	1.38	2.4	0.07	0.23	0.11	0.21	0.394	1.1	0.4	1.3
Chloride	mg.l ⁻¹	60.11	90.1	54.84	86.5	19.72	51.7	22.02	42.2	27.21	58.4
Nickel	mg.l ⁻¹	0.66	1.6	0.33	0.8	0.41	1.4	0.0019	0.0021	0.015	0.199
Total Phenols	mg.l ⁻¹	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02
Cadmium	mg.l ⁻¹	<0.000080	<0.000080	<0.000080	<0.000080	0.00011	0.0015	<0.000080	0.000084	0.00128	0.00016
Mecoprop	mg.l ⁻¹	<0.0001	<0.1	<0.0001	<0.1	<0.0001	<0.1	<0.0001	<0.1	<0.0001	<0.1
Naphthalene	mg.l ⁻¹	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005

4. Review of Leachate

4.1 Leachate Extraction

- 4.1.1 Leachate levels are monitored weekly and the data for 2020 is summarized in Table 10. Extracted leachate is transported by tanker for off-site disposal. A total of 23,582.94 tonnes of leachate was removed off-site for disposal during 2020.
- 4.1.2 The annual leachate extraction volumes for wells LE1, LE2, LE3, LE4, LE5 and LE6 are detailed in Table 9. A total of 4467 m³ of leachate was extracted from these wells during the 2020 monitoring period.

Table 9: Annual Leachate Extraction Volumes for LE1 to LE6

Annual Leachate Extraction Volumes LE1 -6		
Extraction Well	Leachate (m ³)	Volume
LE1	526	
LE2	83	
LE3	988	
LE4	682	
LE5	1080	
LE6	1108	
Total Annual Volume of Leachate Extracted	4467	

- 4.1.3 Table S4.1 of the permit requires the Operator to extract a minimum leachate volume of 1,278 m³ per annum (241 m³ per well) from wells LE1 to LE6. These wells are continuously pumped throughout the year in order to comply with the 1 m leachate head required for permit compliance and are often found and reported to be dry. As such, it is not practicable to comply with the minimum extraction requirements. These requirements are currently being reviewed in conjunction with the Leachate Management Plan review.

4.2 Leachate Levels

- 4.2.1 The 2020 leachate level monitoring data shows that all leachate wells in both Phase 1 and Phase 2 remained within the permit compliance limit of 1 m above cell basal liner. Table 10 summarises the average and maximum leachate levels recorded during 2020.
- 4.2.2 A review of the weekly leachate levels data for 2020 shows that a significant proportion of the leachate wells are dry for much of the year, as such, monitoring levels of 0 have been recorded for these wells.

Table 10: Leachate Level Summary

Monitoring point	Compliance Limit	Mean Leachate Level (m)	Maximum Leachate Level (m)
Cell 11E	1 m above cell basal liner	0.80	0.98
Cell 11W		0.81	0.96
Cell 13		0.84	0.99
Cell 14		0.85	0.97
Cell 15		0.81	0.99
L1		0.79	0.89
L2		0.79	0.94
L3		0.82	0.89
L4		0.78	0.97
L5		0.00	0
LD3		0.80	0.96
SWS		0.00	0
LM1		0.08	0.97
LM2		0.82	0.94
LM3N		0.83	0.94
LM3S		0.00	0
LM4		0.82	0.94
LM5		0.08	0.92
VL1		0.64	0.79
VLM1		0.61	0.69
VL2		0.56	0.69
VL3		0.52	0.69
VSL1		0.53	0.69
VSLM1		0.57	0.69
C4NL1		0.40	0.6
C4NLM1		0.36	0.46
C4NLM2		0.35	0.41
5NL1		0.00	0
5NLM1		0.00	0
5NLM2		0.00	0

4.3 Leachate Quality

4.3.1 Leachate has been sampled at the frequencies and for the parameters specified in Table S4.1 of the site permit during 2020. The leachate quality data for the 2020 period is summarised in Table 13. The data has been compared against the maximum modelled values of priority contaminants as identified in the 2012 HRA (Table 11) and against the assumptions of the November 2019 HRA (Table 12).

Table 11: Maximum Modelled Values of Priority Contaminants for Leachate at Withyhedge (Extracted from HRA 2012).

