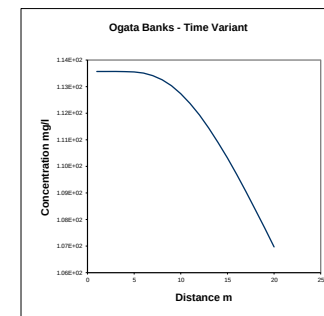
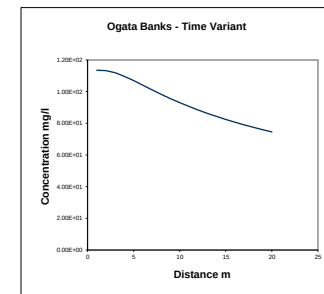


		OGATA BANKS SOLUTION																			
Contaminant		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)																			
Input	Value	Units	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
C _T	1	mg/l	1	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	6.4E-01	1.9E+00	1.1E+46	0.000	3.2E+02	1	-3.2E+02	-1	3.0E+00	1	-3.0E+00	-0.99998	1.14E+02
			2	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.3E+00	3.6E+00	1.1E+46	0.000	2.2E+02	1	-2.2E+02	-1	2.1E+00	0.9973	-2.1E+00	-0.99726	1.13E+02
			3	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.9E+00	6.8E+00	1.1E+46	0.000	1.8E+02	1	-1.8E+02	-1	1.7E+00	0.9856	-1.7E+00	-0.98557	1.12E+02
Co	1.14E+02	mg/l	4	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	2.6E+00	1.3E+01	1.1E+46	0.000	1.6E+02	1	-1.6E+02	-1	1.5E+00	0.9659	-1.5E+00	-0.96587	1.10E+02
λ	5.59E-105	days ⁻¹	5	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	3.2E+00	2.4E+01	1.1E+46	0.000	1.4E+02	1	-1.4E+02	-1	1.3E+00	0.9419	-1.3E+00	-0.94189	1.07E+02
Sz	5.00E+02	m	6	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	3.8E+00	4.6E+01	1.1E+46	0.000	1.3E+02	1	-1.3E+02	-1	1.2E+00	0.9163	-1.2E+00	-0.91633	1.04E+02
Sy	1.50E+00	m	7	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	4.5E+00	8.7E+01	1.1E+46	0.000	1.2E+02	1	-1.2E+02	-1	1.1E+00	0.8907	-1.1E+00	-0.89072	1.01E+02
Kd	8.10E+02	l/kg	8	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	5.1E+00	1.7E+02	1.1E+46	0.000	1.1E+02	1	-1.1E+02	-1	1.1E+00	0.8659	-1.1E+00	-0.86587	9.83E+01
ρ	1.36E+00	g/cm3	9	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	5.7E+00	3.1E+02	1.1E+46	0.000	1.1E+02	1	-1.1E+02	-1	1.0E+00	0.8422	-1.0E+00	-0.84215	9.56E+01
n	8.00E-02		10	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	6.4E+00	5.9E+02	1.1E+46	0.000	1.0E+02	1	-1.0E+02	-1	9.5E-01	0.8197	-9.5E-01	-0.81971	9.31E+01
i	1.00E-02		11	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	7.0E+00	1.1E+03	1.1E+46	0.000	9.5E+01	1	-9.5E+01	-1	9.0E-01	0.7986	-9.0E-01	-0.79858	9.07E+01
K	8.64E-03	m/d	12	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	7.7E+00	2.1E+03	1.1E+46	0.000	9.1E+01	1	-9.1E+01	-1	8.6E-01	0.7787	-8.6E-01	-0.77872	8.84E+01
x	2.00E+01	m	13	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	8.3E+00	4.0E+03	1.1E+46	0.000	8.8E+01	1	-8.8E+01	-1	8.3E-01	0.7601	-8.3E-01	-0.76006	8.63E+01
z	0.00E+00	m	14	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	8.9E+00	7.6E+03	1.1E+46	0.000	8.4E+01	1	-8.4E+01	-1	8.0E-01	0.7425	-8.0E-01	-0.74253	8.43E+01
y	0.00E+00	m	15	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	9.6E+00	1.4E+04	1.1E+46	0.000	8.2E+01	1	-8.2E+01	-1	7.7E-01	0.726	-7.7E-01	-0.72604	8.25E+01
t	1.00E+100	days	16	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.0E+01	2.7E+04	1.1E+46	0.000	7.9E+01	1	-7.9E+01	-1	7.5E-01	0.7105	-7.5E-01	-0.71052	8.07E+01
ax	1.57E+00	m	17	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.1E+01	5.2E+04	1.1E+46	0.000	7.7E+01	1	-7.7E+01	-1	7.3E-01	0.6959	-7.3E-01	-0.69588	7.90E+01
az	1.57E-01	m	18	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.1E+01	9.8E+04	1.1E+46	0.000	7.4E+01	1	-7.4E+01	-1	7.1E-01	0.6821	-7.1E-01	-0.68205	7.75E+01
ay	1.57E-02	m	19	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.2E+01	1.8E+05	1.1E+46	0.000	7.2E+01	1	-7.2E+01	-1	6.9E-01	0.669	-6.9E-01	-0.66897	7.60E+01
			20	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.3E+01	3.5E+05	1.1E+46	0.000	7.1E+01	1	-7.1E+01	-1	6.7E-01	0.6566	-6.7E-01	-0.65658	7.46E+01

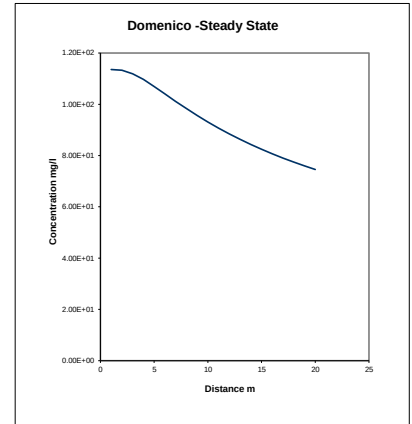
Vertical dispersion option Simulate vertical dispersion in 1 direction

		Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT																			
Calc	Value		X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration
v	1.08E-03	m/d	1	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	6.4E-01	1.9E+00	1.1E+46	0.000	3.2E+02	1	-3.2E+02	-1	6.0E+00	1	-6.0E+00	-1	1.14E+02
Rc	1.39E+04		2	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.3E+00	3.6E+00	1.1E+46	0.000	2.2E+02	1	-2.2E+02	-1	4.2E+00	1	-4.2E+00	-1	1.14E+02
u	7.84E-08	m/d	3	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.9E+00	6.8E+00	1.1E+46	0.000	1.8E+02	1	-1.8E+02	-1	3.5E+00	1	-3.5E+00	-1	1.14E+02
			4	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	2.6E+00	1.3E+01	1.1E+46	0.000	1.6E+02	1	-1.6E+02	-1	3.0E+00	1	-3.0E+00	-0.99998	1.14E+02
			5	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	3.2E+00	2.4E+01	1.1E+46	0.000	1.4E+02	1	-1.4E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99985	1.14E+02
			6	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	3.8E+00	4.6E+01	1.1E+46	0.000	1.3E+02	1	-1.3E+02	-1	2.4E+00	0.9995	-2.4E+00	-0.99946	1.14E+02
			7	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	4.5E+00	8.7E+01	1.1E+46	0.000	1.2E+02	1	-1.2E+02	-1	2.3E+00	0.9986	-2.3E+00	-0.99864	1.13E+02
			8	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	5.1E+00	1.7E+02	1.1E+46	0.000	1.1E+02	1	-1.1E+02	-1	2.1E+00	0.9973	-2.1E+00	-0.99726	1.13E+02
			9	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	5.7E+00	3.1E+02	1.1E+46	0.000	1.1E+02	1	-1.1E+02	-1	2.0E+00	0.9953	-2.0E+00	-0.99527	1.13E+02
			10	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	6.4E+00	5.9E+02	1.1E+46	0.000	1.0E+02	1	-1.0E+02	-1	1.9E+00	0.9926	-1.9E+00	-0.99263	1.13E+02
			11	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	7.0E+00	1.1E+03	1.1E+46	0.000	9.5E+01	1	-9.5E+01	-1	1.8E+00	0.9894	-1.8E+00	-0.98938	1.12E+02
			12	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	7.7E+00	2.1E+03	1.1E+46	0.000	9.1E+01	1	-9.1E+01	-1	1.7E+00	0.9856	-1.7E+00	-0.98557	1.12E+02
			13	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	8.3E+00	4.0E+03	1.1E+46	0.000	8.8E+01	1	-8.8E+01	-1	1.7E+00	0.9812	-1.7E+00	-0.98124	1.11E+02
			14	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	8.9E+00	7.6E+03	1.1E+46	0.000	8.4E+01	1	-8.4E+01	-1	1.6E+00	0.9765	-1.6E+00	-0.97647	1.11E+02
			15	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	9.6E+00	1.4E+04	1.1E+46	0.000	8.2E+01	1	-8.2E+01	-1	1.5E+00	0.9713	-1.5E+00	-0.97133	1.10E+02
			16	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.0E+01	2.7E+04	1.1E+46	0.000	7.9E+01	1	-7.9E+01	-1	1.5E+00	0.9659	-1.5E+00	-0.96587	1.10E+02
			17	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.1E+01	5.2E+04	1.1E+46	0.000	7.7E+01	1	-7.7E+01	-1	1.5E+00	0.9601	-1.5E+00	-0.96015	1.09E+02
			18	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.1E+01	9.8E+04	1.1E+46	0.000	7.4E+01	1	-7.4E+01	-1	1.4E+00	0.9542	-1.4E+00	-0.95421	1.08E+02
			19	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.2E+01	1.8E+05	1.1E+46	0.000	7.2E+01	1	-7.2E+01	-1	1.4E+00	0.9481	-1.4E+00	-0.94812	1.08E+02
			20	14.1963	0.0E+00	1.0E+00	-1.1E+46	2.000	1.3E+01	3.5E+05	1.1E+46	0.000	7.1E+01	1	-7.1E+01	-1	1.3E+00	0.9419	-1.3E+00	-0.94189	1.07E+02

Date: 24/02/2020
Version: 1

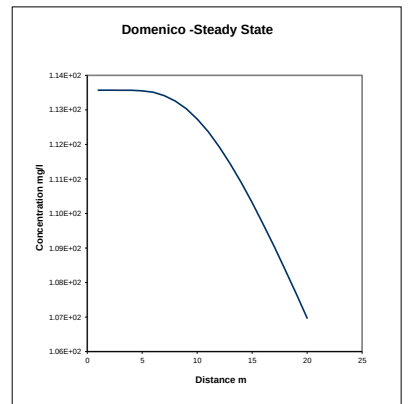


Contaminant		DOMENICO (STEADY STATE)														
Iron		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)														
Input	Value	Units		X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
C _T	1	mg/l	1	1	28.3925	0.00E+00	1.00E+00	3.16E+02	1	-3.16E+02	-1	3.00E+00	1	-3.00E+00	-1	1.14E+02
Co	1.14E+02	mg/l	2	2	28.3925	0.00E+00	1.00E+00	2.23E+02	1	-2.23E+02	-1	2.12E+00	0.997	-2.12E+00	-0.9973	1.13E+02
			3	3	28.3925	0.00E+00	1.00E+00	1.82E+02	1	-1.82E+02	-1	1.73E+00	0.986	-1.73E+00	-0.9856	1.12E+02
			4	4	28.3925	0.00E+00	1.00E+00	1.58E+02	1	-1.58E+02	-1	1.50E+00	0.966	-1.50E+00	-0.9659	1.10E+02
			λ	5.59E-105	days ⁻¹	5	5	28.3925	0.00E+00	1.00E+00	1.41E+02	1	-1.41E+02	-1	1.34E+00	0.942
Sz	5.00E+02	m	6	6	28.3925	0.00E+00	1.00E+00	1.29E+02	1	-1.29E+02	-1	1.22E+00	0.916	-1.22E+00	-0.9163	1.04E+02
Sy	1.50E+00	m	7	7	28.3925	0.00E+00	1.00E+00	1.19E+02	1	-1.19E+02	-1	1.13E+00	0.891	-1.13E+00	-0.8907	1.01E+02
Kd	8.10E+02	l/kg	8	8	28.3925	0.00E+00	1.00E+00	1.12E+02	1	-1.12E+02	-1	1.06E+00	0.866	-1.06E+00	-0.8659	9.83E+01
ρ	1.36E+00	g/cm3	9	9	28.3925	0.00E+00	1.00E+00	1.05E+02	1	-1.05E+02	-1	9.99E-01	0.842	-9.99E-01	-0.8422	9.56E+01
n	8.00E-02		10	10	28.3925	0.00E+00	1.00E+00	9.99E+01	1	-9.99E+01	-1	9.47E-01	0.82	-9.47E-01	-0.8197	9.31E+01
i	1.00E-02		11	11	28.3925	0.00E+00	1.00E+00	9.52E+01	1	-9.52E+01	-1	9.03E-01	0.799	-9.03E-01	-0.7986	9.07E+01
K	8.64E-03	m/d	12	12	28.3925	0.00E+00	1.00E+00	9.12E+01	1	-9.12E+01	-1	8.65E-01	0.779	-8.65E-01	-0.7787	8.84E+01
x	2.00E+01	m	13	13	28.3925	0.00E+00	1.00E+00	8.76E+01	1	-8.76E+01	-1	8.31E-01	0.76	-8.31E-01	-0.7601	8.63E+01
z	0.00E+00	m	14	14	28.3925	0.00E+00	1.00E+00	8.44E+01	1	-8.44E+01	-1	8.01E-01	0.743	-8.01E-01	-0.7425	8.43E+01
y	0.00E+00	m	15	15	28.3925	0.00E+00	1.00E+00	8.15E+01	1	-8.15E+01	-1	7.74E-01	0.726	-7.74E-01	-0.726	8.25E+01
			16	16	28.3925	0.00E+00	1.00E+00	7.90E+01	1	-7.90E+01	-1	7.49E-01	0.711	-7.49E-01	-0.7105	8.07E+01
ax	1.57E+00	m	17	17	28.3925	0.00E+00	1.00E+00	7.66E+01	1	-7.66E+01	-1	7.27E-01	0.696	-7.27E-01	-0.6959	7.90E+01
az	1.57E-01	m	18	18	28.3925	0.00E+00	1.00E+00	7.44E+01	1	-7.44E+01	-1	7.06E-01	0.682	-7.06E-01	-0.6821	7.75E+01
ay	1.57E-02	m	19	19	28.3925	0.00E+00	1.00E+00	7.25E+01	1	-7.25E+01	-1	6.87E-01	0.669	-6.87E-01	-0.669	7.60E+01
			20	20	28.3925	0.00E+00	1.00E+00	7.06E+01	1	-7.06E+01	-1	6.70E-01	0.657	-6.70E-01	-0.6566	7.46E+01



