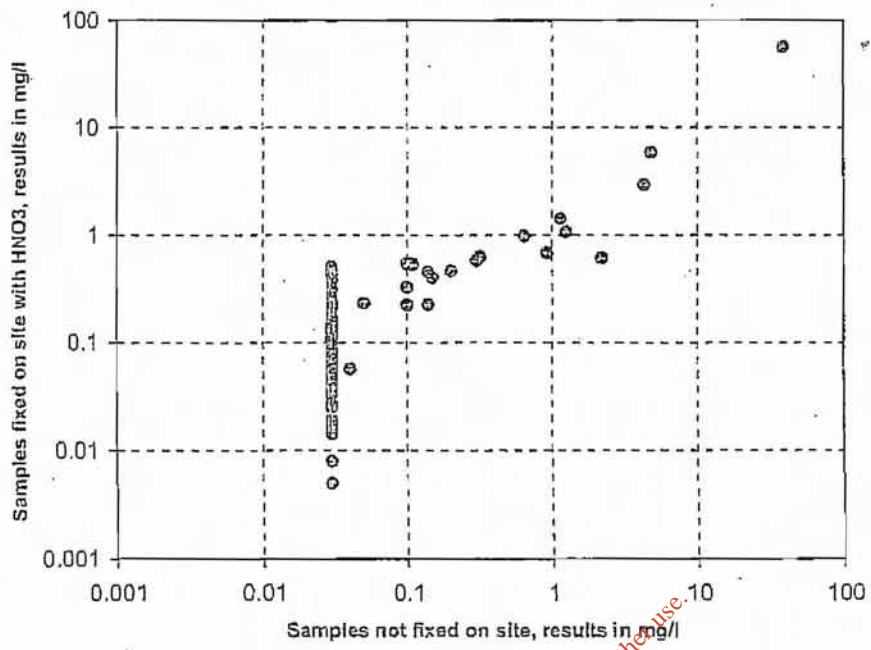
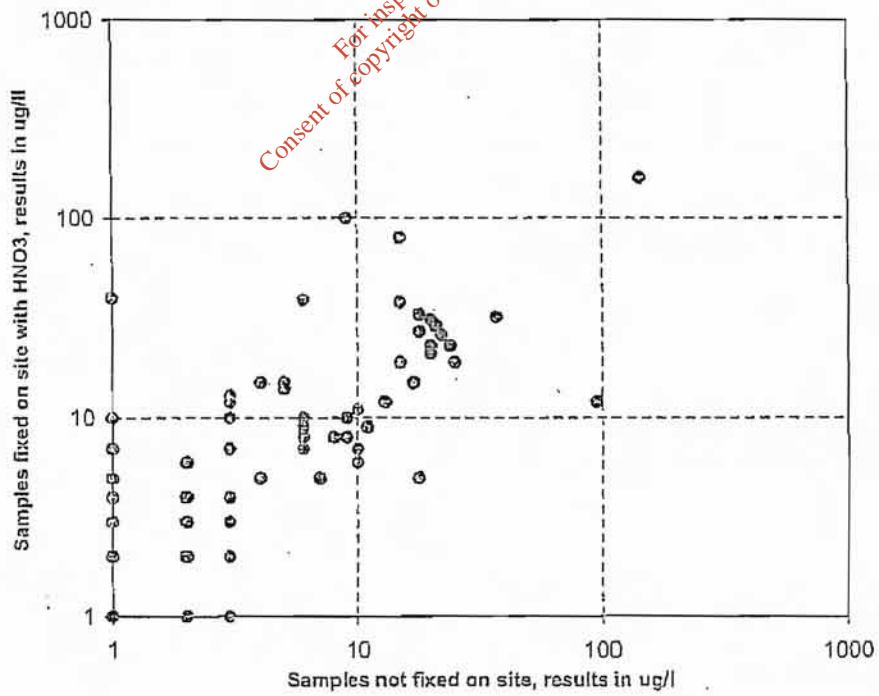


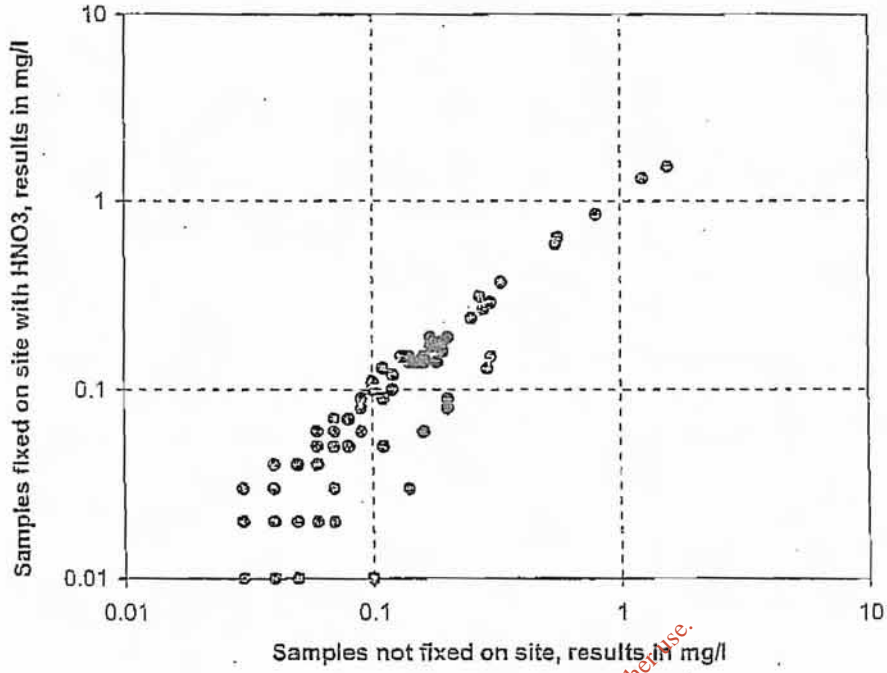
Comparison of zinc in raw and treated leachates



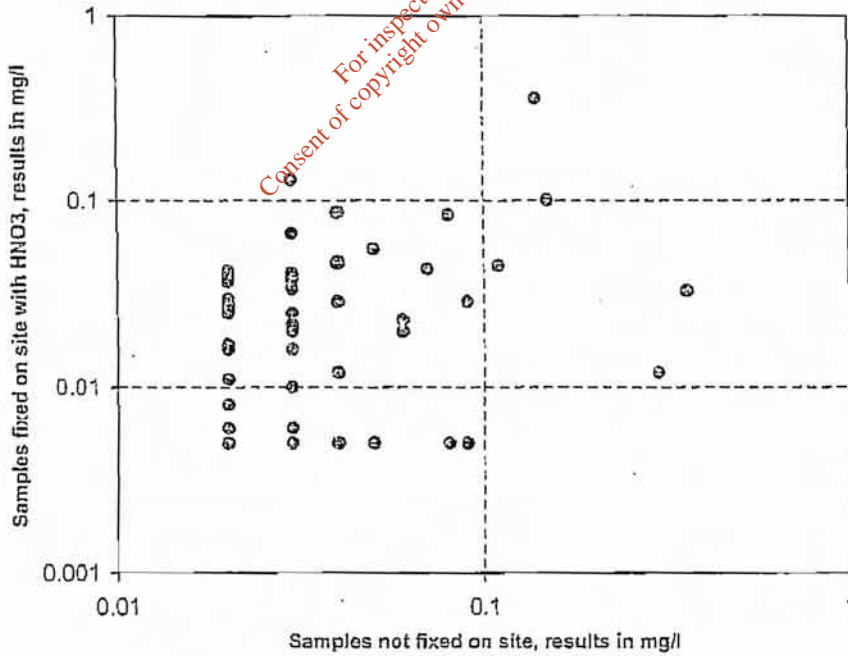
Comparison of arsenic in raw and treated leachates, SAC vs. STL;
(SAC samples fixed with HCl)



Comparison of nickel in raw and treated leachates

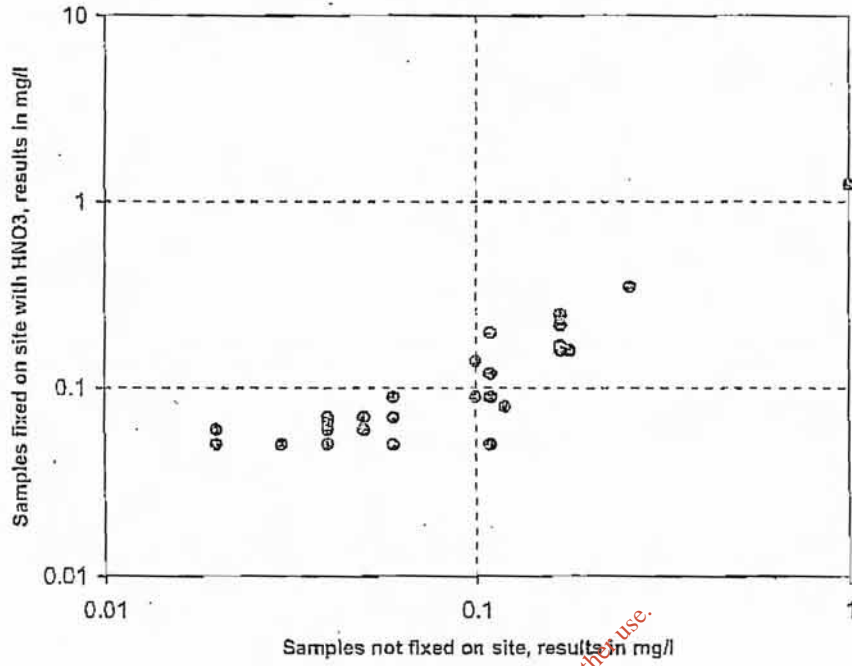


Comparison of copper in raw and treated leachates, SAC vs. STL;
(SAC samples fixed with HCl)

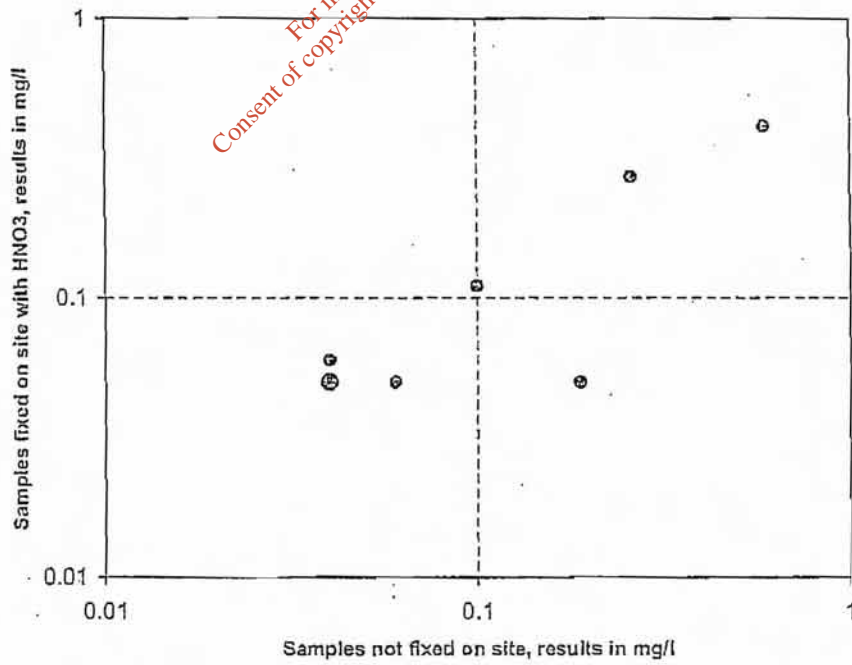


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Comparison of chromium in raw and treated leachates, SAC vs. STL;
(SAC samples fixed with HCl)



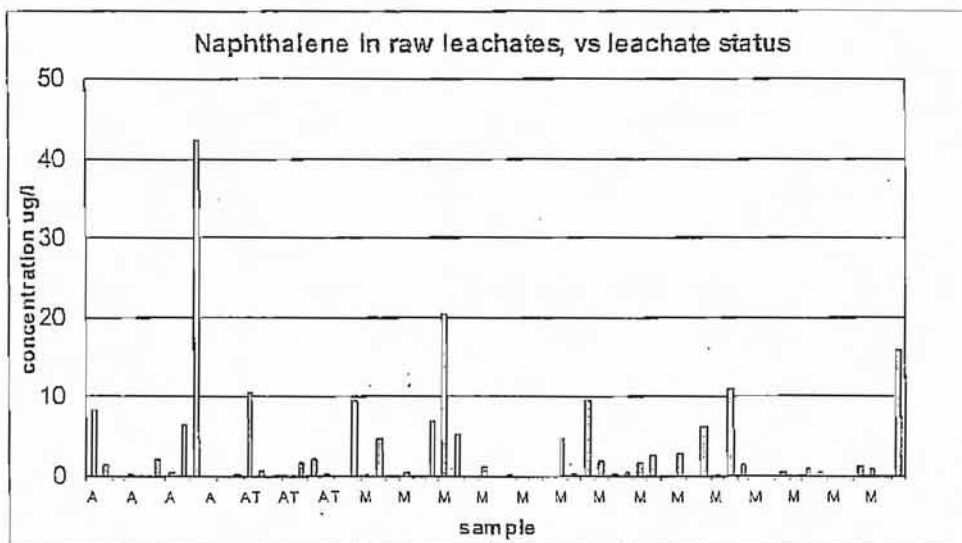
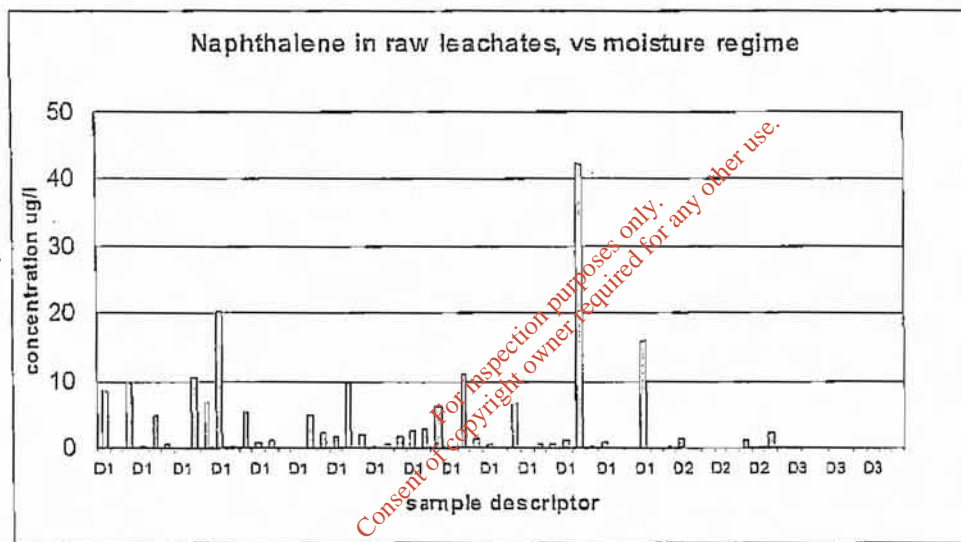
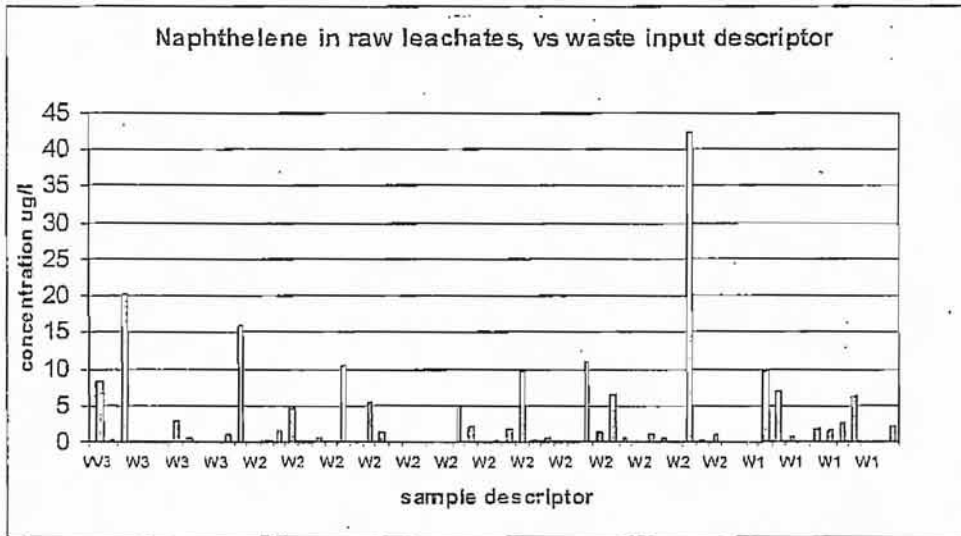
Comparison of lead in raw and treated leachates, SAC vs. STL;
(SAC samples fixed with HCl)

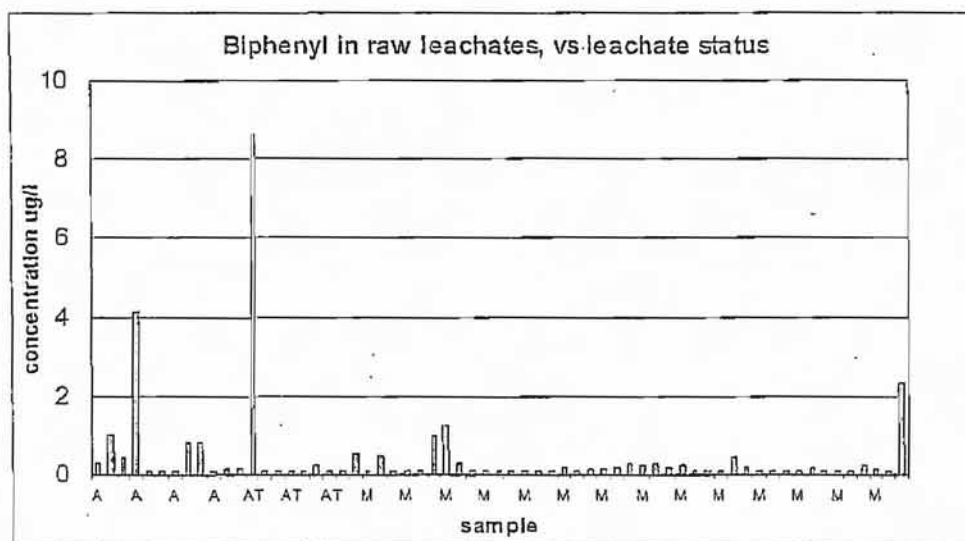
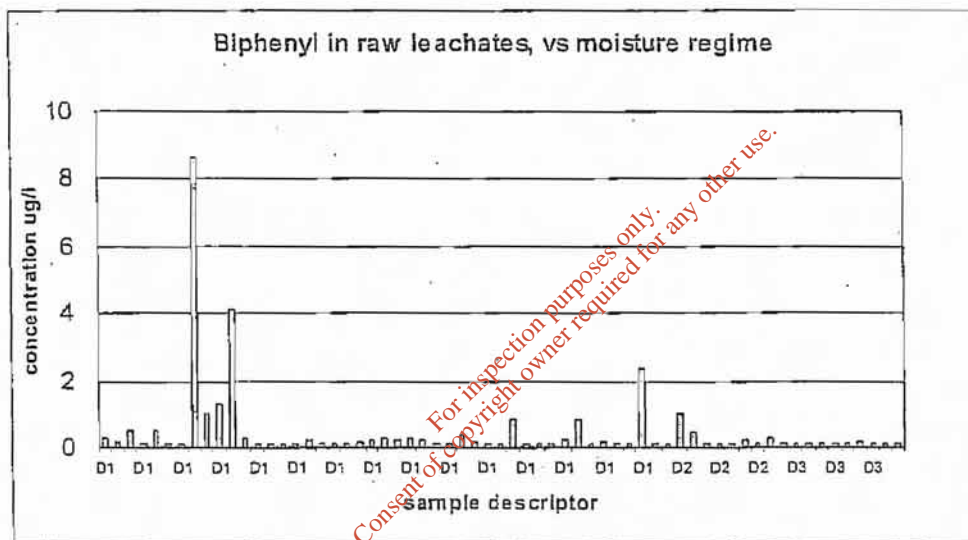
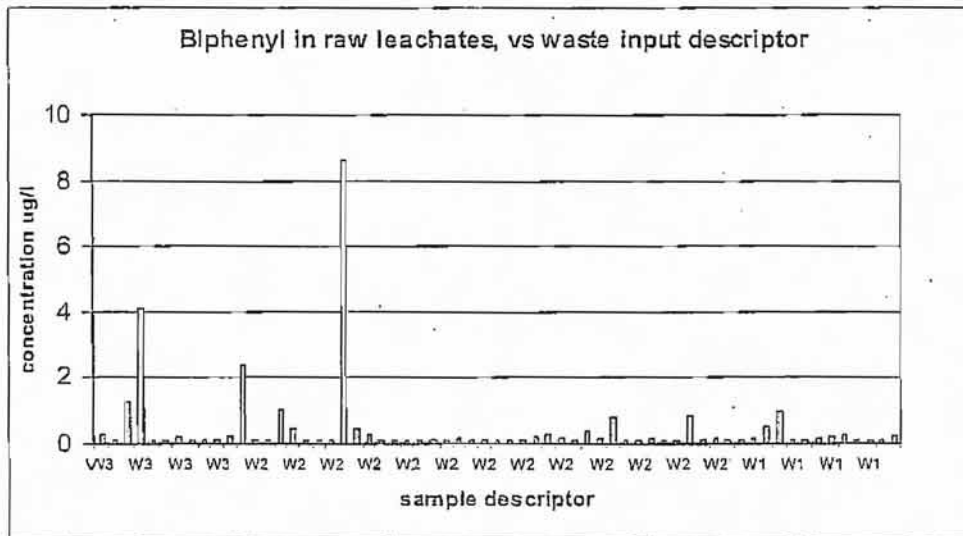


