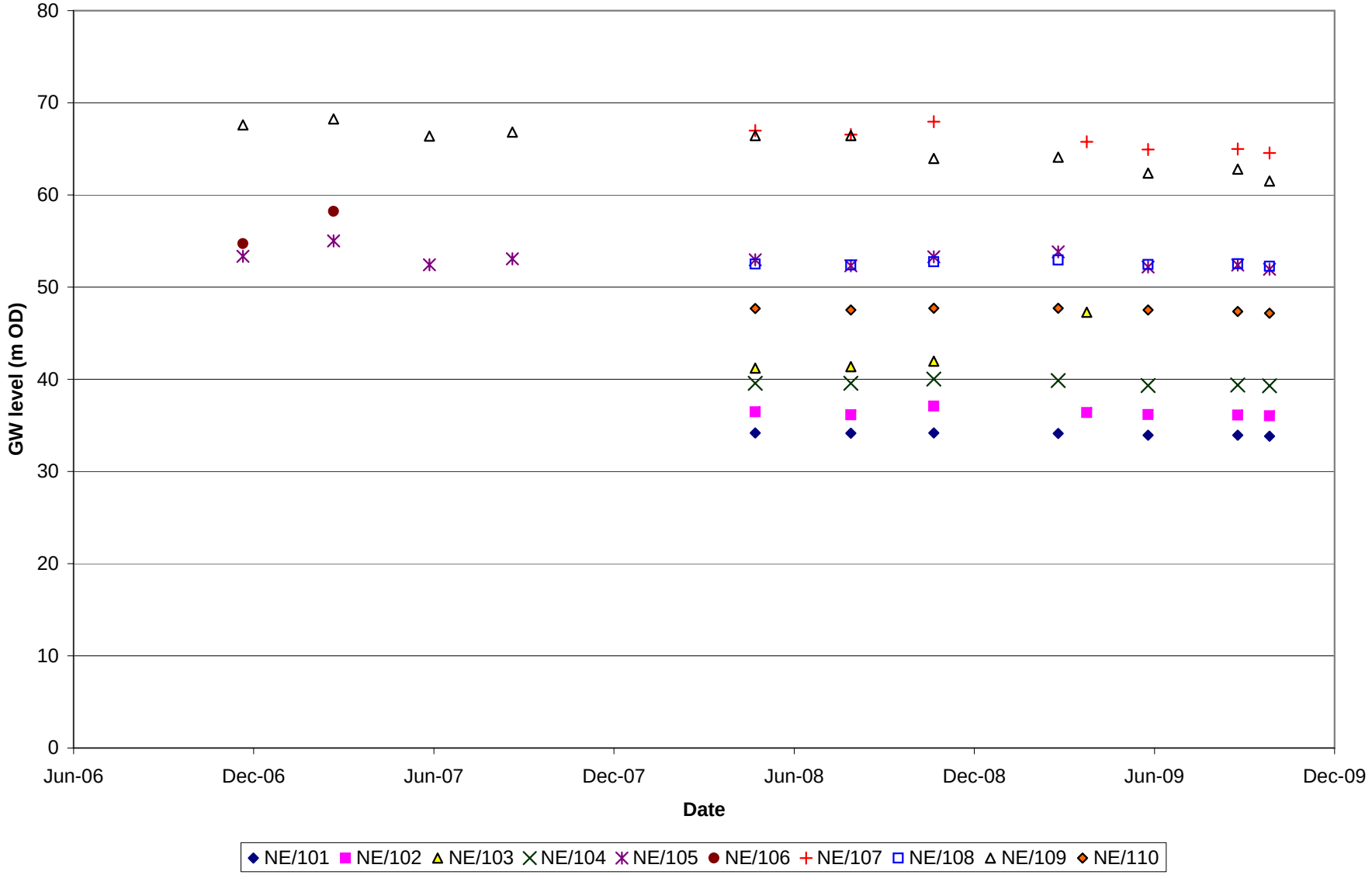
APPENDIX HRA1
Groundwater Hydrograph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30
20
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GW level (m OD)
Jun-06
Dec-06
Jun-07
Dec-07
Jun-08
Dec-08
Jun-09
Dec-09
Date
NE/101
NE/102
NE/103
NE/104
NE/105
NE/106
NE/107
NE/108
NE/109
NE/110

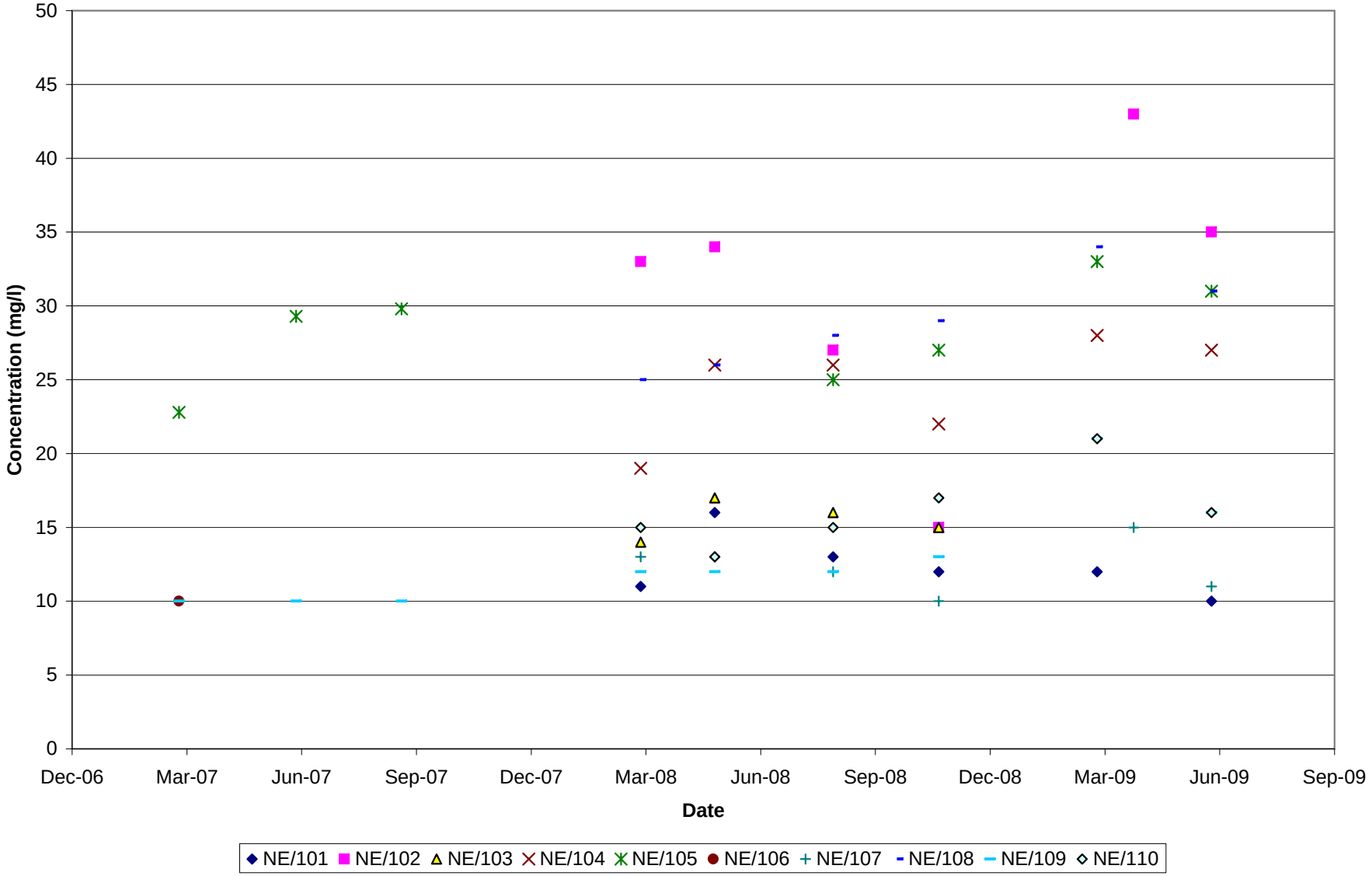
APPENDIX HRA2
Groundwater Quality

Determinand		DWS (mg/l)	NE/101	NE/102	NE/103	NE/104	NE/105	NE/106	NE/107	NE/108	NE/109	NE/110
Calcium (mg/l)	Count	200	6.00	6.00	4.00	6.00	6.00		6.00	6.00	8.00	6.00
	Min		31.00	30.00	34.00	80.00	94.00		55.00	86.00	95.00	46.00
	Mean		44.67	37.50	40.75	88.33	97.38		59.83	93.17	110.63	60.33
	Max		54.00	59.00	44.00	98.00	105.00		75.00	107.00	147.00	74.00
Magnesium (mg/l)	Count		6.00	6.00	4.00	6.00	6.00		6.00	6.00	8.00	6.00
	Min		6.86	6.28	10.00	25.00	27.00		5.69	25.00	7.35	11.00
	Mean		11.74	14.05	12.75	29.67	29.20		7.98	31.17	12.55	15.67
	Max		15.00	19.00	17.00	36.00	32.00		12.00	41.00	20.20	22.00
Potassium (mg/l)	Count		6.00	6.00	4.00	6.00	6.00		6.00	6.00	8.00	6.00
	Min		1.42	0.50	0.80	0.73	1.01		1.06	0.78	0.48	1.38
	Mean		3.01	0.77	1.07	1.57	1.78		1.81	2.22	1.72	2.53
	Max		4.00	1.29	1.30	3.40	2.72		3.70	3.90	2.90	4.80
Sodium (mg/l)	Count	200	6.00	6.00	4.00	6.00	6.00		6.00	6.00	8.00	6.00
	Min		8.15	8.84	10.00	18.00	19.00		7.52	22.00	20.00	13.00
	Mean		13.74	18.64	13.25	19.33	22.68		9.32	29.00	24.84	17.17
	Max		20.00	26.00	19.00	24.00	28.00		15.00	37.00	33.00	23.00
Chloride (mg/l)	Count	250	6.00	6.00	4.00	6.00	7.00	1.00	6.00	6.00	9.00	6.00
	Min		10.00	15.00	14.00	19.00	22.80	10.00	10.00	25.00	10.00	13.00
	Mean		12.33	31.17	15.50	24.67	28.27	10.00	12.33	28.83	12.89	16.17
	Max		16.00	43.00	17.00	28.00	33.00	10.00	15.00	34.00	21.00	21.00
SO4 (mg/l)	Count		6.00	6.00	4.00	6.00	4.00		6.00	6.00	6.00	6.00
	Min		2.50	11.00	12.00	35.00	42.00		13.00	41.00	15.00	9.00
	Mean		7.00	13.17	13.00	44.00	44.75		16.17	55.67	16.17	12.83
	Max		17.00	15.00	15.00	49.00	49.00		22.00	65.00	19.00	21.00
NO3 (mg/l) N	Count		6.00	6.00	4.00	6.00	7.00	1.00	6.00	6.00	9.00	6.00
	Min		0.15	0.15	0.15	0.15	0.15	0.80	0.15	0.15	0.50	0.15
	Mean		0.15	0.18	0.19	0.59	0.17	0.80	0.29	0.15	1.37	0.28
	Max		0.15	0.30	0.30	1.90	0.20	0.80	0.60	0.15	4.94	0.40

Determinand		DWS (mg/l)	NE/101	NE/102	NE/103	NE/104	NE/105	NE/106	NE/107	NE/108	NE/109	NE/110
Hardness as CaCO3	Count		6.00	6.00	4.00	6.00	4.00		6.00	6.00	6.00	6.00
	Min		51.00	54.80	59.50	121.00	144.00		64.00	127.00	110.00	64.00
	Mean		71.55	60.43	61.75	173.96	202.00		72.97	181.79	157.67	103.90
	Max		105.90	69.00	63.50	352.75	358.01		93.00	357.76	273.00	176.02
Conductivity	Count		6.00	6.00	4.00	6.00	7.00	1.00	6.00	6.00	9.00	6.00
	Min		228.00	273.00	227.00	424.00	479.00	199.00	267.00	438.00	411.00	282.00
	Mean		346.83	354.67	357.50	542.17	598.86	199.00	306.33	573.17	522.44	366.67
	Max		658.00	675.00	677.00	602.00	654.00	199.00	433.00	623.00	770.00	717.00
pH	Count		6.00	6.00	4.00	6.00	7.00	1.00	6.00	6.00	9.00	6.00
	Min		7.10	7.70	7.60	7.60	7.11	7.88	7.90	7.30	7.14	7.30
	Mean		7.32	7.95	7.90	7.77	7.59	7.88	8.07	7.53	7.54	7.87
	Max		8.20	8.20	8.30	8.20	7.90	7.88	8.40	7.90	7.80	8.20
Ammoniacal Nitrgogen (N:mg/l)	Count	0.39	6.00	6.00	4.00	6.00	7.00	1.00	6.00	6.00	9.00	6.00
	Min		0.75	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02
	Mean		0.90	0.04	0.02	0.02	0.04	0.03	0.03	0.02	0.04	0.02
	Max		1.14	0.07	0.02	0.02	0.10	0.03	0.06	0.02	0.09	0.02
Iron (Dissolved) (mg/l)	Count	0.2	6.00	6.00	4.00	6.00	7.00	1.00	6.00	6.00	9.00	6.00
	Min		0.02	0.02	0.02	0.02	0.02	0.03	0.02	0.02	0.02	0.02
	Mean		0.02	0.02	0.04	0.02	0.02	0.03	0.02	0.02	0.16	0.02
	Max		0.03	0.03	0.08	0.03	0.03	0.03	0.03	0.03	1.27	0.03
BOD (mg/l)	Count		6.00	6.00	4.00	6.00	7.00	1.00	6.00	6.00	9.00	6.00
	Min		0.50	0.50	0.50	0.50	0.50	4.75	0.50	0.50	0.50	0.50
	Mean		2.00	0.83	0.50	0.75	2.26	4.75	0.83	0.75	1.66	0.83
	Max		5.00	2.00	0.50	2.00	4.75	4.75	2.00	2.00	4.75	2.00
Nickel (Dissolved) (ug/l)	Count	20	6.00	6.00	4.00	6.00	7.00	1.00	6.00	6.00	9.00	6.00
	Min		0.45	0.45	0.45	0.45	0.45	2.50	0.45	2.10	0.45	0.45
	Mean		1.78	1.48	1.99	1.55	3.35	2.50	1.48	5.65	6.32	1.62
	Max		2.50	2.50	2.50	2.50	5.80	2.50	2.50	11.90	41.40	2.50

Determinand		DWS (mg/l)	NE/101	NE/102	NE/103	NE/104	NE/105	NE/106	NE/107	NE/108	NE/109	NE/110
Lead (Dissolved) (ug/l)	Count	10	6.00	6.00	4.00	6.00	7.00	1.00	6.00	6.00	9.00	6.00
	Min		1.00	1.00	1.00	1.00	1.00	3.00	1.00	1.00	1.00	1.00
	Mean		2.33	2.08	2.13	2.25	2.07	3.00	2.08	1.75	2.56	1.75
	Max		6.00	3.00	2.50	3.00	3.00	3.00	3.00	2.50	6.52	2.50
Alluminium (Dissolved) (ug/l)	Count	200	6.00	6.00	4.00	6.00	4.00		6.00	6.00	6.00	6.00
	Min		10.00	10.00	10.00	10.00	10.00		10.00	10.00	10.00	10.00
	Mean		15.83	15.17	22.50	17.00	10.00		19.17	14.67	15.50	21.67
	Max		45.00	41.00	49.00	39.00	10.00		42.00	38.00	43.00	54.00
COD (mg/l)	Count		6.00	6.00	4.00	6.00	7.00	1.00	6.00	6.00	9.00	6.00
	Min		83.00	10.00	10.00	26.00	8.50	19.10	21.00	45.00	23.20	48.00
	Mean		180.00	21.17	29.25	58.33	80.09	19.10	75.83	139.00	88.49	115.00
	Max		268.00	45.00	51.00	120.00	179.00	19.10	165.00	257.00	194.00	219.00
Zinc (Dissolved) (ug/l)	Count	5000	6.00	6.00	4.00	6.00	7.00	1.00	6.00	6.00	9.00	6.00
	Min		2.50	2.50	2.50	2.50	2.50	5.50	1.00	2.50	1.00	2.50
	Mean		9.25	5.58	8.00	8.42	6.36	5.50	4.33	5.92	16.28	4.33
	Max		17.00	7.00	16.00	26.00	16.00	5.50	11.00	10.00	112.00	8.00
TON (N:mg/l)	Count		6.00	6.00	4.00	6.00	4.00		6.00	6.00	6.00	6.00
	Min		0.15	0.15	0.15	0.15	0.15		0.15	0.15	0.50	0.15
	Mean		0.15	0.22	0.19	0.59	0.15		0.29	0.15	0.85	0.28
	Max		0.15	0.40	0.30	1.90	0.15		0.60	0.15	1.50	0.40
Chromium (Dissolved) (ug/l)	Count	50	6.00	6.00	4.00	6.00	7.00	1.00	6.00	6.00	9.00	6.00
	Min		0.50	0.50	0.50	0.50	0.50	2.00	0.50	0.50	0.50	0.50
	Mean		1.50	1.50	2.00	1.50	1.43	2.00	1.50	1.50	8.54	1.50
	Max		2.50	2.50	2.50	2.50	2.50	2.00	2.50	2.50	63.90	2.50
Alkalinity (mg/l)	Count		6.00	6.00	4.00	6.00	4.00		6.00	6.00	6.00	6.00
	Min		123.00	93.60	98.70	255.00	274.00		118.00	240.00	248.00	139.00
	Mean		183.67	105.52	114.18	270.50	294.25		134.00	292.00	289.67	162.17
	Max		254.00	139.00	125.00	284.00	330.00		142.00	337.00	396.00	187.00

