

Preliminary Risk Assessment - Tables

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TABLE 5.2: SOILS/FINES ELUATE & TOTAL POLLUTANT CONTENT RESULTS FROM WITHIN AND BENEATH WASTE BODIES - DECEMBER 2003

SAMPLE LOCATION		TP-1,2,7,13,39A COMP	TP-62	TP- 16,19A,22,24,52 COMP	TP-39B	TP-59B	TP-19B	TP-33	ELUATE*	TOTAL POLLUTANT CONTENT*
ZONE LOCATION		Zone A	Zone B	Zone C	Zone A	Zone B	Zone C	Background		
COMMENTS		Within Waste Body			Beneath Waste Body					
LABORATORY ANALYSIS										
<i>General Water Quality Parameters</i>										
Total dissolved Solids, (in CEN 10:1 Leachate)	mg/kg	3800	670	3200	750	630	2200	500	4000	-
Total Organic Carbon	%	0.82	0.99	1.56	0.23	0.22	0.25	0.2	-	-
Dissolved Organic Carbon (in CEN 10:1 Leachate)	mg/kg	48	<20	60	<20	21	30	<20	500	-
Total Phenols (in CEN 10:1 Leachate)	mg/lkg	0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.0	-
<i>Inorganics (in CEN 10:1 Leachate)</i>										
Chloride	Cl mg/kg	34	17	32	<10	11	27	10	800	-
Fluoride	F mg/kg	2	1	1	1	1	2	1	10	-
Sulphate	SO ₄ mg/kg	<u>2399</u>	39	<u>1317</u>	39	<30	940	<30	1000	-
<i>Metals (in CEN 10:1 Leachate)</i>										
Antimony	Sb mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.06	-
Arsenic	Ar mg/kg	0.04	0.05	0.04	0.02	<0.02	<0.02	<0.02	0.5	-
Barium	Br mg/kg	3.4	3.3	3.5	1.8	3.1	4.6	1.5	20	-
Cadmium	Cd mg/kg	<0.004	<0.004	<0.004	0.007	<0.004	<0.004	0.005	0.04	-
Chromium (Total)	Cr mg/kg	<0.01	0.07	<0.01	0.07	0.07	0.06	0.07	0.5	-
Copper	Cu mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	2	-
Lead	Pb mg/kg	0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.5	-
Mercury	Hg mg/kg	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.01	-
Molybdenum	Mo mg/kg	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.5	-
Nickel	Ni mg/kg	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.4	-
Selenium	Se mg/kg	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.1	-
Zinc	Zn mg/kg	0.41	0.34	0.46	0.6	0.19	0.41	0.33	4	-
<i>Hydrocarbons</i>										
Mineral Oil	mg/kg	<1	<1	<1	<1	<1	<1	<1	-	500
Diesel Range Organics	mg/kg	<1	<1	664	<1	<1	27	<10	-	-
Petrol Range Organics (C5-C9)	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
Petrol Range Organics (C10+)	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
BTEX	mg/kg	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	6
Total 6 PAH's	mg/kg	2.1	<1.6	<1.6	<1.6	<1.6	<1.6	<1.6	-	2**
<i>PCB's</i>										
PCB Congener 28	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
PCB Congener 52	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
PCB Congener 101	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
PCB Congener 118	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
PCB Congener 153	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
PCB Congener 138	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
PCB Congener 180	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	-
PCB Total of 7 Congeners	mg/kg	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-	1
LEGEND										
* = Council Decision of 19 December 2002 (2003/33/EC) - Leaching Limit Values for Inert Waste (L/S 10 l/kg)										
** = Generally Accepted Value by EPA for PAHs is 2 mg/kg										
- = No data reported or no analyses conducted										
< = Less Than										
Bold and underlined values are in excess of limits										

TABLE 6.2: CHEMICAL ANALYSIS OF LEACHATE WITHIN WASTE ZONES B & C AT WHITESTOWN SITE - DECEMBER 2003 (FULL SUITE OF PARAMETERS)