Max Modelled Value (mg/l)	Phase 2 2A to 2E	Phase 1 Cells 1 to 10 & 12	Phase 1 Cells 11 & 13 to 15
Ammoniacal Nitrogen	3640	600	3640
Chloride	7760	3400	7760
Mecoprop	0.067	0.067	0.067
Naphthalene	0.011	0.011	0.011
Nickel	2.21	0.13	2.21
Phenols	12	0.012	0.07

Table 12: Average Modelled Values of Priority Contaminants for Leachate at Withyhedge (Extracted from HRA 2019).

Phase and Cell	Monitoring Point	NH ₄ -N mg/l	Alk mg/l	Ca mg/l	COD mg/l	TOC mg/l	EC µS/cm	Cl mg/l	SO ₄ mg/l	Mg mg/l	K mg/l	Na mg/l
1 (1-10 & 12)	LW1	239	2027	152	536	100	5494	712	134	31	321	736
	LW2	81	690	220	724	77	2096	174	26	23	89	207
	SW (S)	3	220	126	66	85	665	51	143	12	5	23
	LD3	7	290	125	92	37	830	26	177	12	11	25
	CELL 1#	520	5147	399	4018	1236	1240	1240	63	178	453	1095
	CELL 2#	418	4655	1237	10290	3831	1099	1099	105	167	530	849
1 (11)	CELL 11E	331	2484	141	898	469	228	228	86	47	162	308
	CELL 11 W	419	3553	143	626	373	394	394	44	56	257	471
1 (13)	CELL 13	458	3494	151	484	269	388	388	62	41	259	463
1 (14)	CELL 14	1020	10185	108	2135	713	12557	949	125	63	515	1019
1 (15)	CELL 15	524	4699	153	974	370	7048	446	37	38	287	509
2 (1/2 N)	L1	583	4791	191	1175	380	7849	562	123	57	353	730
	L2	567	6080	180	1207	356	7909	719	144	60	425	857
	LM1*		66	24	89	12	230	19		7	4	19
	LM2*		57	26	109	12	231	28		7	4	19
2 (1/2 S)	L4*	1080	9150	107	1647	1287	11110	25	50	41	412	819
	L5*	1000	2440	111	1605	2087	11140	29	44	44	435	872
	LM4*		37	24	117	13	218	20		6	3	19
	LM5*		67	24	80	13	221	20		6	4	17
2 (3)	L3	735	6062	191	2201	662	10498	748	80	61	465	985
	LM3 (N)											
	LM3 (S)											
	LM3		78	24	140	12	223	24		6	3	18

*Only 1 result recorded

Cell 1 and cell 2 data recorded from 2008 only

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- 4.3.2 L1, L2 and L3, which represent the leachate quality in Phase 1 Cells 1 to 10 and 12, recorded levels of ammoniacal nitrogen, and nickel above the maximum modelled values. L1, L2, L3, SW Sump and LD3 (Phase 1 Cells 1 to 10 and 12) and Cell 11E, Cell 11W and Cells 13 -15 (Phase 1 Cells 11 & 13 to 15) also recorded levels of phenol above the maximum modelled values.
- 4.3.3 The leachate data in Table 13 is consistent with expectations for a non-hazardous municipal solid waste landfill. The leachate concentrations in Phase 1 and Phase 2 are discussed in detail in the HRA Review 2019.

Table 13: Leachate Quality Annual Summary Results

Monitoring Point	Ammoniacal Nitrogen mg/l		Chloride mg/l		Mecoprop mg/l		Napthalene mg/l)		Nickel mg/l		Phenol mg/l	
	Mean	Maximum	Mean	Maximum	Mean	Maximum	Mean	Maximum	Mean	Maximum	Mean	Maximum
Phase 1 Cells 11 & 13 to 15												
CELL 11E	345.66	890	587.6	1155	0.0128	0.0128	0.0073	0.0073	0.078	0.153	4.8	4.8
CELL 11W	393.33	950	563	985	0.00815	0.014	0.0086	0.0086	0.073	0.141	2.915	5.6
CELL 13	1032.5	2000	1071	2100	0.00575	0.0096	0.0072	0.0072	0.107	0.15	9.46	21
CELL 14	1673.33	2200	1468	1810	0.0386	0.056	0.00755	0.0077	0.1625	0.173	5.4	6.3
CELL 15	1355	1700	1389	1880	0.00695	0.0121	0.0032	0.0038	0.154	0.217	8.7	18
Phase 1 Cells 1 to 10 & 12												
LD3	9.85	17	22.3	23.3	0.003	0.003	0.00005	0.00005	0.01955	0.0198	0.02	0.84
SW SUMP	2.35	3.2	13.7	20.5	0.0005	0.0005	0.00005	0.00005	0.017	0.0325	0.495	0.89
L1	1092.5	1200	1501.33	1590	0.0127	0.0213	0.0027	0.0034	0.173	0.191	8.133	9.9
L2	922.5	1300	1291.33	1670	0.0093	0.0204	0.00375	0.0048	0.172	0.225	3.32	8
L3	1155	1500	1494.33	1690	0.0109	0.0213	0.0033	0.0061	0.221	0.273	6.93	9.5