Determinand		DWS (mg/l)	NE/101	NE/102	NE/103	NE/104	NE/105	NE/106	NE/107	NE/108	NE/109	NE/110
Copper (Dissolved) (ug/l)	Count	2000	6.00	6.00	4.00	6.00	7.00	1.00	6.00	6.00	9.00	6.00
	Min		0.50	0.50	1.00	0.50	0.50	24.20	0.50	0.50	0.50	0.50
	Mean		2.42	2.58	2.75	2.08	1.14	24.20	2.58	1.58	3.08	1.75
	Max		5.00	6.00	5.00	5.00	2.50	24.20	6.00	2.50	15.20	2.50
Cadmium (Dissolved) (ug/l)	Count	5	6.00	6.00	4.00	6.00	7.00	1.00	6.00	6.00	9.00	6.00
	Min		0.15	0.15	0.15	0.15	0.15	0.28	0.15	0.15	0.15	0.15
	Mean		0.24	0.20	0.23	0.20	0.22	0.28	0.26	0.20	0.23	0.20
	Max		0.40	0.25	0.25	0.25	0.28	0.28	0.50	0.25	0.28	0.25
Arsenic (Dissolved) (ug/l)	Count	10	6.00	6.00	4.00	6.00	4.00		6.00	6.00	6.00	6.00
	Min		0.50	0.50	0.50	0.50	0.50		0.50	0.50	0.50	0.50
	Mean		0.92	0.50	0.50	0.50	0.50		0.50	0.67	0.50	0.67
	Max		2.00	0.50	0.50	0.50	0.50		0.50	1.00	0.50	1.00
Manganese (mg/l)	Count		6.00	6.00	4.00	6.00	4.00		6.00	6.00	6.00	6.00
	Min		5.22	0.01	0.36	0.04	0.05		0.02	0.41	0.02	0.02
	Mean		6.54	0.16	0.72	0.96	0.38		0.34	1.22	0.39	0.52
	Max		7.89	0.33	0.95	3.39	0.68		1.07	1.71	1.26	1.08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20
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Mar-07
Jun-07
Sep-07
Dec-07
Mar-08
Jun-08
Sep-08
Dec-08
Mar-09
Jun-09
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Date
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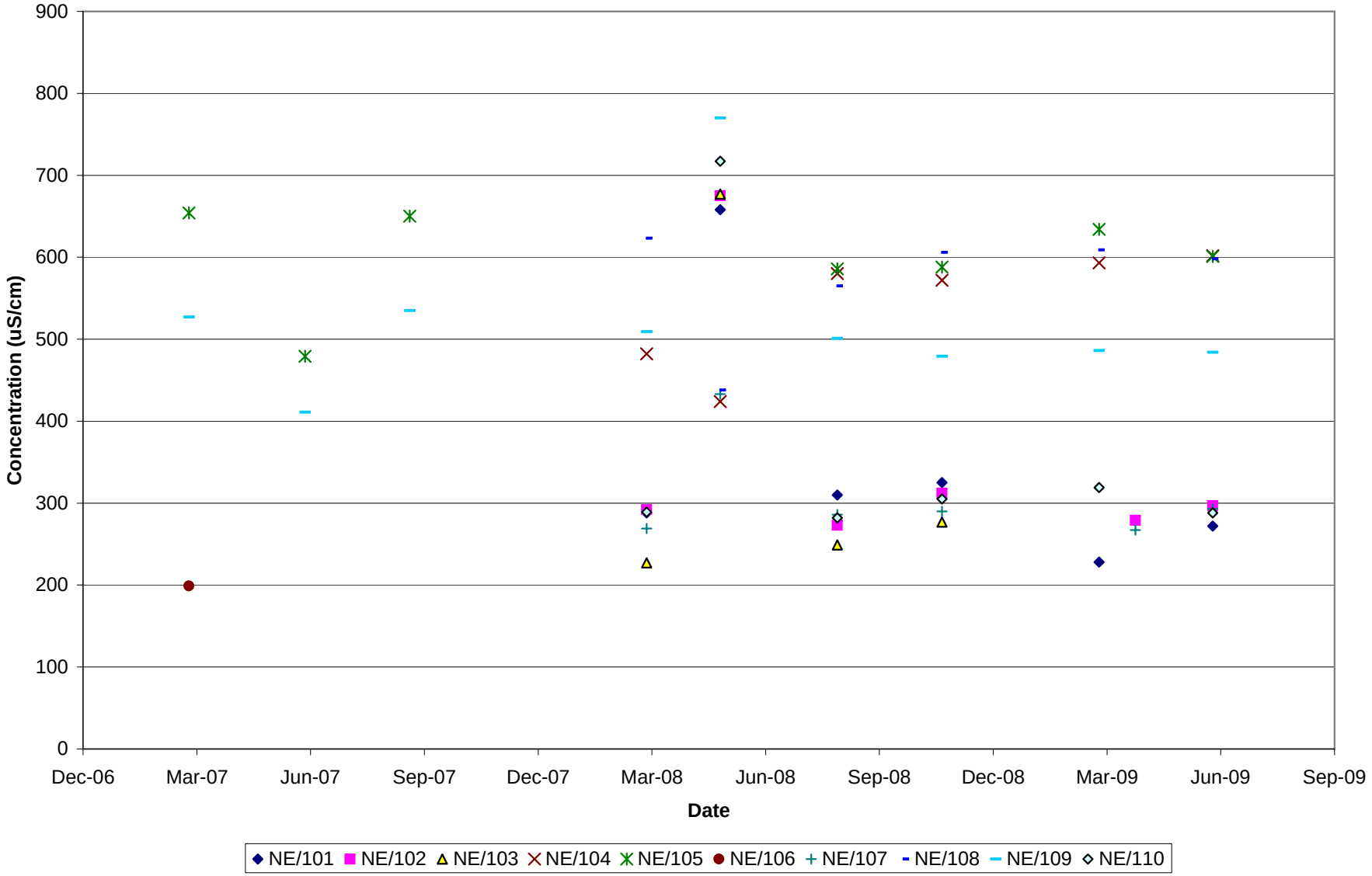
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Concentration (uS/cm)
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Mar-07
Jun-07
Sep-07
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Mar-08
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Mar-09
Jun-09
Sep-09
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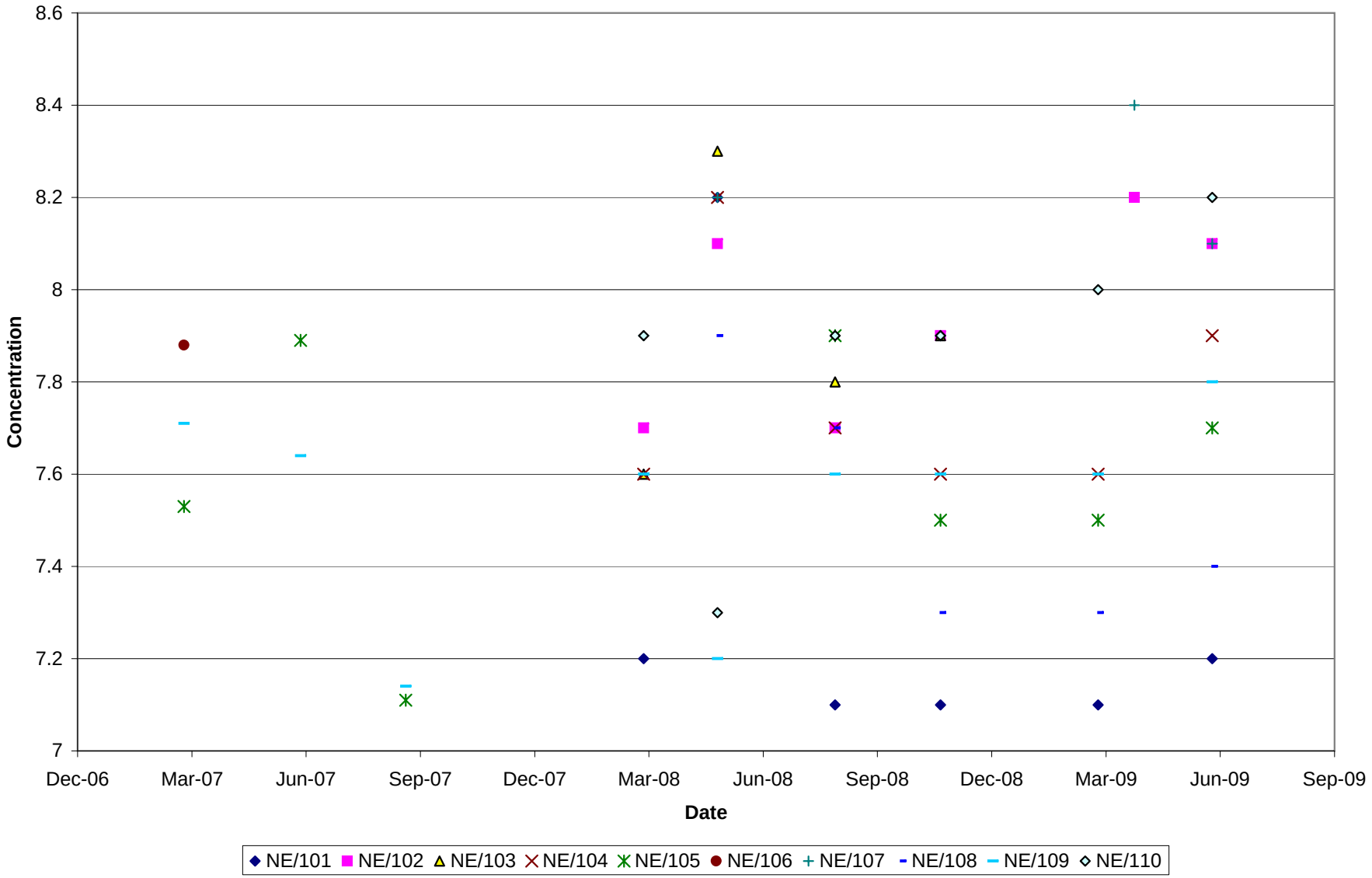
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7.2
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Concentration
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Mar-07
Jun-07
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Dec-07
Mar-08
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Mar-09
Jun-09
Sep-09
Date
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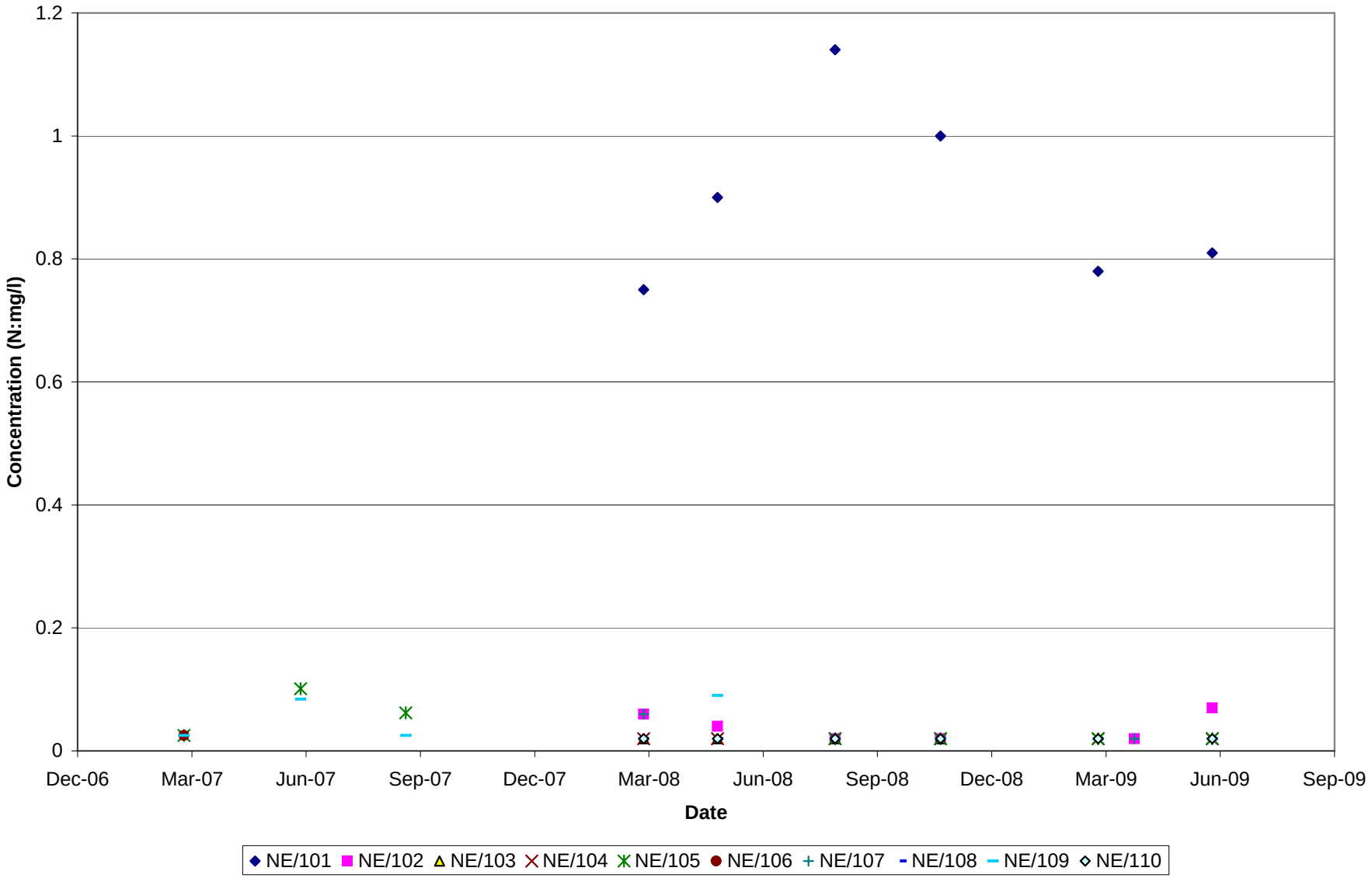
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Concentration (N:mg/l)
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Jun-07
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Mar-08
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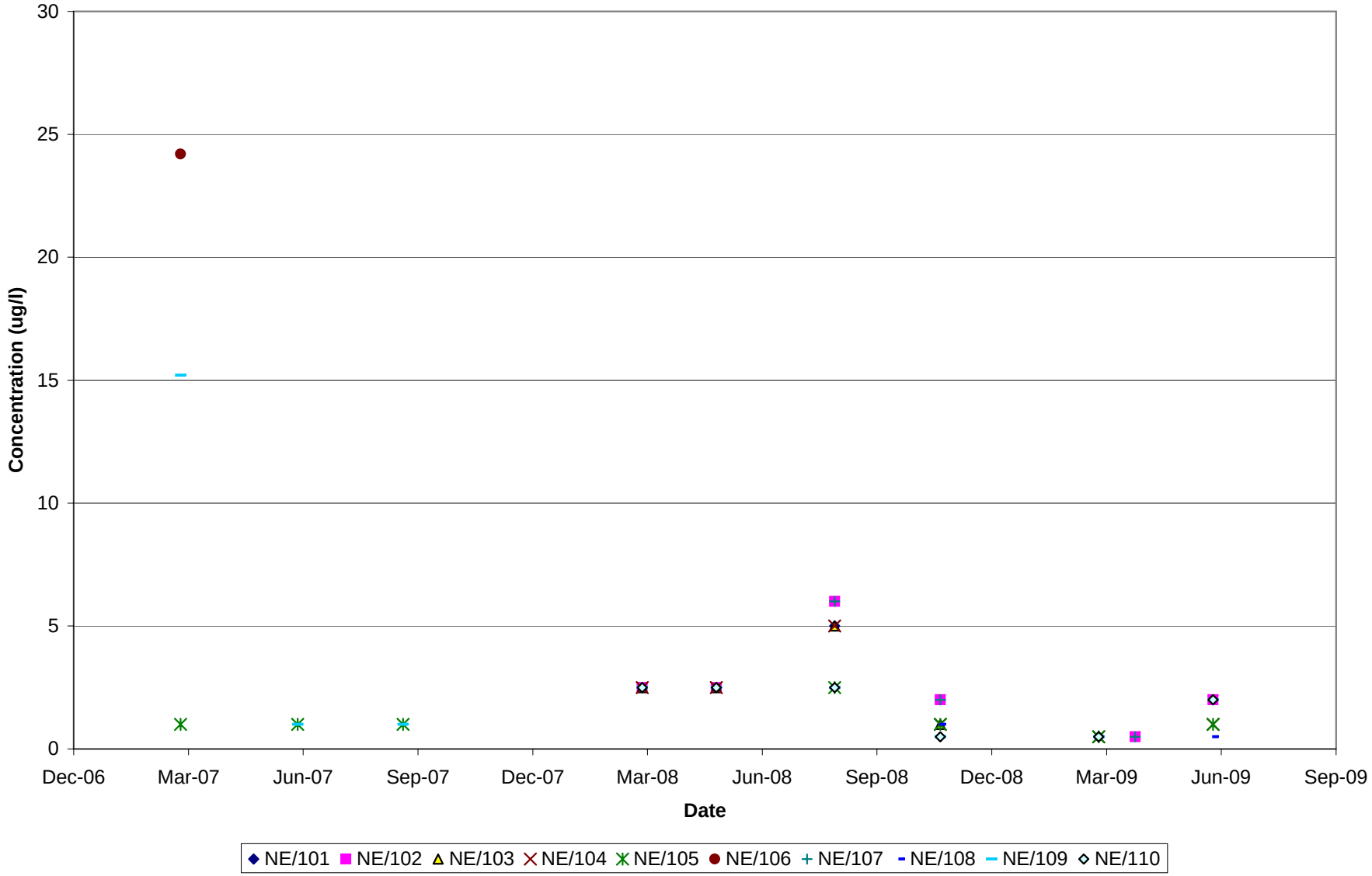
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Concentration (ug/l)
Dec-06
Mar-07
Jun-07
Sep-07
Dec-07
Mar-08
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Sep-08
Dec-08
Mar-09
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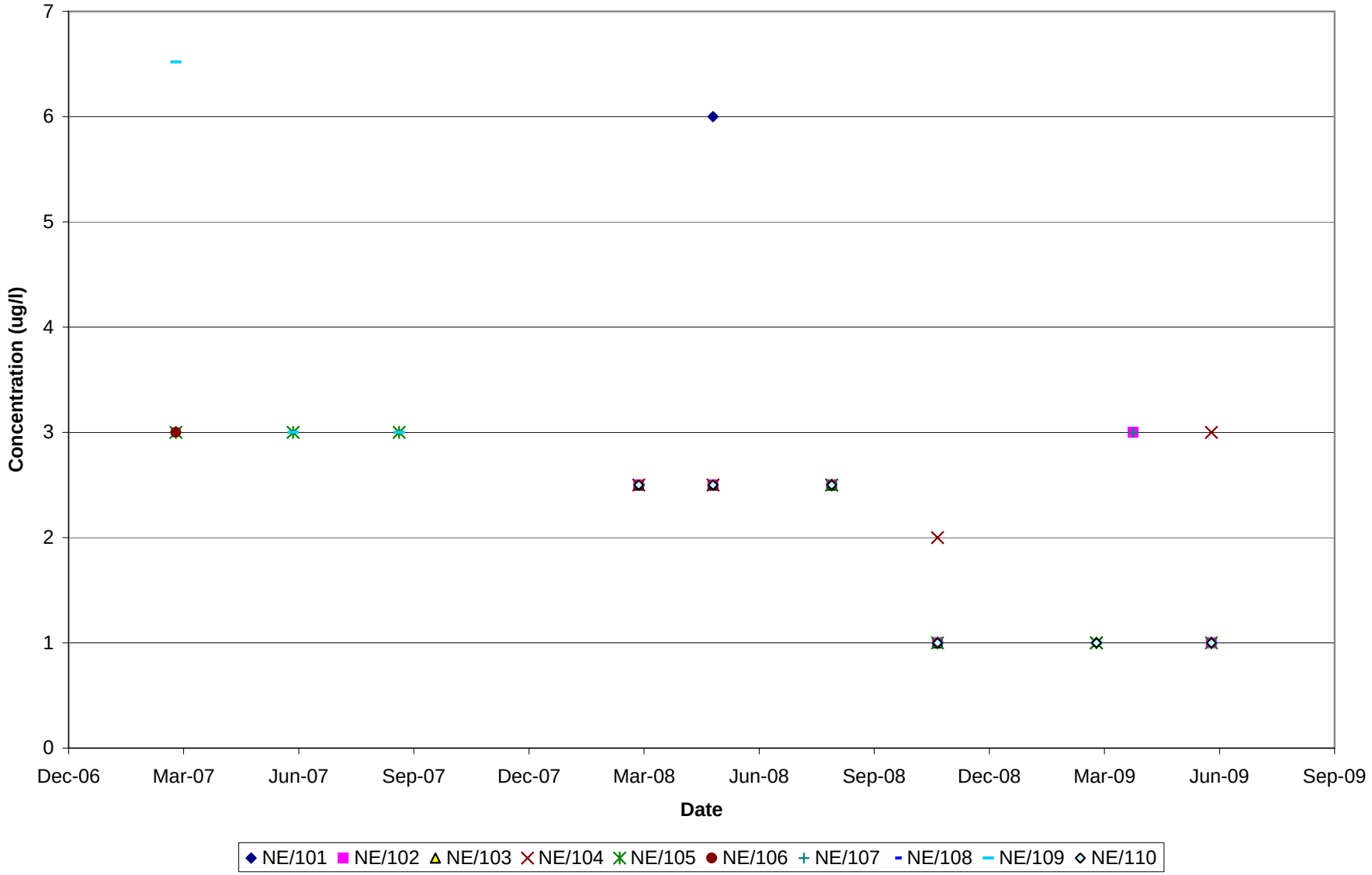
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Concentration (ug/l)
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Mar-07
Jun-07
Sep-07
Dec-07
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Sep-08
Dec-08
Mar-09
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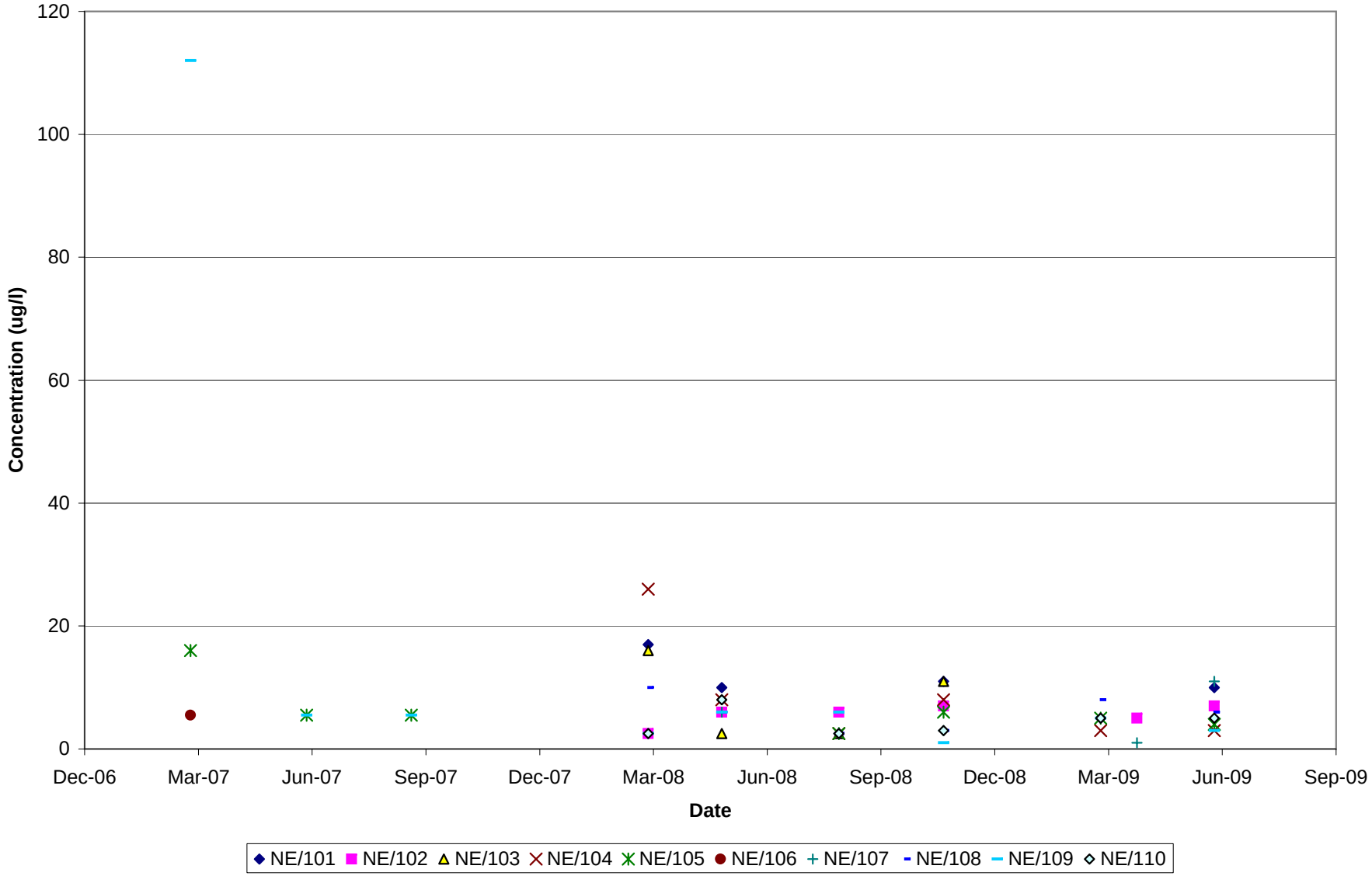
120
100
80
60
40
20
0
Concentration (ug/l)
Dec-06
Mar-07
Jun-07
Sep-07
Dec-07
Mar-08
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Sep-08
Dec-08
Mar-09
Jun-09
Sep-09
Date
NE/101
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APPENDIX HRA3
LandSim Parameterisation Table