PARAMETER	UNIT	TP - 63L (Zone B)	TP - 24L (Zone C)
LABORATORY ANALYSIS			
<i>General Water Quality Parameters</i>			
Conductivity @ 25°C	µS/cm	837	181
pH		6.4	6.3
Total Alkalinity	CaCO ₃ mg/l	480	940
Total Oxidised Nitrogen	O ₂ mg/l	<0.3	<0.3
Total Organic Carbon	C mg/l	7	105
Total Phenols	mg/l	0.2	3.3
<i>Inorganics</i>			
Ammoniacal Nitrogen	N mg/l	32.5	56.8
Calcium	Ca mg/l	183.4	366.2
Chloride	Cl mg/l	6.0	15.0
Fluoride	F mg/l	0.2	0.3
Potassium	K mg/l	13	49
Sodium	Na mg/l	1.8	7.6
Sulphate	SO ₄ mg/l	<3	6.0
Phosphorous	P mg/l	14.5	1.6
Total Orthophosphate	PO ₄ mg/l	<0.03	<0.03
<i>Metals</i>			
Boron	B mg/l	<0.05	0.3
Cadmium	Cd mg/l	<0.0004	<0.0004
Chromium (Total)	Cr mg/l	0.13	<0.05
Copper	Cu mg/l	<0.005	<0.005
Cyanide (Total)	Cn mg/l	<0.05	<0.05
Iron	Fe mg/l	0.0	0.0
Lead	Pb mg/l	<0.005	<0.005
Magnesium	Mg mg/l	8.9	18.5
Manganese	Mn mg/l	2.4	2.0
Mercury	Hg mg/l	<0.00005	<0.00005
Nickel	Ni mg/l	<0.01	0.0
Zinc	Zn mg/l	<0.005	<0.005
<i>Hydrocarbons</i>			
Diesel Range Organics	mg/l	0.4	5.7
Mineral Oil	mg/l	<0.01	<0.01
Petrol Range Organics (C5-C9)	mg/l	<0.01	2.9
Petrol Range Organics (C10+)	mg/l	<0.01	0.2
Benzene	mg/l	<0.01	<0.01
Toluene	mg/l	<0.01	1.6
Ethylbenzene	mg/l	<0.01	0.0
Total Xylene	mg/l	<0.01	0.1
<i>Organics - List I/II</i>			
VOC's	mg/l	all <0.001	all <0.001 except:
Vinyl Chloride	mg/l		0.0
Trichlorofluoromethane	mg/l		0.1
cis-1,2-Dichloroethane	mg/l		0.0
Benzene	mg/l		0.0
Trichloroethane	mg/l		0.0
Toluene	mg/l		1.9
Tetrachloroethene	mg/l		0.0
Ethylbenzene	mg/l		0.0
p/m-Xylene	mg/l		0.1
o-Xylene	mg/l		0.0
Isopropylbenzene	mg/l		0.0
Propylbenzene	mg/l		0.0
1,2,4-Trimethylbenzene	mg/l		0.0
1,2,5-Trimethylbenzene	mg/l		0.0
tert-Butylbenzene	mg/l		0.0
n-Butylbenzene	mg/l		0.0
Naphthalene	mg/l		0.0
Semi VOC's	mg/l	all <0.001	all <0.001 except:
2-Methylphenol	mg/l		0.0
4-Methylphenol	mg/l		0.2
Bis(2-ethylhexyl)phthalate	mg/l		0.0
Butylbenzylphthalate	mg/l		0.0
Pesticides	mg/l	all <0.0001	all <0.0001

LEGEND
 " - " = No data reported or no analyses conducted
 < = Less Than
 Bold underlined values are considered elevated

TABLE 6.3: CHEMICAL ANALYSIS OF SAMPLED LEACHATE WITHIN WASTE ZONES B & C AT WHITESTOWN SITE - (LEACHATE INDICATOR PARAMETERS)

PARAMETER	UNIT	TP - 63L (Zone B)	TP - 24L (Zone C)	Mean of values above laboratory detection limit
Conductivity @ 20°C	µS/cm	837	181	509
Ammoniacal Nitrogen	N mg/l	<u>32.5</u>	<u>56.8</u>	<u>45</u>
Chloride	Cl mg/l	6	15	11
Potassium	K mg/l	13	49	31
Sulphate	SO ₄ mg/l	<3	6.0	6
Boron	B mg/l	<0.05	0.3	0.3
Chromium (Total)	Cr mg/l	<u>0.13</u>	<0.05	<u>0.13</u>

LEGEND

" - " = No data reported or no analyses conducted

< = Less Than

Bold underlined values are considered elevated

Samples taken 12 December 2003

Brownfield Restoration Ireland Ltd.
Preliminary Risk Assessment (March 2004)
Site at Whitestown Lower, Co. Wicklow

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TABLE 7.2: CHEMICAL ANALYSIS OF GROUNDWATER AT WHITESTOWN SITE - DECEMBER 2003 (FULL SUITE)

