POLLUTEv10

Version 10.00

GAEA Technologies Ltd., R.K. Rowe and J.R. Booker

Case 16: Monte Carlo Simulation

THE VARIABLE VELOCITY AND/OR CONCENTRATION OPTION HAS BEEN USED. NOTE THAT THE ACCURACY OF THE CALCULATIONS WITH THIS OPTION WILL DEPEND ON THE NUMBER OF SUBLAYERS USED.

THE PASSIVE SINK OPTION HAS BEEN USED. NOTE THE USER IS RESPONSIBLE FOR ENSURING THAT VELOCITY CHANGES ARE CONSISTENT WITH THE PASSIVE SINK.

Layer Properties

Layer	Thickness	Number of Sublayers	Coefficient of Hydrodynamic Dispersion	Matrix Porosity	Distributon Coefficient	Dry Density
Clay	1 m	4	0.02 m²/a	0.4	0 cm³/g	1.5 g/cm³
Collection System	0.3 m	4	10 m²/a	0.3	0 cm³/g	1.5 g/cm³
Aquitard	2 m	4	0.02 m²/a	0.4	0 cm³/g	1.5 g/cm³

Boundary Conditions

Finite Mass Top Boundary

Fixed Outflow Bottom Boundary

Landfill Length	200 m
Landfill Width	1 m
Base Thickness	1 m
Base Porosity	0.3

Variation in Properties with Time

Time Periods with the same Source and Velocity

Period	Start Time	No. of Steps	Time Step	Source Conc	Rate of Change	Height of Leachate	Volume Collected
1	0 year	1	20 year	1000 mg/L	0	7.5 m	0.29 m/a
2	20 year	5	2 year	-1 mg/L	0	7.5 m	0.2 m/a
3	30 year	2	10 year	-1 mg/L	0	7.5 m	0.2 m/a
4	50 year	5	10 year	-1 mg/L	0	7.5 m	0.2 m/a
5	100 year	5	20 year	-1 mg/L	0	7.5 m	0.2 m/a

Period	Start Time	End Time	Proportion Mass	Dispersivity	Base Velocity
1	0 year	20 year	1 m/a	0.4 m	4 m/a
2	20 year	30 year	1 m/a	0.4 m	4 m/a
3	30 year	50 year	1 m/a	0.4 m	4 m/a
4	50 year	100 year	1 m/a	0.4 m	4 m/a
5	100 year	200 year	1 m/a	0.4 m	4 m/a

Velocity and Sink Profile

Time Period	Minimum Depth	Maximum Depth	Vertical Velocity	Horizontal Outflow
1 / 1	0 m	1 m	0.01 m/a	0 m/a
	1 m	1.3 m	0.01 m/a	6.67 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
2 / 1	0 m	1 m	0.028 m/a	0 m/a
	1 m	1.3 m	0.028 m/a	18.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
2 / 2	0 m	1 m	0.046 m/a	0 m/a
	1 m	1.3 m	0.046 m/a	30.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
2 / 3	0 m	1 m	0.064 m/a	0 m/a
	1 m	1.3 m	0.064 m/a	42.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
2 / 4	0 m	1 m	0.082 m/a	0 m/a
	1 m	1.3 m	0.082 m/a	54.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
2 / 5	0 m	1 m	0.1 m/a	0 m/a
	1 m	1.3 m	0.1 m/a	66.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
3 / 1	0 m	1 m	0.1 m/a	0 m/a
	1 m	1.3 m	0.1 m/a	66.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
3 / 2	0 m	1 m	0.1 m/a	0 m/a
	1 m	1.3 m	0.1 m/a	66.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
4 / 1	0 m	1 m	0.1 m/a	0 m/a
	1 m	1.3 m	0.1 m/a	66.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
4 / 2	0 m	1 m	0.1 m/a	0 m/a
	1 m	1.3 m	0.1 m/a	66.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
4 / 3	0 m	1 m	0.1 m/a	0 m/a
	1 m	1.3 m	0.1 m/a	66.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
4 / 4	0 m	1 m	0.1 m/a	0 m/a
	1 m	1.3 m	0.1 m/a	66.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
4 / 5	0 m	1 m	0.1 m/a	0 m/a
	1 m	1.3 m	0.1 m/a	66.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
5 / 1	0 m	1 m	0.1 m/a	0 m/a

	1 m	1.3 m	0.1 m/a	66.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
5 / 2	0 m	1 m	0.1 m/a	0 m/a
	1 m	1.3 m	0.1 m/a	66.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
5 / 3	0 m	1 m	0.1 m/a	0 m/a
	1 m	1.3 m	0.1 m/a	66.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
5 / 4	0 m	1 m	0.1 m/a	0 m/a
	1 m	1.3 m	0.1 m/a	66.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a
5 / 5	0 m	1 m	0.1 m/a	0 m/a
	1 m	1.3 m	0.1 m/a	66.7 m/a
	1.3 m	3.3 m	0 m/a	0 m/a

Laplace Transform Parameters

TAU	7
N	20
SIG	0
RNU	2

Monte Carlo Simulation Results

Number of Simulations = 2000
Number of Variables = 1
Number of Data Ranges = 20

Variable # 1
Variable Properties End Time
Time Period = 1
Triangular Distribution (Minimum = 15 Maximum = 50 Mode = 25)