Appendix HRA3 – LandSim Model Parameterisation

A: LANDFILL SOURCE

Item	Value/Description	Source/Derivation
Infiltration in to Open Waste during Operational Period (mm/year)	Min: 500 Max: 1200 (Uniform Distribution)	Range based on rainfall values recorded in MAFF[1], with reduced minimum as worst case
Cap Infiltration Rate for Post Closure Period (mm/year)	50 ± 10 (Normal Distribution)	Typical accepted values for restored landfill geomembrane cap.
Cap Design Infiltration Rate for Long Term Post Closure Periods (mm/year)	265 ± 26.5 (Normal Distribution)	50% of winter excess rainfall from MAFF agroclimate data.
End of Filling (years from start of waste disposal)	30 (Single Value)	30 years at most likely input rate of 33,000 tonnes per year
Start of Cap Degradation (years from end of Waste Disposal)	250 (Single Value)	LandSim default value.
End of Cap Degradation (years from end of Waste Disposal)	1000 (Single Value)	LandSim default value.
Final Waste Thickness (m)	Min: 5 Most Likely: 25 Max: 50 (Triangular Distribution)	Based on proposed scheme, assuming pre-settlement elevations as a worst case.
Waste Porosity (%)	Min: 20 Most Likely: 35 Max: 50 (Triangular Distribution)	Wide range to reflect types of proposed wastes.
Waste Density (kg/l)	Min: 0.6 Max: 1.4 (Uniform Distribution)	Wide range to reflect types of proposed waste and high maximum to represent IBA waste stream.
Waste Field Capacity (fraction)	Min: 0.20 Most Likely: 0.30 Max: 0.35 (Triangular Distribution)	Worst-case estimate based on LandSim defaults. Inert wastes expected to have lower field capacities
Head of Leachate when Surface Water Breakout Occurs (m)	Min: 3 Max: 15 (Uniform Distribution)	Values based on proposed scheme. Assumes breakout at current overtopping point of 51 maOD

[1] MAFF (1975) *Bulletin 34 – Climate and Drainage,* Agroclimate 43 south

A: LANDFILL SOURCE (CONT.)

Item	Value/Description	Source/Derivation
Basal Area (Ha)	2.302 (Single Value)	Sum total of all basal areas of all terraces.
Landfill Cap Area (Ha)	5.099 (Single Value)	Based on proposed scheme.
Duration of Management Controls (years from start of waste disposal)	90 (Single Value)	Assumes 60 years of management control following cessation of filling.
Time Offset (years)	0 (Single Value)	Modelled as single phase therefore time offset is not applicable to the site
Leachate Head (m)	Min: 0.5 Max: 2 (Uniform Distribution)	Assumed values based on LandSim approach.

B: LEACHATE QUALITY

Item	Value/Description	Source/Derivation
Ammoniacal-N (mg/l)	Min: 3 Most Likely: 407 Max : 2041 (Log Triangular Distribution)	Range calculated using weighted averages based on the following waste distribution: Rejected MSW: 60% IBA: 14% Commercial and Industrial (C&I): 26% The following sources were used for concentrations: LandSim default values (for C&I) 0.5X LandSim default values (MSW) EA report P1-494/SR2[2] (IBA)
Chloride (mg/l)	Min: 71 Most Likely: 1523 Max : 4724 (Log Triangular Distribution)	
Copper (mg/l)	Min: 0.17 Most Likely 0.85 Max : 3.01 (Log Triangular Distribution)	
Cadmium (mg/l)	Min: 0.029 Most Likely: 0.146 Max : 0.199 (Log Triangular Distribution)	
Lead (mg/l)	Min: 0.014 Most Likely: 0.11 Max : 1.27 (Log Triangular Distribution)	
Zinc (mg/l)	Min: 0.0027 Most Likely: 0.10 Max : 116.66 (Uniform Distribution)	
Mercury (mg/l)	Min: 0.0003 Most Likely: 0.0015 Max : 0.0039 (Log Triangular Distribution)	
Naphthalene (mg/l)	Min: 0.0001 Most Likely: 0.003 Max : 0.042 (Log Triangular Distribution)	Worst-case leachate quality based on Knox *et.al.* (2000)[3],

[2] Environment Agency (2004b): *Testing of residues from incineration of municipal solid waste, Science Report P1-494/SR2*

[3] Knox, K *et.al.* (Oct 2000)[3] : *The Occurrence of Trace Organic Components in Landfill Leachates and their removal during Onsite Treatment.* From the Proceedings of Waste 2000 Conference, Stratford upon Avon, 2-4 October 2000, p263-272.

Item	Value/Description		Source/Derivation
Toluene (mg/l)	Min: Most Likely: Max : (Log Triangular Distribution)	0. 01 0.087 1.287	Worst-case leachate quality based on Knox *et.al.* (2000).
Xylene (mg/l)	Min: Most Likely: Max : (Log Triangular Distribution)	0.03 0.059 0.208	Worst-case leachate quality based on Knox *et.al.* (2000).
Mecoprop (mg/l)	Min: Most Likely: Max : (Log Triangular Distribution)	0.0001 0.011 0.14	Worst-case leachate quality based on Knox *et.al.* (2000).

Note: Non-hazardous (List II and general) substances are input into the LandSim model source term as spot measurements, as per the LandSim manual.

C: LEACHATE SOURCE TERM KAPPA VALUES AND HALF LIVES

Item	Value/Description	Source/Derivation
Values of m and c used to calculate the kappa value		
Ammoniacal-N (kg/l)	m = 0 c = 0.59	After LandSim 2.5 default values.
Chloride (kg/l)	m = 0.0298 c = 0.2919	
Copper (kg/l)	m = 0.0664 c = -0.048	
Cadmium (kg/l)	m = 0.0823 c = 0.1589	
Lead (kg/l)	m = 0.0443 c = 0.0171	
Mercury (kg/l)	m = 0.0767 c = 0.1643	
Zinc (kg/l)	m = 0.0403 c = 0.0561	
Mecoprop (kg/l) Xylene (kg/l) Toluene (kg/l) Naphthalene (kg/l)	m = 0.0298 c = 0.2919	No published data. LandSim 2.5 default value for chloride assumed. This approach has been accepted by the EA (UK) for numerous HRAs completed by SLR. It is assumed that landfill gas extraction will not take place, given the waste stream.

D: ENGINEERED LINING SYSTEM (HDPE & BES)

Item	Value/Description			Source/Derivation
HDPE - Artificial Sealing Liner Defects (per Ha) Pinholes (0.1 – 5mm^2) Holes (5 – 100mm^2) Tears(100 – 10,000mm^2)	Min 0 0 0 (Triangular Distribution)	Most Likely 0.1	Max 13 3 1	Based on LandSim User Manual and assumes leak detection survey and necessary repairs are completed after placement of drainage materials. Range are LandSim default values when CQA is specified.
Onset of HDPE Degradation (years since filling commenced)	150 (Single Value)			LandSim default.
Time for Area of Defects to Double (years)	100 (Single Value)			LandSim default.
Clay Liner Thickness(m)	1.0 (Single Value)			Proposed design thickness.
Moisture Content (fraction)	Min: Max: (Uniform Distribution)	0. 01 0.20		Based on design proposal. Assuming worst case range.
Hydraulic Conductivity (m/s)	Min: Most Likely: Max : (Log Triangular Distribution)	1.0E-11 1.0E-10 1.0E-9		range based on combination of values for GCL and 1.5m clay liner
Longitudinal Dispersion	0.10 (Single Distribution)			LandSim approach (10% of pathway length).
Retardation Parameters (l/kg)		Min	Max	No retardation assumed for chloride
	Amm N	0.5	2	
	Chloride	0		
	Lead	27	270000	LandSim default values used for all other except mecoprop
	Cadmium	1.6	1500	
	Copper	40	27500	
	Zinc	1	600	Mecoprop values based on range for Mercia Mudstone from EA guidance [4] *(*Table 8.2) 1% of minimum used as worst case.
	Mecoprop	0.003	0.7	
	(Uniform Distribution)			
Partition to Organic Carbon (Koc) (l/kg)		Min	Max	Maximum values are based on published values from EA report[5]. Minimum values are 10% of maximum values as a worst case.
	Naphthalene	64.5	645	
	Xylene	49.0	489.8	
	Toluene	20.4	204.2	
	Uniform Distribution) (Single)			
Fraction of Organic Carbon	Min: 0.0001 Max 0.001 (Uniform Distribution)			Values based on range for clay in Table 7.2 EA guidance[6]
Clay Liner Density (kg/l)	Min: Max: (Uniform Distribution)	1.5 1.8		Based on typical values, based on SLR experience.

[4] Environment Agency (2009) *Attenuation of organic contaminants in leachate be mineral landfill liners,* Report No: SC020039/SR5
[5] Environment Agency (2008) *Compilation of data for priority organic pollutants for derivation of soil guideline values,* Report No: SC050021/SR7
[6] Environment Agency (2004) *Attenuation of mecoprop in the subsurface*, Science Group Report No: NC/03/12

Degradation Half Life (years)		Min	Max	After Howard et al, Handbook of Environmental Degradation Rates (1991) for aqueous anaerobic conditions. No degradation assumed for ammoniacal nitrogen in anaerobic conditions. No degradation assumed for metals or chloride.
	Naphthalene	0.07	0.71	
	Toluene	0.154	0.577	
	Xylene	0.5	1.0	
	Mecoprop	0.08	0.5	
	(Uniform Distribution)			

E: UNSATURATED PATHWAY – SUB LINER FORMATION LAYER (DOLERITE)

Item	Value/Description			Source/Derivation
Layer Thickness (m)	Min:	0.01		Large variation to represent the unsaturated zone beneath the various terraces. Minimum of 0.01 used due to model due to error caused by entering a 0 value
	Most Likely:	5		
	Max :	15		
	(log Triangular Distribution)			
Moisture Content (fraction)	Min:	0.01		Typical range for a dolerite / shale geology
	Max:	0.03		
	(Uniform Distribution)			
Hydraulic Conductivity (m/s)	Min:	3.69E-07		Transmissivity values calculated based permeability tests undertaken by SLR and Carnon Contracting. Permeability calculated assuming a 3m mixing zone thickness.
	Most Likely:	8.46E-06		
	Max :	3.21E-05		
	(Log Triangular Distribution)			
Longitudinal Dispersion	Min:	0		10% of layer thickness
	Most Likely:	0.5		
	Max :	1.5		
	(Triangular Distribution)			
Retardation Parameters (l/kg)		Min	Max	No retardation assumed for chloride Non hazardous substances are not modelled within the aquifer pathway Ammoniacal–N range reflects LandSim defaults, with minimum value assumed as worst case . Other parameters based on 10% of LandSim default as maximum, and 0 as a worst case.
	Amm N	0	2	
	Chloride	0		
	Lead	0	27000	
	Copper	0	2750	
	Zinc	0	60	
	(Uniform Distribution)			
Pathway half-Lives (years)		Min	Max	No degradation assumed for metals or chloride. Hazardous substances not modelled in aquifer pathway. Ammoniacal nitrogen values are based on range reported in Erskine, “Transport of ammonium in aquifers: retardation and degradation”, 2000.
	Amm N	5	10	
Pathway Density (kg/l)	Min:	1.5		Worst case density assumed for dolerite.
	Max:	1.8		
	(Uniform Distribution)			

G: GEOLOGICAL PATHWAY

Item	Value/Description	Source/Derivation
Mixing Zone Thickness (m)	Min: 2 Max : 3 (Triangular Distribution)	Assumes a thin preferential pathway beneath the quarry.
Pathway Width (m)	180 (Single Value)	Width of pathway perpendicular to groundwater flow.
Pathway Length (m)	Min Max 40 220 (Uniform Distribution)	Proposed scheme and assuming that the compliance point is the River Yealm.
Hydraulic Conductivity (m/s)	Min: 3.69E-07 Most Likely: 8.46E-06 Max : 3.21E-05 (Log Triangular Distribution)	Transmissivity values calculated based permeability tests undertaken by SLR and Carnon Contracting. Permeability calculated assuming a 3m mixing zone thickness.
Regional Gradient	Min: 0.062 Max: 0.123 (Uniform Distribution)	After inferred regional groundwater contours (Drawing HRA2).
Pathway Porosity (fraction)	Min: 0.01 Max 0.03 (Uniform Distribution)	Typical range for fractured dolerite.
Longitudinal Dispersion	0.001 (Single value)	Very low values used as worst case.
Transverse Dispersion	0.001 (Single value)	
Retardation Parameters (l/kg)	Min Max Amm N 0 2 Chloride 0 Lead 0 27000 Copper 0 2750 Zinc 0 60 (Uniform Distribution)	No retardation assumed for chloride. Ammoniacal–N range reflects LandSim defaults, with minimum value assumed as worst case. . Other parameters based on 10% of LandSim default as maximum, and 0 as a worst case.
Pathway half-Lives (years)	Min Max Amm N 5 10	No degradation assumed for metals or chloride Ammoniacal nitrogen values are based on range reported in Erskine, "Transport of ammonium in aquifers: retardation and degradation", 2000.
Pathway Density (kg/l)	Min: 1.5 Max: 1.8 (Uniform Distribution)	Worst case density assumed for dolerite.

H: BACKGROUND GROUNDWATER QUALITY

Item	Value/Description		Source/Derivation
Ammoniacal-N (mg/l)	Min:	0.02	
	Most Likely	0.03	
	Max:	0.09	
	(Log Triangular Distribution)		
Chloride (mg/l)	Min:	10	
	Most Likely	13.5	
	Max:	21	
	(Log Triangular Distribution)		
Copper (mg/l)	Min:	0.0005	Range based on site specific monitoring data with outliers removed. Results taken from boreholes NE/106, NE/107, NE/109 and NE/110
	Most Likely	0.00354	
	Max:	0.0242	
	(Log Triangular Distribution)		
Lead (mg/l)	Min:	0.001	
	Most Likely	0.0022	
	Max:	0.0065	
	(Log Triangular Distribution)		
Zinc (mg/l)	Min:	0.001	
	Most Likely	0.00927	
	Max:	0.112	
	(Log Triangular Distribution)		

Note: The model does not consider background groundwater quality with regard to List I substances.

APPENDIX HRA4
Diffusion Parameterisation Table

Appendix HRA 4 – Diffusion Model Parameterisation

A: Conceptual Model & Landfill Construction

Parameter	Value	Source
Conceptual model of landfill construction	2 Single Value	A landfill with a geological barrier and an artificial lining system located in a permeable formation a finite distance above an impermeable layer.
Is a geomembrane present?	Yes	-
Basal width (m)	111.7 Single Value	Based on Proposed development drawings, cumulative total of cells 1 and 2
Basal length (m)	111.7 Single Value	Based on Proposed development drawings, cumulative total of cells 1 and 2
Elevation of base of landfill (maOD)	35 Single Value	Base of cell 1 used as worst case
Elevation of base of aquifer (maOD)	30 Single Value	assumes thin aquifer of no more than 5 meters below river level
Leachate head inside landfill (maOD)	Min: 35.5 Max: 37 Uniform Distribution	Assumes leachate heads are maintained at 2m above cell base
Groundwater head outside landfill (maOD)	Min: 45 Max: 55 Uniform Distribution	After inferred regional groundwater contours (Drawing HRA2).

B: Mineral Liner

Parameter	Value	Derivation
Thickness of mineral liner (m)	1.0 Single Value	Based on proposed design
Hydraulic conductivity (m/s)	Min: 1.0×10^{-11} Mode: 1.0×10^{-10} Max: 1.0×10^{-9} Log Triangular Distribution	Range based on a combination of typical values for a GCL and a typical clay liner
Dry bulk density (kg/m^3)	Min: 1.6 Max: 2.4 Uniform Distribution	Typical range for clay liner
Average pore radius (m)	0.00001 Single Value	Typical value for clay
Effective porosity	Min: 0.01 Max: 0.2 Uniform Distribution	Based on SLR design proposals
Tortuosity	10 Single Value	Contaminant Fluxes from Hydraulic Containment Landfills - A Review, Report SC0310/SR: value for clay

C: Steady State Dilution in Groundwater (Dolerite)

Parameter	Value	Derivation
Hydraulic gradient (fraction)	Min: 0.062 Max: 0.123 Uniform Distribution	After inferred regional groundwater contours (Drawing HRA2).
Hydraulic conductivity (m/s)	Min: 3.69E-07 Most Likely: 8.46E-06 Max : 3.21E-05 (Log Triangular Distribution)	Transmissivity values calculated based permeability tests undertaken by SLR and Carnon Contracting. Permeability calculated assuming a 3m mixing zone thickness.
Down-gradient distance of compliance point from landfill (m)	30 Single Value	Approximate distance of River Yealm from landfills Eastern edge

D: Leachate Quality Data

Parameter	Value	Derivation
Ammoniacal-N (mg/l)	Min: 3 Most Likely: 407 Max : 2041 (Log Triangular Distribution)	Range calculated using weighted averages based on the following waste distribution: Rejected MSW: 60% IBA: 14% Commercial and Industrial (C&I): 26% The following sources were used for concentrations: LandSim default values (for C&I) 0.5X LandSim default values (MSW) EA report P1-494/SR2[1] (IBA)
Chloride (mg/l)	Min: 71 Most Likely: 1523 Max : 4724 (Log Triangular Distribution)	
Copper (mg/l)	Min: 0.17 Most Likely 0.85 Max : 3.01 (Log Triangular Distribution)	
Cadmium (mg/l)	Min: 0.029 Most Likely: 0.146 Max : 0.199 (Log Triangular Distribution)	
Lead (mg/l)	Min: 0.014 Most Likely: 0.11 Max : 1.27 (Log Triangular Distribution)	
Zinc (mg/l)	Min: 0.0027 Most Likely: 0.10 Max : 116.66 (Uniform Distribution)	
Mercury (mg/l)	Min: 0.0003 Most Likely: 0.0015 Max : 0.0039 (Log Triangular Distribution)	
Naphthalene (mg/l)	Min: 0.0001 Most Likely: 0.003 Max : 0.042 (Log Triangular Distribution)	Worst-case leachate quality based on Knox *et.al.* (2000)[2], Worst-case leachate quality based on Knox *et.al.* (2000).
Toluene (mg/l)	Min: 0. 01	Worst-case leachate quality based

[1] Environment Agency (2004b): *Testing of residues from incineration of municipal solid waste, Science Report P1-494/SR2*

[2] Knox, K *et.al.* (Oct 2000)[2] : *The Occurrence of Trace Organic Components in Landfill Leachates and their removal during Onsite Treatment.* From the Proceedings of Waste 2000 Conference, Stratford upon Avon, 2-4 October 2000, p263-272.