Monitoring Well Location	UNIT	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7	MW-8	MW-9	MW-10	MW-11	MW-12	MW03-2	MW03-3	MW03-4	MW03-5	MW04-1	MW04-2	MW04-3	MW04-4	MW04-5
Presumed Screen Location		O/B	B/R	B/R	O/B	O/B	O/B	O/B	O/B	O/B	O/B	B/R	B/R	B/R	O/B	B/R	B/R	B/R	B/R	B/R	O/B - B/R	O/B - B/R
Well location in relation to waste		U/G	U/G	U/G	U/G	U/G	D/G	D/G	D/G	D/G	U/G	U/G	U/G	D/G	D/G	U/G	U/G	U/G	U/G	U/G	D/G	D/G
FIELD ANALYSIS																						
General Water Quality Parameters																						
Colour		Silty	Clear	Brown	Cloudy	Clear	Brown	Brown	Clear	Brown	Brown	Clear		Clear	Brown	Clear	Clear					
Conductivity @ 25°C	µS/cm	723	315	421	275	90	98	557	599	806	764	421		951	1409	573	560					
Odour		None	None	None	None	None	None	None	None	None	Slight	None		None	Slight	None	None					
pH		7.61	6.81	6.78	7.2	8.15	6.78	7.19	7.09	6.95	6.98	6.78		7.11	6.76	7.47	7.44					
Temperature	°C	11.3	11.7	10.9	9.7	12.4	9.3	10.5	8	9.5	9.8	10.9		10.9	12.0	11.4	11.1					
LABORATORY ANALYSIS																						
General Water Quality Parameters																						
BOD	O ₂ mg/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
COD	O ₂ mg/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Conductivity @ 20°C	µS/cm	619	331	403	319	139	207	570	603	775	473	399	457	946	1126	505	570					
Dissolved Oxygen	O ₂ mg/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
pH		6.98	6.7	6.59	6.9	6.29	6.29	6.81	6.99	6.69	6.6	7	6.92	6.82	6.91	6.94	7.22					
Residue on Evaporation		-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Alkalinity	CaCO ₃ mg/l	-	-	90	150	-	-	-	-	450	170	-	-	470	560	-	-	-	-	-	-	-
Total Oxidised Nitrogen	O ₂ mg/l	-	-	4.7	4.7	-	-	-	-	<0.3	4	-	-	<0.3	<0.3	-	-	-	-	-	-	-
Total Suspended Solids	mg/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon	C mg/l	15	13	12	11	14	14	20	17	22	26	6	15	13	17	15	13					
Total Phenols	mg/l	<0.01	0.05	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01					
Inorganics																						
Ammoniacal Nitrogen (12/12/03)	N mg/l	0.8	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	3.8	<0.2	<0.2	<0.2	0.4	4.5	<0.2	<0.2					
Ammoniacal Nitrogen (25/2/04) *	N mg/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.20	0.15	0.12	0.13	3.90
Nitrate	NO ₃ mg/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrite	NO ₂ mg/l	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calcium	Ca mg/l	102.3	45.96	48.55	59.39	15.95	34.36	108.3	133.5	149.2	83.41	68.26	79.5	173	217.9	83.4	105.5					
Chloride	Cl mg/l	25	14	46	6	6	3	6	7	6	16	11	15	27	31	24	10					
Fluoride	F mg/l	-	-	0.1	<0.1	-	-	-	-	0.1	0.1	-	-	<0.1	0.1	-	-					
Potassium	K mg/l	-	-	1.4	1	-	-	-	-	1.6	1	-	-	2	9	-	-					
Sodium	Na mg/l	16.8	8.9	14.6	5.1	4.7	4.1	6	4	8.3	8	5.7	6.8	31	25.5	9.2	6.8					
Sulphate	SO ₄ mg/l	15	9	10	13	8	8	20	8	<3	65	12	11	23	26	12	13					
Phosphorous	P mg/l	-	-	0.31	1.02	-	-	-	-	0.38	0.54	-	-	<0.05	0.77	-	-					
Total Orthophosphate	PO ₄ mg/l	-	-	<0.03	<0.03	-	-	-	-	<0.03	0.32	-	-	<0.03	<0.03	-	-					
Metals																						
Boron	B mg/l	-	-	<0.05	<0.05	-	-	-	-	<0.05	<0.05	-	-	<0.05	<0.05	-	-					
Cadmium	Cd mg/l	-	-	<0.0004	<0.0004	-	-	-	-	<0.0004	<0.0004	-	-	<0.0004	<0.0004	-	-					
Chromium (Total)	Cr mg/l	-	-	<0.05	<0.05	-	-	-	-	<0.05	0.08	-	-	<0.05	0.08	-	-					
Copper	Cu mg/l	-	-	<0.005	<0.005	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-					
Cyanide (Total)	Cn mg/l	-	-	<0.05	<0.05	-	-	-	-	<0.05	<0.05	-	-	<0.05	<0.05	-	-					
Iron	Fe mg/l	-	-	<0.001	0.001	-	-	-	-	0.025	0.124	-	-	<0.001	0.002	-	-					
Lead	Pb mg/l	-	-	<0.005	<0.005	-	-	-	-	<0.005	<0.005	-	-	<0.005	<0.005	-	-					
Magnesium	Mg mg/l	-	-	4.83	2.37	-	-	-	-	9.49	3.83	-	-	12.79	16.99	-	-					
Manganese	Mn mg/l	-	-	0.005	0.005	-	-	-	-	0.631	0.399	-	-	0.81	2.112	-	-					
Mercury	Hg mg/l	-	-	<0.00005	<0.00005	-	-	-	-	<0.00005	<0.00005	-	-	<0.00005	<0.00005	-	-					
Nickel	Ni mg/l	-	-	<0.01	<0.01	-	-	-	-	<0.01	0.010	-	-	<0.01	0.011	-	-					
Zinc	Zn mg/l	-	-	0.009	0.029	-	-	-	-	0.01	0.013	-	-	0.023	0.006	-	-					
Hydrocarbons																						
Diesel Range Organics	mg/l	-	-	<0.01	<0.01	-	-	-	-	<0.01	<0.01	-	-	<0.01	<0.01	-	-					
Mineral Oil	mg/l	-	-	<0.01	<0.01	-	-	-	-	<0.01	<0.01	-	-	<0.01	<0.01	-	-					
Petrol Range Organics (C5-C9)	mg/l	-	-	<0.01	<0.01	-	-	-	-	<0.01	<0.01	-	-	<0.01	<0.01	-	-					
Petrol Range Organics (C10+)	mg/l	-	-	<0.01	<0.01	-	-	-	-	<0.01	<0.01	-	-	<0.01	<0.01	-	-					
Benzene	mg/l	-	-	<0.01	<0.01	-	-	-	-	<0.01	<0.01	-	-	<0.01	<0.01	-	-					
Toluene	mg/l	-	-	<0.01	<0.01	-	-	-	-	<0.01	<0.01	-	-	<0.01	<0.01	-	-					
Ethylbenzene	mg/l	-	-	<0.01	<0.01	-	-	-	-	<0.01	<0.01	-	-	<0.01	<0.01	-	-					
Total Xylene	mg/l	-	-	<0.01	<0.01	-	-	-	-	<0.01	<0.01	-	-	<0.01	<0.01	-	-					
Organics - List I/II																						
VOC's	mg/l	-	-	all <0.001	all <0.001	-	-	-	-	all <0.001	all <0.001	-	-	all <0.001	all <0.001	-	-	all <0.001				
except Carbon Disulphide	mg/l	-	-		0.008	-	-	-	-			-	-	0.008	0.013	-	-	0.019				
Semi VOC's	mg/l	-	-	all <0.001	all <0.001	-	-	-	-	all <0.001	all <0.001	-	-	all <0.001	all <0.001	-	-					
Pesticides	mg/l	-	-	all <0.00001	all <0.00001	-	-	-	-	all <0.00001	<0.00001	<0.00001	-	<0.00001	<0.00001	-	-					
Bacteriological Parameters																						
Faecal Coliforms	no. /100 ml	39	<1	24	-	-	-	-	<1	-	-	-	-	<1	-	-	-	1				
Total Coliforms	no. /100 ml	42	9	27	-	-	-	-	<1	-	-	-	-	2	-	-	-	<1				
Faecal Streptococci	no. /100 ml	39	64	28	-	-	-	-	<1	-	-	-	-	44	-	-	-	22				
Total Viable Count @ 22C	no. /100 ml	4800	1680	1520	-	-	-	-	6320	-	-	-	-	4240	-	-	-	480				
Total Viable Count @ 37C	no. /100 ml	2080	20	240	-	-	-	-	880	-	-	-	-	30	-	-	-	20				