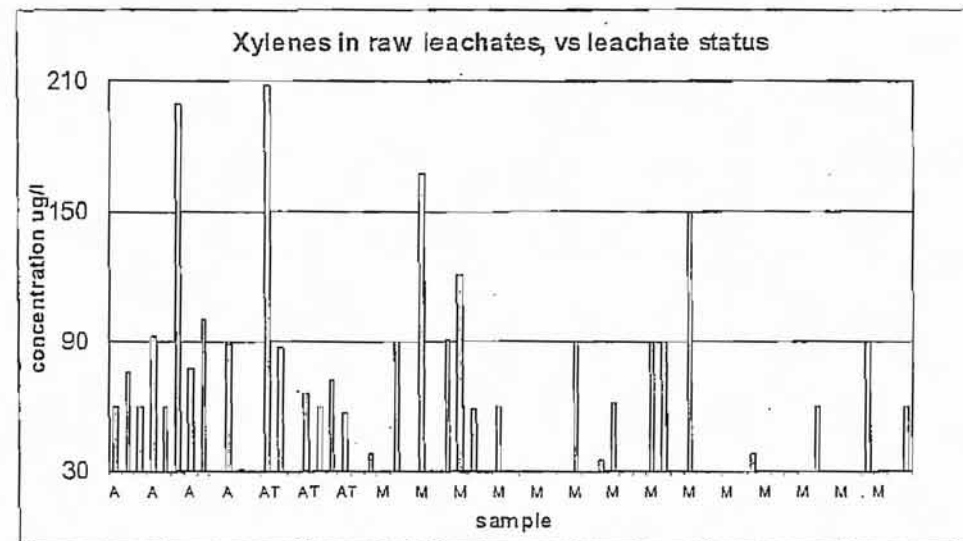
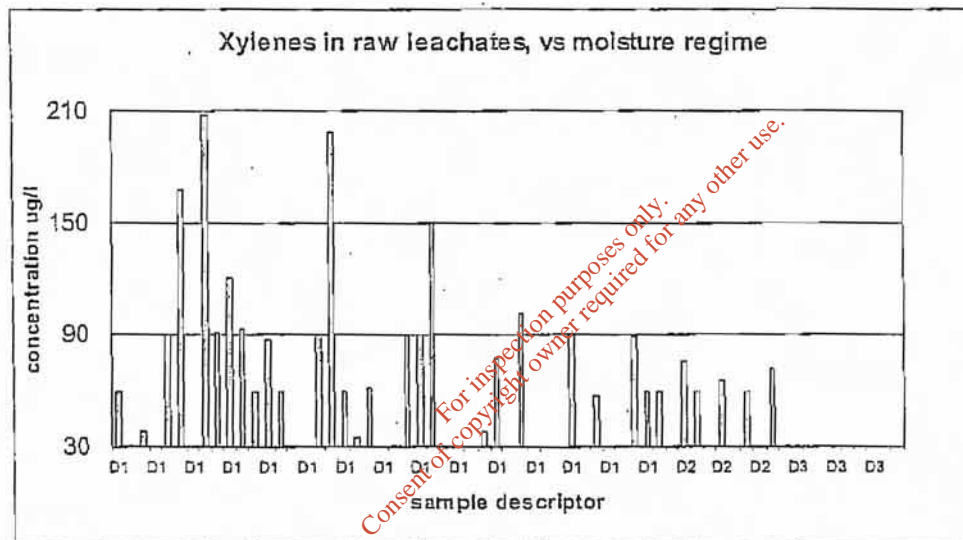
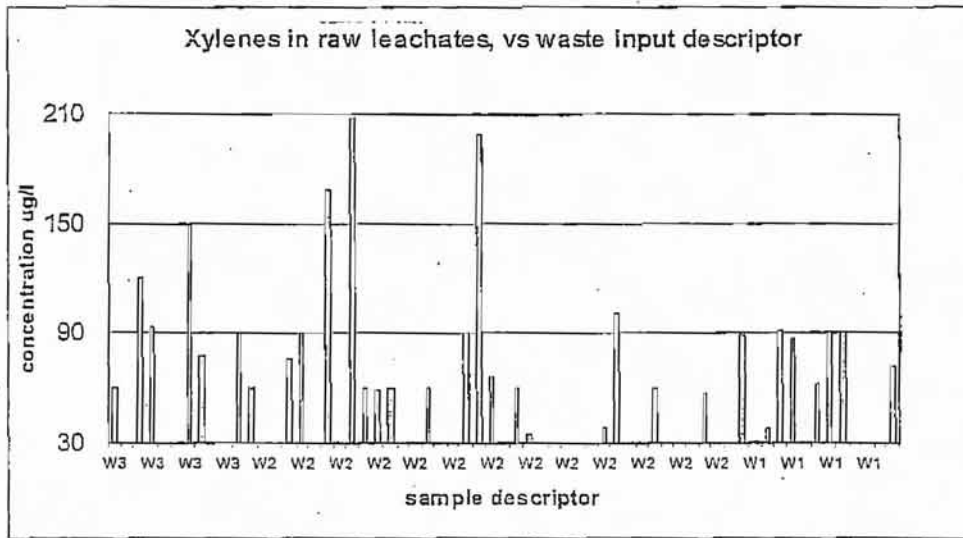
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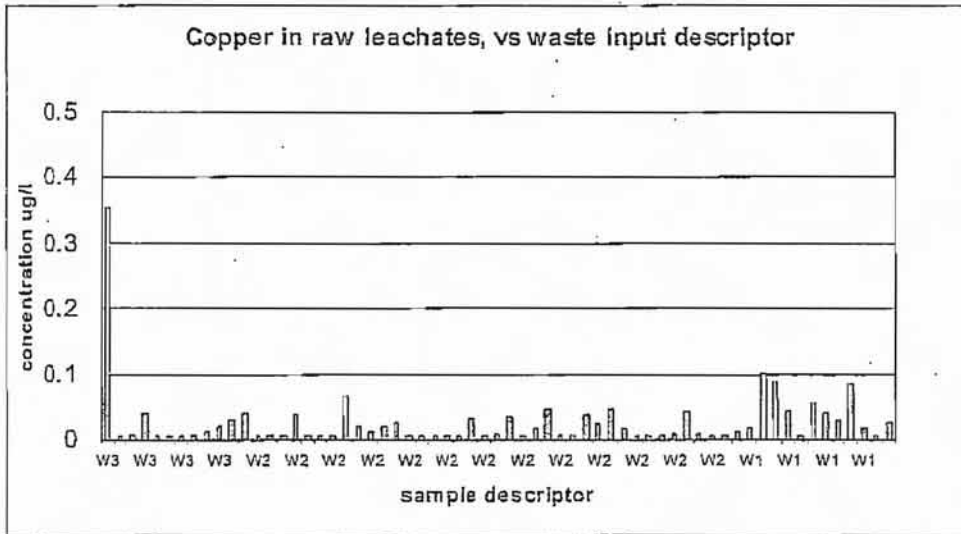
Appendix 4. Bar charts showing concentrations of 12 substances against landfill/leachate descriptors

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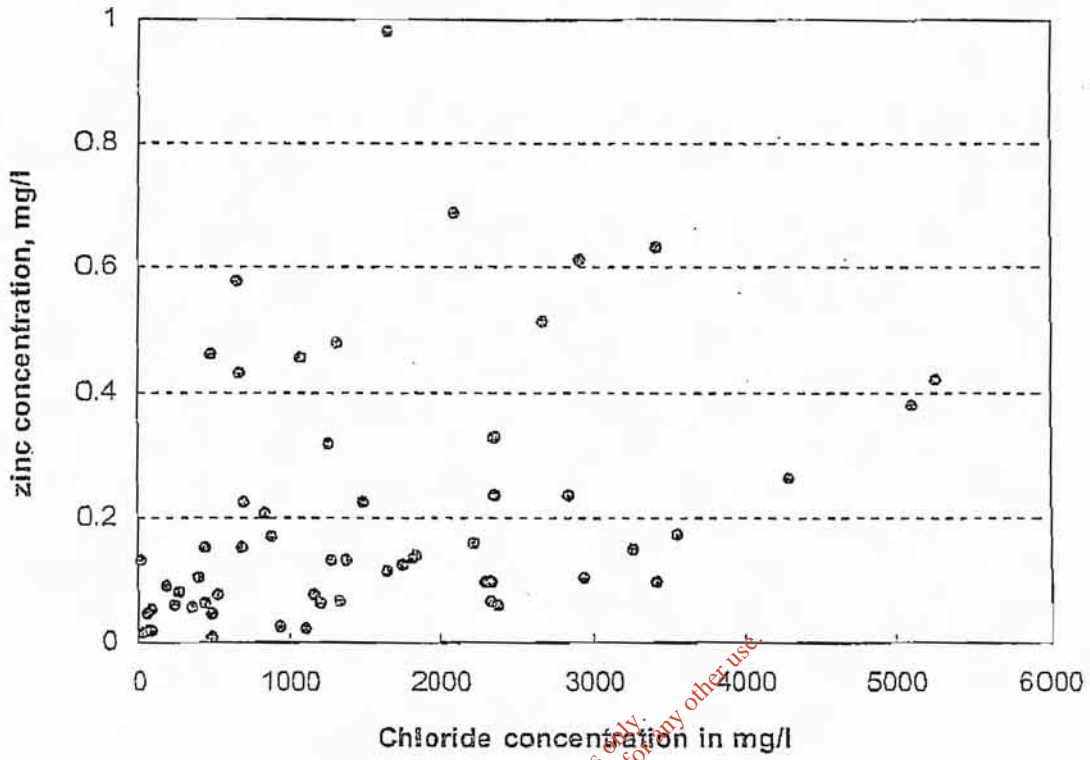




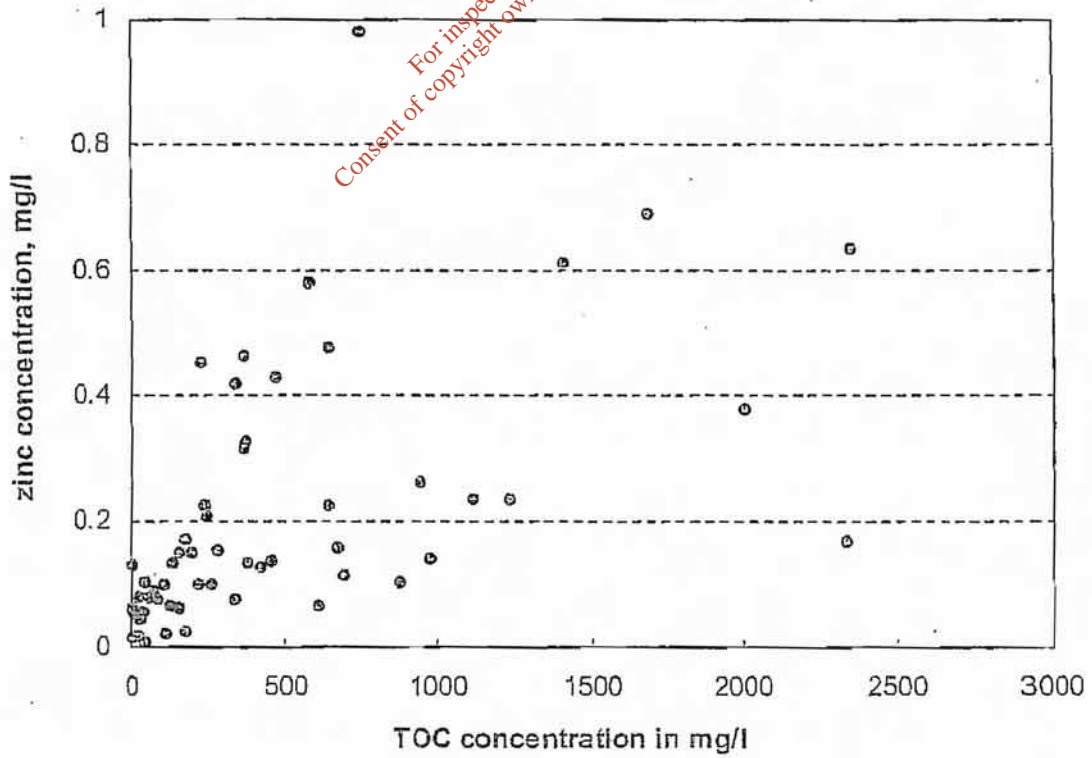
Appendix 5. Scatter graphs showing concentrations of 12 substances against chloride and TOC concentration

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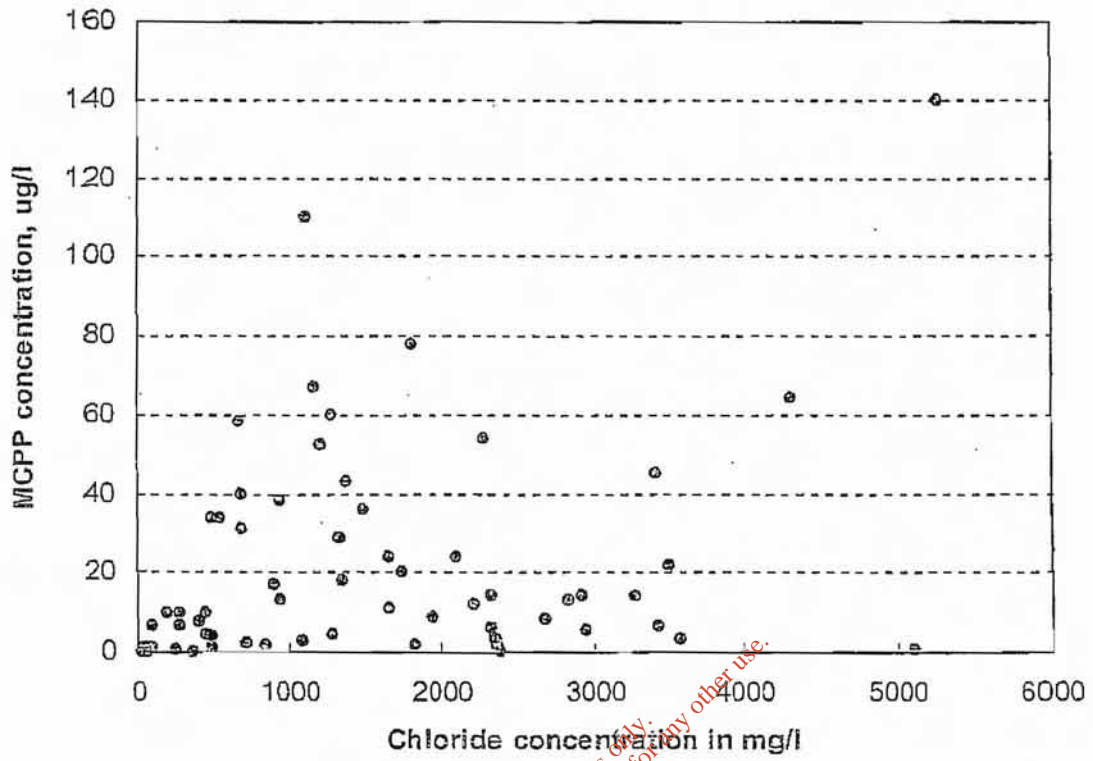
Zinc in raw leachates, vs leachate chloride



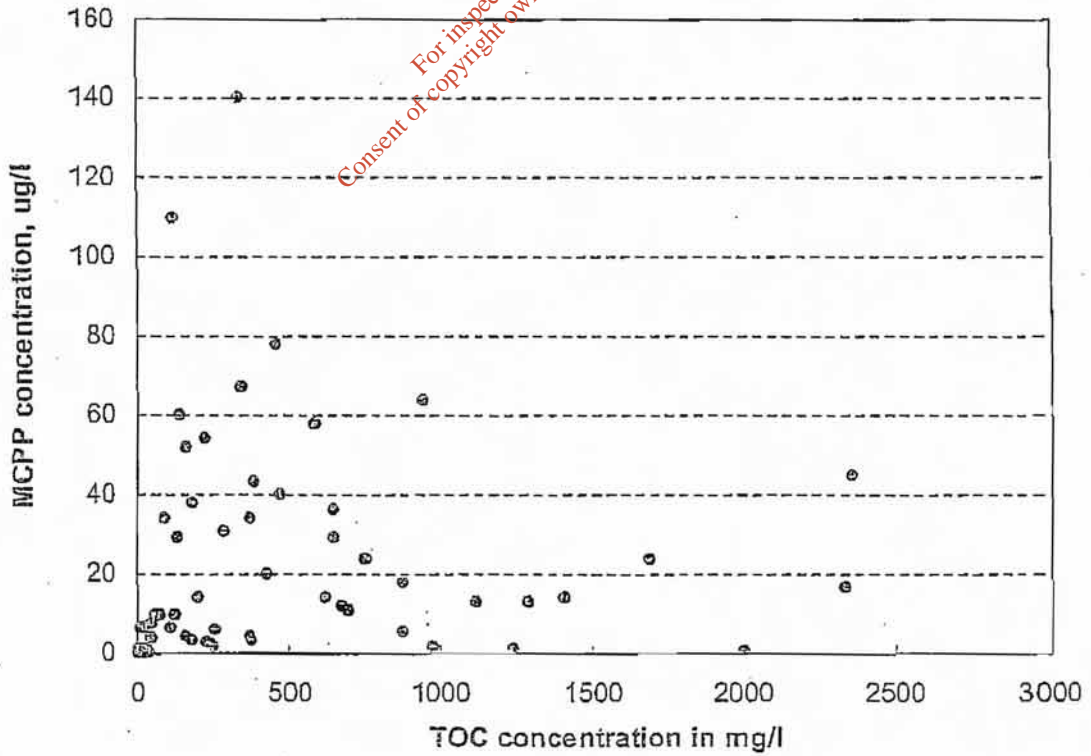
Zinc in raw leachates, vs leachate TOC



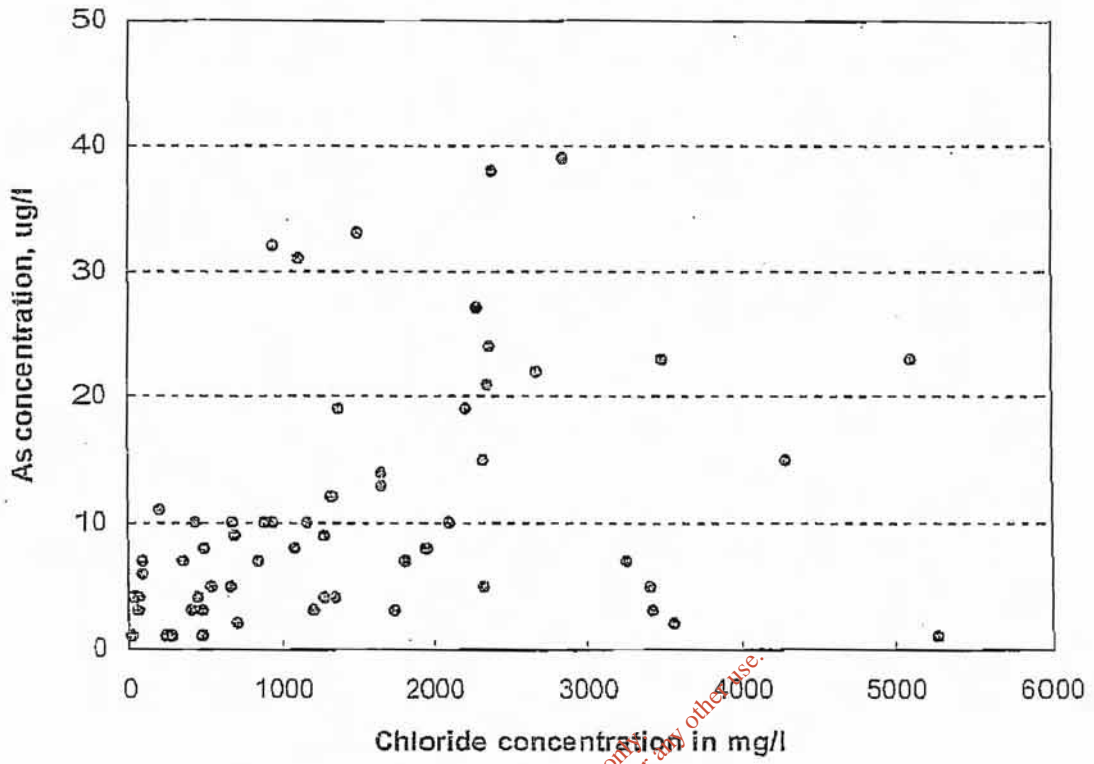
Mecoprop in raw leachates, vs leachate chloride