5. Landfill Gas

5.1 Perimeter and in-Waste Gas Monitoring

- 5.1.1 Landfill gas monitoring is undertaken monthly at 18 perimeter gas boreholes in accordance with the requirements specified in Table S4.6 of the permit. Additionally, monitoring of in-waste gas collection wells is undertaken for the parameters specified in Table S4.8.
- 5.1.2 Installation of monitoring boreholes is dependent on the progression of cell construction. The active part of Phase 2 consisted of Cells 1, 2 and 3 (North and South); however, there are a number of monitoring boreholes installed around the larger Phase 2 footprint in order to establish background gas levels. These include the existing BH6, BH9, BH15, BH18 and BH20 boreholes along with BH7, BH8, BH10, BH11, BH12, BH13 and BH14, which were drilled in the summer of 2019. A further seven new perimeter boreholes have been drilled

this year. Data has been collected from these boreholes but is not included in this annual review as the data sets are incomplete.

- 5.1.3 Two landfill gas engines (No. 1514 and 1510), located in the Gas Utilisation Plant (GUP), treat the gas extracted by the in-waste gas wells.
- 5.1.4 Table S4.6 of the site permit specifies a compliance limit of 1.0 %v/v methane in all external boreholes. Action levels for carbon dioxide have been derived historically and are contained within the Gas Management Plan and are detailed below in Table 14.

Table 14: Perimeter Gas Compliance Limits

Monitoring Point	Methane Compliance Limit (%v/v)	Carbon Dioxide Assessment Level (%v/v)
BH101	1	5.8
BH102 (BH3)	1	5.5
BH104	1	5.5
BH105	1	2.1
BH1	1	11
BH2	1	2.3
BH4	1	1.1
BH5	1	1.1
BH6	1	6
BH9	1	13.8
BH15	1	8.2
BH18	1	8.6
BH20	1	10.1
TP1	1	10
TP9	1	21.7
TP10	1	4.3
TP11	1	3.1
TP12	1	11.6
GW1	1	5
BH24	1	2.3
BH25	1	2.3
BH26	1	2.3
BH27	1	2.3
BH28	1	2.3

- 5.1.5 All perimeter gas concentrations were below the respective compliance limits in Table 14 throughout the year. Methane concentrations were consistently below the limit of detection of 0.1 %v/v. A full summary of results for the 2020 monitoring period can be found in Table 15.

Table 15: Perimeter Gas Summary

Client Sample Reference		Methane	Co2	O2
TP9	mean	0	0.4	19.9
TP9	max	0.1	0.9	20.8
TP12	mean	0	0.58	20.9
TP12	max	0.1	1.8	21.8
TP11	mean	0	0.35	20.4
TP11	max	0.1	1.2	21.7
TP10	mean	0	0.35	20.5
TP10	max	0.1	1	21.5
TP1	mean	0	0.57	19.1
TP1	max	0.1	2.2	20.8
TP09	mean	0.1	1.1	19.9
TP09	max	0.1	2	21.1
TP01	mean	0.1	0.28	21.3
TP01	max	0.2	0.6	22.1
GW1	mean	0	0.99	19.2
GW1	max	0.1	3.3	21.3
BH9	mean	0	0.26	20.6
BH9	max	0.2	0.8	22.3
BH8	mean	0	0.24	0.6
BH8	max	0.2	0.7	22.3
BH7	mean	0	0.22	20.8
BH7	max	0.1	0.6	22.3
BH6	mean	0.1	0.45	20.5
BH6	max	0.2	1.4	22.3
BH5	mean	0	0.23	20.6
BH5	max	0.2	0.6	22.3
BH4	mean	0	0.54	20.1
BH4	max	0.1	2.2	21.7
BH37	mean	0	0.1	21.9
BH37	max	0.1	0.1	22.6
BH36	mean	0.1	0.13	21.3
BH36	max	0.1	0.2	22.3
BH35	mean	0	0.1	21.6
BH35	max	0	0.1	21.8
BH34	mean	0.1	0.2	21.1
BH34	max	0.1	0.4	21.5
BH33	mean	0	0.1	21.8
BH33	max	0.1	0.1	22.5
BH31	mean	0	0.1	21.8
BH31	max	0	0.1	22.1
BH30	mean	0	0.63	19.8
BH30	max	0.1	0.9	21.6