LEGEND

" - " = No data reported or no analyses conducted

< = Less Than

U/G = Upgradient

D/G = Downgradient

O/B = Overburden

B/R = Bedrock

Bold underlined values are considered above background concentrations

* = All analytical results are from 12 December 2003 sampling event with exception of Ammoniacal Nitrogen, which is an additional data set from 25/2/04

Table 6.5: SUMMARY OF COMPOSITION OF LEACHATE FROM DIFFERENT SOURCES

PARAMETER	UNIT	TYPE OF WASTE MANAGEMENT FACILITY							
		Acetogenic Leachate ¹	Methanogenic Leachate ²	Recent Waste ³	Bioreactive Waste ⁴	Waste Licence No. 81-2 ⁵	Commercial & Industrial Wastes ⁶	Commercial & Industrial Wastes with <10% Domestic Waste ⁶	Demolition & Inert Wastes ⁶
Conductivity @ 20°C	µS/cm	16,921	11,502	n/a	n/a	13,325	n/a	n/a	n/a
Ammoniacal Nitrogen	N mg/l	922	889	790	1000	194	42	92	34
Chloride	Cl mg/l	1,805	2,074	1315	1390	1,410	98	190	373
Potassium	K mg/l	1,143	854	780	570	520	150	156	50
Sulphate	SO ₄ mg/l	676	67	n/a	n/a	309	190	525	212
Boron	B mg/l	n/a	n/a	n/a	n/a	8.09	n/a	n/a	n/a
Chromium (Total)	Cr mg/l	0.13	0.09	n/a	n/a	0.08	n/a	n/a	n/a
Toluene	mg/l	n/a	n/a	n/a	n/a	0.10	n/a	n/a	n/a

LEGEND

1. Environmental Protection Agency (2000) "Landfill Site Design Manual" - Summary of Composition of Acetogenic Leachates Sampled from Large Landfills with a Relatively Dry High Waste Input (Overall mean value)
 2. Environmental Protection Agency (2000) "Landfill Site Design Manual" - Summary of Composition of Methanogenic Leachates Sampled from Large Landfills with a Relatively Dry High Waste Input (Overall mean value)
 3. Geological Survey of Ireland (Donal Daly) "Typical Composition of Leachate from Domestic Wastes at Various Stages of Decomposition" - Recent Wastes
 4. Geological Survey of Ireland (Donal Daly) "Typical Composition of Leachate from Domestic Wastes at Various Stages of Decomposition" - Bioreactive Wastes
 5. EPA Public File - Waste Licence No. 81-2 (2002) "Environmental Report Q4 2002" - Maximum Leachate Concentrations Reported (predominantly Commercial/Industrial Wastes)
 6. Wastes Technical Division of Department of the Environment U.K. (1998) "Environmental Impacts from Landfills Accepting Non-Domestic Wastes" Overall Mean Value
- n/a = not available