	Most Likely: 0.087 Max : 1.287 (Log Triangular Distribution)	on Knox *et.al.* (2000). Worst-case leachate quality based on Knox *et.al.* (2000).
Xylene (mg/l)	Min: 0.03 Most Likely: 0.059 Max : 0.208 (Log Triangular Distribution)	
Mecoprop (mg/l)	Min: 0.0001 Most Likely: 0.011 Max : 0.14 (Log Triangular Distribution)	

E: Diffusion Coefficients

Parameter	Value	Derivation
Free Water Diffusion Coefficient		
Ammoniacal-N (m^2/sec)	1.96×10^{-9} (Single Value)	Contaminant Fluxes from Hydraulic Containment Landfills - A Review, Report SC0310/SR
Chloride (m^2/sec)	2.03×10^{-9} (Single Value)	
Naphthalene (m^2/sec)	0.516×10^{-9} (Single Value)	Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values, Report SC050021/SR7
Toluene (m^2/sec)	0.588×10^{-9} (Single Value)	
Xylene (m^2/sec)	0.531×10^{-9} (Single Value)	
Mecoprop (m^2/sec)	0.39×10^{-9} (Single Value)	Contaminant Fluxes from Hydraulic Containment Landfills - A Review, Report SC0310/SR
Cadmium (m^2/sec)	0.717×10^{-9} (Single Value)	
Lead (m^2/sec)	1.0×10^{-10} (Single Value)	CLEA 2002 default value assumed
Copper (m^2/sec)	1.0×10^{-10} (Single Value)	
Zinc (m^2/sec)	1.0×10^{-10} (Single Value)	
Mercury (m^2/sec)	0.63×10^{-9} (Single Value)	RBCA Tool Kit for Chemical Releases, Version 1.0a (1998)
Diffusion Coefficient in Geomembrane		
Naphthalene (m^2/sec)	0.037×10^{-12} (Single Value)	Contaminant Fluxes from Hydraulic Containment Landfills - A Review, Report SC0310/SR Benzene value used for naphthalene
Toluene (m^2/sec)	Min: 0.2×10^{-12} Max: 0.56×10^{-12} Uniform Distribution	
Xylene (m^2/sec)	Min: 0.31×10^{-12} Max: 3.7×10^{-12} Uniform Distribution	

E: Biodegradation And Retardation Within The Engineered Clay Lining System

Parameter	Value	Derivation
Retardation Coefficients - Clay		
Ammoniacal-N (Kd) (l/kg)	Min: 0.5 Max: 2.0 Uniform Distribution	LandSim default values
Chloride (Kd) (l/kg)	0 (Single Value)	
Cadmium (Kd) (l/kg)	Min: 1.6 Max: 1500 Uniform Distribution	
Lead (Kd) (l/kg)	Min: 27 Max: 270000 Uniform Distribution	
Zinc (Kd) (l/kg)	Min: 1 Max: 600	

	Uniform Distribution	
Copper (Kd) (l/kg)	Min: 40 Max: 27500 Uniform Distribution	
Mercury (Kd) (l/kg)	Min: 450 Max: 3835 Uniform Distribution	
Mecoprop (Kd) (l/kg)	Min: 0.03 Max: 0.7 Uniform Distribution	After EA *Attenuation of organic contaminants in leachate by mineral landfill liners, 2009*
Naphthalene (Koc) (l/kg)	Min: 64.5 Max: 645 Uniform Distribution	Maximum values based on published values from EA report No. SC020039/SR5[3] Minimum values taken as 10% of maximum as worst case
Toluene (Koc) (l/kg)	Min: 20.4 Max: 204.2 Uniform Distribution	
Xylene (Koc) (l/kg)	Min: 49 Max: 489.8 Uniform Distribution	
Fraction of Organic Carbon (fraction)	Min: 0.0001 Max: 0.001 Uniform Distribution	EA attenuation of mecoprop in the subsurface
Retardation Coefficients – HDPE Liner		
Mecoprop (Kd)	Min: 0.03 Max: 0.7 Uniform Distribution	Same values used as in clay liner
Naphthalene (Kd)	Min: 54.3 Max: 57.2 Uniform Distribution	Contaminant Fluxes from Hydraulic Containment Landfills - A Review, Report SC0310/SR Benzene value used for naphthalene
Toluene (Kd)	Min: 63.5 Max: 192 Uniform Distribution	
Xylene (Kd)	Min: 192.7 Max: 370 Uniform Distribution	
Half-lives (years)		
Ammoniacal-N	1×10^9 Single Value	Ammoniacal-N may not degrade in anaerobic liner conditions.
Chloride		
Cadmium		High value selected as parameters do not degrade.
Copper		
Zinc		
Lead		
Mercury		
Mecoprop	Min: 0.077 Max: 0.5 Uniform Distribution	Anaerobic half lives after Howard et al, Handbook of Environmental Degradation Rates (1991).
Naphthalene	Min: 0.068 Max: 0.71 Uniform Distribution	
Toluene	Min: 0.15 Max: 0.58	

[3] Environment Agency (2008) *Compilation of data for priority organic pollutants for derivation of soil guideline values*, Report No. SC050021/SR7

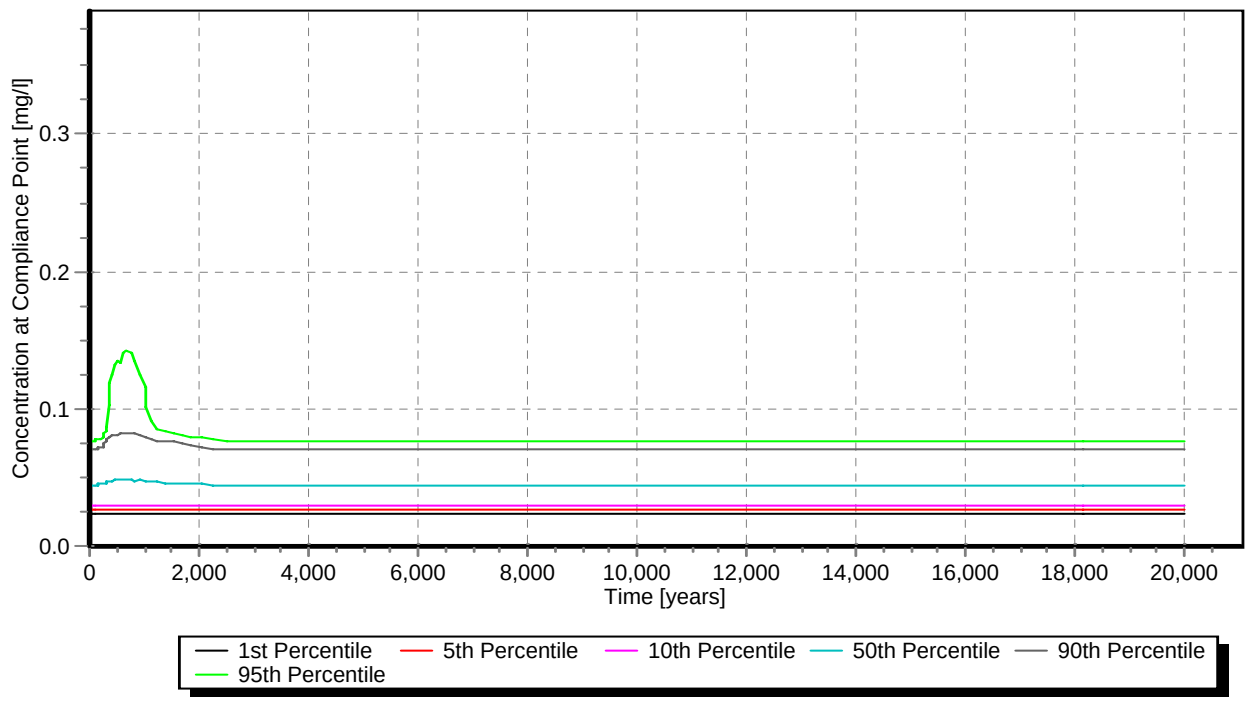
	Uniform Distribution	
Xylene	Min: 0.5 Max: 1.0 Uniform Distribution	

APPENDIX HRA5
LandSim Results Graphs

Project Name: New England Resource Recovery Centre

Customer:Viridor Waste management

Results: Ammoniacal_N Concentration at Compliance Point [mg/l]



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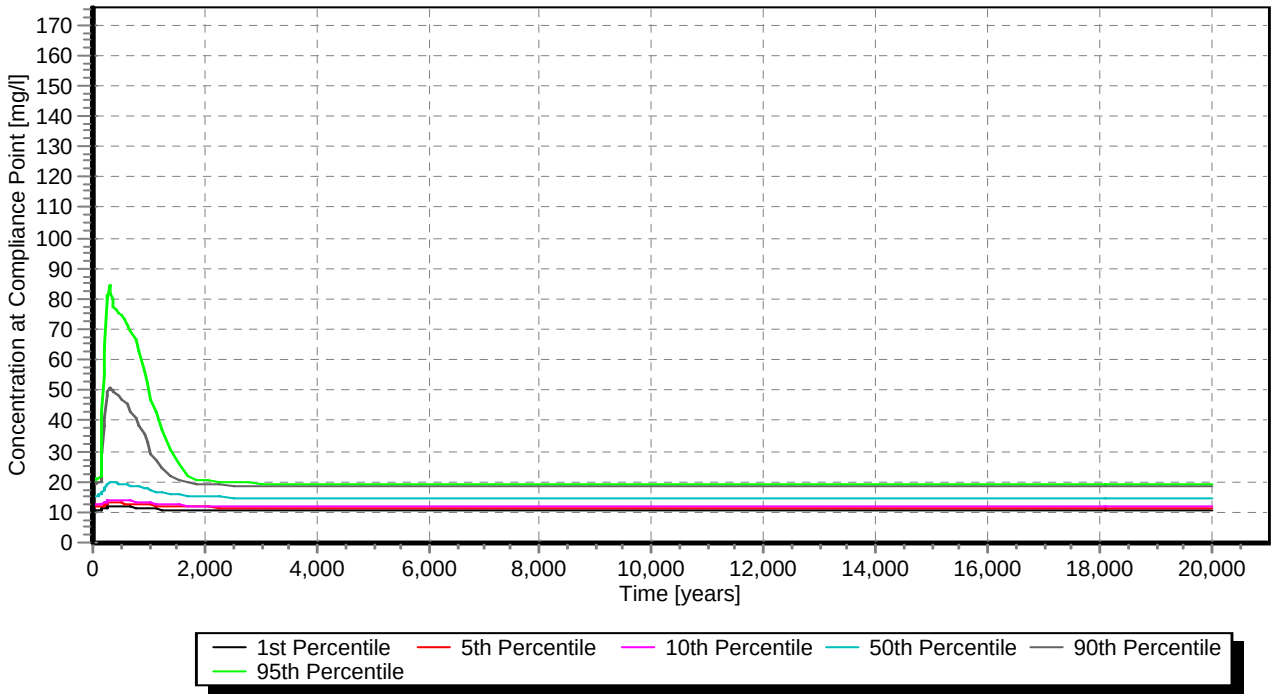
LandSim Version 2.5

Project Name: New England Resource Recovery Centre

Customer:Viridor Waste management

Results: Chloride Concentration at Compliance Point [mg/l]

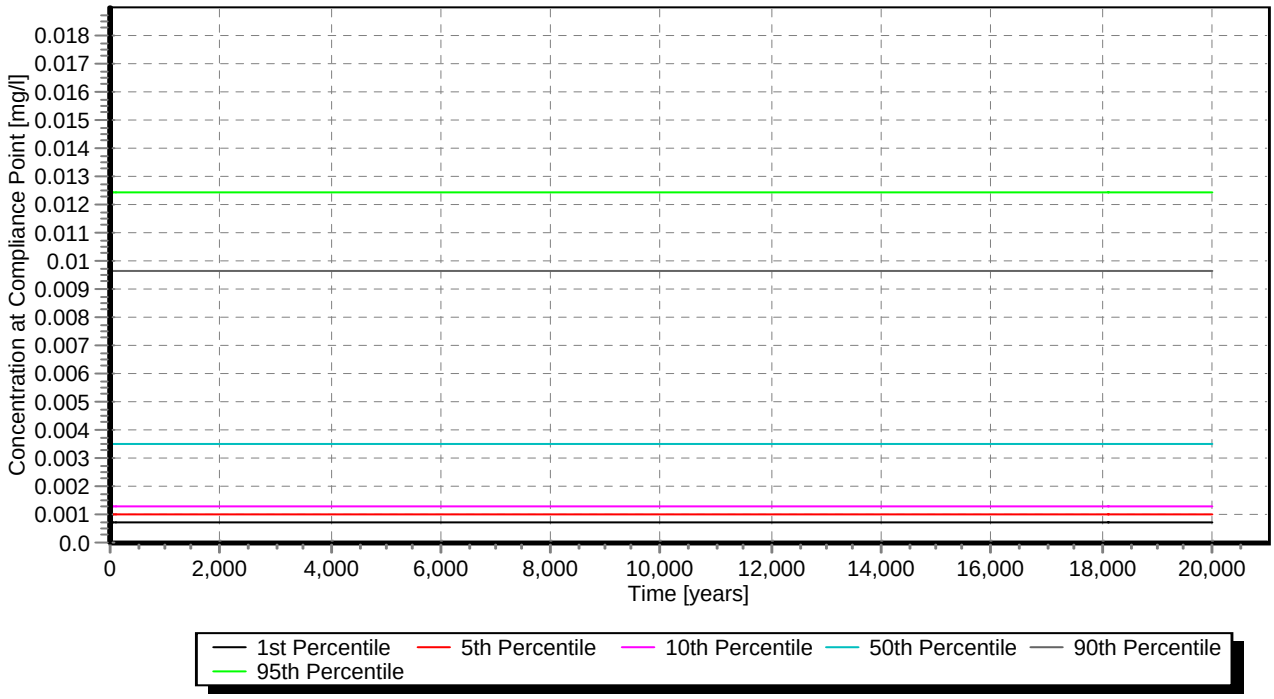


LandSim Version 2.5

Project Name: New England Resource Recovery Centre

Customer:Viridor Waste management

Results: Copper Concentration at Compliance Point [mg/l]



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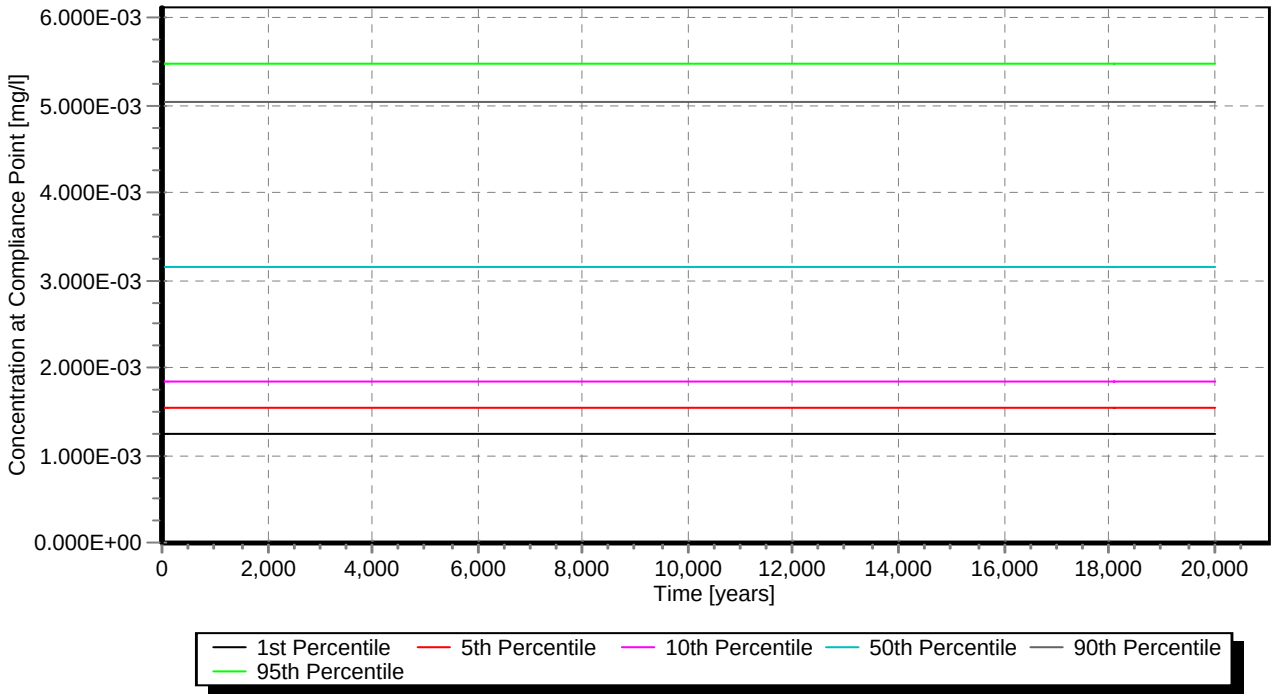
LandSim Version 2.5

Project Name: New England Resource Recovery Centre

Customer:Viridor Waste management

Results: Lead Concentration at Compliance Point [mg/l]

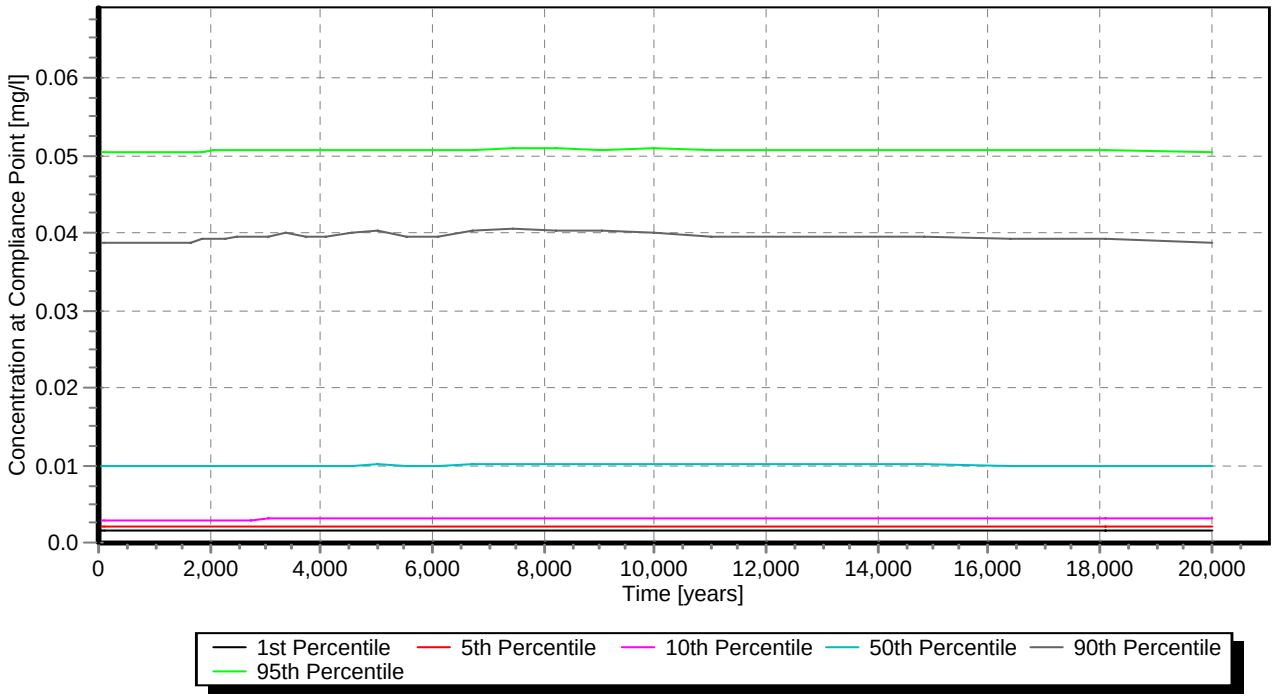


LandSim Version 2.5

Project Name: New England Resource Recovery Centre

Customer:Viridor Waste management

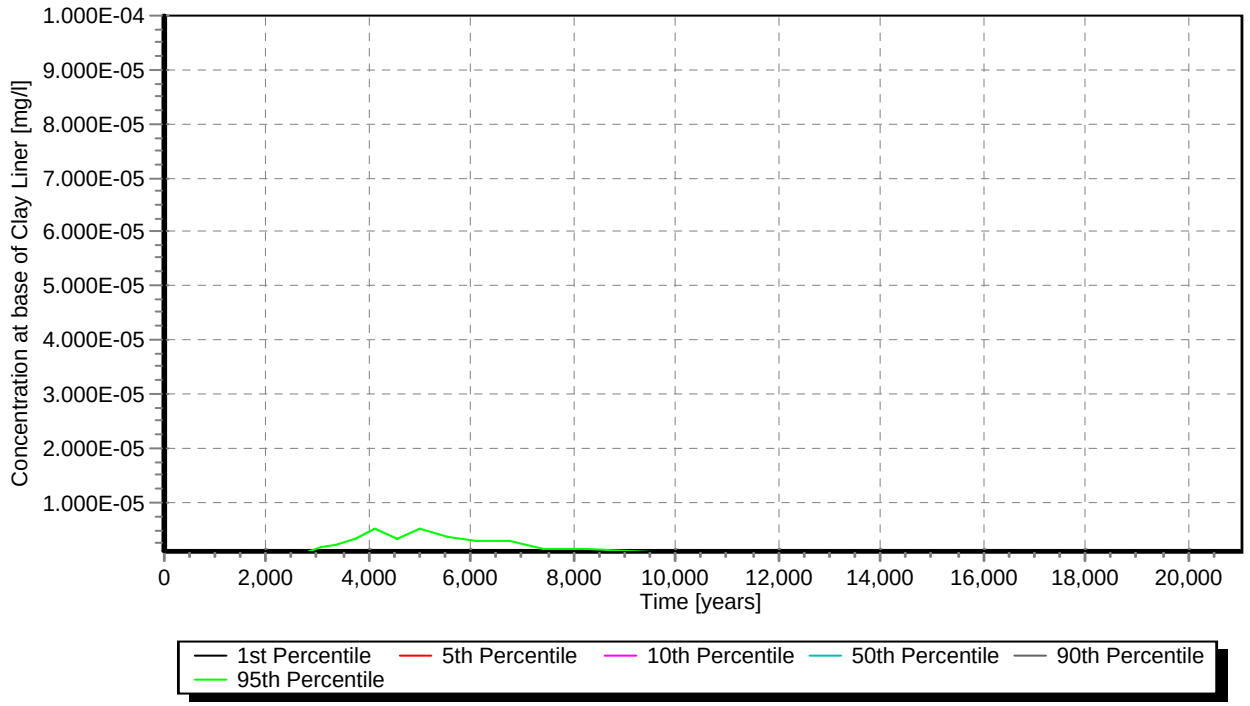
Results: Zinc Concentration at Compliance Point [mg/l]