Depth = 3.3

DISTRIBUTION OF PEAK CONCENTRATION

Minimum Value	Maximum Value	Number Occur.	Probability	Cumulative Probability	Expected Value
2.28539E+01	2.29448E+01	40	0.02	0.02	4.57987E-01
2.29448E+01	2.30358E+01	68	0.03	0.05	7.81669E-01
2.30358E+01	2.31267E+01	102	0.05	0.11	1.17714E+00
2.31267E+01	2.32176E+01	126	0.06	0.17	1.45985E+00
2.32176E+01	2.33086E+01	157	0.08	0.25	1.82615E+00
2.33086E+01	2.33995E+01	194	0.10	0.34	2.26534E+00
2.33995E+01	2.34905E+01	220	0.11	0.45	2.57895E+00
2.34905E+01	2.35814E+01	379	0.19	0.64	4.46006E+00
2.35814E+01	2.36724E+01	503	0.25	0.89	5.94217E+00
2.36724E+01	2.37633E+01	25	0.01	0.91	2.96473E-01
2.37633E+01	2.38543E+01	22	0.01	0.92	2.61897E-01
2.38543E+01	2.39452E+01	18	0.01	0.93	2.15098E-01
2.39452E+01	2.40362E+01	27	0.01	0.94	3.23874E-01
2.40362E+01	2.41271E+01	23	0.01	0.95	2.76939E-01

2.41271E+01	2.42181E+01	22	0.01	0.96	2.65898E-01
2.42181E+01	2.43090E+01	21	0.01	0.97	2.54767E-01
2.43090E+01	2.43999E+01	21	0.01	0.98	2.55722E-01
2.43999E+01	2.44909E+01	22	0.01	0.99	2.68900E-01
2.44909E+01	2.45818E+01	8	0.00	1.00	9.81455E-02
2.45818E+01	2.46728E+01	2	0.00	1.00	2.46273E-02

Expected Maximum Concentration = 2.34917E+01

DISTRIBUTION OF TIME OF PEAK CONCENTRATION

Minimum Value	Maximum Value	Number Occur.	Probability	Cumulative Probability	Expected Value
5.5E+01	5.63641E+01	13	0.01	0.01	3.6E-01
5.6E+01	5.75412E+01	27	0.01	0.02	7.7E-01
5.8E+01	5.87183E+01	41	0.02	0.04	1.2E+00
5.9E+01	5.98953E+01	60	0.03	0.07	1.8E+00
6.0E+01	6.10724E+01	84	0.04	0.11	2.5E+00
6.1E+01	6.22495E+01	90	0.04	0.16	2.8E+00
6.2E+01	6.34265E+01	112	0.06	0.21	3.5E+00
6.3E+01	6.46036E+01	125	0.06	0.28	4.0E+00
6.5E+01	6.57807E+01	133	0.07	0.34	4.3E+00
6.6E+01	6.69577E+01	127	0.06	0.41	4.2E+00
6.7E+01	6.81348E+01	140	0.07	0.48	4.7E+00
6.8E+01	6.93118E+01	157	0.08	0.55	5.4E+00
6.9E+01	7.04889E+01	147	0.07	0.63	5.1E+00
7.0E+01	7.16660E+01	150	0.07	0.70	5.3E+00
7.2E+01	7.28430E+01	121	0.06	0.76	4.4E+00
7.3E+01	7.40201E+01	121	0.06	0.82	4.4E+00
7.4E+01	7.51972E+01	106	0.05	0.88	4.0E+00
7.5E+01	7.63742E+01	99	0.05	0.93	3.8E+00
7.6E+01	7.75513E+01	87	0.04	0.97	3.3E+00
7.8E+01	7.87284E+01	60	0.03	1.00	2.3E+00

Expected Time of Maximum Concentration = 68.2901544682984

VARIABLE NUMBER: 1

Minimum Value	Maximum Value	Number Occur.	Probability	Cumulative Probability	Expected Value
1.51871E+01	1.69068E+01	24	0.01	0.01	1.92563E-01
1.69068E+01	1.86265E+01	55	0.03	0.04	4.88584E-01
1.86265E+01	2.03463E+01	89	0.04	0.08	8.67145E-01
2.03463E+01	2.20660E+01	126	0.06	0.15	1.33599E+00
2.20660E+01	2.37857E+01	155	0.08	0.22	1.77675E+00
2.37857E+01	2.55055E+01	209	0.10	0.33	2.57546E+00
2.55055E+01	2.72252E+01	184	0.09	0.42	2.42561E+00
2.72252E+01	2.89449E+01	193	0.10	0.52	2.71021E+00
2.89449E+01	3.06646E+01	156	0.08	0.60	2.32477E+00
3.06646E+01	3.23844E+01	140	0.07	0.67	2.20672E+00
3.23844E+01	3.41041E+01	130	0.07	0.73	2.16088E+00
3.41041E+01	3.58238E+01	112	0.06	0.79	1.95798E+00
3.58238E+01	3.75436E+01	121	0.06	0.85	2.21936E+00
3.75436E+01	3.92633E+01	77	0.04	0.89	1.47853E+00
3.92633E+01	4.09830E+01	71	0.04	0.92	1.42437E+00
4.09830E+01	4.27028E+01	53	0.03	0.95	1.10884E+00
4.27028E+01	4.44225E+01	43	0.02	0.97	9.36596E-01
4.44225E+01	4.61422E+01	26	0.01	0.98	5.88671E-01
4.61422E+01	4.78619E+01	22	0.01	0.99	5.17023E-01

4.78619E+01	4.95817E+01	14	0.01	1.00	3.41053E-01
0.00000E+00	0.00000E+00	0	0.00	0.00	0.00000E+00

Expected Value = 2.96371E+01