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TABLE 7.3: CHEMICAL ANALYSIS OF GROUNDWATER AT WHITESTOWN SITE - EXTERNAL TO SITE (LEACHATE INDICATOR PARAMETERS)

Monitoring Well Location	UNIT	MW-1	MW-2	MW-3	MW-4	MW-5	MW04-1	MW04-2	MW04-3	Mean of values above laboratory detection limit
Presumed Screen Location		O/B	B/R	B/R	O/B	O/B	B/R	B/R	B/R	
Well location in relation to waste		U/G	U/G	U/G	U/G	U/G	U/G	U/G	U/G	
Conductivity @ 20°C	µS/cm	619	331	403	319	139	-	-	-	362
Ammoniacal Nitrogen	N mg/l	0.6	<0.2	<0.2	<0.2	<0.2	0.20	0.15	0.12	0.27
Chloride	Cl mg/l	25	14	46	6	6	-	-	-	19
Potassium	K mg/l	-	-	1.4	1	-	-	-	-	1.2
Sulphate	SO ₄ mg/l	15	9	10	13	8	-	-	-	11
Boron	B mg/l	-	-	<0.05	<0.05	-	-	-	-	<0.05
Chromium (Total)	Cr mg/l	-	-	<0.05	<0.05	-	-	-	-	<0.05

LEGEND

" - " = No data reported or no analyses conducted
 < = Less Than
 U/G = Upgradient
 D/G = Downgradient
 O/B = Overburden
 B/R = Bedrock
 Bold underlined values are considered above background concentrations
 MW03-1 - No analysis as well was dry

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TABLE 7.4: CHEMICAL ANALYSIS OF GROUNDWATER - DOWNGRAIDENT OF WASTE ZONES (LEACHATE INDICATOR PARAMETERS)

Monitoring Well Location	Unit	MW-7	MW-8	MW-9	MW03-2	MW03-3	MW04-4	MW04-5	Mean of values above laboratory detection limit
Presumed Screen Location		O/B	O/B	O/B	B/R	O/B	O/B - B/R	O/B - B/R	
Well location in relation to waste		D/G	D/G	D/G	D/G	D/G	D/G	D/G	
Conductivity @ 20°C	µS/cm	570	603	775	946	1126	-	-	804.0
Ammoniacal Nitrogen	N mg/l	<0.2	<0.2	3.8	0.4	4.5	0.13	3.90	2.5
Chloride	Cl mg/l	6	7	6	27	31	-	-	15.4
Potassium	K mg/l	-	-	1.6	2	9	-	-	4.2
Sulphate	SO ₄ mg/l	20	8	<3	23	26	-	-	19.3
Boron	B mg/l	-	-	<0.05	<0.05	<0.05	-	-	<0.05
Chromium (Total)	Cr mg/l	-	-	<0.05	<0.05	0.06	-	-	0.06

LEGEND

" - " = No data reported or no analyses conducted
 < = Less Than
 U/G = Upgradient
 D/G = Downgradient
 O/B = Overburden
 B/R = Bedrock
 Bold underlined values are considered above background concentrations
 MW03-1 - No analysis as well was dry
 Samples taken between December 2003 and February 2004

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TABLE 7.6: SUMMARY TABLE OF DATA RELATING TO THE HYDRAULIC CONDUCTIVITY OF THE UPPER SATURATED ZONE