BH3 (102)	mean	0	0.56	20.9
BH3 (102)	max	0.1	1.6	21.9
BH29	mean	0	0.1	21.8
BH29	max	0	0.1	22.5
BH28	mean	0	1.31	19.1
BH28	max	0.1	2.3	20.3
BH27	mean	0.1	0.72	18.4
BH27	max	0.1	1.6	20.6
BH26	mean	0.2	0.99	18.5
BH26	max	0.7	2.3	20.7
BH25	mean	0.2	0.48	18.9
BH25	max	0.9	1.4	20.9
BH24	mean	0.1	0.97	19.8
BH24	max	0.2	2.2	21
BH20	mean	0	0.65	18.8
BH20	max	0.1	2.3	22.1
BH2	mean	0	0.68	19.6
BH2	max	0.1	2	22
BH19	mean	0.1	0.13	21.9
BH19	max	0.1	0.2	22.5
BH18	mean	0.2	0.98	18.1
BH18	max	0.8	2.3	20.3
BH17	mean	0	0.1	21.9
BH17	max	0	0.1	22.5
BH16	mean	0	0.1	21.5
BH16	max	0	0.1	22.5
BH15	mean	0	0.69	20.3
BH15	max	0.1	2.2	21.9
BH14	mean	0	0.3	20
BH14	max	0.1	0.6	22.1
BH13	mean	0	0.33	20.7
BH13	max	0.2	0.89	21.7
BH12	mean	0	0.33	20.8
BH12	max	0.1	1	22.3
BH11	mean	0	0.35	20.6
BH11	max	0.1	0.7	21.7
BH105	mean	0	0.48	21
BH105	max	0.1	1.6	28.6
BH104	mean	0	0.51	19.7
BH104	max	0.1	1.8	21.5
BH10	mean	0	0.2	20.8
BH10	max	0.2	0.4	22.2
BH1	mean	0	0.58	20.2
BH1	max	0.2	2.1	22

5.2 Landfill Gas Production

5.2.1 The volume of gas treated during 2020 was 487,264 Nm³ by flare and 4,122,335 Nm³ by the GUP, giving a total of 4,609,599 Nm³.

5.3 Engine Emissions Monitoring

5.3.1 Landfill gas engine and flare emission monitoring is undertaken annually in accordance with Table S4.2 of the site permit and as specified in permit variation EPR/GP3630HT/V005 at Engine Exhaust 1 (1514) and Engine Exhaust 2 (1538) and the Flare Stack. The compliance limits for Oxides of Nitrogen (NO_x), Carbon Monoxide and Volatile Organic Compounds (VOCs) and monitoring summary for the flare stack and Engine 1514 are shown in Table 16. A full report for both engines has previously been submitted to Natural Resources Wales.

Table 16: Gas Engine and Flare Emission Summary

		Engine Exhaust 1 (1514)	Engine Exhaust 2 (1510)
Substance	Limit (mg(N)m ³)	2020 Monitoring Results (mg(N)m ³)	2020 Monitoring Result (mg(N)m ³)
Oxides of Nitrogen (as NO ₂)	500	478	473
Carbon Monoxide	1400	1000	589
Volatile Organic Compounds (VOCs as carbon)	1000	1169	1197

5.3.2 Engine Exhaust 1 (1514) and Engine Exhaust 2 (1510) exceeded the compliance limit for Volatile Organic Compounds (VOCs as carbon) at 1169 and 1197 (mg(N)m³); however, oxides of nitrogen and carbon monoxide limits were within the compliance limits.

5.3.3 Gas engine emissions are tested monthly using the portable combustion gas analyser, the results of which were provided in the quarterly reports. There are no compliance limits associated with this ongoing monitoring requirement.