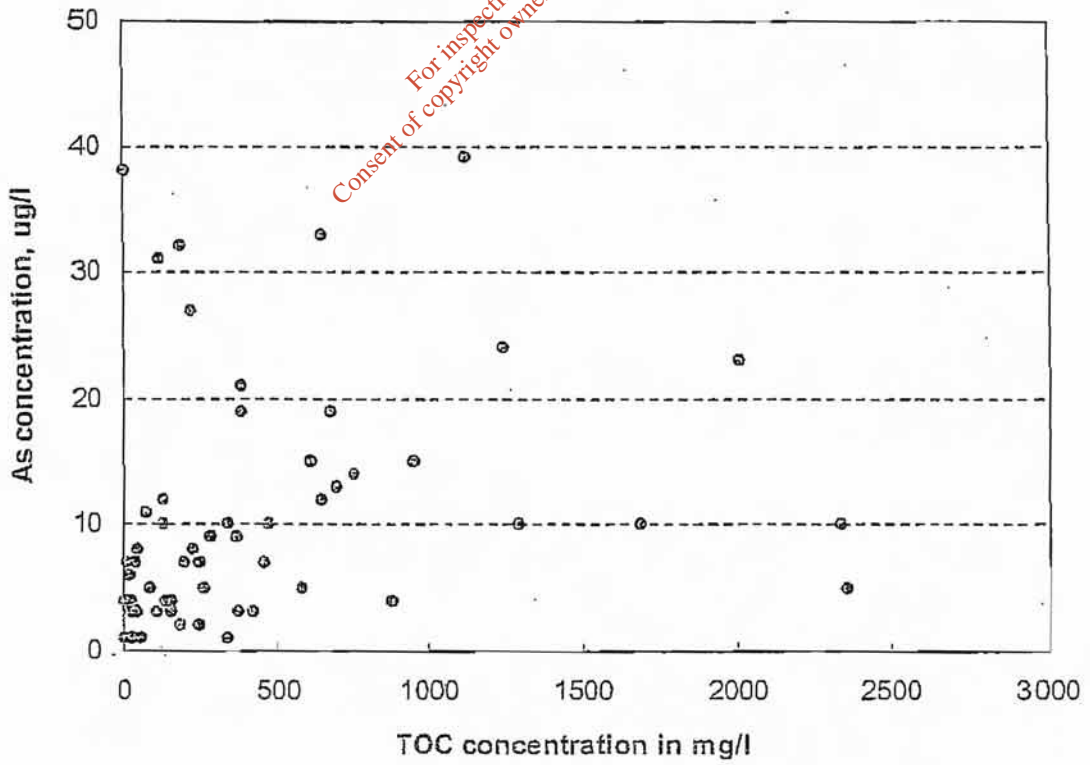
Mecoprop in raw leachates, vs leachate TOC



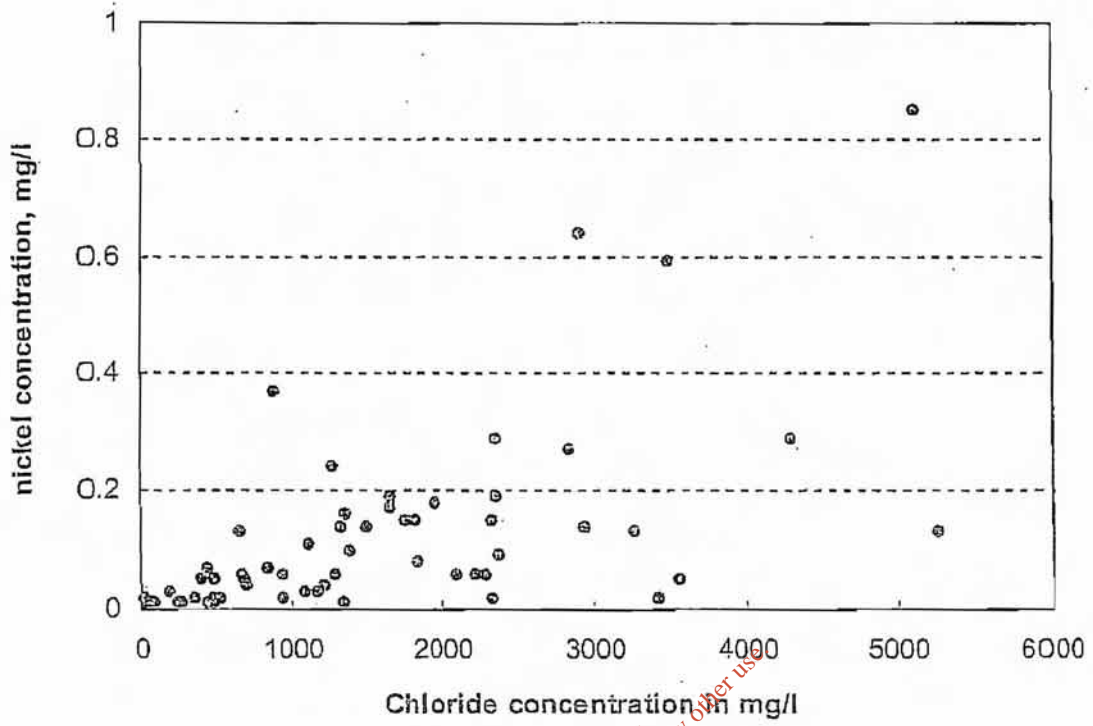
Arsenic in raw leachates, vs leachate chloride



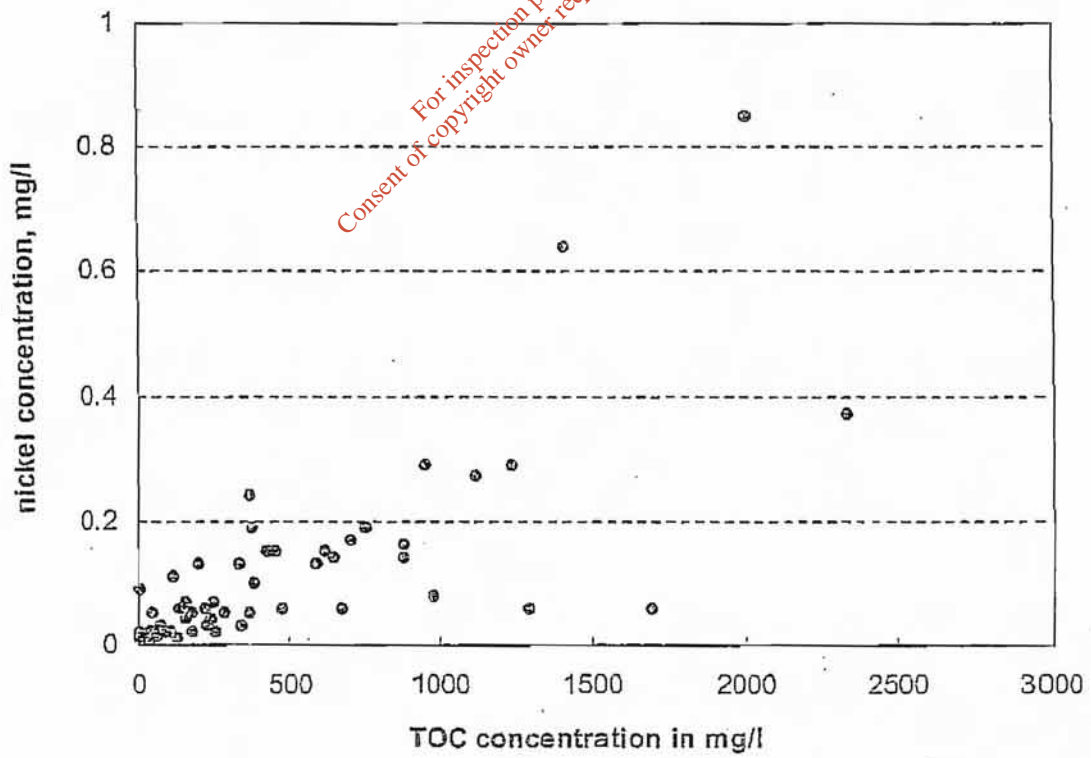
Arsenic in raw leachates, vs leachate TOC



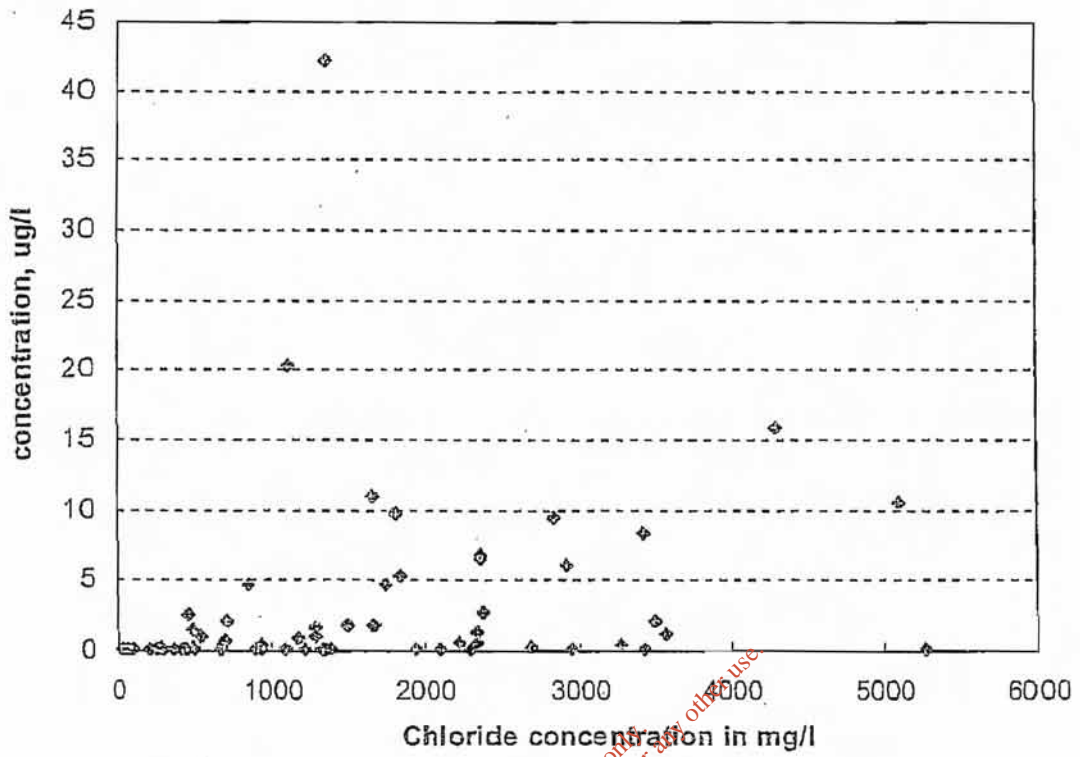
Nickel in raw leachates, vs leachate chloride



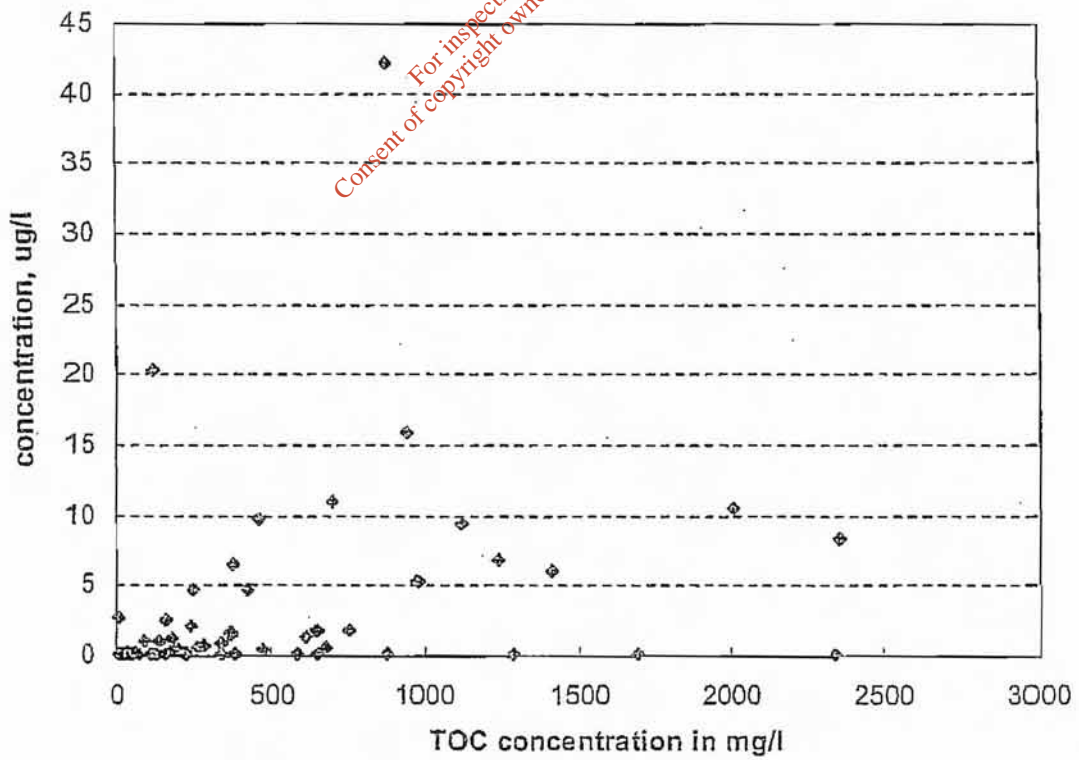
Nickel in raw leachates vs leachate TOC



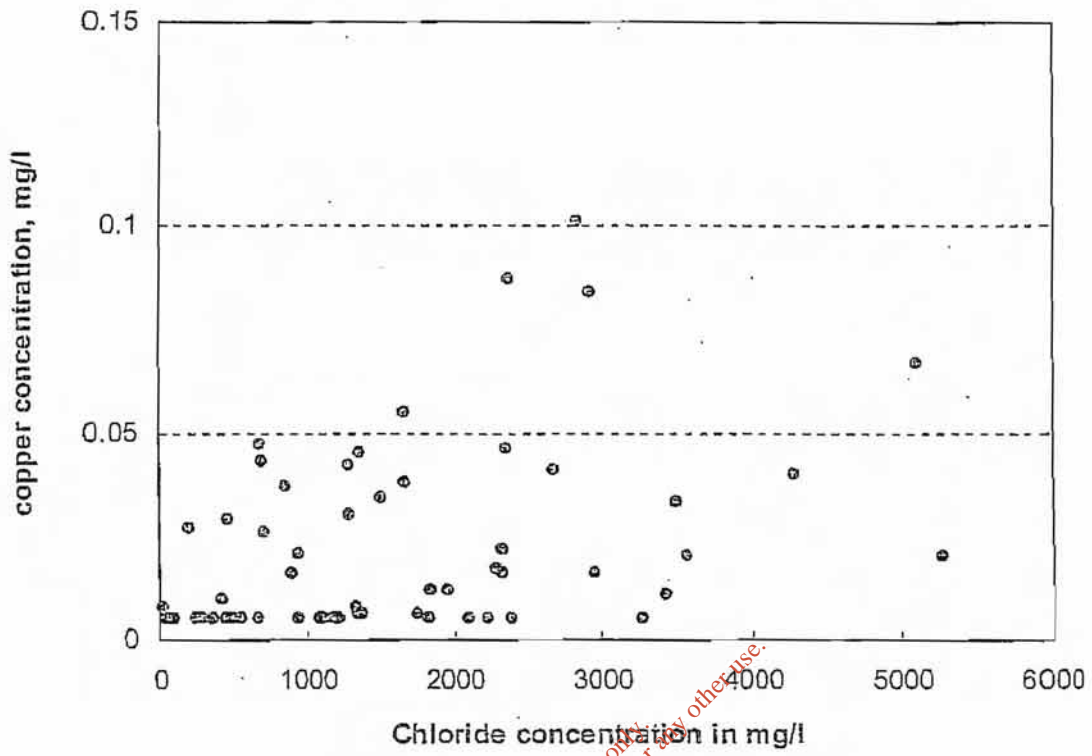
Naphthalenē in raw leachates, vs leachate chloride



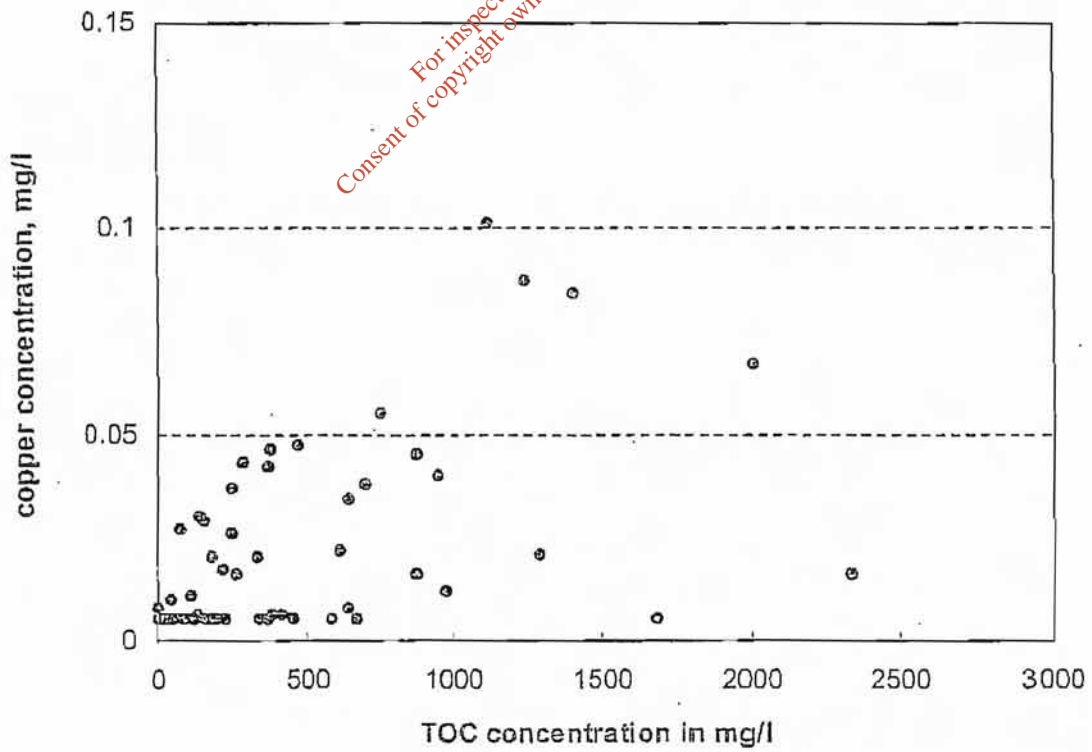
Naphthalene in raw leachates, vs leachate TOC



Copper in raw leachates, vs leachate chloride

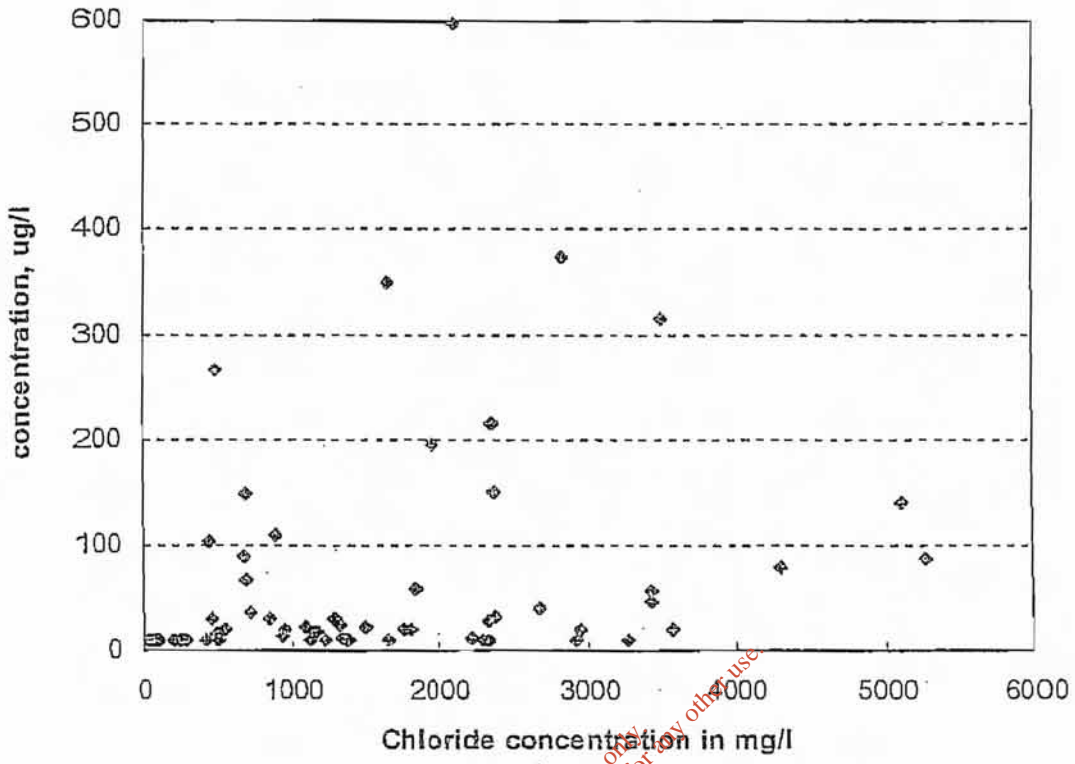


Copper in raw leachates, vs leachate TOC

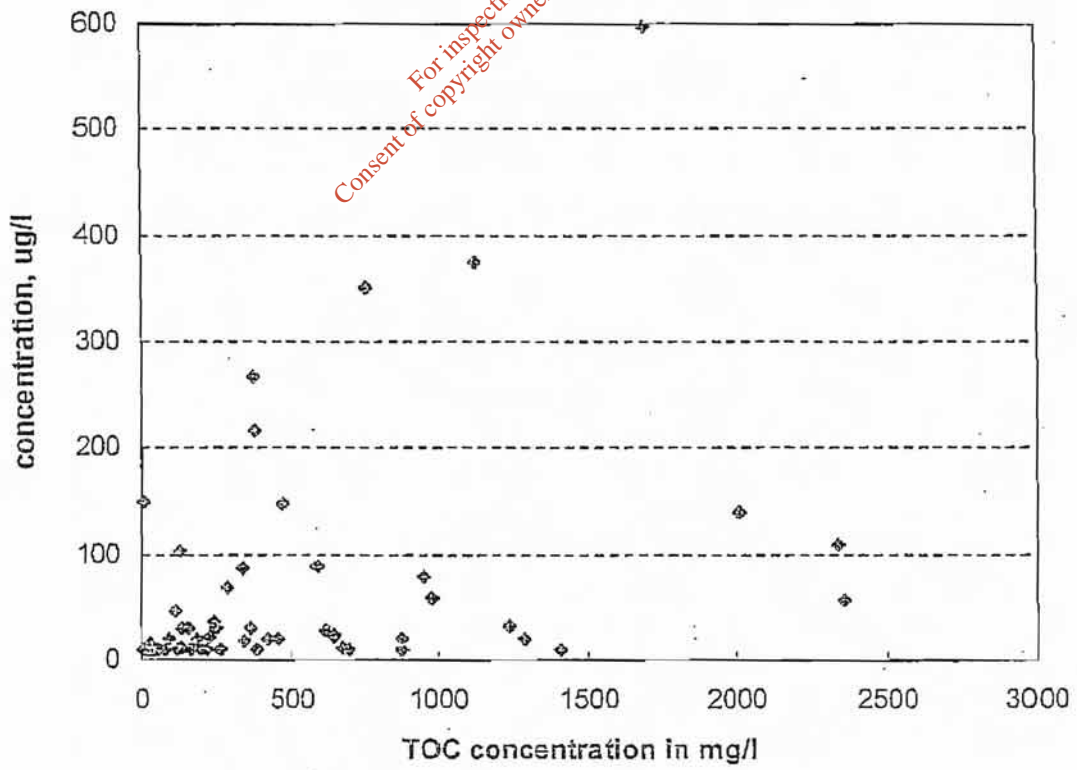


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Toluene in raw leachates, vs leachate chloride