Location	Depth (metres)	Geotesting Sample No.	D10	D10 ²	K cm/sec	K m/sec	Overburden/Bedrock	Description
Trial Pit Locations - Permeability based on Particle Size Distribution (D10²)								
TP 19B	5.0 - 6.0	BWD 07	0.21	0.0441	4.41E-02	4.41E-04	Overburden	Loose greyish brown slightly sandy GRAVEL
TP 33	0.2 - 3.8	BWD 06	0.22	0.0484	4.84E-02	4.84E-04	Overburden	Loose greyish brown slightly sandy GRAVEL
TP 39B	4.5 - 5.5	BWD 01	0.0049	0.00002401	2.40E-05	2.40E-07	Overburden	Soft greyish brown very sandy SILT
TP 59B	3.0 - 5.0	BWD 08	0.085	0.007225	7.23E-03	7.23E-05	Overburden	Loose greyish brown gravelly SAND
TP 65	2.1 - 3.1	BWD 02	0.004	0.000016	1.60E-05	1.60E-07	Overburden	Firm greenish grey SILT with organics
TP 65	3.4 - 4.1	BWD 05	0.018	0.000324	3.24E-04	3.24E-06	Overburden	Soft greyish brown slightly silty gravelly SAND
MW04-4	0 - 8.0	BWD 04	0.029	0.000841	8.41E-04	8.41E-06	Overburden	Loose brown sandy GRAVEL
MW04-5	0 - 8.2	BWD 03	0.039	0.001521	1.52E-03	1.52E-05	Overburden	Loose brown slightly gravelly SAND
MW03-1 to MW03-5 Monitoring Well Series - Permeability based on Rising Head Test (February 2004) - Screen location unknown								
					K m/min	k m/sec		
MW03-4	0	-	-	-	7.48E-03	1.25E-04	Bedrock (presumed)	Presumed bedrock due to depth & location
MW03-5	-	-	-	-	1.20E-02	2.00E-04	Bedrock (presumed)	Presumed bedrock due to depth & location
(MW 1 to MW12) Monitoring Well Series - Permeability based on Rising Head Test (February 2004) - Screen location unknown								
MW-6	-	-	-	-	6.17E-04	1.03E-05	Overburden (presumed)	Presumed overburden due to depth & location
MW-7	-	-	-	-	6.11E-04	1.02E-05	Overburden (presumed)	Presumed overburden due to depth & location
MW-8	-	-	-	-	1.22E-03	2.03E-05	Overburden (presumed)	Presumed overburden due to depth & location
MW-9	-	-	-	-	9.98E-04	1.66E-05	Overburden (presumed)	Presumed overburden due to depth & location
MW04-1 to MW04-5 Monitoring Well Series - Permeability based on Rising Head Test (February 2004) - Screen location known								
MW04-3	4.5 - 8.0 (screen)	-	-	-	5.99E-03	9.98E-05	Bedrock	Dark grey, blue green SLATE
MW04-4	4.0 - 11.0 (screen)	-	-	-	2.92E-04	4.87E-06	Overburden/ weathered bedrock	Clayey SAND/ coarse GRAVEL/ weathered SLATE

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TABLE 8.1: CHEMICAL ANALYSIS OF SURFACE WATER AT WHITESTOWN SITE - DECEMBER 2003 (FULL SUITE)

PARAMETER	UNIT	SW-1	SW-2	SW-3	Duplicate of SW-3	SW-4	SW-5
FIELD ANALYSIS							
<i>General Water Quality Parameters</i>							
Colour	-	Clear	Clear	Clear	Clear	Clear	-
Conductivity @ 20°C	µS/cm	n/a	n/a	n/a	n/a	n/a	-
Odour	-	None	None	None	None	None	-
pH	-	8.45	8.36	8.26	8.26	8.18	-
Temperature	°C	10.9	10.7	10.7	10.7	12.2	-
LABORATORY ANALYSIS							
<i>General Water Quality Parameters</i>							
BOD	O ₂ mg/l	3	3	2	<2	<2	-
COD	O ₂ mg/l	108	159	17	34	79	-
Conductivity @ 20°C	µS/cm	314	244	235	244	238	-
Dissolved Oxygen	O ₂ mg/l	7.6	7.2	7.2	7.7	7.3	-
pH	-	7.43	7.45	7.43	7.25	7.34	-
Total Alkalinity	CaCO ₃ mg/l	120	110	90	63	80	-
Total Oxidised Nitrogen	O ₂ mg/l	3.6	2.7	2.8	2.5	3.8	-
Total Suspended Solids	mg/l	<10	<10	<10	<10	12	-
Total Organic Carbon	C mg/l	20	19	18	22	20	-
<i>Inorganics</i>							
Ammoniacal Nitrogen (12/12/03)	N mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	-
Ammoniacal Nitrogen (25 /2/04) *	N mg/l	0.11	0.09	0.09	-	0.12	0.16
Nitrate	NO ₃ mg/l	15.3	11.5	12	10.5	12	-
Nitrite	NO ₂ mg/l	0.2	0.25	0.27	0.23	0.27	-
Calcium	Ca mg/l	40.3	29.2	32.2	32.0	32.7	-
Chloride	Cl mg/l	12	12	11	11	11	-
Fluoride	F mg/l	<0.1	<0.1	<0.1	<0.1	<0.1	-
Potassium	K mg/l	2.8	2.6	2.6	2.6	2.2	-
Sodium	Na mg/l	8.3	7.5	7.3	7.3	7.5	-
Sulphate	SO ₄ mg/l	14	13	13	12	16	-
Phosphorous	P mg/l	0.07	0.16	<0.05	<0.05	0.12	-
Total Orthophosphate	PO ₄ mg/l	0.12	0.11	0.17	0.76	0.36	-
<i>Metals</i>							
Boron	B mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	-
Cadmium	Cd mg/l	<0.0004	<0.0004	<0.0004	<0.0004	<0.0004	-
Chromium (Total)	Cr mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	-
Copper	Cu mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	-
Iron	Fe mg/l	0.038	0.07	0.068	0.082	0.059	-
Lead	Pb mg/l	<0.005	<0.005	<0.005	<0.005	<0.005	-
Magnesium	Mg mg/l	3.72	3.12	3.23	3.29	3.32	-
Manganese	Mn mg/l	0.003	<0.001	<0.001	<0.001	0.003	-
Mercury	Hg mg/l	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	-
Nickel	Ni mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	-
Zinc	Zn mg/l	0.01	0.006	0.006	0.006	<0.005	-
<i>Hydrocarbons</i>							
Diesel Range Organics	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	-
Mineral Oil	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	-
Petrol Range Organics (C5-C9)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	-
Petrol Range Organics (C10+)	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	-
Benzene	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	-
Toluene	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	-
Ethylbenzene	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	-
Total Xylene	mg/l	<0.01	<0.01	<0.01	<0.01	<0.01	-
<i>Organics - List I/II</i>							
VOC's	mg/l	all <0.001	-	all <0.001	-	-	-
Semi VOC's	mg/l	all <0.001	-	all <0.001	-	-	-
Pesticides	mg/l	all <0.00001	-	all <0.00001	-	-	-
<i>Bacteriological Parameters</i>							
Faecal Coliforms	no. /100 ml	832	858	728	1170	917	-
Total Coliforms	no. /100 ml	24000	14000	20000	10000	17000	-
Faecal Streptococci	no. /100 ml	2184	-	2028	-	-	-
Total Viable Count @ 22C	no. /100 ml	7890	-	5360	-	-	-
Total Viable Count @ 37C	no. /100 ml	2560	-	1800	-	-	-