5.4 Trace Gas Inlet Monitoring

5.4.1 Monitoring was undertaken on the inlet to the GUP in accordance with the requirements of Table S4.8 of the site permit. The trace gas results have been reviewed against the parameters modelled in the gas risk assessment (TerraConsult Report Reference: 1752/R/003/01 dated May 2013) relevant to the facility. The Landfill Gas Risk Assessment (LFGRA) was updated to include amendments to the trace gas source term and annual waste inputs. Trace Gas values were taken from a combination of default values provided in GasSim 2.5 and site-specific data. The indicative values for trace gas are provided in

Table 17 and compared against the 2020 results. The Trace Gas report has been previously submitted to NRW.

- 5.4.2 The majority of the 2020 trace results are higher than those recorded in 2019 (results highlighted in red are higher than those recorded in 2019). However, it is evident from Table 17 that the trace gas results for 2020 are below the maximum modelled thresholds used in the LFGRA. The exception to this is the result for hydrogen sulphide. This is being investigated and a report will be provided as soon as investigations are concluded.

Table 17: Trace Gas Value Summary and Comparison to LFGRA Default Values

Source Gas	Concentration - Default maximum from GasSim2.5 (ug/m3)	Trace Gas Results (2020) (ug/m3)
Hydrogen Sulphide	870,000	1159643
Acetaldehyde (ethanol)	2546	266
1,1-Dichloroethane	3900	28
1,1-Dichloroethene	19000	23
1,2-Dichloroethane	NOT MODELLED	120
1,2-Dichloroethene	NOT MODELLED	278
1-pentene	NOT MODELLED	1298
1-propanethiol	NOT MODELLED	324
2-butoxyethanol	3660	46
Arsenic	200	49
Benzene	73000	6024
Butadien (modelled at 1,3-Butadiene)	1790	46
Butyric Acid	17500	46
Carbon Disulphide	170000	101948
Chloroethane	5300	227
Dichloromethane (methylene chloride)	1520000	97
Dimethyl disulphide	12000	5561
Dimethyl sulphide	24300	19926
Ethanethiol (ethyl mercaptan)	13800	602
Ethyl butyrate	42000	46
Furan (1,4-epoxy-1,3-Butadiene)	6200	2546
Formaldehyde (methanal)	250000	30
Methanethiol (methyl mercaptan)	8400	1019
Butanethiol	NOT MODELLED	185
Styrene	NOT MODELLED	4032
Tetrachloromethane (Carbon tetrachloride)	1000	23
Toluene	1250000	21316
Trichloroethylene (trichloroethene)	88000	310
Vinyl chloride (chloroethene chloroethylene)	730000	348

5.5 Surface Emissions Monitoring

- 5.5.1 An annual surface emissions FID walkover survey was undertaken in July 2020 and the results assessed against operational assessment limits as specified in LFTGN07. A copy of the surface emissions report was sent through to NRW in August 2020.
- 5.5.2 All readings were below 100ppm; however, there were thirty elevated readings between 1 and 56ppm, all of which were recorded in a similar location. Of these elevated readings, only 1 was >50 ppm. This was recorded at the western crest of the cap. The remaining 29 elevated readings were not considered to be related to the capping system as they were all consistent at 20ppm.

6.0 Reporting

6.1 Condition 4.2.2

- 6.1.1 Condition 4.2.2 (a) requests a review of the results of the monitoring and assessment carried out in accordance with the permit. This document provides that review.
- 6.1.2 Condition 4.2.2 (b) and (c) are detailed in R20408 Potter Group Withyhedge 2020 – Mcerts Report and R20408 Potter Group Withyhedge 2020 – Trace Gas Report.
- 6.1.6 Condition 4.2.2 (d) requires a topographical survey to be completed. This is attached to this report as drawing reference January 2021 to January 2020.
- 6.1.7 Condition 4.2.2 (e) requires a calculation of the volume of waste deposited over the year. From surveys carried out by Walters Group, 158,766m³ of waste has been deposited at Withyhedge over the last 12 months. This is also shown in the attached drawing reference Jan 2021 to Jan 2020.
- 6.1.8 Condition 4.2.2 (f) requires an assessment of the settlement of the waste, evidence of which is provided in drawing reference January 2021 to January 2020.
- 6.1.9 Condition 4.2.2 (g) requires a calculation of the remaining capacity, reported in cubic metres. Survey results give an overall void space calculation of 2,418,026 m³.

END OF REPORT