Vertical dispersion optio Simulate vertical dispersion in 1 direction

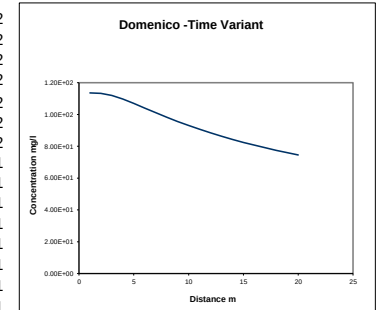
Calc	Value		DOMENICO (STEADY STATE)													
			Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT													
v	1.08E-03	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration	
Rc	1.38E+04															
u	7.84E-08	m/d	1	1	28.3925	0.00E+00	1.00E+00	3.16E+02	1	-3.16E+02	-1	5.99E+00	1	-5.99E+00	-1	1.14E+02
			2	2	28.3925	0.00E+00	1.00E+00	2.23E+02	1	-2.23E+02	-1	4.24E+00	1	-4.24E+00	-1	1.14E+02
			3	3	28.3925	0.00E+00	1.00E+00	1.82E+02	1	-1.82E+02	-1	3.46E+00	1	-3.46E+00	-1	1.14E+02
			4	4	28.3925	0.00E+00	1.00E+00	1.58E+02	1	-1.58E+02	-1	3.00E+00	1	-3.00E+00	-1	1.14E+02
			5	5	28.3925	0.00E+00	1.00E+00	1.41E+02	1	-1.41E+02	-1	2.68E+00	1	-2.68E+00	-0.9998	1.14E+02
			6	6	28.3925	0.00E+00	1.00E+00	1.29E+02	1	-1.29E+02	-1	2.45E+00	0.999	-2.45E+00	-0.9995	1.14E+02
			7	7	28.3925	0.00E+00	1.00E+00	1.19E+02	1	-1.19E+02	-1	2.26E+00	0.999	-2.26E+00	-0.9986	1.13E+02
			8	8	28.3925	0.00E+00	1.00E+00	1.12E+02	1	-1.12E+02	-1	2.12E+00	0.997	-2.12E+00	-0.9973	1.13E+02
			9	9	28.3925	0.00E+00	1.00E+00	1.05E+02	1	-1.05E+02	-1	2.00E+00	0.995	-2.00E+00	-0.9953	1.13E+02
			10	10	28.3925	0.00E+00	1.00E+00	9.99E+01	1	-9.99E+01	-1	1.89E+00	0.993	-1.89E+00	-0.9926	1.13E+02
			11	11	28.3925	0.00E+00	1.00E+00	9.52E+01	1	-9.52E+01	-1	1.81E+00	0.989	-1.81E+00	-0.9894	1.12E+02
			12	12	28.3925	0.00E+00	1.00E+00	9.12E+01	1	-9.12E+01	-1	1.73E+00	0.986	-1.73E+00	-0.9856	1.12E+02
			13	13	28.3925	0.00E+00	1.00E+00	8.76E+01	1	-8.76E+01	-1	1.66E+00	0.981	-1.66E+00	-0.9812	1.11E+02
			14	14	28.3925	0.00E+00	1.00E+00	8.44E+01	1	-8.44E+01	-1	1.60E+00	0.976	-1.60E+00	-0.9765	1.11E+02
			15	15	28.3925	0.00E+00	1.00E+00	8.15E+01	1	-8.15E+01	-1	1.55E+00	0.971	-1.55E+00	-0.9713	1.10E+02
			16	16	28.3925	0.00E+00	1.00E+00	7.90E+01	1	-7.90E+01	-1	1.50E+00	0.966	-1.50E+00	-0.9659	1.10E+02
			17	17	28.3925	0.00E+00	1.00E+00	7.66E+01	1	-7.66E+01	-1	1.45E+00	0.96	-1.45E+00	-0.9601	1.09E+02
			18	18	28.3925	0.00E+00	1.00E+00	7.44E+01	1	-7.44E+01	-1	1.41E+00	0.954	-1.41E+00	-0.9542	1.08E+02
			19	19	28.3925	0.00E+00	1.00E+00	7.25E+01	1	-7.25E+01	-1	1.37E+00	0.948	-1.37E+00	-0.9481	1.08E+02
			20	20	28.3925	0.00E+00	1.00E+00	7.06E+01	1	-7.06E+01	-1	1.34E+00	0.942	-1.34E+00	-0.9419	1.07E+02
24/02/2020																
n:	1															



Date: 24/02/2020
Version: 1

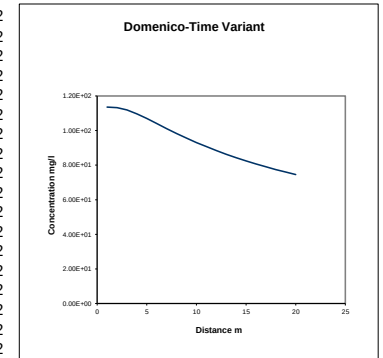
DOMENICO (TIME VARIANT)

Contaminant		Iron		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)														Concentration
Input	Value	Units	X		Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	
C _T	1	mg/l	1	m														
Co λ Sz Sy Kd ρ n i K x z y t ax az ay	1.14E+02	mg/l	2	2	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	2.23E+02	1	-2.23E+02	-1	2.12E+00	0.9973	-2.12E+00	-0.997	1.13E+02
	5.59E-105	days ⁻¹	3	3	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.82E+02	1	-1.82E+02	-1	1.73E+00	0.9856	-1.73E+00	-0.986	1.12E+02
	5.00E+02	m	4	4	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.58E+02	1	-1.58E+02	-1	1.50E+00	0.9659	-1.50E+00	-0.966	1.10E+02
	1.50E+00	m	5	5	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.41E+02	1	-1.41E+02	-1	1.34E+00	0.9419	-1.34E+00	-0.942	1.07E+02
	8.10E+02	l/kg	6	6	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.29E+02	1	-1.29E+02	-1	1.22E+00	0.9163	-1.22E+00	-0.916	1.04E+02
	1.36E+00	g/cm3	7	7	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.19E+02	1	-1.19E+02	-1	1.13E+00	0.8907	-1.13E+00	-0.891	1.01E+02
	8.00E-02		8	8	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.12E+02	1	-1.12E+02	-1	1.06E+00	0.8659	-1.06E+00	-0.866	9.83E+01
	1.00E-02		9	9	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.05E+02	1	-1.05E+02	-1	9.99E-01	0.8422	-9.99E-01	-0.842	9.56E+01
	8.64E-03	m/d	10	10	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	9.99E+01	1	-9.99E+01	-1	9.47E-01	0.8197	-9.47E-01	-0.82	9.31E+01
	2.00E+01	m	11	11	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	9.52E+01	1	-9.52E+01	-1	9.03E-01	0.7986	-9.03E-01	-0.799	9.07E+01
	0.00E+00	m	12	12	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	9.12E+01	1	-9.12E+01	-1	8.65E-01	0.7787	-8.65E-01	-0.779	8.84E+01
	0.00E+00	m	13	13	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	8.76E+01	1	-8.76E+01	-1	8.31E-01	0.7601	-8.31E-01	-0.76	8.63E+01
	1.00E+100	days	14	14	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	8.44E+01	1	-8.44E+01	-1	8.01E-01	0.7425	-8.01E-01	-0.743	8.43E+01
	1.57E+00	m	15	15	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	8.15E+01	1	-8.15E+01	-1	7.74E-01	0.726	-7.74E-01	-0.726	8.25E+01
	1.57E-01	m	16	16	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.90E+01	1	-7.90E+01	-1	7.49E-01	0.7105	-7.49E-01	-0.711	8.07E+01
	1.57E-02	m	17	17	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.66E+01	1	-7.66E+01	-1	7.27E-01	0.6959	-7.27E-01	-0.696	7.90E+01
			18	18	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.44E+01	1	-7.44E+01	-1	7.06E-01	0.6821	-7.06E-01	-0.682	7.75E+01
			19	19	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.25E+01	1	-7.25E+01	-1	6.87E-01	0.669	-6.87E-01	-0.669	7.60E+01
			20	20	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.06E+01	1	-7.06E+01	-1	6.70E-01	0.6566	-6.70E-01	-0.657	7.46E+01



Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc	Value	Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT																
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration	
v	1.08E-03	m/d	1	1	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	3.16E+02	1	-3.16E+02	-1	5.99E+00	1	-5.99E+00	-1	1.14E+02
Rc	1.38E+04		2	2	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	2.23E+02	1	-2.23E+02	-1	4.24E+00	1	-4.24E+00	-1	1.14E+02
u	7.84E-08	m/d	3	3	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.82E+02	1	-1.82E+02	-1	3.46E+00	1	-3.46E+00	-1	1.14E+02
			4	4	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.58E+02	1	-1.58E+02	-1	3.00E+00	1	-3.00E+00	-1	1.14E+02
			5	5	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.41E+02	1	-1.41E+02	-1	2.68E+00	0.9998	-2.68E+00	-1	1.14E+02
			6	6	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.29E+02	1	-1.29E+02	-1	2.45E+00	0.9995	-2.45E+00	-0.999	1.14E+02
			7	7	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.19E+02	1	-1.19E+02	-1	2.26E+00	0.9986	-2.26E+00	-0.999	1.13E+02
			8	8	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.12E+02	1	-1.12E+02	-1	2.12E+00	0.9973	-2.12E+00	-0.997	1.13E+02
			9	9	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	1.05E+02	1	-1.05E+02	-1	2.00E+00	0.9953	-2.00E+00	-0.995	1.13E+02
			10	10	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	9.99E+01	1	-9.99E+01	-1	1.89E+00	0.9926	-1.89E+00	-0.993	1.13E+02
			11	11	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	9.52E+01	1	-9.52E+01	-1	1.81E+00	0.9894	-1.81E+00	-0.989	1.12E+02
			12	12	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	9.12E+01	1	-9.12E+01	-1	1.73E+00	0.9856	-1.73E+00	-0.986	1.12E+02
			13	13	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	8.76E+01	1	-8.76E+01	-1	1.66E+00	0.9812	-1.66E+00	-0.981	1.11E+02
			14	14	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	8.44E+01	1	-8.44E+01	-1	1.60E+00	0.9765	-1.60E+00	-0.976	1.11E+02
			15	15	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	8.15E+01	1	-8.15E+01	-1	1.55E+00	0.9713	-1.55E+00	-0.971	1.10E+02
			16	16	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.90E+01	1	-7.90E+01	-1	1.50E+00	0.9659	-1.50E+00	-0.966	1.10E+02
			17	17	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.66E+01	1	-7.66E+01	-1	1.45E+00	0.9601	-1.45E+00	-0.96	1.09E+02
			18	18	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.44E+01	1	-7.44E+01	-1	1.41E+00	0.9542	-1.41E+00	-0.954	1.08E+02
			19	19	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.25E+01	1	-7.25E+01	-1	1.37E+00	0.9481	-1.37E+00	-0.948	1.08E+02
			20	20	14.1963	0.00E+00	1.00E+00	-1.12E+46	2	7.06E+01	1	-7.06E+01	-1	1.34E+00	0.9419	-1.34E+00	-0.942	1.07E+02
	24/02/2020																	
	1																	



Date: 24/02/2020
Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions)

Details to be completed for each assessment

Site Name:	Glan Llyn		
Site Address:	Llanwern		
Completed by:	Ross Cameron	Version:	1
Date:	24-Feb-20		
Contaminant	Manganese		
Target Concentration (C _T)	0.123	mg/l	Origin of C _T : Water Framework Directive (EQS)

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant
Target concentration

C_T

Manganese
0.123 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

0.5

Air filled soil porosity

θ_a

3.70E-01

fraction

0.0037

Bulk density of soil zone material

ρ

1.36E+00

g/cm³

1.36

Henry's Law constant

H

1.00E+00

dimensionless

1

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

1.34E+02

l/kg

1.34E+02

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

fraction

Organic carbon partition coefficient

K_{oc}

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.34E+02

l/kg

Specified value

Level 1 Remedial Target

Level 1 Remedial Target

1.66E+01

mg/kg

(for comparison with soil analyses)

or

0.123

mg/l

(for comparison with leachate test results)

Site being assessed: Glan Llyn
Completed by: Ross Cameron
Date: 24-Feb-20
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Manganese
0.123

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	0.00E+00	m/d	
Area of contaminant source	A	0.00E+00	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	0.00E+00	m	
Saturated aquifer thickness	da	0.00E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	0.00E+00	m/d	
Hydraulic gradient of water table	i	0.00E+00	fraction	
Width of contaminant source perpendicular to groundwater flow	w	0.00E+00	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	0.00E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	#DIV/0!	
Level 2 Remedial Target		#DIV/0! or #DIV/0!	mg/l mg/kg
For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration			
For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water			

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		#DIV/0!	mg/l	0

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Manganese		from Level 1
Target Concentration	C _T	0.123	mg/l	from Level 1
Dilution Factor	DF	#DIV/0!		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks	Equations in HRA publication
-------------	------------------------------

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to pollutants in all phases (e.g. field derived value, then on pull-down menu)

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+100	days	
Calculated decay rate	6.93E-101	days ⁻¹	calculated
Width of plume in aquifer at source	0.00E+00	m	from Level 2
Plume thickness in aquifer at source	0.00E+00	m	from Level 2
Bulk density of aquifer materials	0.00E+00	g/cm ³	
Effective porosity of aquifer	0.00E+00	fraction	
Hydraulic gradient	#DIV/0!	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	0.00E+00	m/d	from Level 2
Distance to compliance point	0.00E+00	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	0.00E+00	l/kg see options
Longitudinal dispersivity	ax	0.000	m see options
Transverse dispersivity	az	0.000	m see options
Vertical dispersivity	ay	0.000	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	v	#DIV/0! m/d
Retardation factor	Rf	#DIV/0! fraction
Decay rate used	λ	6.93E-101 d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	#DIV/0! fraction
Rate of contaminant flow due to retardation	u	#DIV/0! m/d
Ratio of Compliance Point to Source Concentration	C _{CP} /C ₀	#DIV/0! fraction
Attenuation factor (C ₀ /C _{CP})	AF	#DIV/0! fraction
Calculated soil leachate concentration	Co	0.00E+00 mg/l

Remedial Targets

Level 3 Remedial Target	#DIV/0!	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	0	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{CP} /C ₀	#DIV/0! fraction	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd 0.00E+00 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Organic carbon partition coefficient Koc 0.00E+00 l/kg

Sorption coefficient for related species K_{oc,n} 0.00E+00 l/kgSorption coefficient for ionised species K_{oc,i} 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

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Acid dissociation constant pKa 0.00E+00

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Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

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Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

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Acid dissociation constant pKa 0.00E+00

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Soil water partition coefficient Kd 0.00E+00 l/kg

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Acid dissociation constant pKa 0.00E+00

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Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

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Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00E+00 fraction

Soil water partition coefficient Kd 0.00E+00 l/kg

pH value pH 0.00E+00

Acid dissociation constant pKa 0.00E+00

Fraction of organic carbon in aquifer foc 0.00

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant Manganese
Target Concentration C_r 1.23E-01 mg/l from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Source of parameter value