LEGEND

" - " = No data reported or no analyses conducted

< = Less Than

Bold underlined values are considered above background concentrations

* = All analytical results are from 12 December 2003 sampling event with exception of Ammoniacal Nitrogen, which is an additional data set from 25/2/04

TABLE 8.2: CHEMICAL ANALYSIS OF SURFACE WATER AT WHITESTOWN SITE - DECEMBER 2003 (LEACHATE INDICATOR PARAMETERS)

PARAMETER	UNIT	SW-1	SW-2	SW-3	SW-4	SW-5	Mean of Values Above Detection Limit
Conductivity @ 20°C	µS/cm	314	244	235	238	-	258
Ammoniacal Nitrogen (12/12/03)	N mg/l	<0.2	<0.2	<0.2	<0.2	-	<0.2
Ammoniacal Nitrogen (25/2/04)*	N mg/l	0.11	0.09	0.09	-	0.12	0.10
Chloride	Cl mg/l	12	12	11	11	-	12
Potassium	K mg/l	2.8	2.6	2.6	2.2	-	3
Sulphate	SO ₄ mg/l	14	13	13	16	-	14
Boron	B mg/l	<0.05	<0.05	<0.05	<0.05	-	<0.05
Chromium (Total)	Cr mg/l	<0.05	<0.05	<0.05	<0.05	-	<0.05

LEGEND

" - " = No data reported or no analyses conducted

< = Less Than

Bold underlined values are considered above background concentrations

* = All analytical results are from 12 December 2003 sampling event with exception of Ammoniacal Nitrogen, which is an additional data set from 25/2/04

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TABLE 9.1 LANDFILL GAS MONITORING RESULTS FROM WHITESTOWN SITE (SEPTEMBER 2003 - FEBRUARY 2004)