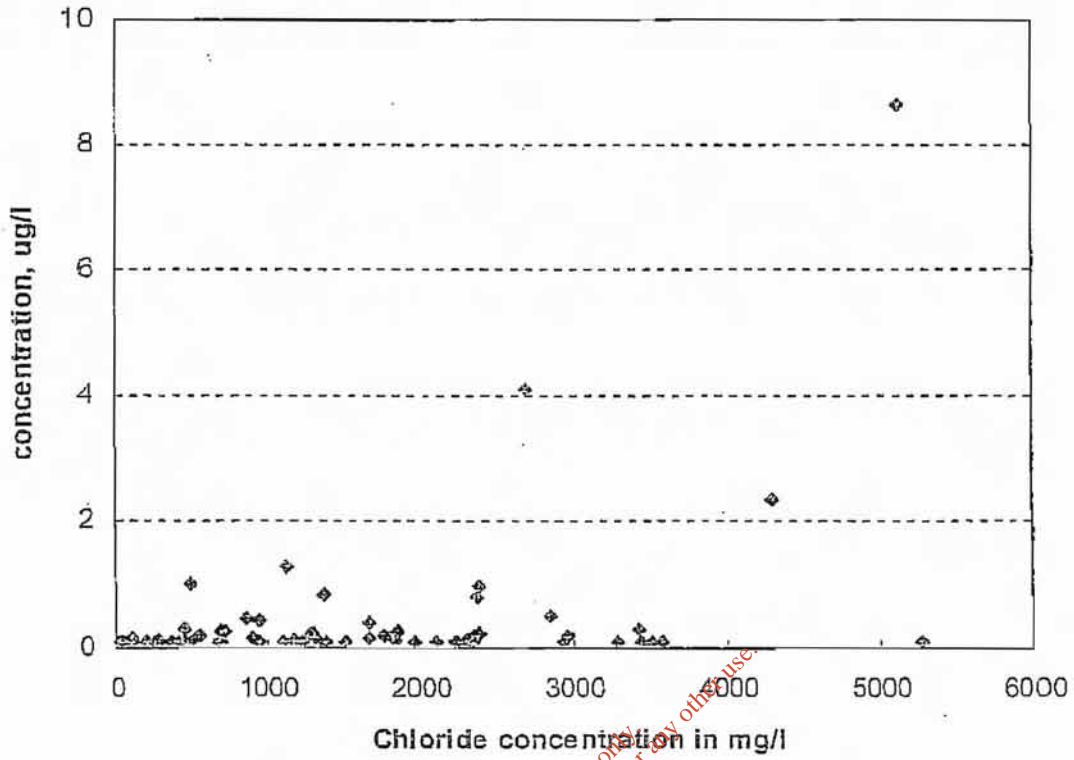


Toluene in raw leachates, vs leachate TOC

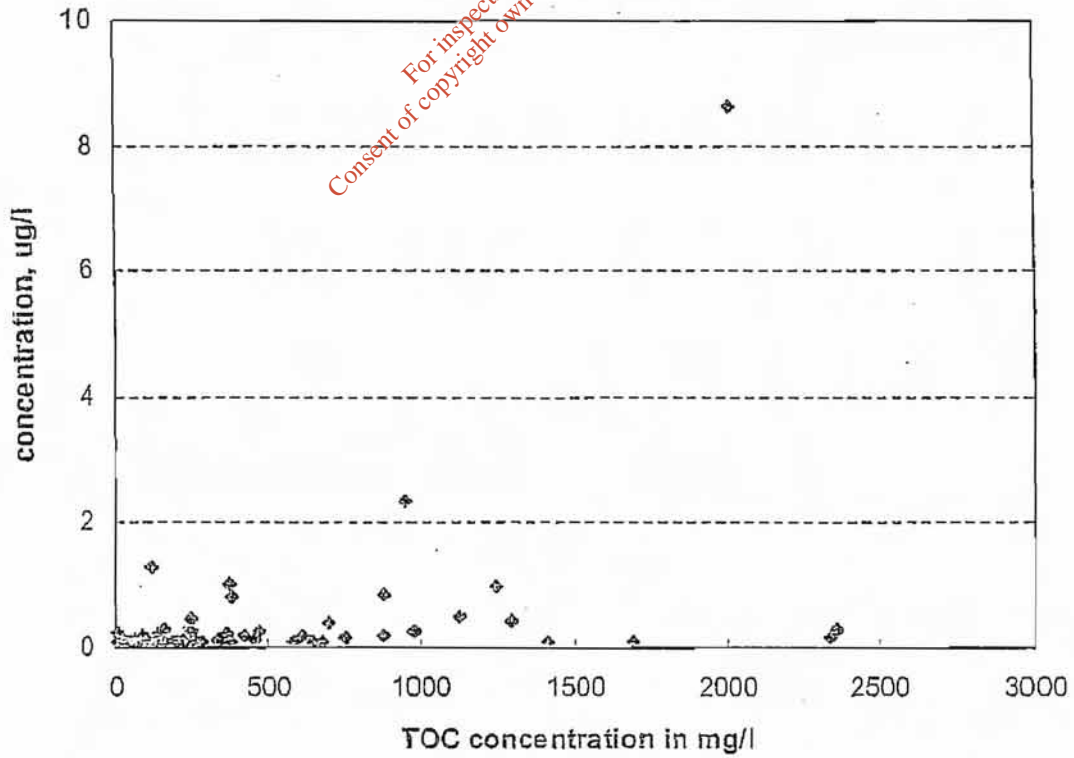


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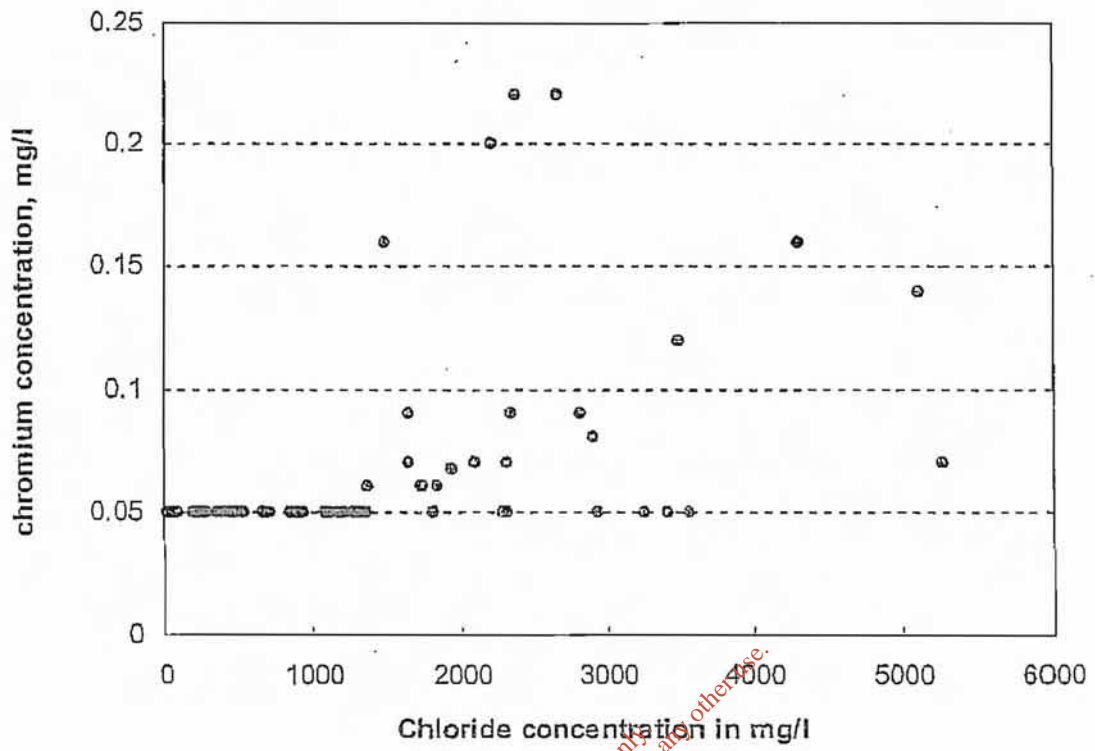
Biphenyl in raw leachates, vs leachate chloride



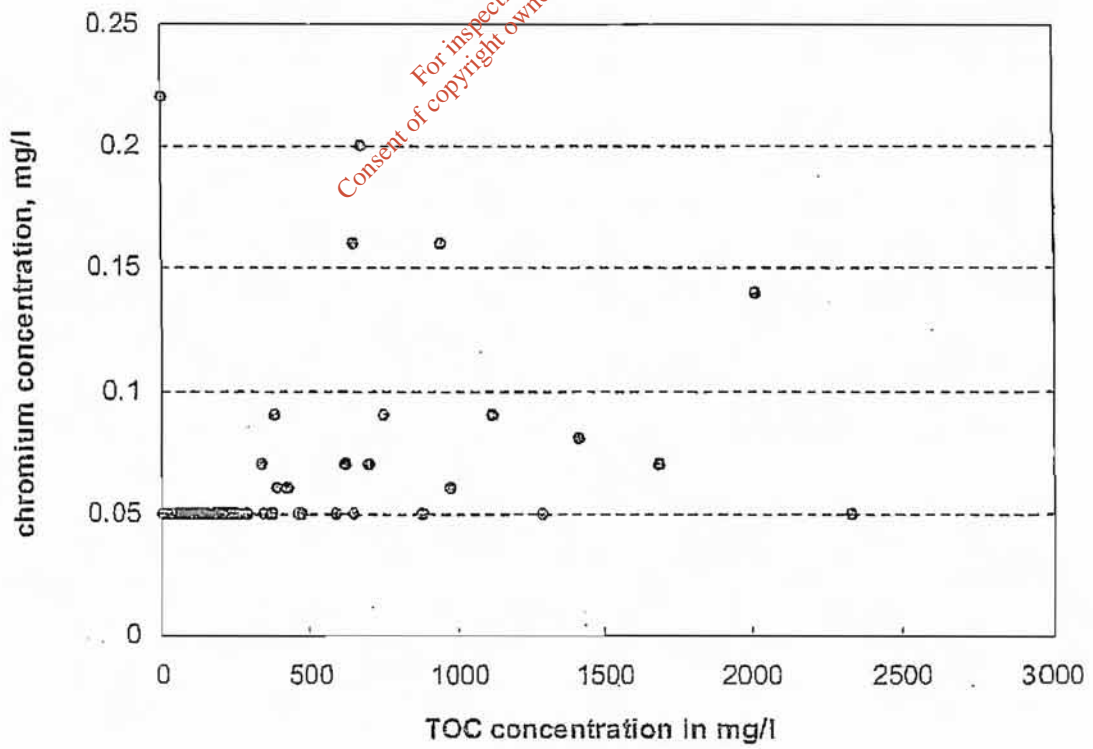
Biphenyl in raw leachates, vs leachate TOC



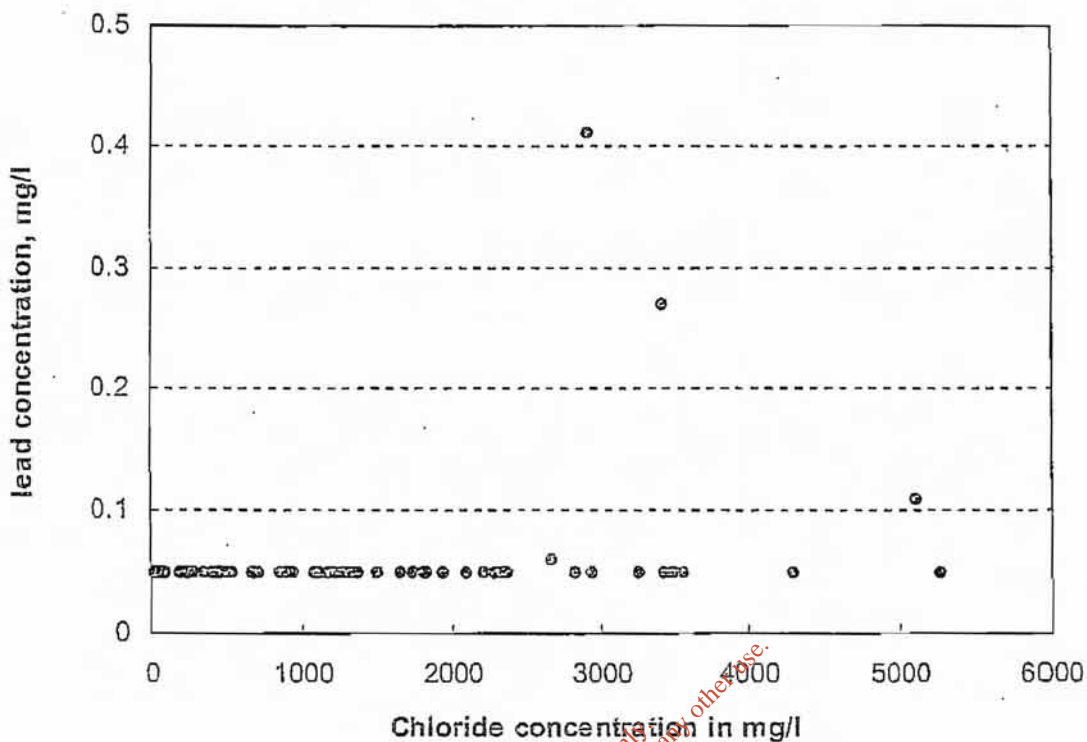
Chromium in raw leachates, vs leachate chloride



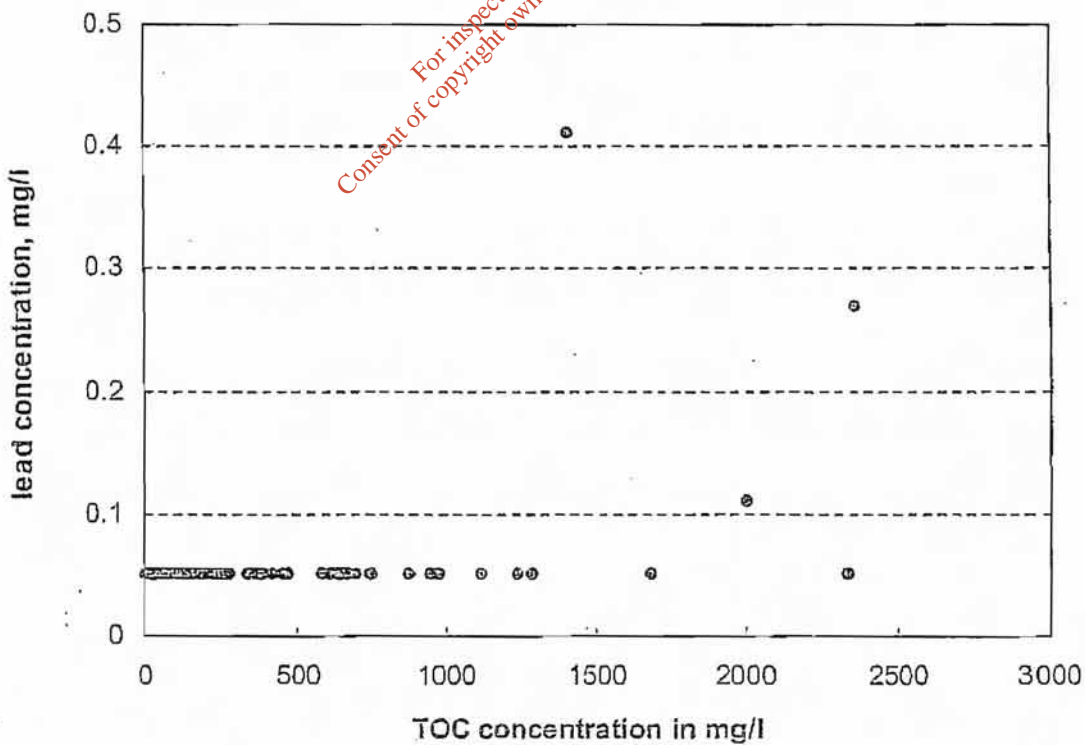
Chromium in raw leachates, vs leachate TOC



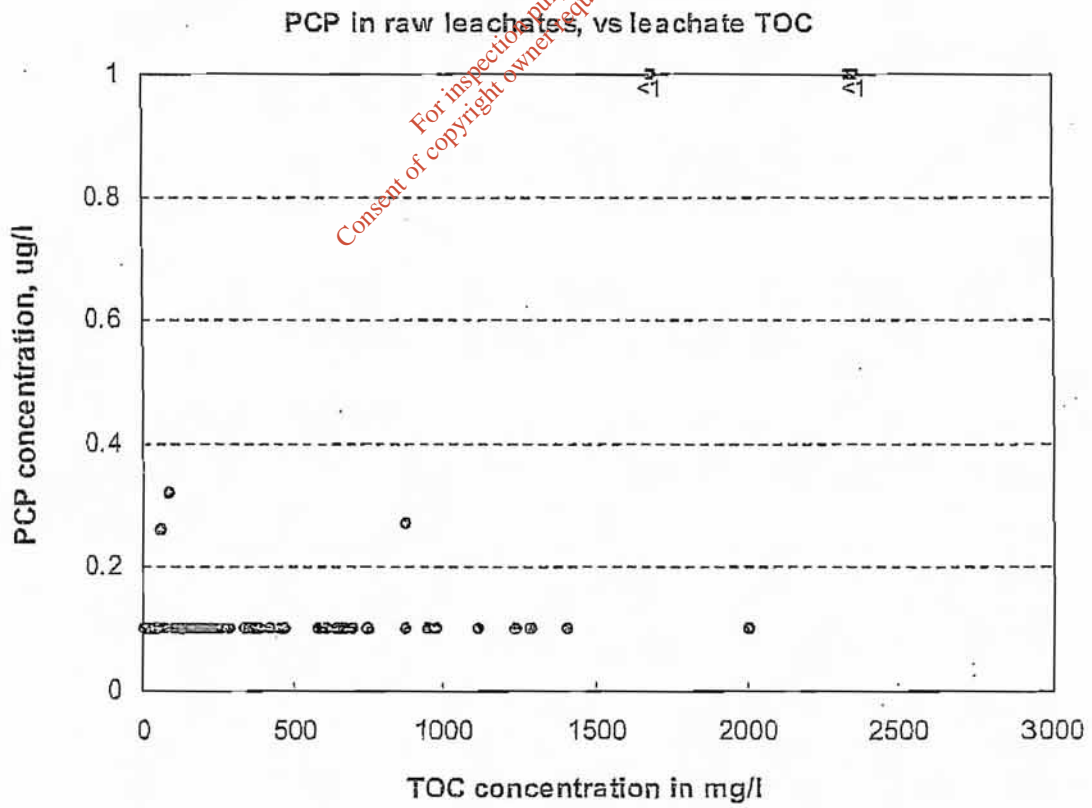
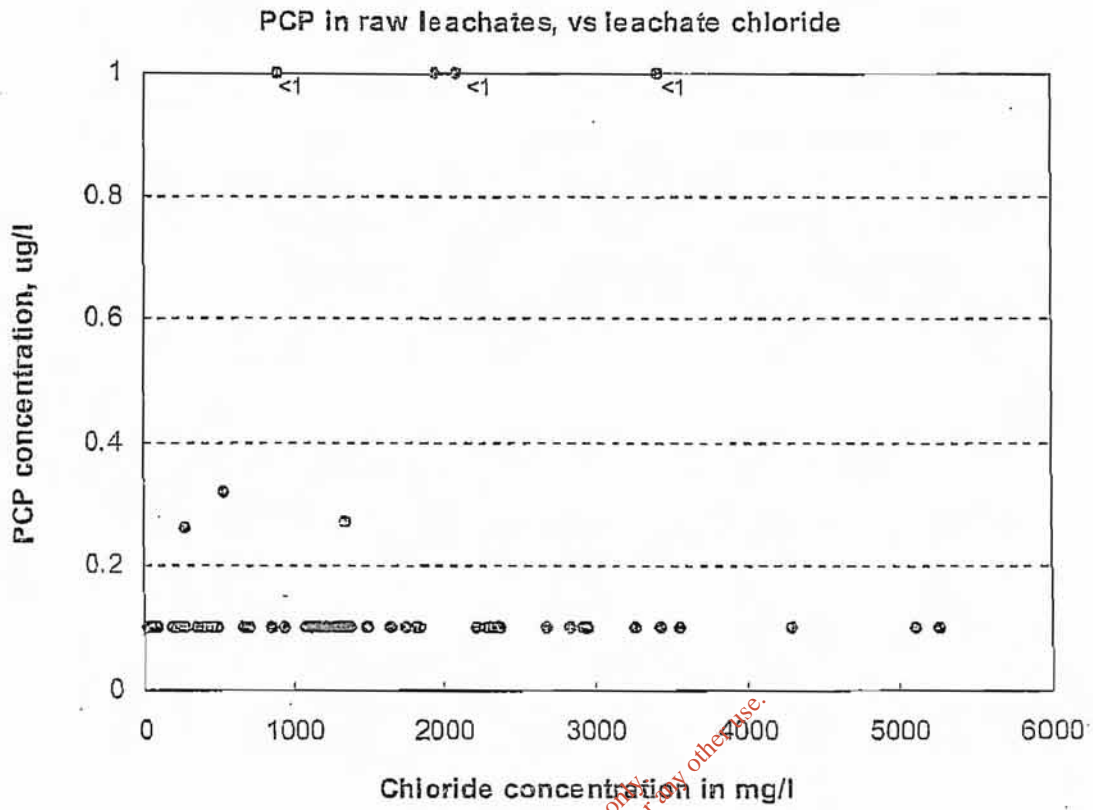
Lead in raw leachates, vs leachate chloride