Initial contaminant concentration in groundwater at plume core C₀ 1.20E+01 mg/l Based on average soil conc of 8645mg/kg
Half life for degradation of contaminant in water t_{1/2} 9.00E+99 days Estimation
Calculated decay rate λ 7.70E-101 days⁻¹
Width of plume in aquifer at source (perpendicular to flow) Sz 5.00E+02 m Site data
Plume thickness at source Sy 1.50E+00 m Thickness of re-engineered MG
Saturated aquifer thickness da 2.00E+00 m Based upon proposed total MG and caprock
Bulk density of aquifer materials ρ 1.36E+00 g/cm³ Site data
Effective porosity of aquifer n 8.00E-02 fraction Estimate
Hydraulic gradient i 1.00E-02 fraction
Hydraulic conductivity of aquifer K 8.64E-03 m/d Proposed best achievable
Distance to compliance point x 2.00E+01 m Site data
Distance (lateral) to compliance point perpendicular to flow direction z m
Distance (depth) to compliance point perpendicular to flow direction y m
Time since pollutant entered groundwater t 1.00E+100 days time variant options only
Parameters values determined from options
Partition coefficient Kd 7.20E+02 l/kg see options
Longitudinal dispersivity ax 1.57E+00 m see options
Transverse dispersivity az 1.57E-01 m see options
Vertical dispersivity ay 1.57E-02 m see options

Calculated Parameters Variable

Groundwater flow velocity v 1.08E-03 m/d
Retardation factor Rf 1.22E+04 fraction
Decay rate used λ 6.29E-105 d⁻¹
Rate of contaminant flow due to retardation u 8.82E-08 m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion C_{ED} 1.13E+01 mg/l
Attenuation factor (one way vertical dispersion, CO/CEd) AF 1.06E+00

Remedial Targets

Remedial Target 1.31E-01 mg/l For comparison with measured groundwater concentration.
Domenico - Steady state
Distance to compliance point 20 m
Concentration of contaminant at compliance point C_{ED}/C₀ 1.13E+01 mg/l Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target.
The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

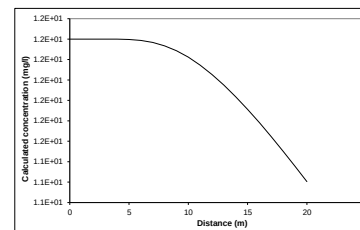
User specified value for partition coefficient

Entry if specify partition coefficient (option)
Soil water partition coefficient Kd 7.20E+02 l/kg
Entry for non-polar organic chemicals (option)
Fraction of organic carbon in aquifer f_{oc} fraction
Organic carbon partition coefficient K_{oc} l/kg
Entry for ionic organic chemicals (option)
Sorption coefficient for related species K_{oc,n} l/kg
Sorption coefficient for ionised species K_{oc,i} l/kg
pH value pH
acid dissociation constant pKa
Fraction of organic carbon in aquifer f_{oc} fraction
Soil water partition coefficient Kd 7.20E+02 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivity based on Xu & Eckstein (1995)

Longitudinal dispersivity ax 1.57E+00 m
Transverse dispersivity az 1.57E-01 m
Vertical dispersivity ay 1.57E-02 m
Note values of dispersivity must be > 0
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{0.414}, az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.
Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used

Calculated concentrations for distance-concentration graph

Domenico - Steady state

From calculation sheet

Distance Concentration
mg/l
0 1.2E+01
1.0 1.20E+01
2.0 1.20E+01
3.0 1.20E+01
4.0 1.20E+01
5.0 1.20E+01
6.0 1.20E+01
7.0 1.20E+01
8.0 1.20E+01
9.0 1.19E+01
10.0 1.19E+01
11.0 1.19E+01
12.0 1.18E+01
13.0 1.18E+01
14.0 1.17E+01
15.0 1.17E+01
16.0 1.16E+01
17.0 1.15E+01
18.0 1.14E+01
19.0 1.14E+01
20.0 1.13E+01

Site being assessed: Gian Lynn
Completed by: Ross Cameron
Date: 11/11/2021
Version: 1

Porosity Calculator

These results are not carried through to any of the other worksheets

DRY BULK DENSITY DATA

Variable	Value	Unit	justification
Natural Moisture Content	0.00	% wt	(Change this number only if you have specific information)
Particle Density	2.78	tonnes/m ³	
Dry Bulk Density	0.00	tonnes/m ³	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
Initial Saturation	#DIV/0!	%	
Total porosity	1.000	fraction	
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

WET BULK DENSITY DATA

	Variable	Value	Unit	
	Moisture Content	0.00	% wt	(Change this number only if you have specific information)
	Particle Density	2.78	tonnes/m ³	
Actual (wet) Bulk Density (i.e. at natural MC)		0.00	tonnes/m ³	
Calculated Parameters				
	Voids Ratio	#DIV/0!	fraction	
	dry bulk density	0.00	tonnes/m ³	
	Initial Saturation	#DIV/0!	%	
Total porosity				#DIV/0!
Air Filled Porosity				#DIV/0!
Water Filled Porosity				#DIV/0!

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol	unit	justification
Hydraulic conductivity	K	0.00E+00 m/d	
Hydraulic gradient	i	0.00E+00 unitless	
Effective porosity of aquifer	n	0.00E+00 fraction	
Thickness of saturated aquifer	b	0.00E+00 m	
Width of aquifer perpendicular to flow	w	0.00E+00 m	
Distance to receptor	x	0.00E+00 m	
Bulk density of aquifer materials	ρ	0.00E+00 g/cm ³	
Soil-water partition co-efficient	Kd	0.00E+00 l/kg	
Retardation factor of pollutant	R	#DIV/0!	

Groundwater flow velocity	v(GW)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for groundwater to reach receptor	t(GW)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years
Rate of groundwater flow through aquifer	Q	0.00E+00	m ³ /s	0.00E+00	m ³ /day	0.00E+00	m ³ /year
Contaminant flow velocity	v(contam)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for contaminant to reach receptor	t(contam)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years

Level 1 Calculation Sheet

Contaminant Manganese

Parameter (carried over from input sheet)	Value	Units	Calculations (Refer to Table 4.3, R&D Publication 20)
			Selected option
			calc calc Calc Kd l/kg
C_T	1.23E-01	mg/l	Calculation of partition coefficient
Kd	1.34E+02	l/kg	for ionic organic chemical
foc		fraction	
koc		l/kg	Partition coefficient used in Level 1 Assessment
θ_w	5.00E-01	fraction	1.34E+02 l/kg
θ_a	3.70E-01	fraction	
ρ	1.36E+00	g/cm3	
H	1.00E+00	dimensionless	
Koc,n		l/kg	
Koc,i		l/kg	
pH		pH units	
pKa			
foc (ionic)		fraction	

Calculated Remedial Target **1.66E+01 mg/kg** **for Manganese**

Factor (partitioning between soil and water) 1.35E+02

Site being assessed: Glan Llyn
 Completed by: Ross Cameron
 Date: 24/02/2020
 Version: 1

Level 2 Calculation Sheet
Contaminant Manganese

Site assessed:	Glan Llyn
Date:	24/02/2020
Version:	1

Parameter Value Units
(carried over from input sheet)

Mz	0.00E+00	m
L	0.00E+00	m
da	0.00E+00	m
Inf	0.00E+00	m/d
K	0.00E+00	m/d
i	0.00E+00	m3/d
A	0.00E+00	m2
		m3/d
Cc	0.00E+00	mg/l
C _T	1.23E-01	mg/l
Cu	0.00E+00	mg/l
w	0.00E+00	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Calculated
Dilution Factor

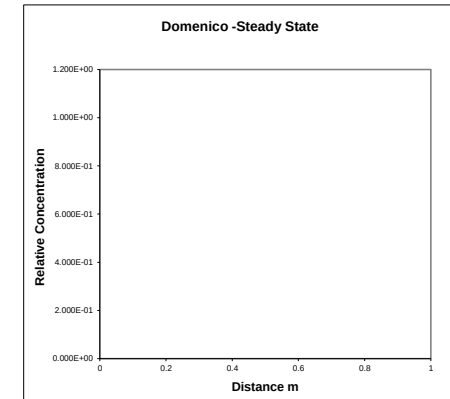
#DIV/0!

#DIV/0!