Project Name: New England Resource Recovery Centre

Customer:Viridor Waste management

Results: Cells 1-6, Cadmium Concentration at base of Clay Liner [mg/l]



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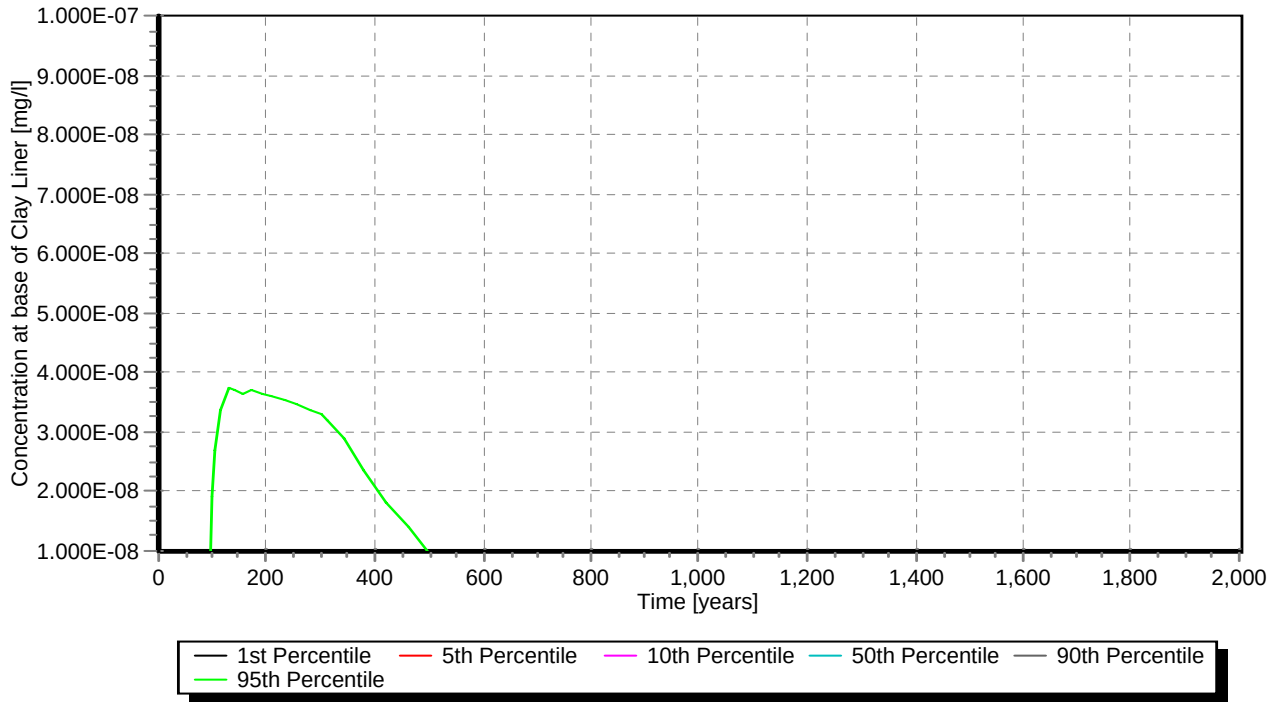
Project Name: New England Resource Recovery Centre

Customer:Viridor Waste management

Results: Cells 1-6, Mecoprop Concentration at base of Clay Liner [mg/l]

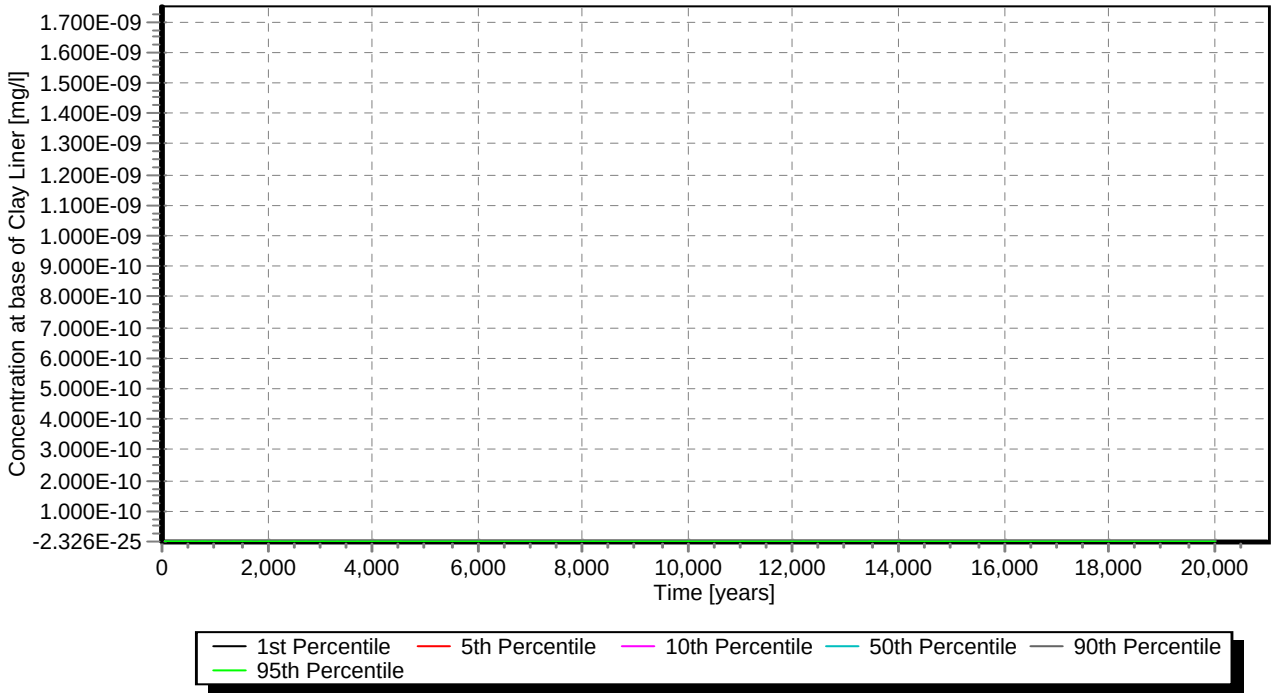


LandSim Version 2.5

Project Name: New England Resource Recovery Centre

Customer:Viridor Waste management

Results: Cells 1-6, Mercury Concentration at base of Clay Liner [mg/l]



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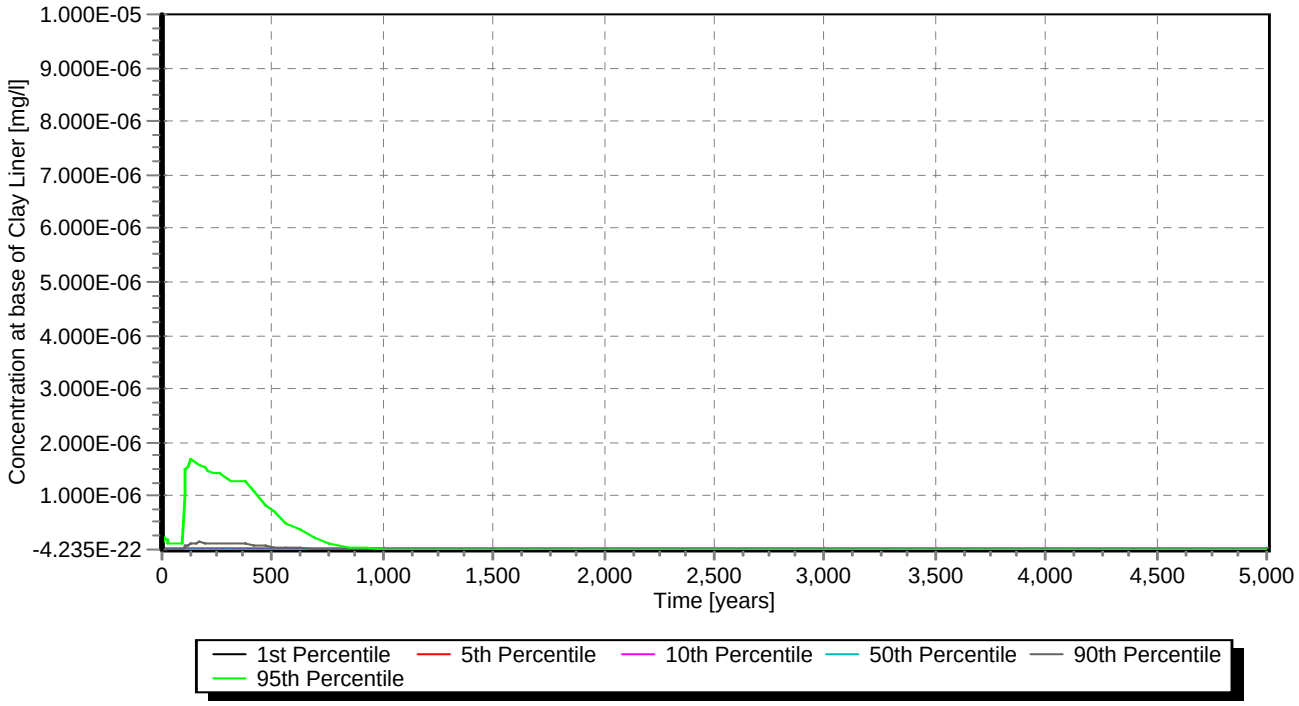
LandSim Version 2.5

Project Name: New England Resource Recovery Centre

Customer:Viridor Waste management

Results: Cells 1-6, Naphthalene Concentration at base of Clay Liner [mg/l]

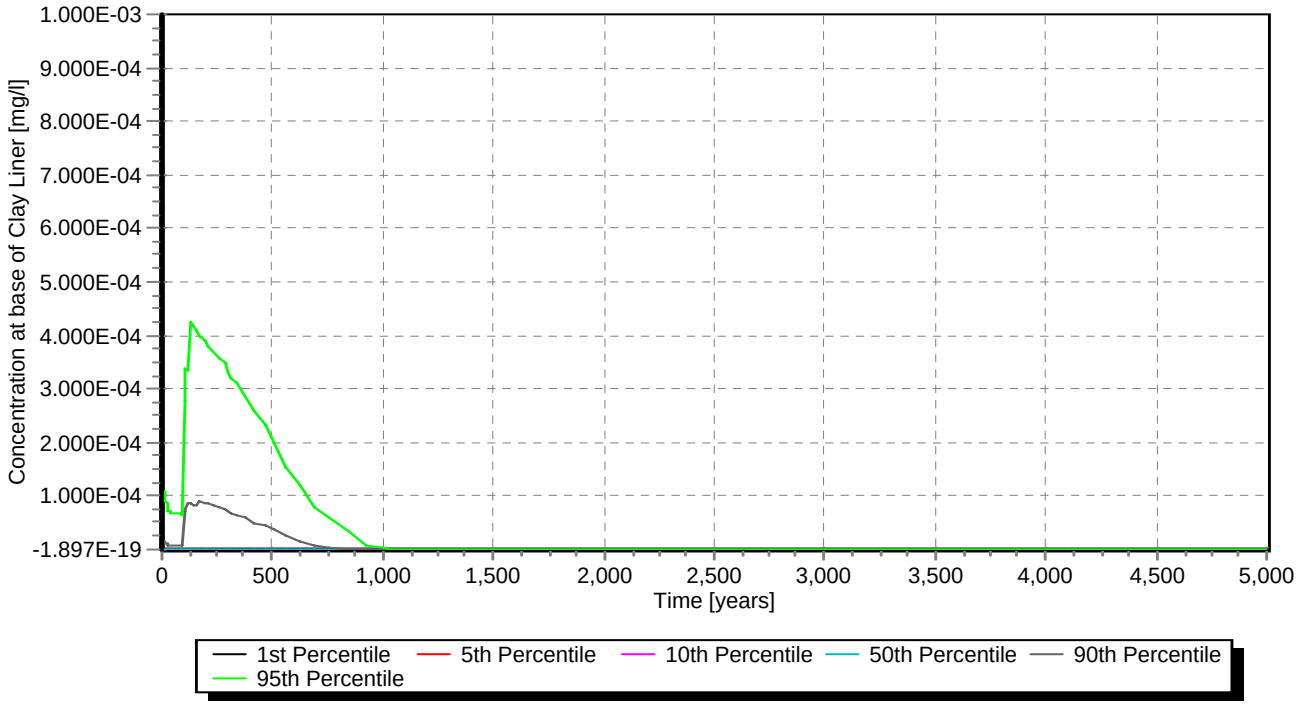


LandSim Version 2.5

Project Name: New England Resource Recovery Centre

Customer:Viridor Waste management

Results: Cells 1-6, Toluene Concentration at base of Clay Liner [mg/l]

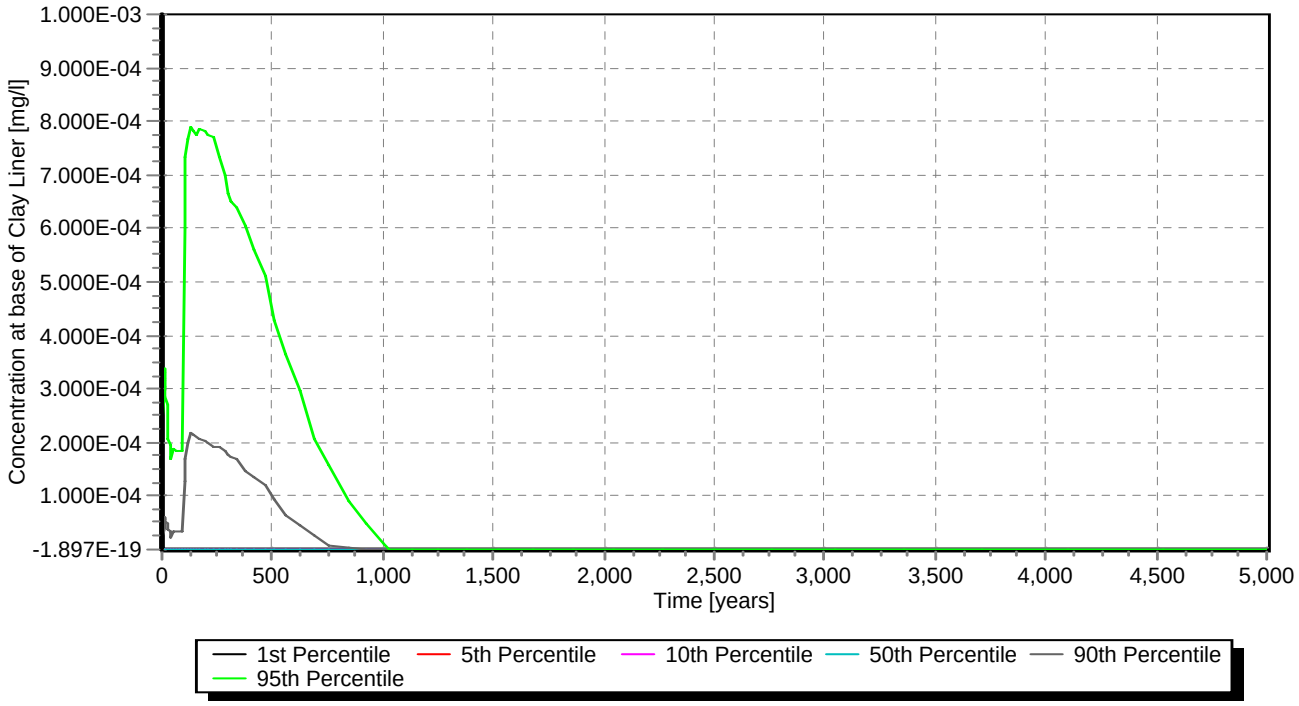


LandSim Version 2.5

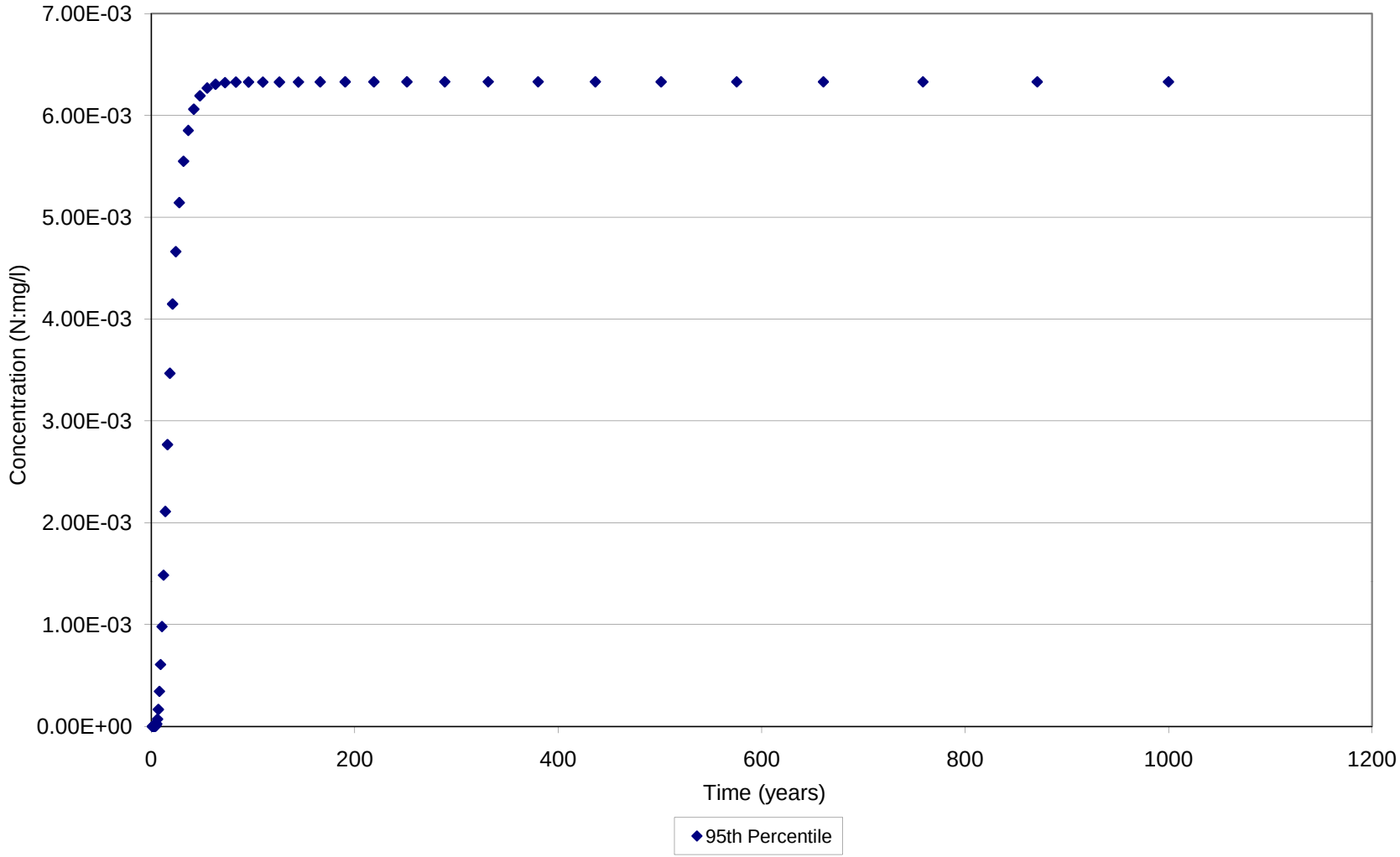
Project Name: New England Resource Recovery Centre

Customer:Viridor Waste management

Results: Cells 1-6, Xylene Concentration at base of Clay Liner [mg/l]