Lead in raw leachates, vs leachate TOC



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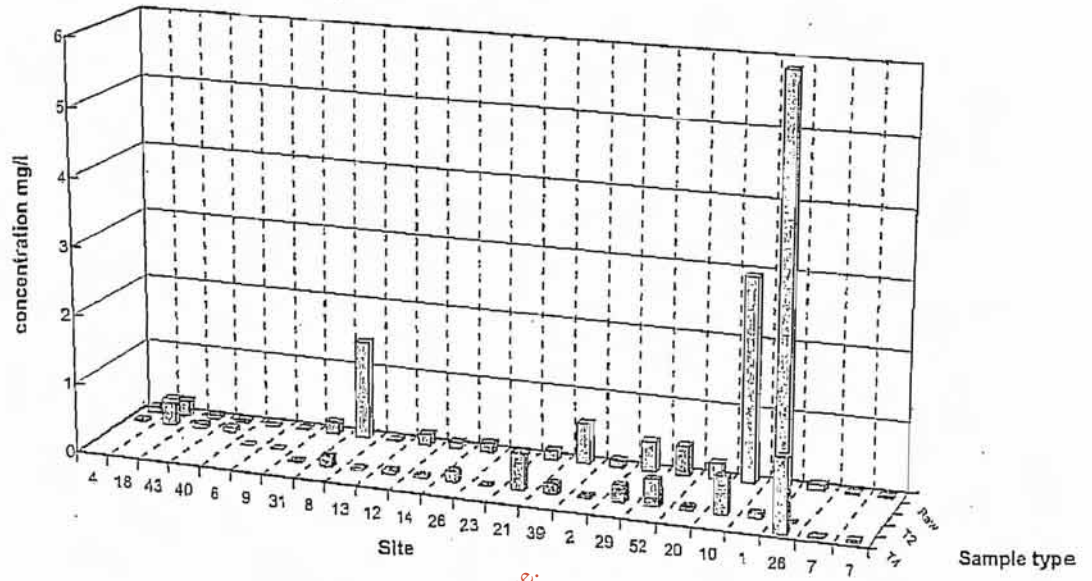


Appendix 6. Bar charts showing comparison of concentrations of 11 substances in raw and treated leachates. [lead not shown, because no results were above detection limit, at sites with leachate treatment.]

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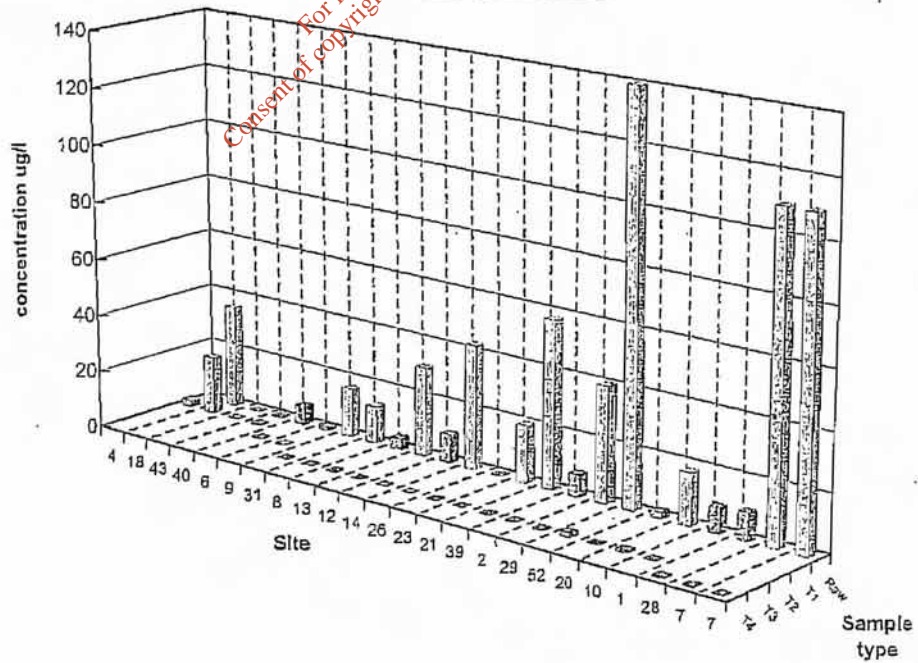
Zinc in raw and treated leachates

T4 T3 T2 T1 Raw

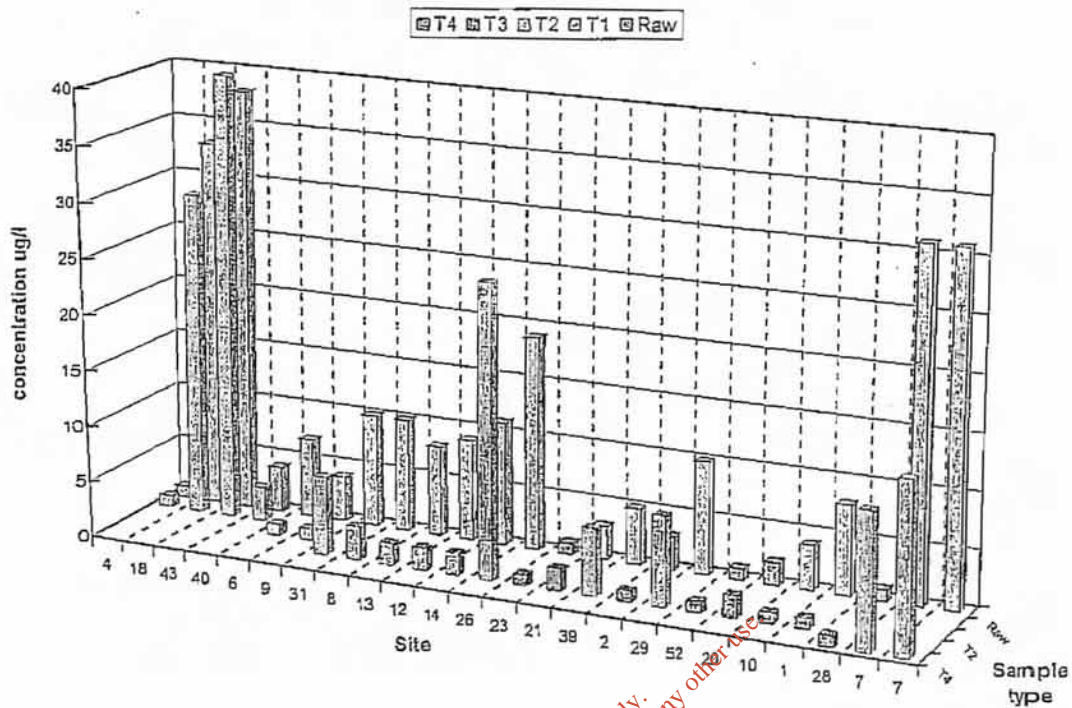


Mecoprop in raw and treated leachate

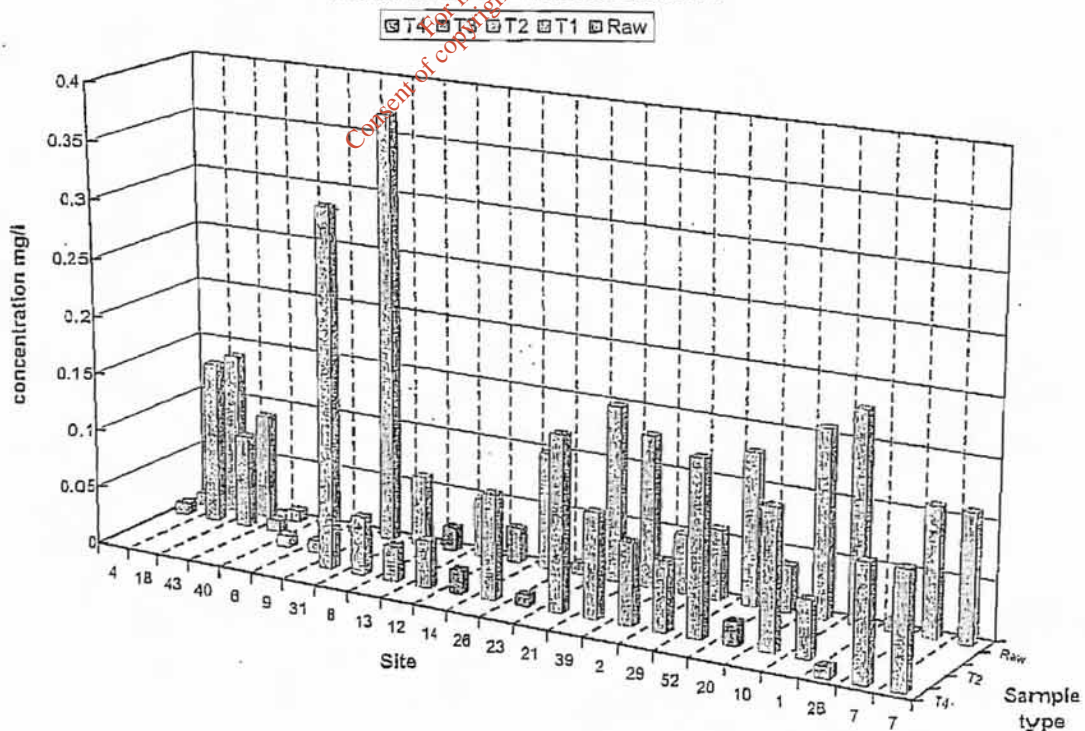
T4 T3 T2 T1 Raw



Arsenic in raw and treated leachates

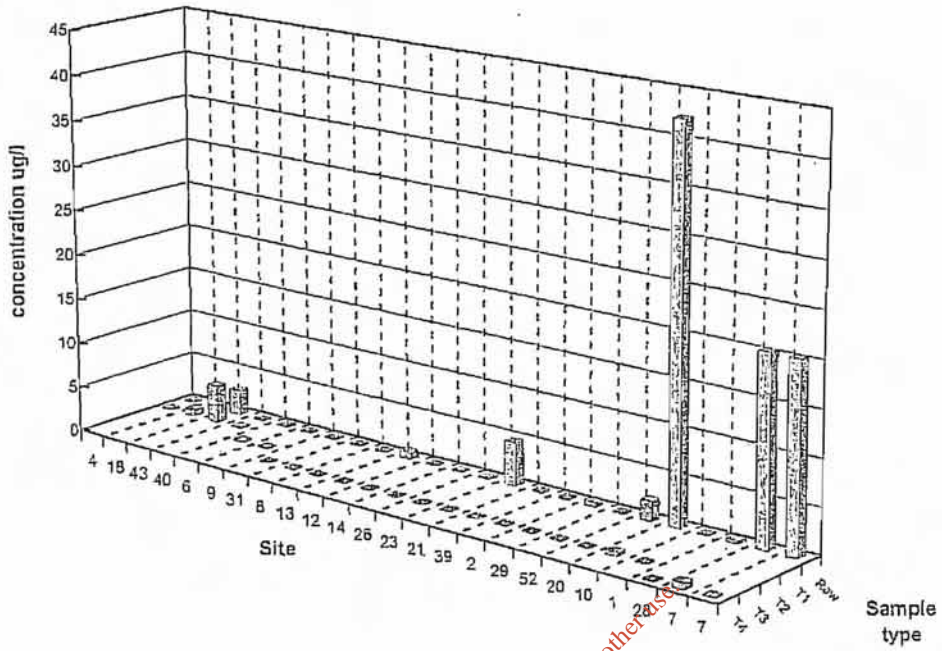


Nickel in raw and treated leachates



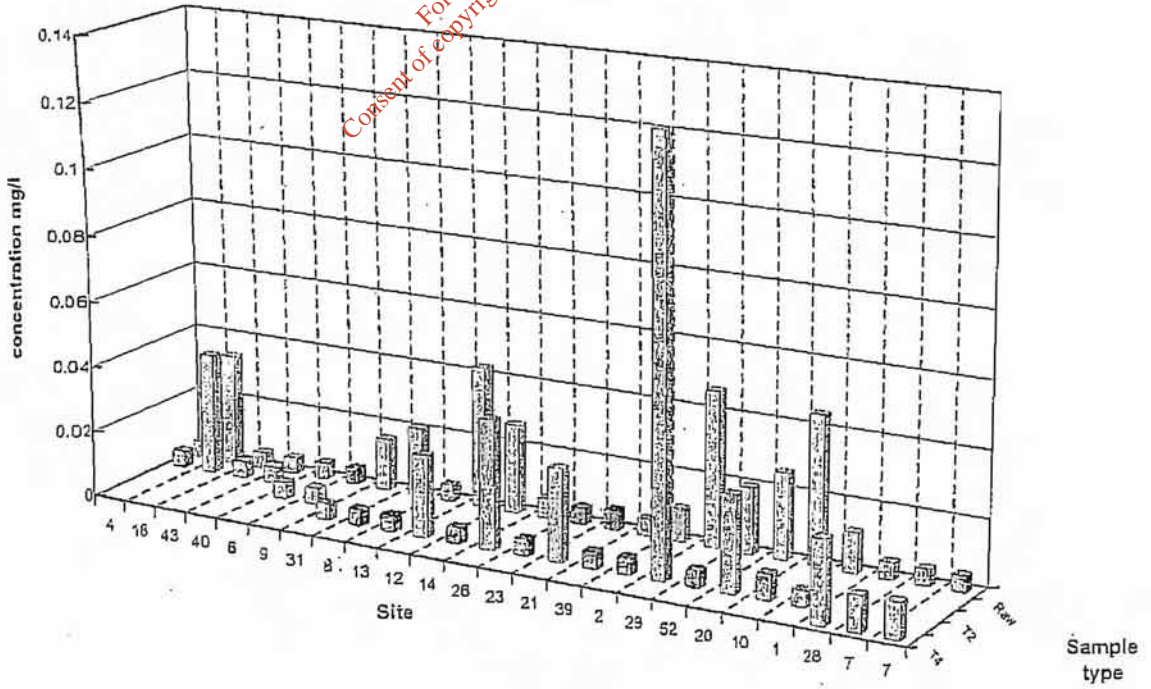
Naphthalene in raw and treated leachates

T4 T3 T2 T1 Raw



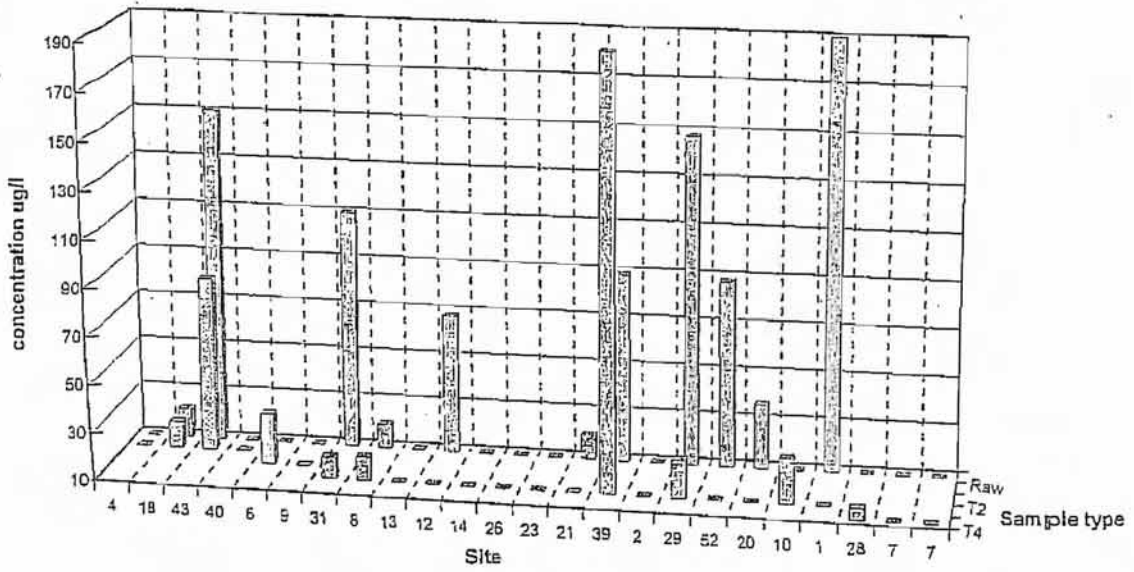
Copper in raw and treated leachates

T4 T3 T2 T1 Raw



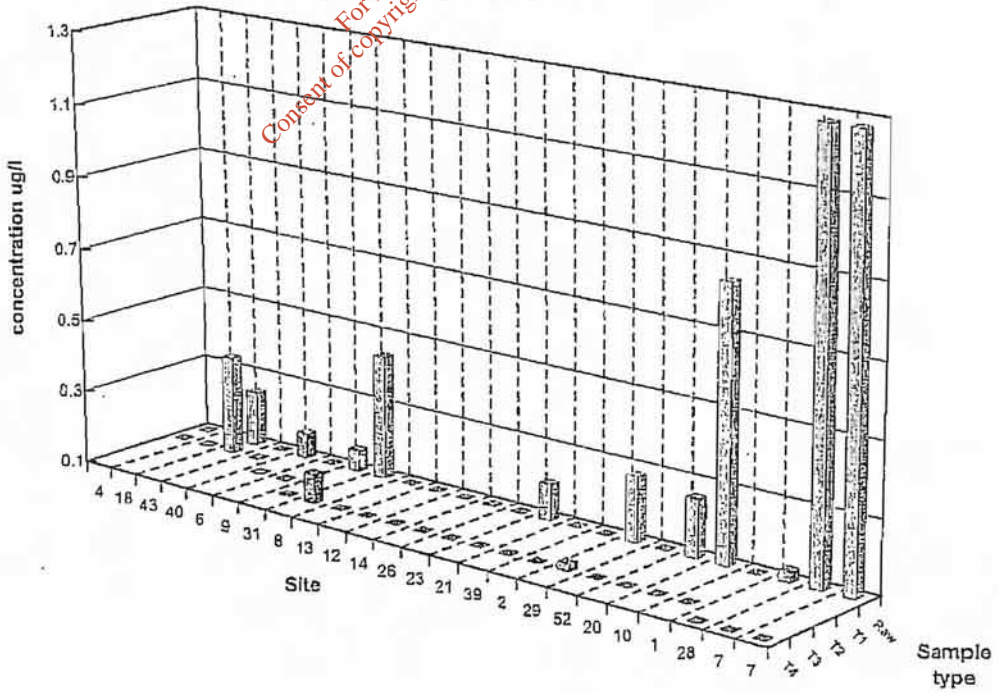
Toluene in raw and treated leachates

T4 T3 T2 T1 Raw



Biphenyl in raw and treated leachates

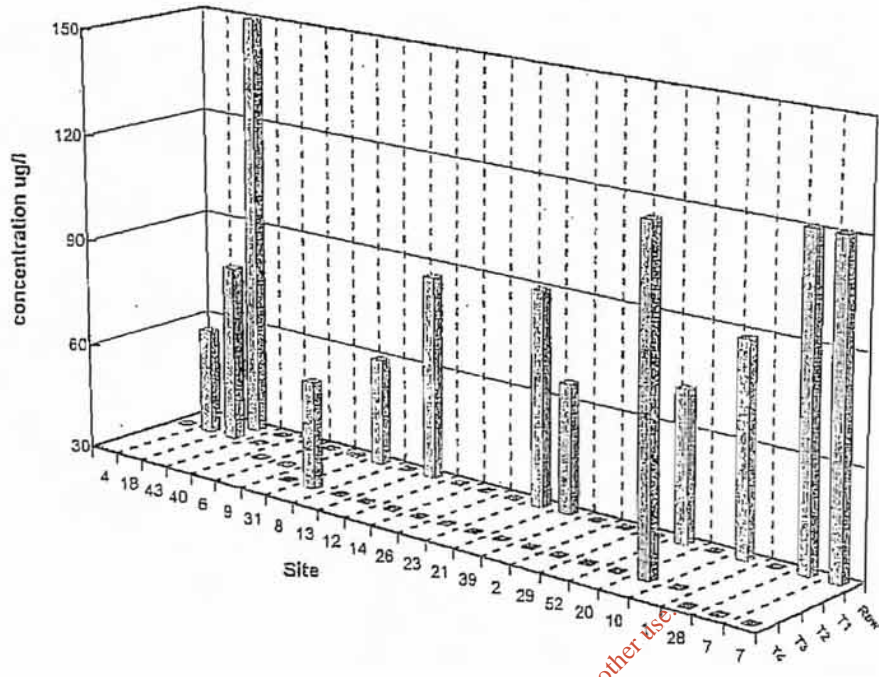
T4 T3 T2 T1 Raw



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Xylenes in raw and treated leachates