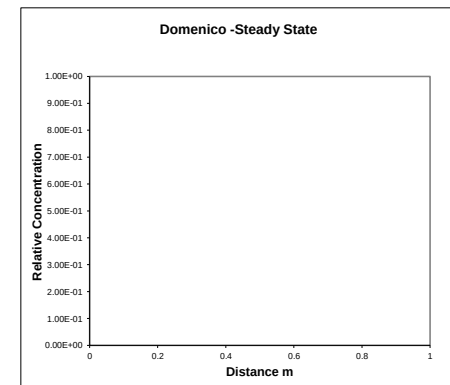


Figure 1 is a line graph titled "Ogata Banks - Time Variant". The Y-axis is labeled "Relative Concentration" and ranges from 0.00E+00 to 1.00E+00 in increments of 0.10E+00. The X-axis is labeled "Distance m" and ranges from 0 to 1 in increments of 0.1. The graph shows a single data series represented by a solid line. The concentration starts at 1.00E+00 at distance 0 and decreases steadily, reaching approximately 0.25E+00 at distance 1.

		DOMENICO (STEADY STATE)													
		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)													
Contaminant	Manganese		X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
Input	Value	Units													
C _T	1.230E-01	mg/l	1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
DF	#DIV/0!		2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
λ	6.931E-101	days ⁻¹	5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Sz	0.000E+00	m	6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Sy	0.000E+00	m	7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Kd	0.000E+00	l/kg	8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
ρ	0.000E+00	g/cm3	9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
n	0.000E+00		10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
i	#DIV/0!		11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
K	0.000E+00	m/d	12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
x	0.000E+00	m	13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
z	0.000E+00	m	14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
y	0.000E+00	m	15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
ax	0.000E+00	m	16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
az	0.000E+00	m	17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
ay	0.000E+00	m	18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!



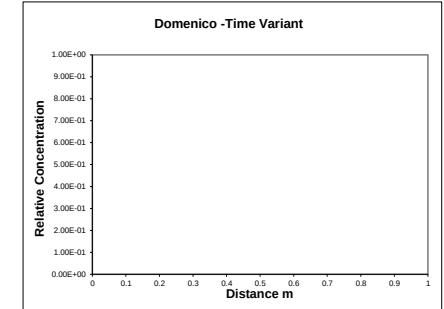
		DOMENICO (STEADY STATE)													
		Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT													
Calc	Value		X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
v	#DIV/0!	m/d	1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Rc	#DIV/0!		2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
u	#DIV/0!	m/d	3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!



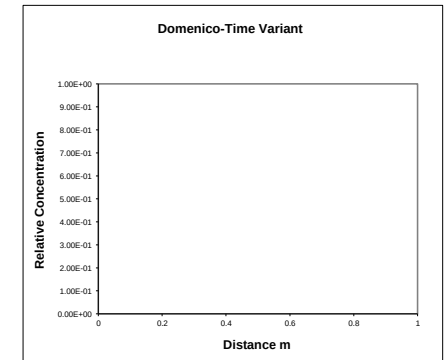
Date: 24/02/2020
Version: 1

DOMENICO (TIME VARIANT)

Contaminant	Manganese		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)														Relative Concentration
Input	Value	Units	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	
C _T	0.123	mg/l	1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
DF	#DIV/0!		2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
λ	6.931E-101	days ⁻¹	5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Sz	0.000E+00	m	6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Sy	0.000E+00	m	7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Kd	0.000E+00	l/kg	8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
ρ	0.000E+00	g/cm3	9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
n	0.000E+00		10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
i	#DIV/0!		11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
K	0.000E+00	m/d	12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
x	0.000E+00	m	13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
z	0.000E+00	m	14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
y	0.000E+00	m	15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
t	1.000E+99	days	16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
ax	0.000E+00	m	17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
az	0.000E+00	m	18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
ay	0.000E+00	m	19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calc	Value		Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT														Relative Concentration
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	
v	#DIV/0!	m/d	1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Rc	#DIV/0!		2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
u	#DIV/0!	m/d	3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

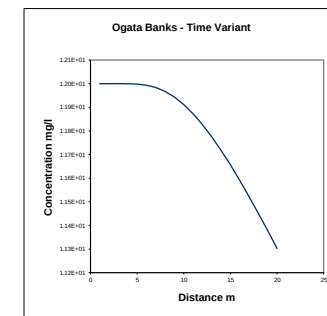
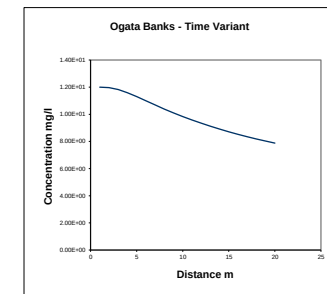