APPENDIX HRA6
Diffusion Modelling Results Graphs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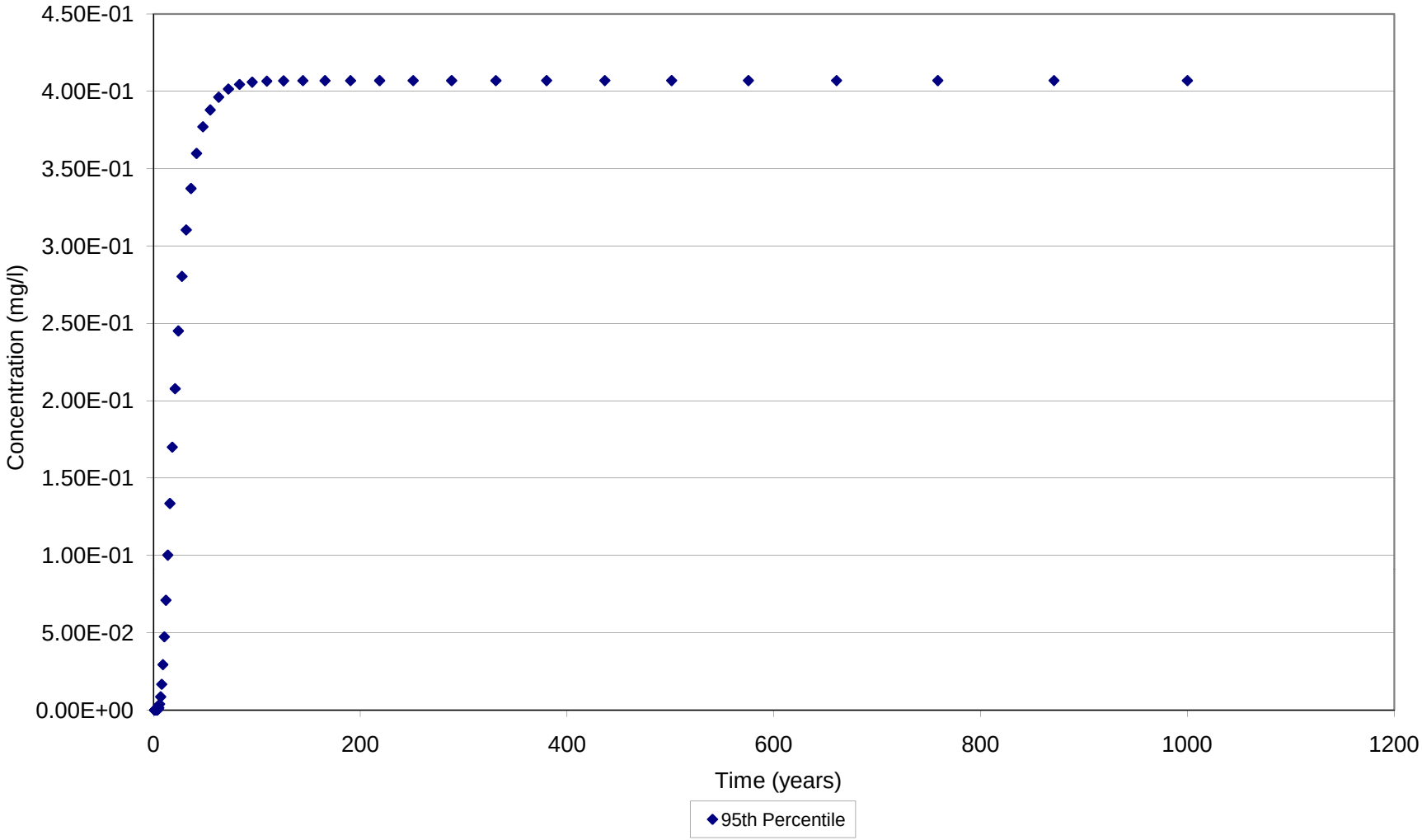
6.00E-03
5.00E-03
4.00E-03
3.00E-03
2.00E-03
1.00E-03
0.00E+00
Concentration (N:mg/l)
0
200
400
600
800
1000
1200
Time (years)
95th Percentile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3.00E-01
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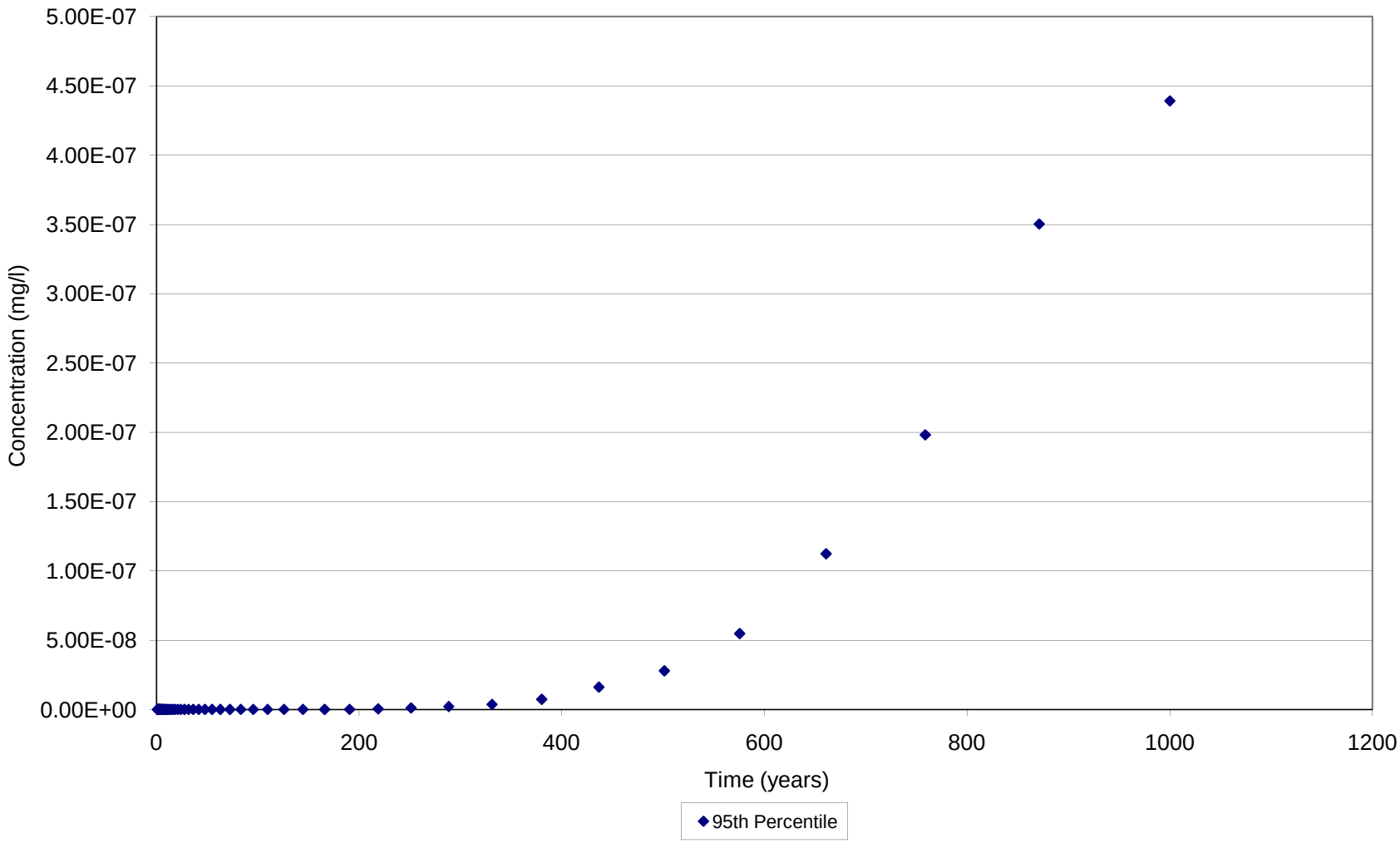
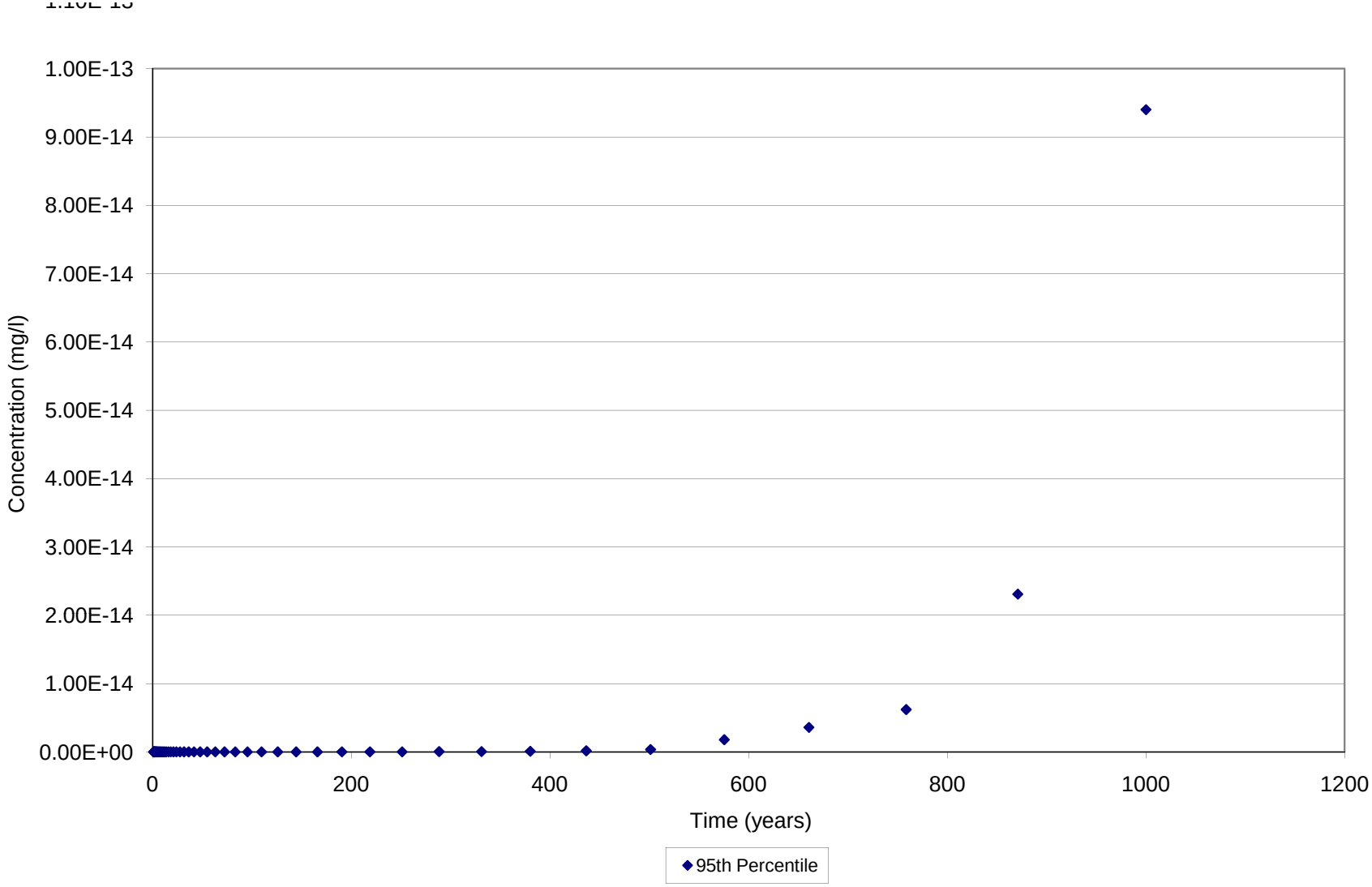
5.00E-02
0.00E+00
Concentration (mg/l)
0
200
400
600
800
1000
1200
Time (years)
95th Percentile

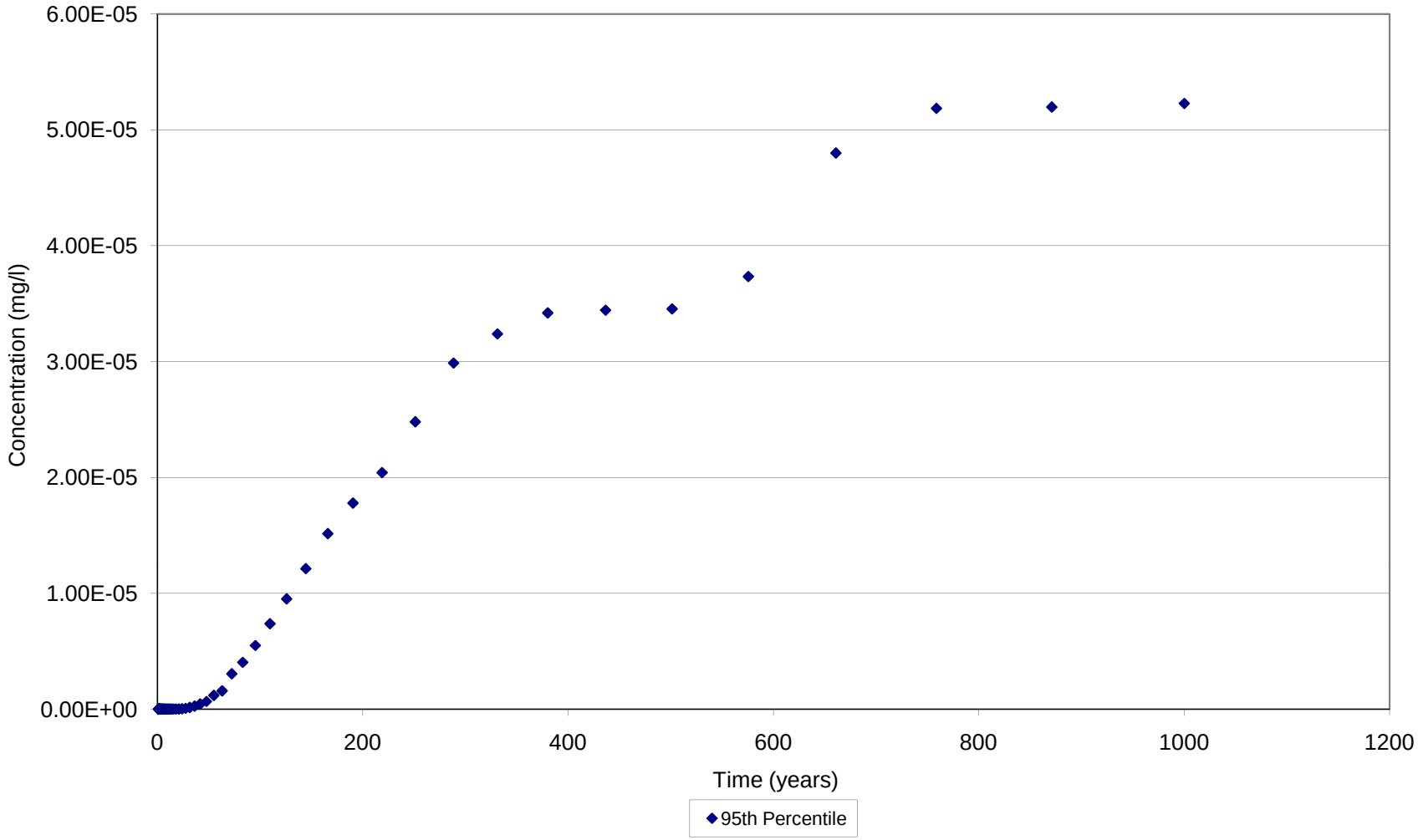
Appendix HRA 6:
Predicted Diffusion from New England Landfill
- Copper (mg/l)



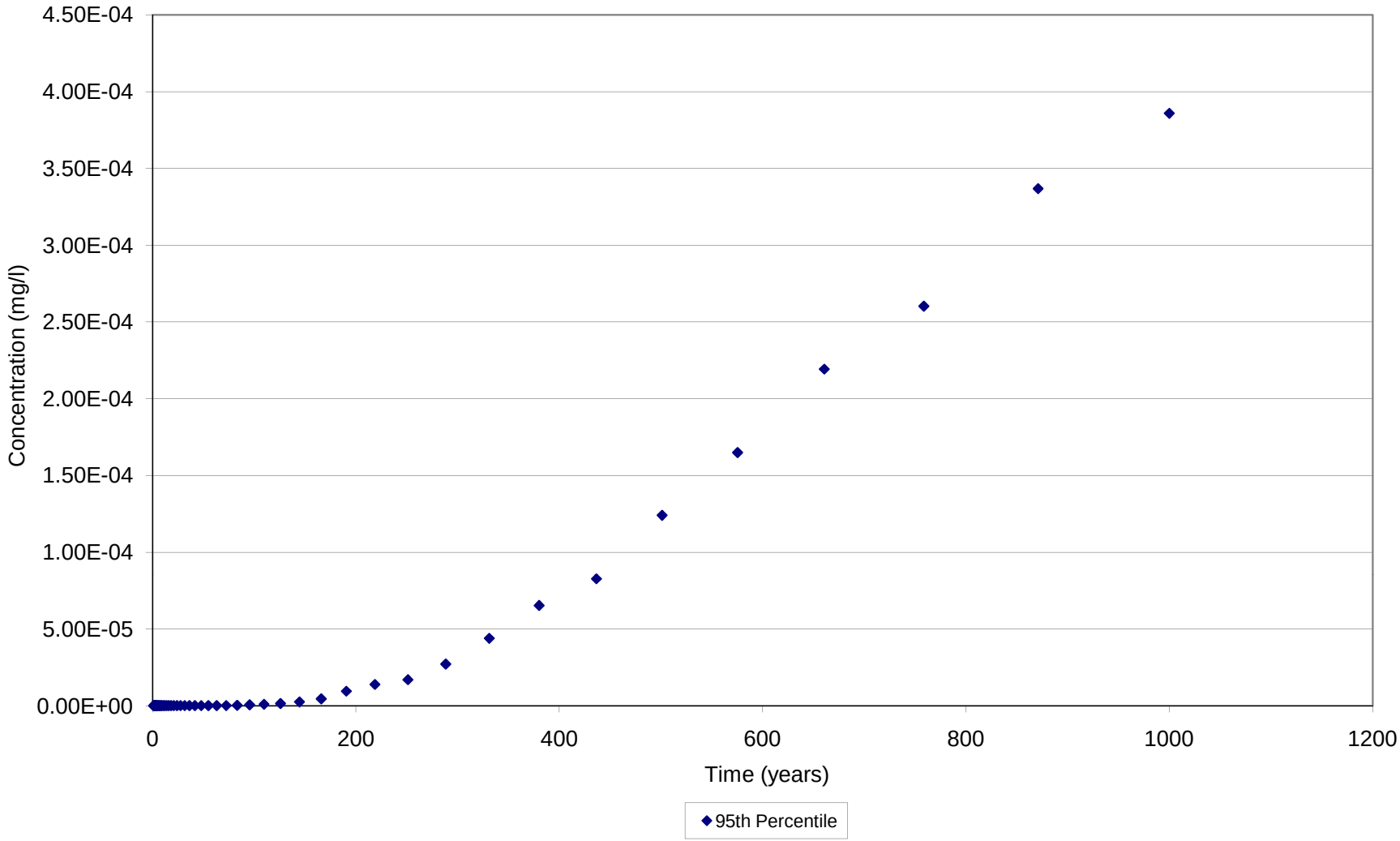
Appendix HRA 6:
Predicted Diffusion from New England Landfill
Lead