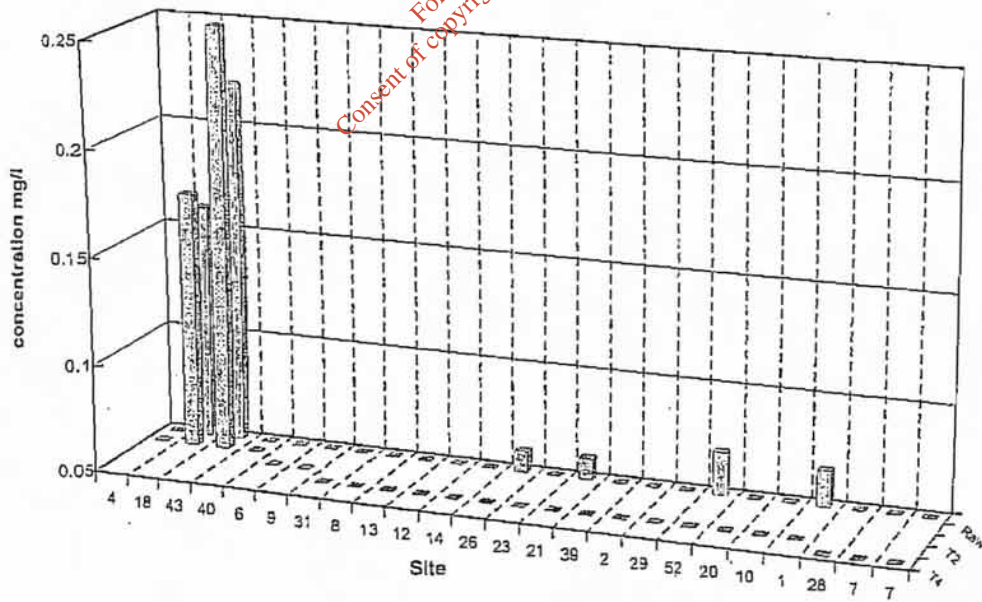
T4 T3 T2 T1 Raw



Sample type

Chromium in raw and treated leachates

T4 T3 T2 T1 Raw

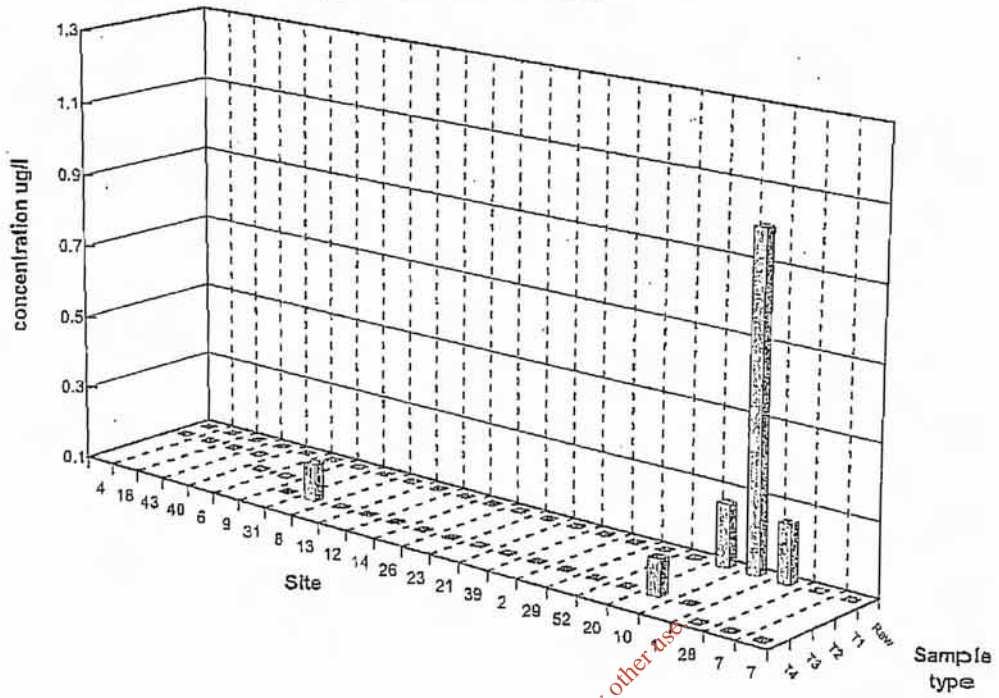


Sample type

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Pentachlorophenol In raw and treated leachates

T4 T3 T2 T1 Raw



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ANNEX C - Case Studies – Leachate

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Chapel Farm Landfill

Chapel Farm Landfill (Wiltshire UK) serving Swindon Concentration

	Leachate Cell 1	Leachate Cell 2	Effluent	Overall Removal %
pH	7.0	6.9	8.8	n.a.
COD	10600	10400	491	94.4%
BOD	4100	4200	3.0	99.9%
Amm.N.	412	585	0.3	99.9%
Nitrate N	< 0.2	0.5	27.2	n.a.
Nitrite N	0.3	0.3	< 0.1	n.a.
Chloride	4670	2180	3870	0.0%
Sodium	1360	1210	1070	16.7%
Magnesium	420	310	284	22.2%
Potassium	900	840	710	18.4%
Calcium	1040	1030	25	97.6%
Chromium	0.05	0.06	< 0.04	n.a.
Manganese	2.7	4.0	< 0.10	97.0%
Iron	340	126	0.6	99.7%
Nickel	0.1	0.07	0.06	29.4%
Copper	0.04	0.03	0.04	0.0%
Zinc	0.09	0.22	0.03	80.6%
Cadmium	0.02	< 0.0	< 0.0	n.a.
Lead	0.2	0.73	< 0.04	75.8%
Arsenic	0.01	0.012	0.007	36.4%

Notes:-

1 Flow weighted mean data

2 Data from "Leachate Collection, Treatment and Disposal"

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Harewood Whin Landfill

Harewood Whin Landfill serving York

	Concentration		Overall Removal %
	Leachate	Effluent	
pH	6	8.8	n.a.
COD	33800	292	99.1%
BOD	21800	4.0	99.98%
Amm.N.	603	4.3	99.3%
Nitrate N	0.2	< 0.2	n.a.
Nitrite N	< 0.1	< 0.1	n.a.
Chloride	1380	587	57.5%
Suspended Solids	184	39	78.8%
VSS	110	20	81.8%
Sodium	1150	420	63.5%
Magnesium	820	341	58.4%
Potassium	900	328	63.6%
Calcium	2900	9	99.7%
Chromium	0.17	< 0.04	n.a.
Manganese	25.6	0.3	98.8%
Iron	560	1.0	99.8%
Nickel	0.13	0.1	61.5%
Copper	0.05	< 0.02	60.0%
Zinc	0.32	0.02	93.8%
Cadmium	< 0.1	< 0.1	n.a.
Lead	0.45	0.07	84.4%

Notes:-

- 1 Flow weighted mean data
 - 2 Data from "Leachate Collection, Treatment and Disposal "
- H.D.Robinson, M.J.Barr and S.D.Last J. IWEM Vol 6 June 1992

Bryn Posteg Landfill

Bryn Posteg Landfill Mid Wales

	Concentration		Overall Removal %
	Leachate	Effluent	
pH	5.8	8	n.a.
COD	5518	153	97.2%
BOD	3670	18	99.5%
Amm.N.	130	9.4	92.8%
Organic N	27	11	59.3%
Chloride	1522	1300	14.6%
Suspended Solids	184	39	78.8%
VSS	110	20	81.8%
Sodium	904	808	10.6%
Magnesium	85	63	25.9%
Potassium	195	140	28.2%
Calcium	477	105	78.0%
Chromium	< 0.1	< 0.1	n.a.
Manganese	40	2.4	94.0%
Iron	242	3.2	98.7%
Nickel	< 0.1	< 0.1	n.a.
Copper	0.13	< 0.1	23.1%
Zinc	4.9	0.2	95.9%
Cadmium	< 0.1	< 0.1	n.a.
Lead	< 0.1	< 0.1	n.a.

Notes:-

- 1 150 tonnes of waste accepted each day
 - 2 Flow weighted mean data for 30 months operation
 - 3 Mean Leachate Volumes 29 cum/d
 - 4 Data from "Leachate Collection, Treatment and Disposal "
- H.D.Robinson, M.J.Barr and S.D.Last J. IWEM Vol 6 June 1992

**ANNEX D - 2003 Leachate Chemical Analysis (Extract from Leachate
Characterisation Report, TES 2003)**

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Table 1A. Standard Inorganic and Wet Chemistry Laboratory Suite for Leachate Generated at Derrinerra and Water Samples taken at Castlebar Wastewater Treatment Plant

Parameter	Units	Leachate Results						Mean Concentrations for Typical Leachate - From EPA Landfill Operational Practices Manual		
		WA-LCH-01	WA-LCH-02	WA-LCH-03	WA-LCH-04	WA-LCH-05	Maximum		Standard Deviation	
FIELD RESULTS										
pH		7.76	7.97	7.30	8.06	7.62	7.742	8.06	0.30	7.20
Temperature	units	10.00	11.00	10.50	10.75	11.00	10.65	11.00	0.42	-
Electrical conductivity (EC)	Degree Celsius	2727	2908	3779	3206	3027	3129	3779	402.89	7789.00
Dissolved oxygen (DO)	µS/cm	1.40	5.80	8.40	8.00	2.70	5.26	8.40	3.13	-
LAB RESULTS										
Heavy Metals										
Arsenic (As)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	0.00	0.000	0.000	<0.01
Cadmium (Cd)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	0.00	0.000	0.000	0.070
Chromium (Cr)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	0.00	0.000	0.000	0.040
Copper (Cu)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	0.00	0.000	0.000	54.500
Iron (Fe)	mg/l	0.13	22.00	0.10	0.09	0.15	4.49	22.000	9.786	0.100
Lead (Pb)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	0.58	0.940	0.338	1.990
Manganese (Mn)	mg/l	0.15	0.14	0.94	0.58	0.58	0.48	0.940	0.000	0.000
Mercury (Hg)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	0.00	0.000	0.000	0.100
Nickel (Ni)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	0.00	0.000	0.000	0.580
Zinc (Zn)	mg/l	<0.05	<0.05	0.30	<0.05	0.07	0.07	0.300	0.163	-
Major Cations										
Calcium (Ca)	mg/l	174.30	195.40	149.00	125.50	171.10	155.62	195.40	35	250
Magnesium (Mg)	mg/l	42.80	46.07	93.00	51.32	51.10	46.86	51.32	4	151
Potassium (K)	mg/l	88.00	128.00	152.00	118.00	122.00	121.60	152.00	23	491
Sodium (Na)	mg/l	82.00	158.00	228.00	319.00	212.00	198.00	310.00	85	904
Standard Water Chemistry										
Biochemical oxygen demand (BOD)	mg/l	80.00	33.00	730.00	21.00	31.00	179.00	730.00	308.86	>798
Chemical oxygen demand (COD)	mg/l	329.00	39.00	435.00	496.00	237.00	307.20	496.00	179.80	3078.00
Total organic carbon (TOC)	mg/l	71.00	154.00	4.00	99.00	80.00	83.60	154.00	54.15	717.00
Total Hardness (mg/l CaCO ₃ equivalent)	mg/l	614.08	680.46	459.21	527.08	610.67	584.30	680.46	89.77	-
Total alkalinity (as CaCO ₃)	mg/l	900.00	1010.00	1200.00	520.00	1140.00	954.00	1200.00	269.04	3438.00
Total oxidised nitrogen (TON)	mg/l	0.40	0.30	2.90	9.20	<0.3	2.56	9.20	4.18	-
Nitrite (NO ₂)	mg/l	0.48	0.21	4.90	15.40	0.50	4.30	15.40	6.51	0.20
Nitrate (NO ₃)	mg/l	1.00	1.20	6.00	19.20	0.30	5.54	19.20	7.96	2.40
Ammoniacal nitrogen (NH ₄ -N)	mg/l	113.00	7.70	124.00	137.00	120.00	100.34	137.00	52.52	491.00
Phosphate (PO ₄)	mg/l	0.63	1.20	0.29	0.47	<0.05	0.52	1.20	0.39	0.98
Sulphate (SO ₄)	mg/l	211.00	186.00	278.00	192.00	137.00	200.80	278.00	51.07	136.00
Chloride (Cl)	mg/l	195.00	190.00	230.00	640.00	220.00	295.00	640.00	193.58	1256.00
Cyanide (Total)	mg/l	<0.05	<0.05	<0.05	<0.05	<0.05	0.00	0.00	0.00	<0.05
Fluoride	mg/l	0.40	0.40	0.40	0.40	0.40	0.40	0.40	0.00	-
Boron	mg/l	0.79	0.87	0.82	1.04	0.95	0.89	1.04	0.10	7.00
Total Suspended Solids	mg/l	52.00	<10	32.00	34.40	10.32	34.40	34.40	10.32	-
Total Dissolved Solids	mg/l	1390.00	1219.00	1440.00	1534.00	1339.00	1384.40	1534.00	117.18	-
Dissolved Methane	mg/l	0.221	0.332	0.006	0.006	0.396	0.19	0.40	0.18	-
MBAS Surfactant	mg/l	<0.2	<0.2	<0.2	<0.2	<0.2	0.000	0.00	0.00	-
Bacterial Analysis										
Faecal coliforms	(mpn/100mls)	3000	1248	195	60	2480	1397	3000	1323	-
Total coliforms	(mpn/100mls)	13800	2000	15600	180	3000	6756	15600	7503	-

Note: '-' signifies no Mean Values from EPA Landfill Operational Practices Manual are available, '<' = Less than

Table 1B. Standard Inorganic and Wet Chemistry Laboratory Suite for Leachate Generated at Derrinerra and Water Samples taken at Castlèbar Wastewater Treatment Plant

Parameter	Units	Newport WWTP Discharge Limit Values	S.I. No. 254, Urban Wastewater Treatment Regulations, 2001, (MACs)	S.I. No. 200, Quality of Shellfish Waters Regulations, 1994, (MACs)	Treated Wastewater Results			Standard Deviation
					WA-WWTP-01	WA-WWTP-02	Mean	
FIELD RESULTS								
pH				$\geq 7 < 9$	7.53	7.05	7.29	0.34
Temperature	units	-	-	-	7.00	8.00	9.00	1.41
Electrical conductivity (EC)	$\mu\text{S/cm}$	-	-	-	800.00	1025.00	912.50	159.10
Dissolved oxygen (DO)	mg/l	-	-	-	7.20	5.10	6.15	1.48
LAB RESULTS								
Heavy Metals								
Arsenic (As)	mg/l	-	-	-	<0.05	<0.05	<0.05	0.000
Cadmium (Cd)	mg/l	-	-	-	<0.05	<0.05	<0.05	0.000
Chromium (Cr)	mg/l	-	-	-	<0.05	<0.05	<0.05	0.000
Copper (Cu)	mg/l	-	-	-	<0.05	<0.05	<0.05	0.000
Iron (Fe)	mg/l	-	-	-	<0.05	<0.05	<0.05	0.000
Lead (Pb)	mg/l	-	-	-	<0.05	<0.05	<0.05	0.000
Manganese (Mn)	mg/l	-	-	-	<0.05	<0.05	<0.05	0.000
Mercury (Hg)	mg/l	-	-	-	<0.05	<0.05	<0.05	0.000
Nickel (Ni)	mg/l	-	-	-	<0.05	<0.05	<0.05	0.000
Zinc (Zn)	mg/l	-	-	-	<0.05	<0.05	<0.05	0.000
Major Cations								
Calcium (Ca)	mg/l	-	-	-	68.77	60.94	64.86	68.77
Magnesium (Mg)	mg/l	-	-	-	5.88	5.88	5.88	0
Potassium (K)	mg/l	-	-	-	10.00	12.20	11.10	12.20
Sodium (Na)	mg/l	-	-	-	63.00	128.00	95.50	128.00
Standard Water Chemistry								
Biochemical oxygen demand (BOD)	mg/l	25	25	-	2.000	16.000	9.00	16.00
Chemical oxygen demand (COD)	mg/l	125	125	-	300.000	30.000	165.00	300.00
Total organic carbon (TOC)	mg/l	-	-	-	6.000	10.000	8.00	10.00
Total Hardness (mg/l CaCO ₃ equivalent)	mg/l	-	-	-	196.425	176.850	186.64	196.43
Total alkalinity (as CaCO ₃)	mg/l	-	-	-	160.000	230.000	195.00	230.00
Total oxidised nitrogen (TON)	mg/l	-	-	-	15.000	10.200	12.65	15.10
Nitrite (NO ₂)	mg/l	-	-	-	0.610	0.150	0.38	0.61
Nitrate (NO ₃)	mg/l	-	-	-	65.000	44.1	54.55	65.00
Ammoniacal nitrogen (NH ₄ -N)	mg/l	5	5	-	3.400	2.800	3.10	3.40
Phosphate (PO ₄)	mg/l	-	-	-	0.810	0.230	0.52	0.81
Sulphate (SO ₄)	mg/l	-	-	-	75.000	60.000	67.50	75.00
Chloride (Cl)	mg/l	-	-	-	129.000	182.000	155.50	182.00
Cyanide (Total)	mg/l	-	-	-	<0.05	<0.05	<0.05	<0.05
Fluoride	mg/l	-	-	-	0.500	0.500	0.50	0.50
Boron	mg/l	-	-	-	0.090	0.100	0.10	0.10
Total Suspended Solids	mg/l	35	35	-	<10	184.000	92.00	184.00
Total Dissolved Solids	mg/l	-	-	-	498.000	574.000	536.00	574.00
Dissolved Methane	mg/l	-	-	-	0.002	<0.001	0.00	0.00
MBAS Surfactant	mg/l	-	-	-	<0.2	<0.2	<0.2	0.00
Bacterial Analysis								
Faecal coliforms	(mpn/100mls)	2000	2000	-	3120	11700	7410	11700
Total coliforms	(mpn/100mls)	-	-	-	9000	44000	26500	44000
Note: M.A.C = Maximum Admissible Concentration, \circ signifies MAC exceeded, \leq = Less than Values are shaded wherever Newport WWTP Discharge Limit Values, S.I. No. 254, Urban Wastewater Treatment Regulations, 2001, S.I. No. 200 or Quality of Shellfish Waters Regulations, 1994 MACs are exceeded. * - signifies no S.I.81 or S.I.12MAC Values are available.								

Table 2. Volatile Organic Compound Laboratory Suite for Leachate Generated at Derrinnuma and Water Samples taken at Castlebar Wastewater Treatment Plant

Compound	EPA Interim Guideline Values Groundwater Protection	Dutch Criteria TV (TARGET)	Dutch Criteria TV (INTERVENTION)	SI 12, 2001 Water Quality (Dangerous Substances) MAC	Leachate Results					Wastewater Results	
					WA-LCH-01	WA-LCH-02	WA-LCH-03	WA-LCH-04	WA-LCH-05	WA-WWTF-01	WA-WWTF-02
Dichlorodifluoromethane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chloroethane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Vinyl Chloride	-	-	0.0007	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bromomethane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chloroethane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Trichlorofluoromethane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
trans-1,2-Dichloroethane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dichloromethane	0.00004	0.00001(d)	1.00	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Carbon disulfide	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-Dichloroethane	0.03	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-Dichloroethane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
tert-butyl methyl ether	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
cis-1,2-Dichloroethane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bromochloromethane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chloroform	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2,2-Dichloropropane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-Dichloroethane	0.003	0.00001(d)	0.40	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,1-Trichloroethane	0.5	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1-Dichloropropene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Benzene	0.001	0.0002	0.03	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Carbon tetrachloride	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-Dichloropropane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dibromomethane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bromodichloromethane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Trichloroethane	0.07	0.00001(d)	0.50	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
cis-1,3-Dichloropropene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
trans-1,3-Dichloropropene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,2-Trichloroethane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Toluene	0.010	0.0002	1.00	0.005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,3-Dichloropropane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dibromochloromethane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-Dibromoethane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Tetrachloroethene	0.04	0.00001(d)	0.04	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,1,2-Tetrachloroethane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chlorobenzene	0.001	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Ethylbenzene	0.01	0.0002	0.15	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
pnc-Xylene	0.01	0.0002	0.07	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bromobenzene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Styrene	-	-	0.30	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,1,2,2-Tetrachloroethane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
o-Xylene	0.01	0.0002	0.07	0.01	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,3-Trichloropropane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Isopropylbenzene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Bromobenzene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2-Chlorotoluene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Propylbenzene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
4-Chlorotoluene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-Trimethylbenzene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
4-Isopropyltoluene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,3,5-Trimethylbenzene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-Dichlorobenzene	0.01	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,4-Dichlorobenzene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,3-Dichlorobenzene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Dichlorobenzenes	-	0.00001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
sec-Butylbenzene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
tert-Butylbenzene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
n-Butylbenzene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2-Dibromo-3-chloropropane	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-Trichlorobenzene	0.4	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,3-Trichlorobenzene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Total Trichlorobenzenes	-	0.00001	0.01	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Naphthalene	-	-	0.07	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Hexachlorobutadiene	0.0001	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001

Note: M.A.C = Maximum Admissible Concentration, <= Less than
 Values are shaded wherever EPA Interim Guideline Values, Dutch TV, Dutch-IV or SI 12 MAC Values are exceeded
 * signifies analysis not carried out on sample or no Dutch Criteria or SI 12 MACs available.