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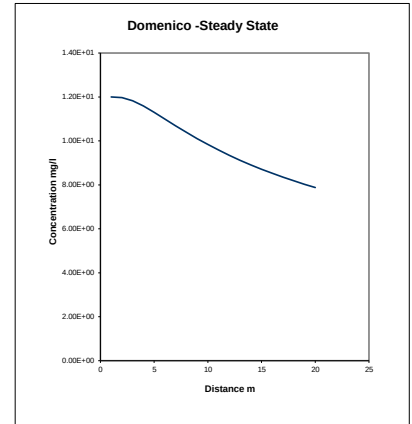
OGATA BANKS SOLUTION																							
Contaminant		Manganese		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)																			
				X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration	
Input	Value	Units																					
C _T	0.123	mg/l	1	1	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	6.4E-01	1.9E+00	1.2E+46	0.000	3.2E+02	1	-3.2E+02	-1	3.0E+00	1	-3.0E+00	-0.99998	1.20E+01	
			2	2	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.3E+00	3.6E+00	1.2E+46	0.000	2.2E+02	1	-2.2E+02	-1	2.1E+00	0.9973	-2.1E+00	-0.99726	1.20E+01	
			3	3	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.9E+00	6.8E+00	1.2E+46	0.000	1.8E+02	1	-1.8E+02	-1	1.7E+00	0.9856	-1.7E+00	-0.98557	1.18E+01	
Co	1.20E+01	mg/l	4	4	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	2.6E+00	1.3E+01	1.2E+46	0.000	1.6E+02	1	-1.6E+02	-1	1.5E+00	0.9659	-1.5E+00	-0.96587	1.16E+01	
λ	6.29E-105	days ⁻¹	5	5	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	3.2E+00	2.4E+01	1.2E+46	0.000	1.4E+02	1	-1.4E+02	-1	1.3E+00	0.9419	-1.3E+00	-0.94189	1.13E+01	
Sz	5.00E+02	m	6	6	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	3.8E+00	4.6E+01	1.2E+46	0.000	1.3E+02	1	-1.3E+02	-1	1.2E+00	0.9163	-1.2E+00	-0.91633	1.10E+01	
Sy	1.50E+00	m	7	7	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	4.5E+00	8.7E+01	1.2E+46	0.000	1.2E+02	1	-1.2E+02	-1	1.1E+00	0.8907	-1.1E+00	-0.89072	1.07E+01	
Kd	7.20E+02	l/kg	8	8	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	5.1E+00	1.7E+02	1.2E+46	0.000	1.1E+02	1	-1.1E+02	-1	1.1E+00	0.8659	-1.1E+00	-0.86587	1.04E+01	
ρ	1.36E+00	g/cm3	9	9	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	5.7E+00	3.1E+02	1.2E+46	0.000	1.1E+02	1	-1.1E+02	-1	1.0E+00	0.8422	-1.0E+00	-0.84215	1.01E+01	
n	8.00E-02		10	10	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	6.4E+00	5.9E+02	1.2E+46	0.000	1.0E+02	1	-1.0E+02	-1	9.5E-01	0.8197	-9.5E-01	-0.81971	9.84E+00	
i	1.00E-02		11	11	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	7.0E+00	1.1E+03	1.2E+46	0.000	9.5E+01	1	-9.5E+01	-1	9.0E-01	0.7986	-9.0E-01	-0.79858	9.58E+00	
K	8.64E-03	m/d	12	12	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	7.7E+00	2.1E+03	1.2E+46	0.000	9.1E+01	1	-9.1E+01	-1	8.6E-01	0.7787	-8.6E-01	-0.77872	9.34E+00	
x	2.00E+01	m	13	13	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	8.3E+00	4.0E+03	1.2E+46	0.000	8.8E+01	1	-8.8E+01	-1	8.3E-01	0.7601	-8.3E-01	-0.76006	9.12E+00	
z	0.00E+00	m	14	14	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	8.9E+00	7.6E+03	1.2E+46	0.000	8.4E+01	1	-8.4E+01	-1	8.0E-01	0.7425	-8.0E-01	-0.74253	8.91E+00	
y	0.00E+00	m	15	15	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	9.6E+00	1.4E+04	1.2E+46	0.000	8.2E+01	1	-8.2E+01	-1	7.7E-01	0.726	-7.7E-01	-0.72604	8.71E+00	
t	1.00E+100	days	16	16	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.0E+01	2.7E+04	1.2E+46	0.000	7.9E+01	1	-7.9E+01	-1	7.5E-01	0.7105	-7.5E-01	-0.71052	8.53E+00	
ax	1.57E+00	m	17	17	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.1E+01	5.2E+04	1.2E+46	0.000	7.7E+01	1	-7.7E+01	-1	7.3E-01	0.6959	-7.3E-01	-0.69588	8.35E+00	
az	1.57E-01	m	18	18	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.1E+01	9.8E+04	1.2E+46	0.000	7.4E+01	1	-7.4E+01	-1	7.1E-01	0.6821	-7.1E-01	-0.68205	8.18E+00	
ay	1.57E-02	m	19	19	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.2E+01	1.8E+05	1.2E+46	0.000	7.2E+01	1	-7.2E+01	-1	6.9E-01	0.669	-6.9E-01	-0.66897	8.03E+00	
			20	20	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.3E+01	3.5E+05	1.2E+46	0.000	7.1E+01	1	-7.1E+01	-1	6.7E-01	0.6566	-6.7E-01	-0.65658	7.88E+00	
Vertical dispersion option Simulate vertical dispersion in 1 direction																							
Calc	Value		Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT																				
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration		
v	1.08E-03	m/d	1	1	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	6.4E-01	1.9E+00	1.2E+46	0.000	3.2E+02	1	-3.2E+02	-1	6.0E+00	1	-6.0E+00	-1	1.20E+01	
			2	2	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.3E+00	3.6E+00	1.2E+46	0.000	2.2E+02	1	-2.2E+02	-1	4.2E+00	1	-4.2E+00	-1	1.20E+01	
Rc	1.22E+04		3	3	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.9E+00	6.8E+00	1.2E+46	0.000	1.8E+02	1	-1.8E+02	-1	3.5E+00	1	-3.5E+00	-1	1.20E+01	
			4	4	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	2.6E+00	1.3E+01	1.2E+46	0.000	1.6E+02	1	-1.6E+02	-1	3.0E+00	1	-3.0E+00	-0.99998	1.20E+01	
u	8.82E-08	m/d	5	5	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	3.2E+00	2.4E+01	1.2E+46	0.000	1.4E+02	1	-1.4E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99985	1.20E+01	
			6	6	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	3.8E+00	4.6E+01	1.2E+46	0.000	1.3E+02	1	-1.3E+02	-1	2.4E+00	0.9995	-2.4E+00	-0.99946	1.20E+01	
			7	7	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	4.5E+00	8.7E+01	1.2E+46	0.000	1.2E+02	1	-1.2E+02	-1	2.3E+00	0.9986	-2.3E+00	-0.99864	1.20E+01	
			8	8	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	5.1E+00	1.7E+02	1.2E+46	0.000	1.1E+02	1	-1.1E+02	-1	2.1E+00	0.9973	-2.1E+00	-0.99726	1.20E+01	
			9	9	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	5.7E+00	3.1E+02	1.2E+46	0.000	1.1E+02	1	-1.1E+02	-1	2.0E+00	0.9953	-2.0E+00	-0.99527	1.19E+01	
			10	10	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	6.4E+00	5.9E+02	1.2E+46	0.000	1.0E+02	1	-1.0E+02	-1	1.9E+00	0.9926	-1.9E+00	-0.99263	1.19E+01	
			11	11	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	7.0E+00	1.1E+03	1.2E+46	0.000	9.5E+01	1	-9.5E+01	-1	1.8E+00	0.9894	-1.8E+00	-0.98938	1.19E+01	
			12	12	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	7.7E+00	2.1E+03	1.2E+46	0.000	9.1E+01	1	-9.1E+01	-1	1.7E+00	0.9856	-1.7E+00	-0.98557	1.18E+01	
			13	13	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	8.3E+00	4.0E+03	1.2E+46	0.000	8.8E+01	1	-8.8E+01	-1	1.7E+00	0.9812	-1.7E+00	-0.98124	1.18E+01	
			14	14	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	8.9E+00	7.6E+03	1.2E+46	0.000	8.4E+01	1	-8.4E+01	-1	1.6E+00	0.9765	-1.6E+00	-0.97647	1.17E+01	
			15	15	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	9.6E+00	1.4E+04	1.2E+46	0.000	8.2E+01	1	-8.2E+01	-1	1.5E+00	0.9713	-1.5E+00	-0.97133	1.17E+01	
			16	16	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.0E+01	2.7E+04	1.2E+46	0.000	7.9E+01	1	-7.9E+01	-1	1.5E+00	0.9659	-1.5E+00	-0.96587	1.16E+01	
			17	17	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.1E+01	5.2E+04	1.2E+46	0.000	7.7E+01	1	-7.7E+01	-1	1.5E+00	0.9601	-1.5E+00	-0.96015	1.15E+01	
			18	18	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.1E+01	9.8E+04	1.2E+46	0.000	7.4E+01	1	-7.4E+01	-1	1.4E+00	0.9542	-1.4E+00	-0.95421	1.15E+01	
			19	19	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.2E+01	1.8E+05	1.2E+46	0.000	7.2E+01	1	-7.2E+01	-1	1.4E+00	0.9481	-1.4E+00	-0.94812	1.14E+01	
			20	20	1.5	0.0E+00	1.0E+00	-1.2E+46	2.000	1.3E+01	3.5E+05	1.2E+46	0.000	7.1E+01	1	-7.1E+01	-1	1.3E+00	0.9419	-1.3E+00	-0.94189	1.13E+01	