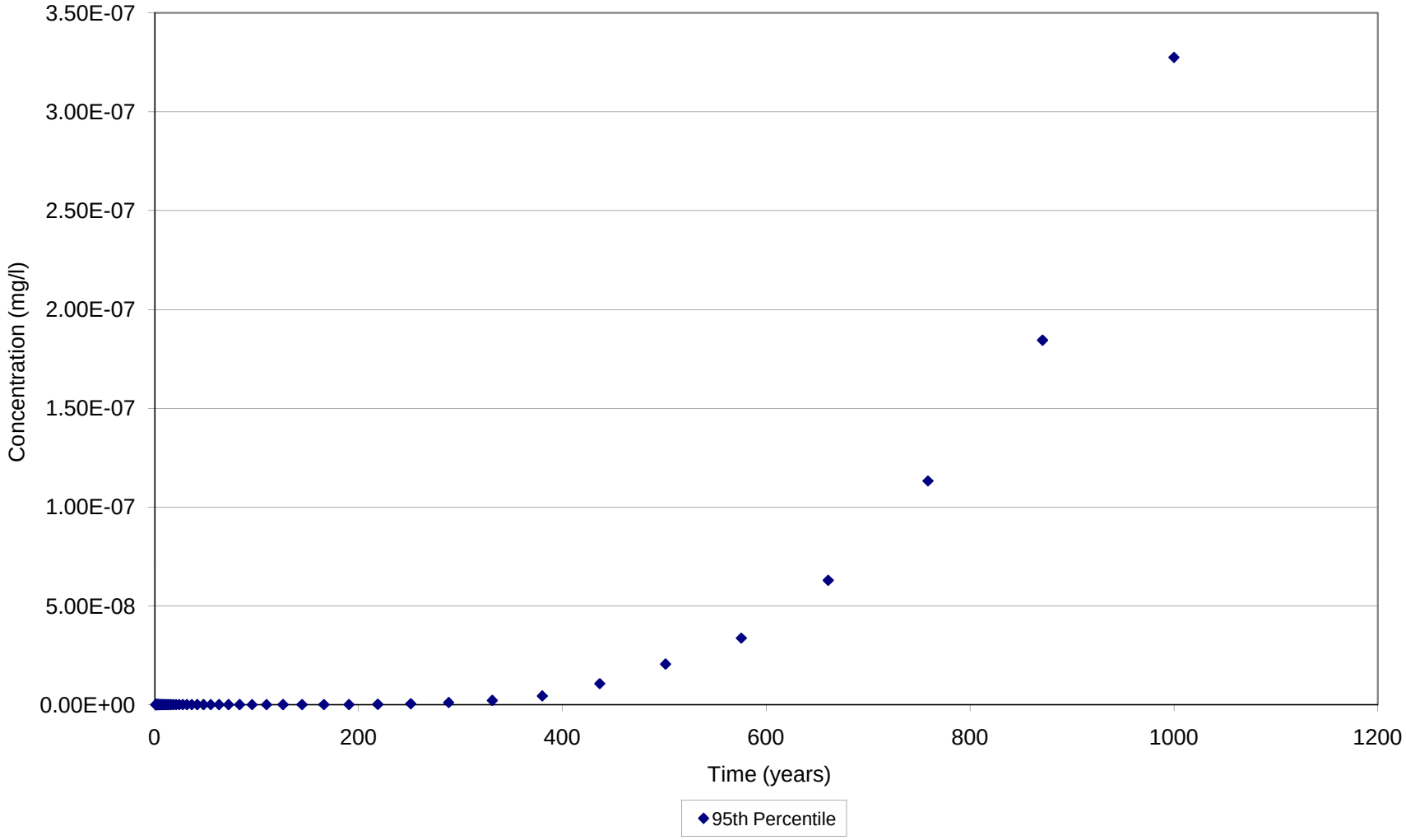
Appendix HRA 6:
Predicted Diffusion from New England Landfill
- Zinc



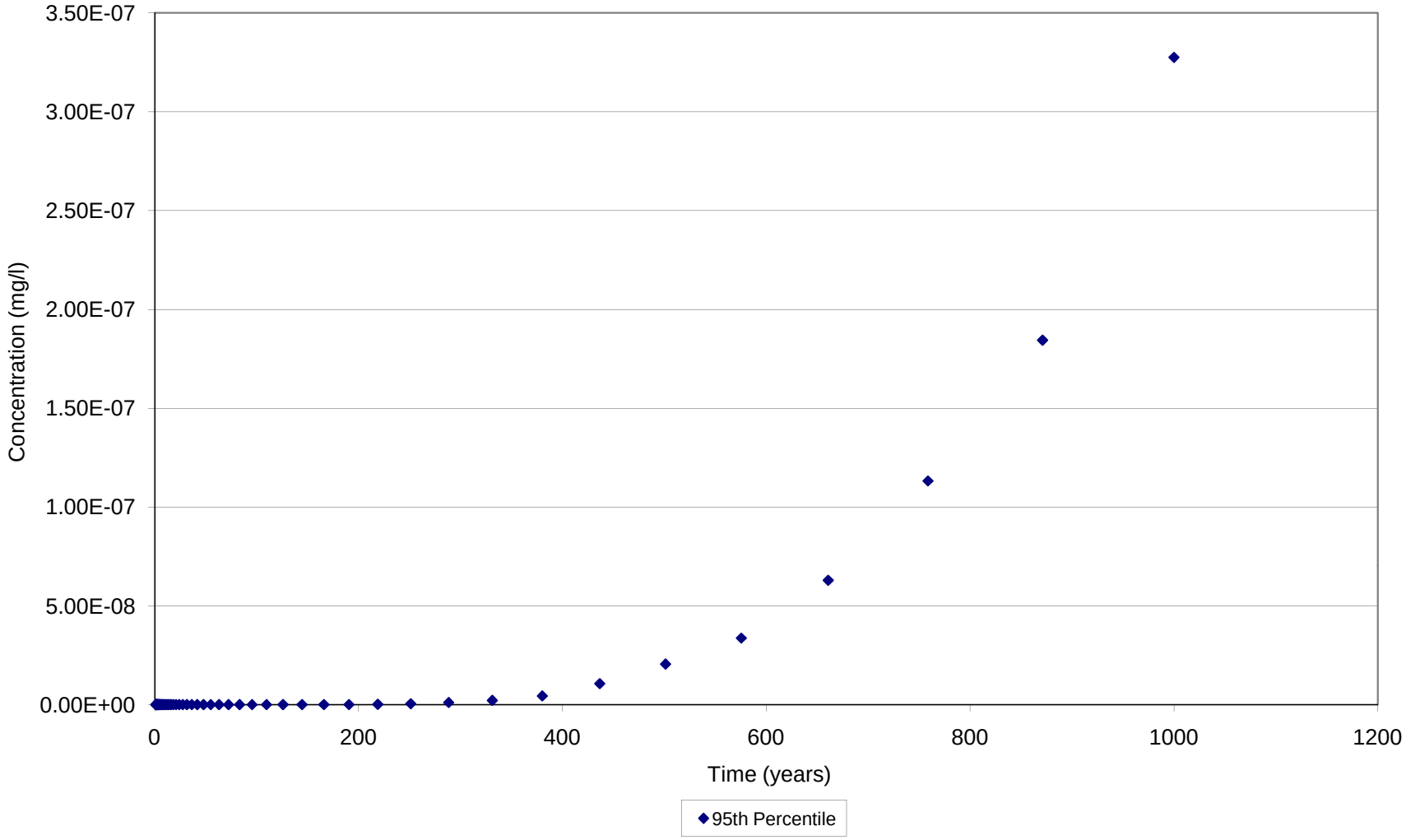
Appendix HRA 6:
Predicted Diffusion from New England Landfill
- Cadmium (mg/l)



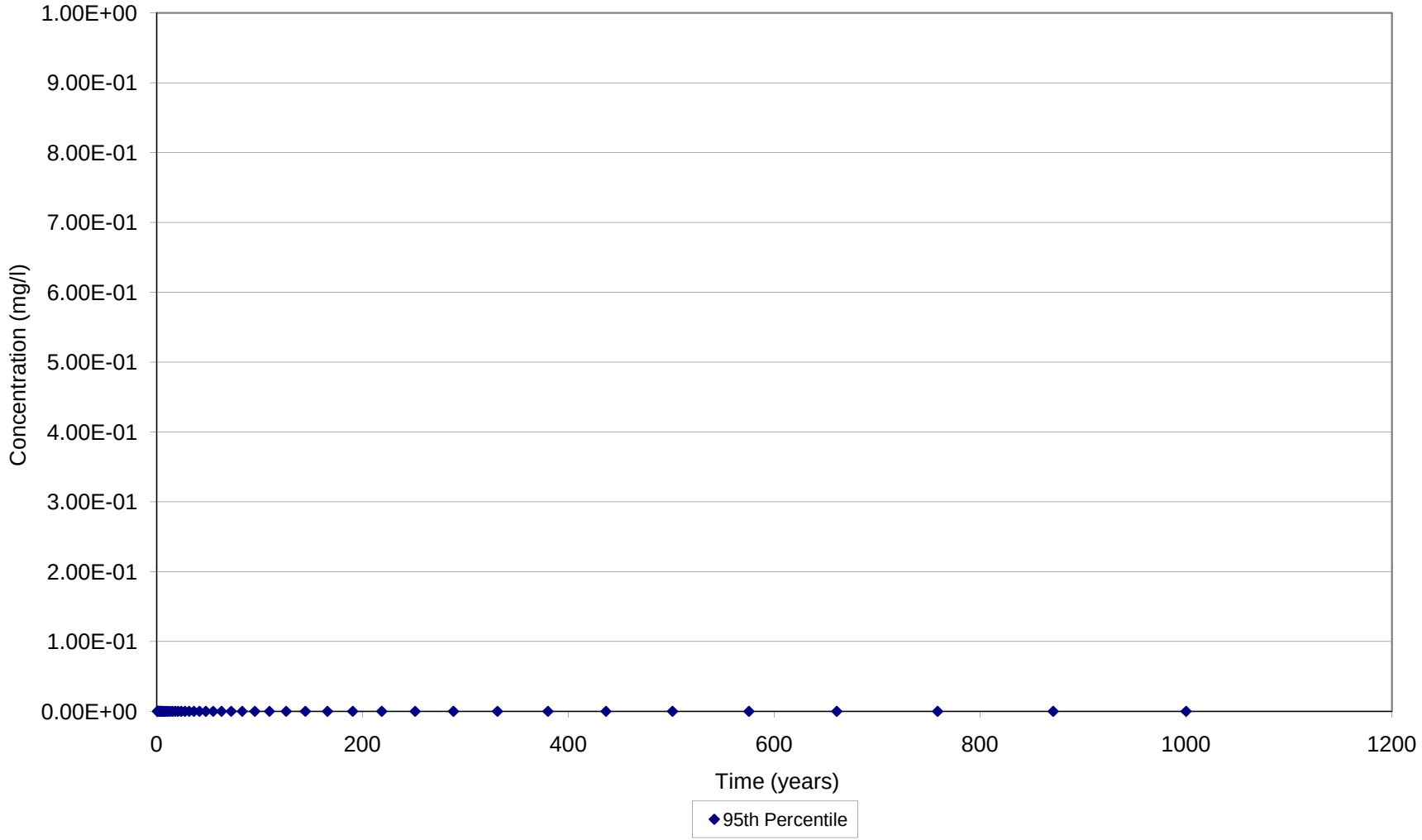
Appendix HRA 6:
Predicted Diffusion from New England Quarry
- Mercury (mg/l)



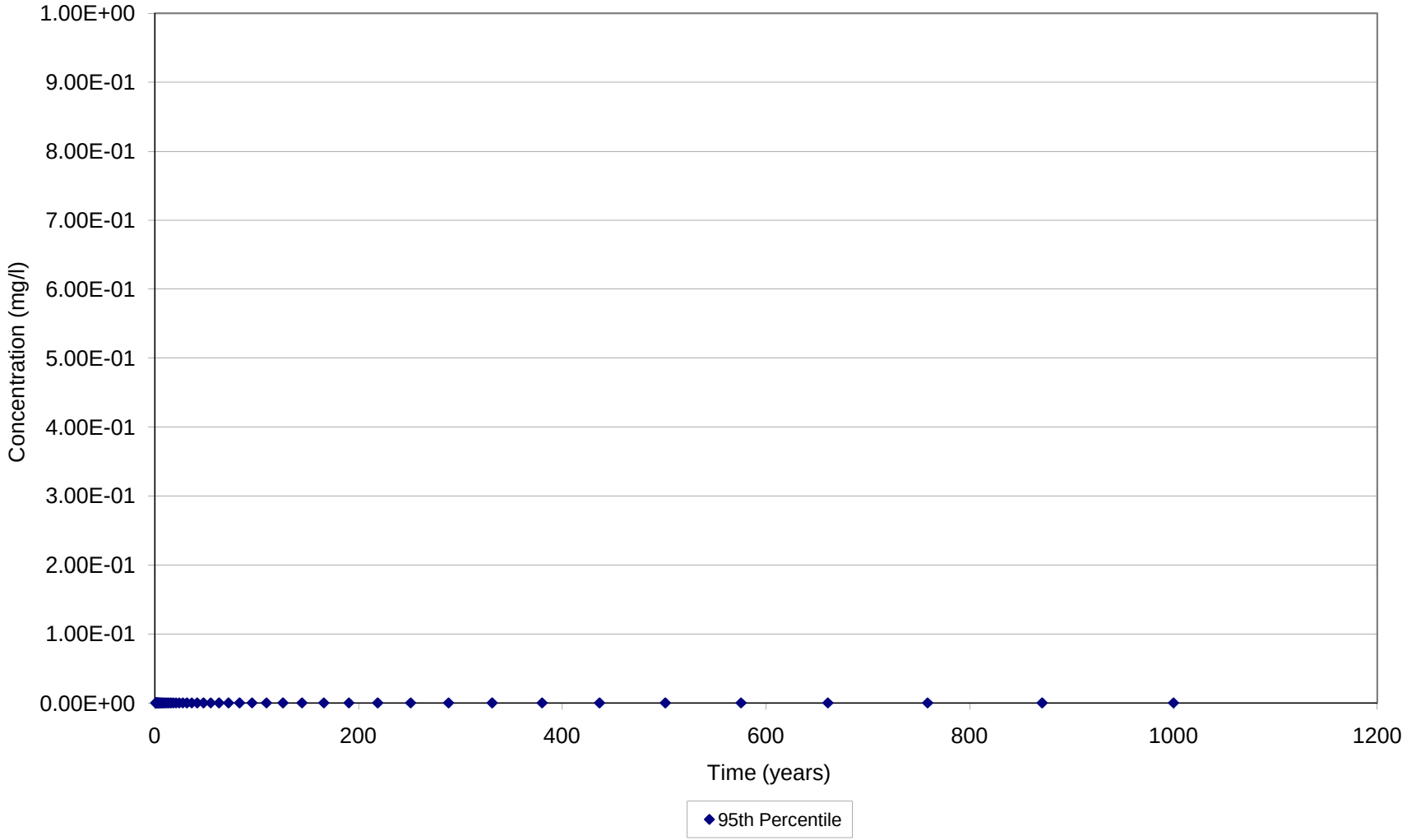
Appendix HRA 6:
Predicted Diffusion from New England Quarry
- Mercury (mg/l)



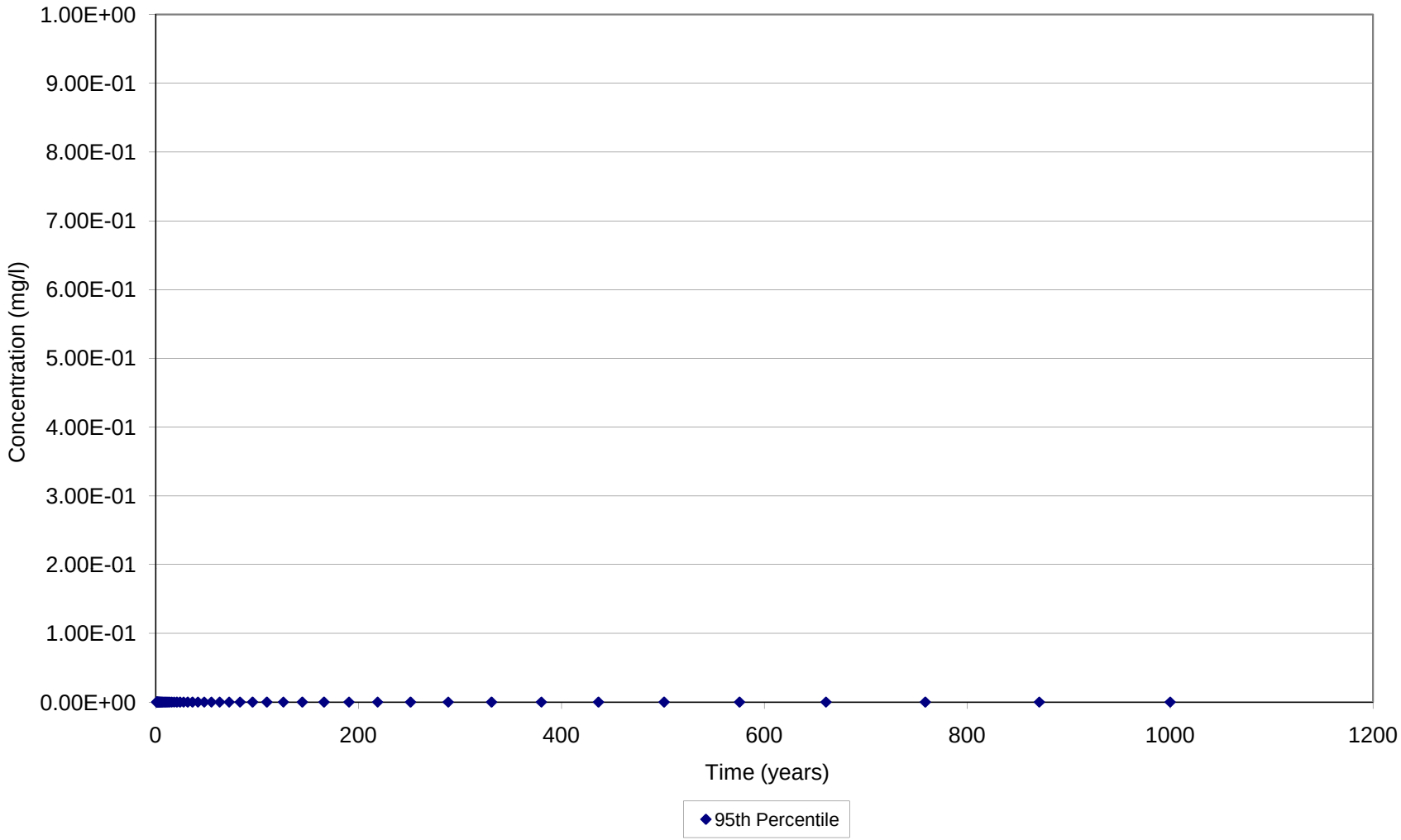
Appendix HRA 6
Predicted Diffusion from New England Landfill
- Naphthalene (mg/l)



Appendix HRA 6:
Predicted Diffusion from New England Landfill
- Toluene (mg/l)



Appendix HRA 6:
Predicted Diffusion from New England Landfill
- Xylene (mg/l)

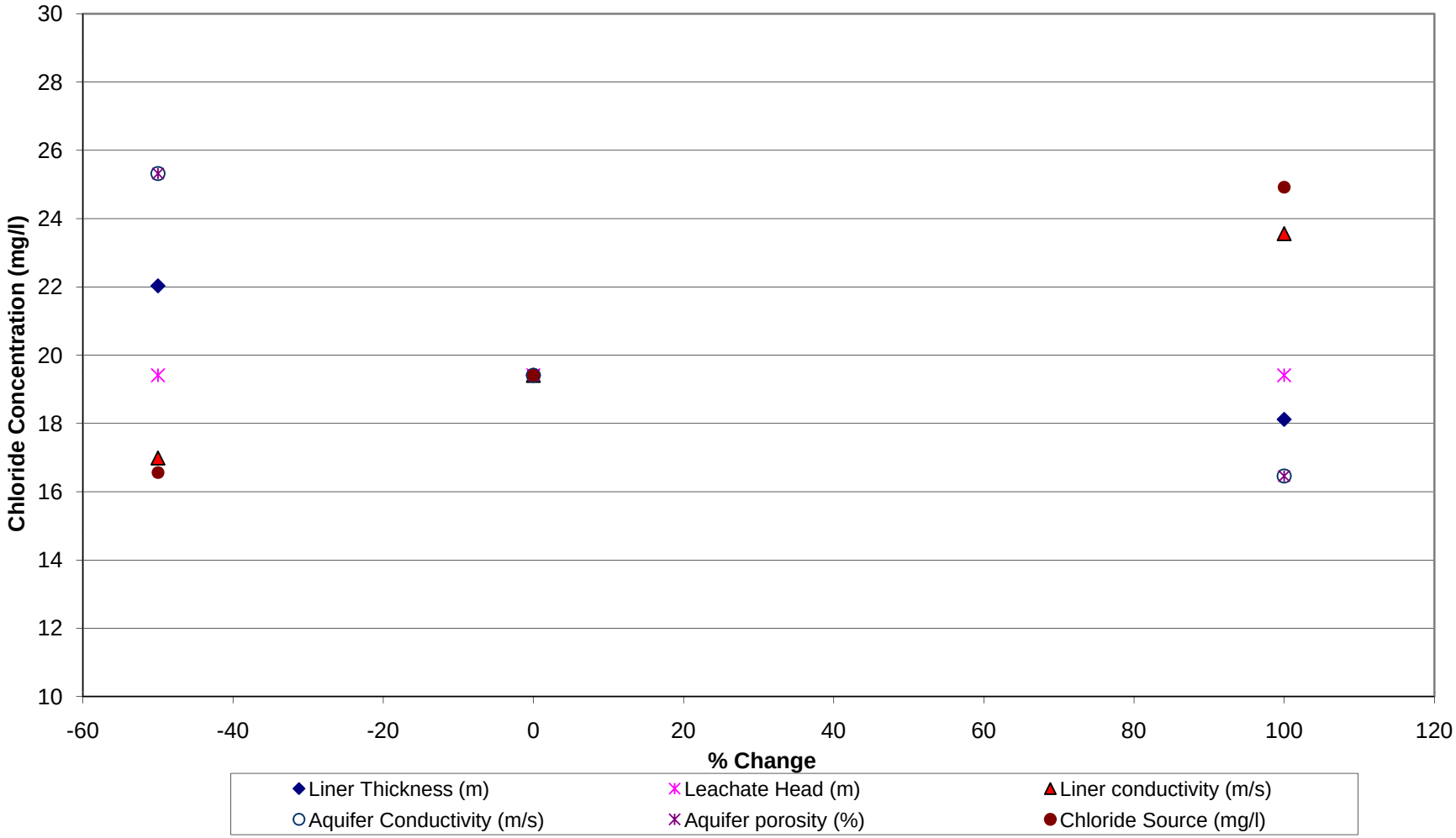


APPENDIX HRA7

Electronic Copies of LandSim and Diffusion Models (CD)

APPENDIX HRA8
Sensitivity Analysis Results

Appendix HRA8 Sensitivity Analysis Results



All results taken from downgradient compliance point

APPENDIX HRA9
Leachate Balance

Leachate Estimation Spreadsheet

Project Information

Site	New England Quarry Landfill New England Quarry, Lee Mill, Devon
Date:	Feb-11
	Note - Cells shaded in green require manual input of data.