Sample Station	GPS Coordinate/Location	CH ₄ (%)			CO ₂ (%)			O ₂ (%)		
		2-Sep-03	19-Dec-03	20-Feb-03	2-Sep-03	19-Dec-03	20-Feb-03	2-Sep-03	19-Dec-03	20-Feb-03
		EPA	ERML	ERML	EPA	ERML	ERML	EPA	ERML	ERML
MW-03-1	n/a	n/a	0.0	<u>10.9</u>	n/a	0.0	14.4	n/a	20.9	0.4
MW-03-2	n/a	n/a	0.0	0	n/a	0.1	0	n/a	20.9	21.6
MW-03-3	n/a	n/a	0.0	<u>11.5</u>	n/a	0.0	19.3	n/a	20.8	32767
MW-03-4	n/a	n/a	0.0	0	n/a	0.0	0	n/a	20.7	21.2
MW-03-5	n/a	n/a	0.0	0	n/a	0.0	0	n/a	20.9	21.5
MW-1	n/a	n/a	0.0	0	n/a	0.2	0	n/a	20.7	21
MW-2	n/a	0.0	0.0	0	1.0	0.0	0.1	20.1	20.9	21
MW-3	n/a	n/a	0.0	0	n/a	0.1	0	n/a	20.8	21.2
MW-4	n/a	n/a	0.0	0	n/a	0.2	0.1	n/a	20.4	22
MW-5	n/a	0.0	0.0	0	1.6	0.2	0	19.6	20.4	21.9
MW-6	n/a	0.0	0.0	0	0.3	0.2	0	20.7	20.5	22
MW-7	n/a	0.0	0.0	0	0.5	0.0	0	20.5	20.7	21.8
MW-8	n/a	0.0	0.0	0	1.5	0.0	0	19.7	21.1	21.9
MW-9	n/a	0.0	0.0	0	0.3	0.3	0.4	20.7	20.8	21.5
MW-10	n/a	n/a	0.0	0	n/a	0.0	0	n/a	20.9	21.7
MW-11	n/a	0.0	0.0	0	0.6	0.0	0	20.0	20.8	21.3
MW-12 (EPA Unnamed Borehole 2)	n/a	<u>4.7</u>	0.0	0	3.9	0.5	0	1.6	20.0	21.5
MW-04-1	n/a	n/a	n/a	0	n/a	n/a	0.2	n/a	n/a	21.2
MW04-1	n/a	n/a	n/a	0	n/a	n/a	1	n/a	n/a	21
MW04-3	n/a	n/a	n/a	0	n/a	n/a	0	n/a	n/a	21.6
MW04-4	n/a	n/a	n/a	0	n/a	n/a	7.5	n/a	n/a	10.5
MW04-5	n/a	n/a	n/a	0	n/a	n/a	0	n/a	n/a	21.9
Unnamed Borehole 1	n/a	0.0	n/a	n/a	1.6	n/a	n/a	19.4	n/a	n/a
Spike 1 (Waste Zone B)	291255E 195205N	<u>24.4</u>	n/a	n/a	23.0	n/a	n/a	6.2	n/a	n/a
Spike 2 (Waste Zone C)	291285E 195410N	<u>17.3</u>	n/a	n/a	16.3	n/a	n/a	10.8	n/a	n/a
Spike 3 (Waste Zone A)	291385E 195525N	<u>27.2</u>	n/a	n/a	27.2	n/a	n/a	0.0	n/a	n/a
Spike 4 (Waste Zone A)	TP-9	n/a	n/a	<u>28.5</u>	n/a	n/a	23.9	n/a	n/a	0

Legend

EPA sampled 2 September 2003 - ca. 1009 millibars pressure
 ERML Sampled 19 December 2003 - ca. 995 millibars atmospheric pressure
 ERML Sampled 20 January 2004 - ca. 1000 millibars atmospheric pressure
 n/a = not available
 Elevated Methane concentrations are highlighted and underlined

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TABLE 10.1: GROUNDWATER/SURFACE WATER IMPACT ASSESSMENT MODEL (ERM March 2004)

1 Data										
Description of Groundwater Recharge Zone	Area (m ²)	Assumed Recharge Rate (m/year)	Q (m ³ /day)	Symbol	Ammoniacal Nitrogen	Chloride	Potassium	Sulphate	Boron	Chromium
Catchment External to Site	534,000	0.206	301	0.27	19	1.2	11	0.05	0.05	0.05
Site Area excluding areas of waste	116,000	0.800	254	0.27	19	1.2	11	0.05	0.05	0.05
Surface area of existing waste ('Worse Case Scenario')	30,000	0.400	33	C (assumed)	180	1,700	180	300	8	0.1
Total groundwater catchment incorporating site discharging to Carrigower River	680,000	589								
2 Groundwater Discharge - Mass Flux Computation										
Flux kg/day										
Catchment External to Site	0.081	5.726	0.362	3.315	0.015	0.015	0.015	0.015	0.015	0.015
Site Area excluding areas of waste	0.069	4.831	0.305	2.797	0.013	0.013	0.013	0.013	0.013	0.013
Surface area of existing waste ('Worse Case Scenario')	5.918	55.890	5.918	9.863	0.263	0.263	0.263	0.263	0.263	0.003
Total groundwater catchment incorporating site discharging to Carrigower River (sum)	6.068	66.447	6.585	15.975	0.291	0.291	0.291	0.291	0.291	0.031
3 Surface Water Impact Calculation										
Units										
Value										
Mass Flux - Catchment of Carrigower upstream of site	ha	5832								
Area	ha	5832								
95 Percentile at Station No. 12028	m ³ /day	30,240								
Area of gauged catchment at Station No. 12028	ha	5,300								
Factor		0.912								
Inferred 95 Percentile Flow in Carrigower at site	m ³ /day	27,570								
C _e for various parameters in river	mg/l		0.1	12	3	14	0.05	0.05	0.05	0.05
Mass Flux for 95 percentile flow (Mo)	kg/day		2.76	330.84	82.71	385.98	1.38	1.38	1.38	1.38
Mass Flux from groundwater flowing beneath site	kg/day		6.068	66.447	6.585	15.975	0.291	0.291	0.291	0.031
Mass Flux in Carrigower river Immediately downgradient of site	kg/day		8.82	397.28	89.29	401.95	1.67	1.67	1.67	1.41
3.4 Predicted Concentrations of Indicator Parameters in Carrigower River										
Catchment Area	ha.	4,900								
95 Percentile Flow in Carrigower	m ³ /day	28,158								
C1 Concentration	%		0.31	14.11	3.17	14.27	0.06	0.06	0.06	0.05
Percent Increase over Baseline	%		213.4	17.6	5.7	2.0	18.6	0.1	0.1	0.1

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