Table 3A. Semivolatile Organic Compounds (Phenols, PAH's, etc) Laboratory Suite for Leachate Generated at Derrinnumera

Semi-Volatile Organic Compounds (SVOCs)	EPA Interim Guideline Value Groundwater Protection	Dutch Criteria (mg/l) (TARGET)	Dutch Criteria (mg/l) (INTERVENTION)	SI 81,198 Water Quality Consumer	Leachate Results					Mean	Maximum	Standard Deviation
					WA-LCH-01	WA-LCH-02	WA-LCH-03	WA-LCH-04	WA-LCH-05			
ENDOCRINE DISRUPTORS												
Nonyl-phenol	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Biphenol A	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Alkylol	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Chloroac	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dicofol	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Methoprene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Preconcent	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Dibutyltin	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Tributyltin	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fenoxarb	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2,3,7,8-TCDF	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phenol	0.0005	0.0002	2	0.0005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2-Chlorophenol	0.2	0.00025	0.1	0.0005	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TOTAL DICHLOROPHENOLS (sum of 2)	-	0.00028	0.03	-	0.0002	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2,4,6-Trichlorophenol	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2,4,5-Trichlorophenol	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TOTAL TRICHLOROPHENOLS (sum of 3)	-	0.02560	0.01000	-	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2-Methylphenol	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
4-Methylphenol	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2-Nitrophenol	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
4-Nitrophenol	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
2,4-Dimethylphenol	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
4-Chloro-3-methylphenol	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Phenol	0.002	0.00060	0.003	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Nitrobenzene	0.01	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Azobenzene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Azobiphenyl	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Fluorene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(a)fluoranthene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Benzo(b)fluoranthene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,3-Trichlorobenzene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
1,2,4-Trichlorobenzene	-	-	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
TOTAL DICHLOROBENZENES (sum of 3)	-	0.00001	0.00000	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
1,2,4-Trichlorobenzene	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Hexachlorobenzene	0.0003	0.0001	0.01	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Naphthalene	0.001	0.0001	0.005	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Anthracene	0.001	0.0001	0.07	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Phenanthrene	0.001	0.0001	0.005	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Fluoranthene	0.001	0.0001	0.005	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Benzo(a)anthracene	0.001	0.0001	0.001	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Chrysene	0.001	0.0001	0.005	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Benzo(e)pyrene	0.0001	0.0001	0.005	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Benzo(g)herylene	0.0005	0.0001	0.005	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Benzo(k)fluoranthene	0.0005	0.000002	0.005	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Indene(1,2,3-c)pyrene	0.0005	0.000002	0.005	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Dimethyl phthalate	0.0005	0.000004	0.005	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Diethyl phthalate	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
D-n-butylphthalate	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bis(2-ethylhexyl)phthalate	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bis(2-propylheptyl)phthalate	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
TOTAL PHTHALATES (sum of 6)	-	0.00050	0.00000	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
2-Chloroaniline	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
2-Methylanthraniline	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Catechol	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Isochlorogenic	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Dibenzofuran	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
4-Chloroaniline	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
2-Nitroaniline	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
3-Nitroaniline	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
4-Nitroaniline	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
2,4-Dinitrochlorobenzene	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
2,6-Dinitrochlorobenzene	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bis(2-chloroethyl)ether	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
4-Bromophenyl ether	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
4-Bromophenyl ether	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Hexachlorobenzene	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Hexachlorocyclopentadiene	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Hexachlorocyclopentadiene	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
Bis(2-chloroethoxy)methane	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001
N-tetradecyl-propanolamine	-	-	-	-	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001

Values are listed wherever EPA, Interim Guideline Values, Dutch-TV, Dutch-IV or SI 81 MAC Values are exceeded. * signifies MAC exceeded.

† signifies MAC Values are available.

Table 4. Polychlorinated Biphenyl (PCBs), Chlorinated Pesticides and Diesel Range Organics (DRO) Laboratory Results for Leachate Generated at Dorrinnumera and Water Samples taken at Castlebar Wastewater Treatment Plant

Parameters	SI 81, 1988 Water Quality (Human Consumption) MAC mg/l	EPA Interim Guideline Values Groundwater Protection	Dutch Criteria TV (TARGET) (mg/l)	Dutch Criteria IV (INTERVENTION) (mg/l)	Leachate Results					Wastewater Results				
					WA-LCH-01	WA-LCH-02	WA-LCH-03	WA-LCH-04	WA-LCH-05	WA-WTP-01	WA-WTP-02			
PCBs														
PCB Congener 52	0.1	0.00001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
PCB Congener 101	0.1	0.00001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
PCB Congener 118	0.1	0.00001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
PCB Congener 153	0.1	0.00001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
PCB Congener 138	0.1	0.00001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
PCB Congener 180	0.1	0.00001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
PCB Total of 7 Congeners	0.1	0.00001	0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
CHLORINATED PESTICIDES														
Teaazene	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Trifluralin	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
alpha-HCH(Lindane)	0.1	0.0001	0.0001	0.0001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Hexachlorobenzene	0.1	0.0001	0.00050	0.00050	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
beta-HCH(Lindane)	0.1	0.0001	0.0000002	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
gamma-HCH(Lindane)	0.1	0.0001	0.0000002	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Quintozene (PCNB)	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Trifluate	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Chlorobalonil	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Heptachlor	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Aldrin	0.1	0.00001	0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Triadimefon	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Pendimethalin	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Heptachlor Epoxide	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
o,p'-DDE	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Endosulfan I	0.1	0.000001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
p,p'-DDE	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Dieldrin	0.1	0.00001	0.0000002	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
p,p'-TDE(DDD)	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Endrin	0.1	0.0001	0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Endosulfan II	0.1	0.000001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
o,p'-TDE	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
o,p'-DDT	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
p,p'-DDT	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Endosulfan Sulphate	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
o,p'-Methoxychlor	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
p,p'-Methoxychlor	0.1	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Permethrin	0.1	0.02	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
DIESEL RANGE ORGANICS (DRO)														
Mineral Oil	0.01	0.01	0.05000	0.60000	0.205 ¹	0.038	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
% Mineral Oil	0.01	0.01	0.05000	0.60000	0.082	0	0	0	0	0	0	0	0	0

Note: M.A.C = Maximum Admissible Concentration, < = Less than
 Values are shaded wherever EPA Interim Guideline Values, Dutch-TV, Dutch-IV or S.I.81 MAC Values are exceeded.
 -: signifies no Dutch-TV, Dutch-IV or S.I.81 MAC Values are available, ○ signifies MAC exceeded.
 The laboratory interpretation of the chromatogram indicates that a highly degraded diesel was detected within the leachate.

Table 5. Acid, Triazine and Nitrile Herbicides, Organophosphorous Pesticides, and Organotin Compound Laboratory Suite for Leachate Generated at Derrinnumera and Water Samples taken at Castlebar Wastewater Treatment Plant

Parameters	SI 12, 2001 Water Quality (Dangerous Substances) MAC	EPA Interim Guideline Values for Groundwater Protection	Dutch Criteria (mg/l) TV (TARGET)	Dutch Criteria (mg/l) IV (INTERVENTION)	Leachate Results					Wastewater Results	
					WA-LCH-01	WA-LCH-02	WA-LCH-03	WA-LCH-04	WA-LCH-05	WA-WWTP-01	WA-WWTP-02
<i>ACID HERBICIDES</i>											
Clopyralid	-	0.0001	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Picoram	-	0.0001	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
2,4,6- TBA	-	0.0001	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Dicamba	-	0.0001	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Benazolin	-	0.0001	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
4-CPA	-	0.0001	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Benazone	-	0.0001	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
2,4-D	-	0.0001	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MCPA	-	0.0001	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
2,4-DP	-	0.0001	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Triclopyr	-	0.0001	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Mecoprop	-	0.01	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
2,4,5-T	-	0.0001	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
2,4-DB	-	0.0001	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
MCPB	-	0.0001	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Fenoprop (2,4,5-TP)	-	0.0001	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Diclofop	-	0.1	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
Pentachlorophenol	-	0.0001	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
<i>TRIAZINE HERBICIDES</i>											
Atrazine	0.001	0.001	0.0000075	0.15	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
Simazine	0.01	0.001	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001
<i>NITRILE HERBICIDES</i>											
Bromoxymil	-	0.005	-	-	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003
<i>ORGANOPHOSPHOROUS PESTICIDES</i>											
Diclorvos	-	0.000001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Mevinphos	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Dimethoate	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Parathion	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Methyl Parathion	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Propetamphos	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Diazinon	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Etrinfos	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Chlorpyrifos-methyl	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Pirimiphos Methyl	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Fenitrothion	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Malathion	-	0.00001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Fenthion	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Chlorpyrifos	-	0.005	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Chlorfenvinphos	-	0.005	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Ethion	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Triazophos	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Carbophenothion	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Phosalone	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Azinophos ethyl	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
Azinophos ethyl	-	0.0001	-	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001
<i>ORGANOTIN COMPOUNDS</i>											
Tributyltin	0.000001	0.0007 ¹	-	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005
Triphenyltin	-	0.0007 ¹	-	-	<0.00005	<0.00005	<0.00005	0.00041	<0.00005	<0.00005	<0.00005
Dibutyltin	-	0.0007 ¹	-	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005

Note: M.A.C = Maximum Admissible Concentration, <= Less than
 Values are shaded wherever EPA Interim Guideline Values, Dutch-TV, Dutch-IV, S.I. 12 or S.I.81 MAC Values are exceeded.
¹ signifies no Dutch-TV, Dutch-IV, S.I. 12 or S.I.81 MAC Values are available.
 1. As Sn.

Table 6. Toxicity Testing Results for Leachate Generated at Derrinnumera and Water Samples taken at Castlebar Wastewater Treatment Plant

Parameters	Units	Leachate Results						Wastewater Results	
		WA-LCH-01	WA-LCH-02	WA-LCH-03	WA-LCH-04	WA-LCH-05	WA-WWTP-01	WA-WWTP-02	
5 minute EC_{50}	No. of Toxic Units Test Result	<2.2 >45% vol./vol.	<2.2 >45% vol./vol.	<2.2 >45% vol./vol.	<2.2 >45% vol./vol.	<2.2 >45% vol./vol.	<2.2 >45% vol./vol.	<2.2 >45% vol./vol.	
15 minute EC_{50}	No. of Toxic Units Test Result	<2.2 >45% vol./vol.	<2.2 >45% vol./vol.	<2.2 >45% vol./vol.	<2.2 >45% vol./vol.	<2.2 >45% vol./vol.	<2.2 >45% vol./vol.	<2.2 >45% vol./vol.	

Note:

If the results from a 5 minute EC_{50} is 20% v/v, this means that 200ml of leachate made up to 4 litre with water had a specified effect on 50% of the test species in 5 minutes. To avoid confusion and to report increasing toxicity with a correspondingly increasing number of test species, the result is expressed as a function of the undiluted sample (100%). This form of expression is known as the Toxicity Unit (Tu) and is defined as follows:

$$Tu = \frac{100}{EC_{50}}$$

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**ANNEX E - The Acute Toxicity of a Derrinnumera Landfill Leachate Sample to
Aquatic Organisms, 2004 Results**

*For inspection purposes only.
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The acute toxicity of a
Derrinumeria
landfill leachate sample
to aquatic organisms

FORIN CONSULTING ENGINEERS
CASTLEBAR

PROJECT NO.		
FILE REF.		
Date Received	05 NOV 2004	
PASS TO	ACTION BY	DATE

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**CONFIDENTIAL REPORT
TECHNOLOGY SERVICES DIRECTORATE**

Dept. Toxicity

Sheet no. 1 of 4 sheets

Client
Mayo County Council
Derrinnumera Landfill
Newport
Co Mayo

Title
The acute toxicity of a Derrinnumera
landfill leachate sample
to aquatic organisms

Attn: Ms. Eileen Cavanagh

Report ref.: 04T144

Order no.: 5132898

File no.: R.6.01561L

Report by:

Robert Hernan *R. Hernan*
Kathleen O'Rourke *K. O'Rourke*
James O'Neill *J. O'Neill*

Date recd.: 19/10/04

Approved by: Jim Clancy
Head of Department

Copies to: R.6. Files

Date: 28/10/04

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Test report relates only to the sample(s) tested



TOXICOLOGICAL TESTING REPORT Form No.: ToxF035 Ver 1.8

SAMPLE DESCRIPTION

Client: Mayo County Council

Client Sample Description: Derrinnumera Landfill Leachate, L1, grab, 19.10.04

Tox. Ref. No.: 04T144

Date of Receipt: 19.10.04 Storage Conditions: 3°C ± 3°C

SAMPLE INFORMATION

(supporting data not within scope of INAB accreditation)

	SATL	Client	Other
Sampled by:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Collected by:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sampling Procedure:	ISO 5667-2, grab		
Temperature: (°C)	13.5	pH (at 13.5°C)	7.6
Dissolved Oxygen: (mg/l)	8.2	Dissolved Oxygen: (% saturation)	79
Conductivity: (mS/cm at 25°C)	2.1	Salinity ‰ (at 20°C)	< 1

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TEST PROCEDURE

Test Species: *Oncorhynchus mykiss* Test Date: 19.10.04

Test Procedure: Method 6.8 based on 'OECD 1992, guideline for testing of chemicals 203, - Fish acute toxicity test'

TEST RESULT

Test Parameter	Test Result	No. of Toxic Units	95% Conf. Limits
96 h LC ₅₀	24.0% vol./vol.	4.2	n/a

Method of Calculation: Binomial

Comments:

100% mortality occurred at 32% vol./vol.
No mortality occurred at 18% vol./vol.

TOXICOLOGICAL TESTING REPORT Form No.: ToxF035 Ver 1.8

SAMPLE DESCRIPTION

Client:	Mayo County Council		
Client Sample Description:	Derrinnumera Landfill Leachate, L1, grab, 19.10.04		
Tox. Ref. No.:	04T144		
Date of Receipt:	19.10.04	Storage Conditions:	3°C ± 3°C

SAMPLE INFORMATION

(supporting data not within scope of INAB accreditation)

	SATL	Client	Other
Sampled by:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Collected by:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sampling Procedure:	ISO 5667-2, grab		
Temperature: (°C)	13.5	pH: (at 13.5°C)	7.6
Dissolved Oxygen: (mg/l)	8.2	Dissolved Oxygen: (% saturation)	79
Conductivity: (mS/cm at 25°C)	2.1	Salinity ‰: (at 20°C)	< 1

TEST PROCEDURE

Test Species:	<i>Daphnia magna</i>	Test Date:	19.10.04
Test Procedure: Method 6.1 based on BS6068: Section 5.1:1996; BS EN ISO 6341:1996 'Water quality - Determination of the inhibition of the mobility of <i>Daphnia magna</i> Straus (Cladocera, Crustacea)'			

TEST RESULT

Test Parameter	Test Result	No. of Toxic Units	95% Conf. Limits
48 h EC ₅₀	68.6% vol./vol.	1.4	n/a

* Indicates that test result is INAB accredited
Method of Calculation: Binomial

Comments:

100% of the *Daphnia* were immobilized at 100% vol./vol.
15% of the *Daphnia* were immobilized at 56% vol./vol.
No *Daphnia* were immobilized at 32% vol./vol.

TOXICOLOGICAL TESTING REPORT Form No.: ToxF035 Ver 1.8

SAMPLE DESCRIPTION

Client:	Mayo County Council		
Client Sample Description:	Derrinnumera Landfill Leachate, L1, grab, 19.10.04		
Tox. Ref. No.:	04T144		
Date of Receipt:	19.10.04	Storage Conditions:	3°C ± 3°C

SAMPLE INFORMATION

(supporting data not within scope of INAB accreditation)

	SATL	Client	Other
Sampled by:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Collected by:	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Sampling Procedure:	ISO 5667-2, grab		
Temperature: (°C)	13.5	pH: (at 13.5°C)	7.6
Dissolved Oxygen: (mg/l)	8.2	Dissolved Oxygen: (% saturation)	79
Conductivity: (mS/cm at 25°C)	2.1	Salinity ‰: (at 20°C)	< 1

TEST PROCEDURE

Test Species:	<i>Pseudokirchneriella subcapitata</i>	Test Date:	19.10.04
---------------	--	------------	----------

Method 6.5 based on Draft International Standard ISO/DIS 8692; 'Water quality - Algal growth inhibition test with *Selenastrum capricornutum* and *Scenedesmus subspicatus*'

TEST RESULT

Test Parameter	Test Result	No. of Toxic Units	95% Conf. Limits
72h IC ₅₀	22.2% vol./vol.	4.5	16.2-27.4% vol./vol.

Method of Calculation: Log-linear interpolation

Comments:

- 100% growth inhibition occurred at 56% vol./vol.
- 74% growth inhibition occurred at 32% vol./vol.
- 36% growth inhibition occurred at 18% vol./vol.
- 10% growth inhibition occurred at 10 and 5.6% vol./vol.
- No growth inhibition occurred at 3.2% vol./vol.

- compared to the control.

ANNEX F - Derrinnumera Raw Leachate Chemical Analysis – 2005 Results

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0754 Group





**NATIONAL LABORATORY SERVICE
ANALYSIS REPORT**

REPORT : COM102092

Tobin Consultants

Lab ID: LL0319749

Sample Date: 13/06/2005

Sample Time: 10:00

Sample Description: water analysis

Quote / Group: LL05-00252 / 1

Analyte	Result	Units	Accreditation	
			Status	Analysing Lab
Cyanide as CN	<0.010	mg/l	UKAS	Llanelli
Aldrin	<0.0025	ug/l	UKAS	Llanelli
Dieldrin	<0.0025	ug/l	UKAS	Llanelli
Endrin	<0.0025	ug/l	UKAS	Llanelli
HCH -alpha	<.001	ug/l	UKAS	Llanelli
HCH -beta	<0.001	ug/l	UKAS	Llanelli
HCH -delta	<0.001	ug/l	UKAS	Llanelli
HCH -gamma :- (Lindane)	<0.001	ug/l	UKAS	Llanelli
Hexachlorobenzene	<0.001	ug/l	UKAS	Llanelli
Isodrin	<0.0025	ug/l	UKAS	Llanelli
Hexachlorobutadiene	<0.001	ug/l	UKAS	Llanelli
DDE - op	<0.002	ug/l	UKAS	Llanelli
DDE - pp	<0.0015	ug/l	UKAS	Llanelli
DDT - op	<0.0015	ug/l	UKAS	Llanelli
DDT - pp	<0.001	ug/l	UKAS	Llanelli
TDE - op	<0.002	ug/l	UKAS	Llanelli
TDE - pp	<0.0015	ug/l	UKAS	Llanelli
PCB - 028	<0.001	ug/l	UKAS	Llanelli
PCB - 052	<0.001	ug/l	UKAS	Llanelli
PCB - 101	<0.001	ug/l	UKAS	Llanelli
PCB - 105	<0.001	ug/l	none	Llanelli
PCB - 118	<0.001	ug/l	UKAS	Llanelli
PCB - 128	<0.001	ug/l	none	Llanelli
PCB - 138	<0.001	ug/l	UKAS	Llanelli
PCB - 153	<0.001	ug/l	UKAS	Llanelli
PCB - 156	<0.001	ug/l	none	Llanelli
PCB - 170	<0.001	ug/l	none	Llanelli
PCB - 180	<0.001	ug/l	UKAS	Llanelli
PCB : Total	NoResult	ug/l	UKAS	Llanelli
Atrazine	<0.01	ug/l	UKAS	Llanelli
Simazine	<0.0488	ug/l	UKAS	Llanelli
Fluoride	0.190	mg/l	UKAS	Llanelli

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continued...

Llanelli Laboratory, Penyfal House, 19 Penyfal Lane, Furnace, Llanelli,
Carmarthenshire, SA15 4EL





**NATIONAL LABORATORY SERVICE
ANALYSIS REPORT**

REPORT : COM102092

Tobin Consultants

Lab ID: LL0319749, continued...