1. Input Parameters

1.1 Water Inputs

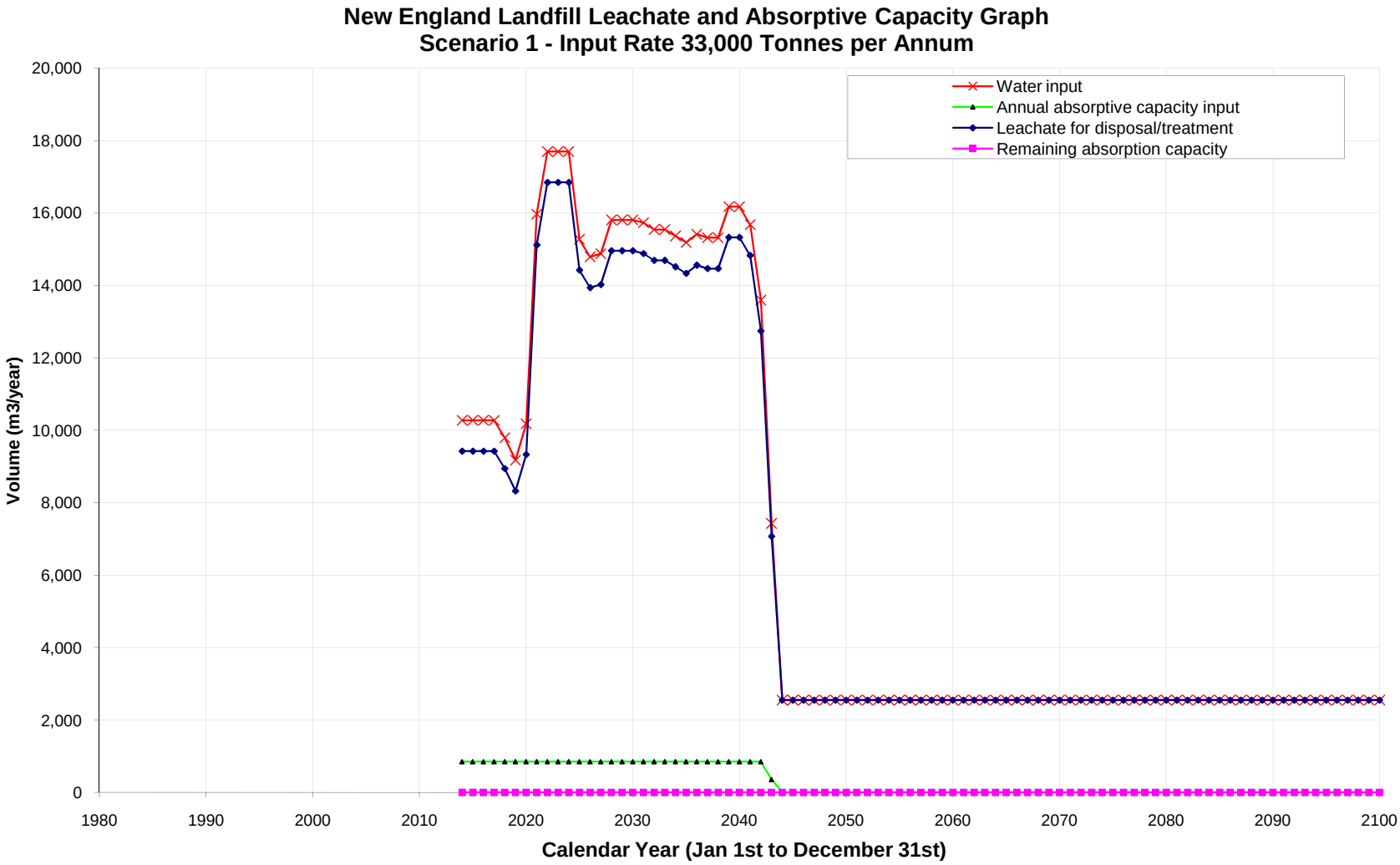
Parameter	Value	Unit	Derivation
Active (During Landfilling)			
Annual Rainfall	1048	mm/year	
Annual Rainfall	1.05	m/year	MAFF Annual Average
Annual Rainfall	0.087333333	m/mth	
Effective Rainfall (Active Phases)	1	Coef.	Worst case assumption
Effective Rainfall (Active Phases)	1048	mm/year	
Effective Rainfall (Active Phases)	0.087333333	m/mth	
Uncapped (Temporary)			
Effective Rainfall (300 to 500mm soil - Type 1)	262	mm/year	50% Winter Excess Rainfall - MAFF
Effective Rainfall (300 to 500mm soil - Type 1)	0.262	m/year	
Effective Rainfall (300 to 500mm soil - Type 1)	0.021833333	m/mth	
Effective Rainfall (Temporary Geocomposite - Type 2)	150	mm/year	
Effective Rainfall (Temporary Geocomposite - Type 2)	0.15	m/year	
Effective Rainfall (Temporary Geocomposite - Type 2)	0.0125	m/mth	
Restored (Final Capping)			
Effective Rainfall (Final cap 500mm soil and or 1.5mm LDPE and or GCL)	50	mm/year	LandSim and ETSU (50mm/yr)
Effective Rainfall (Final cap 500mm soil and or 1.5mm LDPE and or GCL)	0.004166667	m/mth	

1.2 Storage Characteristics

Parameter	Value	Unit	Derivation
Waste Density	1.00	t/m^3	Assumed representative value
Absorption Capacity	0.0258	m^3/t	NWWDO Leachate Management Report
Saturated Storage Coeff.	20%	% v/v	Water Balance Report

1.3 Landfill Characteristics

Phase / Cell / Area Identifier	Base Area	Cap Area	Mean area	Waste volume	Waste mass	Input Rate	Phase / Cell life	Phase / Cell life	Start date	End date	Cumulative life	Temporary Cap Type	
USER INFORMATION	m^2	m^2	m^2	m^3	T	T/a	Years	Months			Years	Select Type 1 or Type 2 in Table 1.1	
1		9,805		134,515	134,515	33,000	4.08	48.91	Jan-2014	Jan-2018	4.08	2	OK
2 Temp (A)		9,305		38,436	38,436	33,000	1.16	13.98	Jan-2018	Mar-2019	5.24	2	OK
2 Capped		1,294		0	0	33,000	0.00		Mar-2019	Mar-2019	5.24	2	OK
2 Temp (B)		7,179		35,320	35,320	33,000	1.07	12.84	Mar-2019	Apr-2020	6.31	2	OK
2 Active		7,866		30,125	30,125	33,000	0.91	10.95	Apr-2020	Mar-2021	7.22	2	OK
3a Active		14,465		129,925	129,925	33,000	3.94	47.25	Mar-2021	Feb-2025	11.16	2	OK
3a Temp		20,606		0	0	33,000	0.00		Feb-2025	Feb-2025	11.16	2	OK
3b Active		10,956		91,084	91,084	33,000	2.76	33.12	Feb-2025	Dec-2027	13.92	2	OK
3b Temp		23,883		0	0	33,000	0.00		Dec-2027	Dec-2027	13.92	2	OK
3c Active		11,460		109,516	109,516	33,000	3.32	39.82	Dec-2027	Mar-2031	17.24	2	OK
3c Capped		4,840		0	0	33,000	0.00		Mar-2031	Mar-2031	17.24	2	OK
3c Temp		21,562		0	0	33,000	0.00		Mar-2031	Mar-2031	17.24	2	OK
4a Active		11,307		96,026	96,026	33,000	2.91	34.92	Mar-2031	Feb-2034	20.15	2	OK
4a Capped		4,904		0	0	33,000	0.00		Feb-2034	Feb-2034	20.15	2	OK
4a Temp		16,887		0	0	33,000	0.00		Feb-2034	Feb-2034	20.15	2	OK
4b Active		11,400		82,498	82,498	33,000	2.50	30.00	Feb-2034	Aug-2036	22.65	2	OK
4b Capped		7,345		0	0	33,000	0.00		Aug-2036	Aug-2036	22.65	2	OK
4b Temp		13,330		0	0	33,000	0.00		Aug-2036	Aug-2036	22.65	2	OK
5a Active		11,685		81,320	81,320	33,000	2.46	29.57	Aug-2036	Feb-2039	25.11	2	OK
5a Capped		5,779		0	0	33,000	0.00		Feb-2039	Feb-2039	25.11	2	OK
5a Temp		10,017		0	0	33,000	0.00		Feb-2039	Feb-2039	25.11	2	OK
5b Active		12,704		75,968	75,968	33,000	2.30	27.62	Feb-2039	Jun-2041	27.42	2	OK
6		11,067		63,326	63,326	33,000	1.92	23.03	Jun-2041	May-2043	29.34	2	OK
3a Capped		3,063		0	0	33,000	0.00		May-2043	May-2043	29.34	2	OK
					0								OK
TOTAL	**0**	**50,996**	**0**	**968,059**	**968,059**		**29.34**	**352**			**29**		


New England Landfill Leachate and Absorptive Capacity Graph
Scenario 1 - Input Rate 33,000 Tonnes per Annum
Water input
Annual absorptive capacity input
Leachate for disposal/treatment
Remaining absorption capacity
Volume (m3/year)
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
Calendar Year (Jan 1st to December 31st)

Leachate Estimation Spreadsheet

Project Information

Site	New England Quarry Landfill New England Quarry, Lee Mill, Devon
Date:	Feb-11
	Note - Cells shaded in green require manual input of data.

1. Input Parameters

1.1 Water Inputs

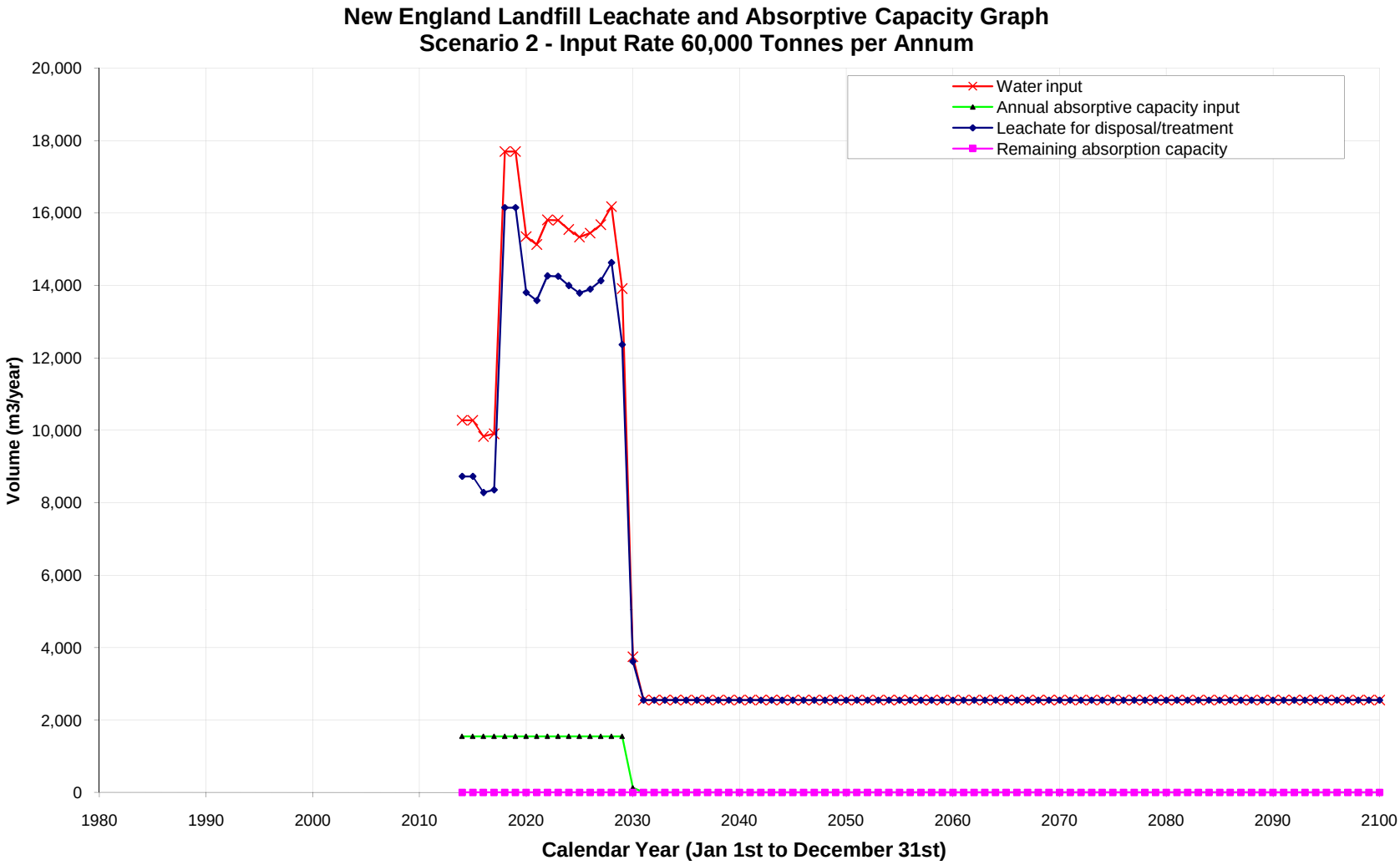
Parameter	Value	Unit	Derivation
Active (During Landfilling)			
Annual Rainfall	1048	mm/year	
Annual Rainfall	1.05	m/year	MAFF Annual Average
Annual Rainfall	0.087333333	m/mth	
Effective Rainfall (Active Phases)	1	Coef.	Worst case assumption
Effective Rainfall (Active Phases)	1048	mm/year	
Effective Rainfall (Active Phases)	0.087333333	m/mth	
Uncapped (Temporary)			
Effective Rainfall (300 to 500mm soil - Type 1)	262	mm/year	50% Winter Excess Rainfall - MAFF
Effective Rainfall (300 to 500mm soil - Type 1)	0.262	m/year	
Effective Rainfall (300 to 500mm soil - Type 1)	0.021833333	m/mth	
Effective Rainfall (Temporary Geocomposite - Type 2)	150	mm/year	
Effective Rainfall (Temporary Geocomposite - Type 2)	0.15	m/year	
Effective Rainfall (Temporary Geocomposite - Type 2)	0.0125	m/mth	
Restored (Final Capping)			
Effective Rainfall (Final cap 500mm soil and or 1.5mm LDPE and or GCL)	50	mm/year	LandSim and ETSU (50mm/yr)
Effective Rainfall (Final cap 500mm soil and or 1.5mm LDPE and or GCL)	0.004166667	m/mth	

1.2 Storage Characteristics

Parameter	Value	Unit	Derivation
Waste Density	1.00	t/m^3	Assumed representative value
Absorption Capacity	0.0258	m^3/t	NWWDO Leachate Management Report
Saturated Storage Coeff.	20%	% v/v	Water Balance Report

1.3 Landfill Characteristics

Phase / Cell / Area Identifier	Base Area	Cap Area	Mean area	Waste volume	Waste mass	Input Rate	Phase / Cell life	Phase / Cell life	Start date	End date	Cumulative life	Temporary Cap Type	
USER INFORMATION	m^2	m^2	m^2	m^3	T	T/a	Years	Months			Years	Select Type 1 or Type 2 in Table 1.1	
1		9,805		134,515	134,515	60,000	2.24	26.90	Jan-2014	Mar-2016	2.24	2	OK
2 Temp (A)		9,305		38,436	38,436	60,000	0.64	7.69	Mar-2016	Nov-2016	2.88	2	OK
2 Capped		1,294		0	0	60,000	0.00		Nov-2016	Nov-2016	2.88	2	OK
2 Temp (B)		7,179		35,320	35,320	60,000	0.59	7.06	Nov-2016	Jun-2017	3.47	2	OK
2 Active		7,866		30,125	30,125	60,000	0.50	6.03	Jun-2017	Dec-2017	3.97	2	OK
3a Active		14,465		129,925	129,925	60,000	2.17	25.99	Dec-2017	Feb-2020	6.14	2	OK
3a Temp		20,606		0	0	60,000	0.00		Feb-2020	Feb-2020	6.14	2	OK
3b Active		10,956		91,084	91,084	60,000	1.52	18.22	Feb-2020	Aug-2021	7.66	2	OK
3b Temp		23,883		0	0	60,000	0.00		Aug-2021	Aug-2021	7.66	2	OK
3c Active		11,460		109,516	109,516	60,000	1.83	21.90	Aug-2021	Jun-2023	9.48	2	OK
3c Capped		4,840		0	0	60,000	0.00		Jun-2023	Jun-2023	9.48	2	OK
3c Temp		21,562		0	0	60,000	0.00		Jun-2023	Jun-2023	9.48	2	OK
4a Active		11,307		96,026	96,026	60,000	1.60	19.21	Jun-2023	Jan-2025	11.08	2	OK
4a Capped		4,904		0	0	60,000	0.00		Jan-2025	Jan-2025	11.08	2	OK
4a Temp		16,887		0	0	60,000	0.00		Jan-2025	Jan-2025	11.08	2	OK
4b Active		11,400		82,498	82,498	60,000	1.37	16.50	Jan-2025	Jun-2026	12.46	2	OK
4b Capped		7,345		0	0	60,000	0.00		Jun-2026	Jun-2026	12.46	2	OK
4b Temp		13,330		0	0	60,000	0.00		Jun-2026	Jun-2026	12.46	2	OK
5a Active		11,685		81,320	81,320	60,000	1.36	16.26	Jun-2026	Oct-2027	13.81	2	OK
5a Capped		5,779		0	0	60,000	0.00		Oct-2027	Oct-2027	13.81	2	OK
5a Temp		10,017		0	0	60,000	0.00		Oct-2027	Oct-2027	13.81	2	OK
5b Active		12,704		75,968	75,968	60,000	1.27	15.19	Oct-2027	Jan-2029	15.08	2	OK
6		11,067		63,326	63,326	60,000	1.06	12.67	Jan-2029	Feb-2030	16.13	2	OK
3a Capped		3,063		0	0	60,000	0.00		Feb-2030	Feb-2030	16.13	2	OK
					0								OK
TOTAL	0	50,996	0	968,059	968,059		16.13	194			16		


New England Landfill Leachate and Absorptive Capacity Graph
Scenario 2 - Input Rate 60,000 Tonnes per Annum
Water input
Annual absorptive capacity input
Leachate for disposal/treatment
Remaining absorption capacity
Volume (m3/year)
20,000
18,000
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
1980
1990
2000
2010
2020
2030
2040
2050
2060
2070
2080
2090
2100
Calendar Year (Jan 1st to December 31st)

APPENDIX HRA10
Estimation of Hydraulic conductivity

BH	Strata	Base mOD	WL mOD	Sat thick m	Depth	Carnon Tests		SLR Tests	
						K m/s	T m2/d	K m/d	T m2/d
101	Slate	12.27	34.12	21.85	24	5.94E-07	1.1	5.07E-08	0.10
102	Dolerite	14.1	36.45	22.35	30	1.45E-06	2.8	1.40E-07	0.27
103	Dolerite	18.86	41.52	22.66	31	3.05E-06	6.0		
104	Slate	18.84	39.68	20.84	30	1.85E-06	3.3	1.50E-07	0.27
105	Slate	22.42	53.16	30.74	39	3.13E-06	8.3	1.09E-06	2.89
106	Dolerite	22.05	56.48	34.43	50	2.65E-06	7.9		
107	Slate	20.33	66.43	46.1	55	6.42E-07	2.6	9.65E-08	0.38
108	Slate	18.64	52.61	33.97	40			6.29E-08	0.18
109	Slate	14.08	65.82	51.74	61	6.30E-08	0.3	3.71E-08	0.17
110	Dolerite	18.97	47.62	28.65	30	1.18E-07	0.3	1.83E-07	0.45

Summary

T m2/d	K m/s	T m2/d
0.1	3.71E-08	0.1
0.6	9.03E-07	2.2
2.9	3.13E-06	8.3

Calculated Representative Hydraulic Conductivity

	T m2/d	K m/s b=3
		3
Min	0.1	3.69E-07
Mean	2.2	8.46E-06
Max	8.3	3.21E-05