Sample Date: 13/06/2005

Sample Time: 10:00

Sample Description: water analysis

Quote / Group: LL05-00252 / 1

Analyte	Result	Units	Accreditation	
			Status	Analysing Lab
Dimethylbenzene : Sum of isomers (1,2- 1,3- 1,4-) :-(Xylene)	<1	ug/l	none	Llanelli
Toluene :- {Methylbenzene}	<1	ug/l	UKAS	Llanelli
Dichloromethane :- {Methylene Dichloride}	<0.1000	mg/l	UKAS	Llanelli
Benzo(a)pyrene	<0.0100	ug/l	UKAS	Llanelli
Benzo(b)fluoranthene	<0.0100	ug/l	UKAS	Llanelli
Benzo(ghi)perylene	<0.0100	ug/l	UKAS	Llanelli
Benzo(k)fluoranthene	<0.0100	ug/l	UKAS	Llanelli
Fluoranthene	<0.0100	ug/l	UKAS	Llanelli
Indeno(1,2,3-cd)pyrene	<0.0100	ug/l	UKAS	Llanelli
Acenaphthene	<0.0100	ug/l	UKAS	Llanelli
Acenaphthylene	<0.0100	ug/l	none	Llanelli
Anthracene	<0.0100	ug/l	UKAS	Llanelli
Benzo(a)anthracene	<0.0100	ug/l	UKAS	Llanelli
Chrysene	<0.0100	ug/l	none	Llanelli
Dibenzo(ah)anthracene	<0.0100	ug/l	none	Llanelli
Fluorene	<0.0100	ug/l	UKAS	Llanelli
Naphthalene	<0.01	ug/l	none	Llanelli
Phenanthrene	<0.0100	ug/l	UKAS	Llanelli
Pyrene	<0.0100	ug/l	UKAS	Llanelli
Tributyl Tin	<0.002	ug/l	UKAS	Llanelli
Mercury	<0.008	ug/l	UKAS	Llanelli
Arsenic	<1.0	ug/l	UKAS	Llanelli
Aluminium	78.200	ug/l	UKAS	Llanelli
Cadmium	<0.1000	ug/l	UKAS	Llanelli
Chromium	11.90	ug/l	UKAS	Llanelli
Copper	53.900	ug/l	UKAS	Llanelli
Lead	2.460	ug/l	UKAS	Llanelli
Nickel	35.200	ug/l	UKAS	Llanelli
Zinc	246.000	ug/l	UKAS	Llanelli
Silver	<1.000	ug/l	UKAS	Llanelli

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NATIONAL LABORATORY SERVICE ANALYSIS REPORT

REPORT : COM102092

Tobin Consultants

Key to Accreditation Status: UKAS = Method accredited to ISO/IEC 17025, none = Method not accredited
MCertS = Method accredited to MCertS Performance Standard for testing of soil

Key to "Analysing Lab" field

Llanelli = Analysed at NLS Laboratory at Llanelli, SA15 4EL

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ANNEX G - Extract from S.I. No. 268 of 2006 – European Communities (Quality of Shellfish Waters) Regulations, 2006

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STATUTORY INSTRUMENTS

S.I. No. 268 of 2006

**EUROPEAN COMMUNITIES (QUALITY OF SHELLFISH WATERS)
REGULATIONS 2006**

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European Communities (Quality of Shellfish Waters) Regulations 2006

I, Noel Dempsey, Minister for Communications, Marine and Natural Resources, in exercise of the powers conferred on me by section 3 of the European Communities Act, 1972 (No. 27 of 1972) and for the purpose of giving effect to Directive 79/923/EEC¹ of 30 October 1979 on the quality required of shellfish waters, hereby make the following regulations:

Citation

1. These Regulations may be cited as the European Communities (Quality of Shellfish Waters) Regulations 2006.

Object of these Regulations

2. The object of these Regulations is to give effect in the State to Directive 79/923/EEC of 30 October 1979 on the quality required of shellfish waters.

Interpretation

3. (1) In these Regulations—

“Minister” means the Minister for Communications, Marine and Natural Resources;

“prescribed public authority” means a person or body specified in Schedule 1;

“shellfish” means a bivalve or gastropod mollusc;

¹ OJ No. L 281, 10.11.1979, p. 47

“shellfish waters” means an area of water specified in Schedule 3;

“Shellfish Waters Directive” means Directive 79/923/EEC of 30 October 1979 on the quality required of shellfish waters.

(2) Notes appearing in the text are provided for information only and do not form part of these Regulations.

General duty of public authorities

4. Every public authority that has functions the performance of which may affect shellfish waters shall perform those functions in a manner that will, as far as practicable, promote compliance with the Shellfish Waters Directive and these Regulations and, in particular, shall—

- (a) ensure that, as far as practicable, those shellfish waters comply with the quality standards specified in the Schedule 2, and
- (b) take such action, consistent with the performance of its functions, as will secure compliance with that Directive and these Regulations and with any programme established by the Minister in accordance with Regulation 6, and
- (c) consult, co-operate and liaise with other public authorities and with competent authorities established in Northern Ireland in such a manner and to such extent as is necessary to co-ordinate compliance with these Regulations or that Directive, and
- (d) if any other public authority, or any competent authority established in Northern Ireland, asks for information that it reasonably needs in order to perform its functions with respect to compliance with these Regulations or that Directive, provide the authority with that information.

Minister’s responsibilities with respect to sampling of shellfish waters

5. (1) The Minister shall ensure—

- (a) that all shellfish waters comply with Schedule 2 and in particular that sampling of shellfish waters and shellfish flesh is carried out in accordance with the parameters and frequencies specified in that Schedule, and
- (b) records of the results of the sampling are kept for a period of not less than 2 years.

(2) The Minister shall arrange—

- (a) for the results of sampling to be published by electronic means, and
- (b) for the records of the sampling to be kept at the head office of the Department of Communications, Marine and Natural Resources or at such other place as the Minister has publicly notified.

(3) The Minister shall, in consultation with the Environmental Protection Agency, determine on the basis of local environmental conditions—

- (a) each sampling point, and
- (b) the distance from a sampling point to the nearest point at which trade effluent or sewage effluent or polluting matter is discharged to shellfish waters, and
- (c) the depth at which samples are to be taken.

(4) On being satisfied that sampling has produced results that are appreciably better than the standard for a parameter specified in Schedule 2 or 4, the Minister may authorise the frequency of sampling to be reduced.

(5) On being satisfied that the quality of particular shellfish waters will not deteriorate, the Minister may authorise sampling for those waters to be discontinued.

(6) The Minister shall ensure that, as far as practicable, reference methods of analysis or inspection specified in the Schedule 2 are used for establishing the standards for each of the parameters concerned.

(7) The Minister shall ensure that other methods of analysis or inspection are used only if the results obtained are equivalent or comparable to the results obtained by the methods specified in Schedule 2.

Minister to try to ensure that shellfish waters comply with certain quality standards

6. (1) The Minister shall, in consultation with the prescribed public authorities, establish a programme of action in respect of each area of shellfish waters with a view to providing that, as far as reasonably practicable, those waters comply with the Shellfish Waters Directive and these Regulations. In particular, the objective of such a programme must be to take reasonably practicable steps to reduce pollution in those waters with a view to meeting the standards specified in Schedule 4.

(2) When a programme of action is established in accordance with paragraph (1), the Minister shall arrange for the programme to be published by electronic means or by such other means as the Minister considers appropriate.

(3) The Minister shall take all practicable steps to ensure that implementation of a programme of action does not lead, directly or indirectly, to increased pollution of coastal and brackish waters.

What constitutes compliance with Schedules 2 and 4

7. (1) For the purposes of these Regulations, shellfish waters comply with the standards specified in Schedule 2 for any period of 12 months if, during that period—

(a) in the case of parameter 3 (organohalogenated substances) and

parameter 9 (metals) specified in that Schedule, 100 per cent of the samples taken from the same sampling point in accordance with Regulation 5 comply with those standards, and

- (b) in the case of parameter 5 (salinity) and parameter 6 (dissolved oxygen) specified in that Schedule, 95 per cent of the samples taken from the same sampling point in accordance with Regulation 5 comply with those standards, and
- (c) in the case of the other specified parameters specified in that Schedule, 75 per cent of the samples taken from the same sampling point in accordance with Regulation 5 comply with those standards.

This paragraph is subject to paragraphs (3) and (4) and to any departure authorised under paragraph (5).

(2) For the purposes of these Regulations, shellfish waters comply with the standards specified in Schedule 4 for any period of 12 months if, during that period—

- (a) in the case of parameter 8 (organohalogenated substances) and parameter 9 (metals) specified in that Schedule, 100 per cent of the samples taken from the same sampling point in accordance with Regulation 5 comply with those standards, and
- (b) in the case of parameter 5 (salinity) and parameter 6 (dissolved oxygen) specified in that Schedule, 95 per cent of the samples taken from the same sampling point in accordance with Regulation 5 comply with those standards, and
- (c) in the case of the other parameters specified in that Schedule, 75 per cent of the samples taken from the same sampling point in accordance with Regulation 5 comply with those standards.

This paragraph is subject to paragraph (3).

(3) If the sampling frequency is reduced in accordance with Regulation 5(4), the sample taker must ensure that all samples comply with the relevant standard.

(4) Deviations from the standards specified in Schedule 2 are not to be taken into account in determining whether these Regulations are being, or have been, complied with if the deviations are attributable to an event that, in the Minister's opinion, is a natural or man-made disaster.

(5) The Minister may, by notice in writing, authorise a departure from a standard specified in Schedule 2 if, in the Minister's opinion, an exceptional meteorological or geophysical event has occurred. Subject to paragraph (7), such an authorisation has effect for such period, or until such time, as is specified in the notice.

(6) The Minister may impose conditions in authorising a departure from such a standard. Any such conditions have effect for the duration of the notice of authorisation or until such earlier date or time as is specified in that notice.

(7) Contravention of, or failure to comply with, a condition imposed under paragraph (6) terminates the authorisation.

Minister to determine reasons for non-compliance with standards

8. (1) If at any time an area of shellfish waters does not comply with the standards specified in Schedule 2, the Minister shall—

- (a) take all necessary steps to determine the reasons for the non-compliance, and
- (b) in particular, determine whether non-compliance is attributable to chance, natural factors or to discharges of trade effluent, sewage effluent, surface runoff, point or diffuse pollution sources or other polluting matter.

(2) The Minister shall take the required action in consultation with the prescribed public authorities and such other persons as the Minister thinks appropriate.

Certain other Regulations not affected

9. Nothing in these Regulations affects the operation of the Water Quality (Dangerous Substances) Regulations 2001 (S.I. No. 12 of 2001).

Revocation of certain Regulations

10. The Quality of Shellfish Waters Regulations 1994 (S.I. No. 200 of 1994) and the Quality of Shellfish Waters (Amendment) Regulations 2001 (S.I. No. 459 of 2001) are revoked.

SCHEDULE I

PRESCRIBED PUBLIC AUTHORITIES

The following persons and bodies are prescribed public authorities for the purposes of these Regulations:

- the Minister for Agriculture and Food
- the Minister for Communications, Marine and Natural Resources
- the Minister for the Environment, Heritage and Local Government
- the Minister for Community, Rural and Gaeltacht Affairs
- the Environmental Protection Agency
- relevant local authorities
- relevant regional authorities
- the Marine Institute
- the relevant Regional Fisheries Board
- the Central Fisheries Board

SCHEDULE 2

SHELLFISH WATERS MANDATORY VALUES

Parameter No.	Parameter	Unit of Measurement	Standard/Value	Reference Method of analysis or inspection	Frequency of sampling
1	pH	pH unit	Not less than 7 nor greater than 9	Electrometry	Quarterly Measured in situ at the time of sampling.
2	Temperature	Degrees Celsius		Thermometry	Quarterly Measured in situ at the time of sampling.
3	Coloration (After Filtration)	Milligrams per litre	A discharge affecting shellfish waters must not cause the colour of the waters after filtration to deviate by more than 10 milligrams per litre from the colour of waters not so affected.	Filter through a 0.45 micrometre membrane. Photometric method, using the platinum/cobalt scale.	Quarterly
4	Suspended solids	Milligrams per litre	A discharge affecting shellfish waters must not cause the suspended solids content of the waters to exceed by more than 30 per cent the suspended solids content of waters not so	Filtration through a 0.45 micrometre membrane, drying at 105 degrees Celsius and weighing. Centrifuging (for at least 5 minutes, with mean acceleration	Quarterly

			affected.	2,800 to 3,200g), drying at 105 degrees Celsius and weighing.	
5	Salinity	Practical salinity units	<p>(a) less than 40 practical salinity units, and</p> <p>(b) discharges affecting shellfish waters must not cause the salinity of the waters to exceed by more than 10 per cent the salinity of waters not so affected.</p>	Conductimetry	Monthly
6	Dissolved oxygen	Saturation per cent	<p>(a) equal to or greater than 70 per cent (average value)</p> <p>(b) no individual measurement to indicate a value less than 60 per cent unless it can be established that there are no harmful consequences for the development of shellfish colonies.</p> <p>Should an individual measurement indicate a</p>	Winkler's method or electrochemical method	Monthly, with a minimum of one sample representative of low oxygen conditions on the day of sampling. However, where major daily variations are suspected, a minimum of two samples in one day must be taken.

			value less than 70 per cent, measurements must be repeated.		
7	Petroleum hydrocarbons		Hydrocarbons must not be present in the shellfish waters in such quantities as will— (a) produce a visible film on the surface of the water or a deposit on the shellfish, or both, or (b) have harmful effects on the shellfish.	Visual examination	Quarterly
8	Organohalogenated substances Polychlorinated biphenyls Polychlorinated Biphenyls: Sum of ICES 7CBs ¹	$\mu\text{g. litre}^{-1}$ (seawater) $\mu\text{g. kilogram}^{-1}$ wet weight @ 1 per cent lipid (shellfish flesh ²)	0.30 300.00 The concentration of each substance in the shellfish water or in the shellfish flesh must not reach or exceed a level, which has harmful	Gas chromatography after extraction with suitable solvents and purification.	Half-yearly

			effects on the shellfish and their larvae.		
9	Metals (Dissolved): Arsenic Cadmium Chromium Copper Lead Mercury Nickel Silver Zinc	$\mu\text{g. litre}^{-1}$ (seawater)	40.00 5.00 30.00 10.00 20.00 0.40 50.00 10.00 200.00 The concentration of each substance in the shellfish water must not exceed a level that gives rise to harmful effects on the shellfish and their larvae. The synergic effects of these metals must be taken into consideration.	Spectrometry of atomic absorption preceded, when appropriate, by concentration or extraction, or both.	Half-yearly
10	Faecal coliforms	Number of faecal coliforms per 100 millilitres		Method of dilution with fermentation in liquid substrates in at least three tubes in three dilutions. Subculturing of the positive tubes on a confirmation medium. Count according to MPN (most probable number). Incubation temperature $44^{\circ}\text{C} \pm 0.5^{\circ}\text{C}$.	Quarterly

11	Substances affecting the taste of shellfish		The concentrations of such substances in shellfish waters or in shellfish flesh must be limited so that the taste of shellfish is not impaired.	Examination of the shellfish by tasting.	If the presence of any of these substances is presumed.
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¹ ICES 7 CBs: PCBs 28, 52, 101, 118, 138, 153, 180

² Applies to shellfish flesh of bivalve molluscs

SCHEDULE 3

SHELLFISH WATERS

The following are the shellfish waters to which these Regulations apply:

Mulroy Bay, Co. Donegal	The designated area covers all points due south of an imaginary line between Melmore Head and Ballyhoorisky Point, to the high water mark, as shown on a map of public record certified by the Minister for the purposes of these Regulations and kept at the head office of the Department of Communications, Marine and Natural Resources or at such other place as the Minister has publicly notified.
Killary Harbour, Co. Mayo	The designated area covers the full area of the Harbour below the high water mark from Aasleagh at the head, to Dooneen at the mouth of the harbour, as shown on a map of public record certified by the Minister for the purpose of these Regulations and kept at the head office of the Department of Communications, Marine and Natural Resources or at such other place as the Minister has publicly notified.

Kilkieran Bay, Co. Galway	The designated area is as shown on a map of record certified by the Minister for the purposes of these Regulations and kept at the head office of the Department of Communications, Marine and Natural Resources or at such other place as the Minister has publicly notified.
Clarinbridge/Kinvara Bay, Co. Galway	The designated area covers all points East of a line drawn between Kilcolgan Point on Tawin Island, and Eddy Point on island Eddy, and continued on to the Mainland at Doorus, to the high water mark, as shown on a map of public record certified by the Minister for the purposes of these Regulations and kept at the head office of the Department of Communications, Marine and Natural Resources or at such other place as the Minister has publicly notified.
Inner Bantry Bay, Co. Cork	The designated shellfish area of Inner Bantry Bay at the head of the bay covers the area of approximately 1100 hectares, east of an imaginary line due south from Ardnamanagh South on the mainland to Whiddy Point East on Whiddy Island, and from Cusroe on Whiddy Island due south to the mainland near Dromclough, to the high water mark, with the exclusion of Bantry Harbour, as shown on a map of public record certified by the Minister for the purposes of these Regulations and kept at the head office of the Department of Communications, Marine and Natural Resources or at such other place as the Minister has publicly notified.
Glengarriff Harbour, Co. Cork	The designated area covers all points north of a line drawn between Big Point and the unnamed point south east of Illauncreeveen, and the high water mark, as shown on a map of public record certified by the Minister for the purposes of these Regulations and kept at the head office of the Department of Communications, Marine and Natural Resources or at such other place as the Minister has

	publicly notified.
Roaringwater Bay, Co. Cork	The designated area covers that part of inner Roaringwater Bay that lies east of an imaginary line southeast from a point 1 kilometre east of Coosheen Point on the mainland to the northwest of Castle Island, and from the southeast of Castle Island west to the northwest of Skeam West to Skeam East and on to the westerly point of Cunnamore, north of Coolim and Goose Island, to the high water mark, but not including Ballydehob Bay, as shown on a map of public record certified by the Minister for the purposes of these Regulations and kept at the head office of the Department of Communications, Marine and Natural Resources or at such other place as the Minister has publicly notified.
Aughinish Bay, Co. Galway	The designated area is as shown on a map of record certified by the Minister for the purposes of these Regulations and kept at the head office of the Department of Communications, Marine and Natural Resources or at such other place as the Minister has publicly notified.
Cromane, Co. Kerry	The designated area is as shown on a map of record certified by the Minister for the purposes of these Regulations and kept at the head office of the Department of Communications, Marine and Natural Resources or at such other place as the Minister has publicly notified.
Inner Bay, Maharees, Co. Kerry	The designated area covers all points south west of an imaginary line from Rough Point, (062 660E 120 150N), to 065 210E 120 150N, to 062 500E 114 240N to the high water mark, as shown on a map of public record certified by the Minister for the purposes of these Regulations and kept at the head office of the Department of Communications, Marine and Natural Resources or at such other place as the Minister has publicly notified.

<p>Kilmakilloge Harbour, Co. Kerry</p>	<p>The designated area covers all points east of an imaginary line from Loughaunacreen point to the most north westerly point of Collorus head to the high water mark (excluding the area south of the road between Lauragh and Ardgroom), as shown on a map of public record certified by the Minister for the purposes of these Regulations and kept at the head office of the Department of Communications, Marine and Natural Resources or at such other place as the Minister has publicly notified.</p>
<p>Carlingford Lough, Co. Louth</p>	<p>The designated area is as is shown on a map of record certified by the Minister for the purposes of these Regulations and kept at the head office of the Department of Communications, Marine and Natural Resources or at such other place as the Minister has publicly notified.</p>
<p>Clew Bay (East of Old Head), Co. Mayo</p>	<p>The designated area covers all that area up to the high water mark and east of a line drawn from the most northerly point at Old Head to the most easterly point at Gubbain Point as shown on a map of public record certified by the Minister for the purposes of these Regulations and kept at the head office of the Department of Communications, Marine and Natural Resources or at such other place as the Minister has publicly notified.</p>
<p>Bannow Bay, Co. Wexford</p>	<p>The designated area is as is shown on a map of record certified by the Minister for the purposes of these Regulations and kept at the head office of the Department of Communications, Marine and Natural Resources or at such other place as the Minister has publicly notified.</p>

SCHEDULE 4

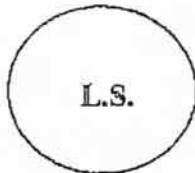
SHELLFISH WATERS GUIDE VALUES

Parameter No.	Parameter	Unit of Measurement	Standard/Value
1	pH	pH unit	
2	Temperature	Degrees Celsius	A discharge affecting shellfish must not cause the temperature of the waters to exceed by more than 2 degrees Celsius the temperatures of waters not so affected.
3	Coloration (after filtration)	Milligrams per litre	
4	Suspended solids	Milligrams per litre	
5	Salinity	Practical salinity units	12 to 38 practical salinity units.
6	Dissolved oxygen	Saturation per cent	Equal to or greater than 80 per cent (average value)
7	Petroleum hydrocarbons		
8	Organohalogenated substances: Polychlorinated biphenyls: Sum of ICES 7CBs ¹	µg.kilogram ⁻¹ wet weight @ 1 per cent lipid (shellfish flesh ²)	100.00 The concentration of each substance in the shellfish flesh must be so limited that it contributes to the high quality of shellfish products.

9	Metals: Arsenic Cadmium Chromium Copper Lead Mercury Nickel Silver Zinc	Milligrams/ kilogram ⁻¹ dry weight (shellfish flesh)	<p style="text-align: right;">30.00 5.00 6.00 400.00 7.50 1.00 5.00 15.00 4000.00</p> <p>The concentration of each substance in the shellfish flesh must be so limited that it contributes to the high quality of shellfish products.</p>
10	Faecal coliforms	Number of faecal coliforms per 100 millilitres	Equal to or less than 300 in the shellfish flesh and intervalvular liquid
11	Substances affecting the taste of shellfish		

¹ ICES 7 CBs: PCBs 28, 52, 101, 118, 138, 153, 180

² Applies to shellfish flesh of bivalve molluscs



GIVEN under my Official Seal,
22 May 2006

Noel Dempsey

Minister for Communications, Marine
and Natural Resources

EXPLANATORY NOTE.

(This note is not part of the Instrument and does not purport to be a legal interpretation).

These Regulations prescribe quality standards for shellfish waters and designate the waters to which they apply, together with sampling and analysis procedures to be used to determine compliance with the standards. The Regulations also require the preparation and implementation of action programmes in respect of all such waters. The Regulations give effect to Council Directive 79/923/EEC of 30 October 1979 on the quality required of shellfish waters and replace earlier Statutory Instruments Nos. 200 of 1994 and 459 of 2001.

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