Date: 24/02/2020

Version: 1

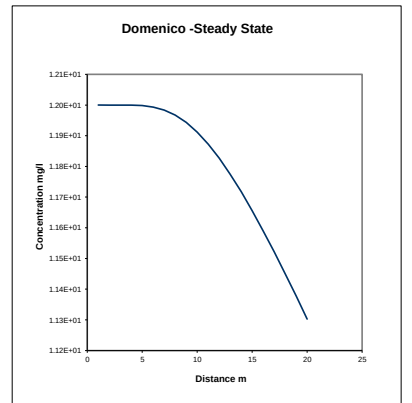


Contaminant		DOMENICO (STEADY STATE)														
Manganese		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)														
Input	Value	Units	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration	
C _T	0.123	mg/l	1	1	3	0.00E+00	1.00E+00	3.16E+02	1	-3.16E+02	-1	3.00E+00	1	-3.00E+00	-1	1.20E+01
			2	2	3	0.00E+00	1.00E+00	2.23E+02	1	-2.23E+02	-1	2.12E+00	0.997	-2.12E+00	-0.9973	1.20E+01
			3	3	3	0.00E+00	1.00E+00	1.82E+02	1	-1.82E+02	-1	1.73E+00	0.986	-1.73E+00	-0.9856	1.18E+01
Co	1.20E+01	mg/l	4	4	3	0.00E+00	1.00E+00	1.58E+02	1	-1.58E+02	-1	1.50E+00	0.966	-1.50E+00	-0.9659	1.16E+01
λ	6.29E-105	days ⁻¹	5	5	3	0.00E+00	1.00E+00	1.41E+02	1	-1.41E+02	-1	1.34E+00	0.942	-1.34E+00	-0.9419	1.13E+01
Sz	5.00E+02	m	6	6	3	0.00E+00	1.00E+00	1.29E+02	1	-1.29E+02	-1	1.22E+00	0.916	-1.22E+00	-0.9163	1.10E+01
Sy	1.50E+00	m	7	7	3	0.00E+00	1.00E+00	1.19E+02	1	-1.19E+02	-1	1.13E+00	0.891	-1.13E+00	-0.8907	1.07E+01
Kd	7.20E+02	l/kg	8	8	3	0.00E+00	1.00E+00	1.12E+02	1	-1.12E+02	-1	1.06E+00	0.866	-1.06E+00	-0.8659	1.04E+01
ρ	1.36E+00	g/cm3	9	9	3	0.00E+00	1.00E+00	1.05E+02	1	-1.05E+02	-1	9.99E-01	0.842	-9.99E-01	-0.8422	1.01E+01
n	8.00E-02		10	10	3	0.00E+00	1.00E+00	9.99E+01	1	-9.99E+01	-1	9.47E-01	0.82	-9.47E-01	-0.8197	9.84E+00
i	1.00E-02		11	11	3	0.00E+00	1.00E+00	9.52E+01	1	-9.52E+01	-1	9.03E-01	0.799	-9.03E-01	-0.7986	9.58E+00
K	8.64E-03	m/d	12	12	3	0.00E+00	1.00E+00	9.12E+01	1	-9.12E+01	-1	8.65E-01	0.779	-8.65E-01	-0.7787	9.34E+00
x	2.00E+01	m	13	13	3	0.00E+00	1.00E+00	8.76E+01	1	-8.76E+01	-1	8.31E-01	0.76	-8.31E-01	-0.7601	9.12E+00
z	0.00E+00	m	14	14	3	0.00E+00	1.00E+00	8.44E+01	1	-8.44E+01	-1	8.01E-01	0.743	-8.01E-01	-0.7425	8.91E+00
y	0.00E+00	m	15	15	3	0.00E+00	1.00E+00	8.15E+01	1	-8.15E+01	-1	7.74E-01	0.726	-7.74E-01	-0.726	8.71E+00
			16	16	3	0.00E+00	1.00E+00	7.90E+01	1	-7.90E+01	-1	7.49E-01	0.711	-7.49E-01	-0.7105	8.53E+00
ax	1.57E+00	m	17	17	3	0.00E+00	1.00E+00	7.66E+01	1	-7.66E+01	-1	7.27E-01	0.696	-7.27E-01	-0.6959	8.35E+00
az	1.57E-01	m	18	18	3	0.00E+00	1.00E+00	7.44E+01	1	-7.44E+01	-1	7.06E-01	0.682	-7.06E-01	-0.6821	8.18E+00
ay	1.57E-02	m	19	19	3	0.00E+00	1.00E+00	7.25E+01	1	-7.25E+01	-1	6.87E-01	0.669	-6.87E-01	-0.669	8.03E+00
			20	20	3	0.00E+00	1.00E+00	7.06E+01	1	-7.06E+01	-1	6.70E-01	0.657	-6.70E-01	-0.6566	7.88E+00



Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc	Value	DOMENICO (STEADY STATE)														
		Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT														
v	1.08E-03	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration	
Rc	1.22E+04															
u	8.82E-08	m/d	1	1	3	0.00E+00	1.00E+00	3.16E+02	1	-3.16E+02	-1	5.99E+00	1	-5.99E+00	-1	1.20E+01
			2 <td>2<td>3<td>0.00E+00<td>1.00E+00<td>2.23E+02<td>1<td>-2.23E+02<td>-1<td>4.24E+00<td>1<td>-4.24E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	2 <td>3<td>0.00E+00<td>1.00E+00<td>2.23E+02<td>1<td>-2.23E+02<td>-1<td>4.24E+00<td>1<td>-4.24E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>2.23E+02<td>1<td>-2.23E+02<td>-1<td>4.24E+00<td>1<td>-4.24E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>2.23E+02<td>1<td>-2.23E+02<td>-1<td>4.24E+00<td>1<td>-4.24E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>2.23E+02<td>1<td>-2.23E+02<td>-1<td>4.24E+00<td>1<td>-4.24E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td></td>	2.23E+02 <td>1<td>-2.23E+02<td>-1<td>4.24E+00<td>1<td>-4.24E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td>	1 <td>-2.23E+02<td>-1<td>4.24E+00<td>1<td>-4.24E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td>	-2.23E+02 <td>-1<td>4.24E+00<td>1<td>-4.24E+00<td>-1<th>1.20E+01</th></td></td></td></td></td>	-1 <td>4.24E+00<td>1<td>-4.24E+00<td>-1<th>1.20E+01</th></td></td></td></td>	4.24E+00 <td>1<td>-4.24E+00<td>-1<th>1.20E+01</th></td></td></td>	1 <td>-4.24E+00<td>-1<th>1.20E+01</th></td></td>	-4.24E+00 <td>-1<th>1.20E+01</th></td>	-1 <th>1.20E+01</th>	1.20E+01
			3 <td>3<td>3<td>0.00E+00<td>1.00E+00<td>1.82E+02<td>1<td>-1.82E+02<td>-1<td>3.46E+00<td>1<td>-3.46E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	3 <td>3<td>0.00E+00<td>1.00E+00<td>1.82E+02<td>1<td>-1.82E+02<td>-1<td>3.46E+00<td>1<td>-3.46E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>1.82E+02<td>1<td>-1.82E+02<td>-1<td>3.46E+00<td>1<td>-3.46E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>1.82E+02<td>1<td>-1.82E+02<td>-1<td>3.46E+00<td>1<td>-3.46E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>1.82E+02<td>1<td>-1.82E+02<td>-1<td>3.46E+00<td>1<td>-3.46E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td></td>	1.82E+02 <td>1<td>-1.82E+02<td>-1<td>3.46E+00<td>1<td>-3.46E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td>	1 <td>-1.82E+02<td>-1<td>3.46E+00<td>1<td>-3.46E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td>	-1.82E+02 <td>-1<td>3.46E+00<td>1<td>-3.46E+00<td>-1<th>1.20E+01</th></td></td></td></td></td>	-1 <td>3.46E+00<td>1<td>-3.46E+00<td>-1<th>1.20E+01</th></td></td></td></td>	3.46E+00 <td>1<td>-3.46E+00<td>-1<th>1.20E+01</th></td></td></td>	1 <td>-3.46E+00<td>-1<th>1.20E+01</th></td></td>	-3.46E+00 <td>-1<th>1.20E+01</th></td>	-1 <th>1.20E+01</th>	1.20E+01
			4 <td>4<td>3<td>0.00E+00<td>1.00E+00<td>1.58E+02<td>1<td>-1.58E+02<td>-1<td>3.00E+00<td>1<td>-3.00E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	4 <td>3<td>0.00E+00<td>1.00E+00<td>1.58E+02<td>1<td>-1.58E+02<td>-1<td>3.00E+00<td>1<td>-3.00E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>1.58E+02<td>1<td>-1.58E+02<td>-1<td>3.00E+00<td>1<td>-3.00E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>1.58E+02<td>1<td>-1.58E+02<td>-1<td>3.00E+00<td>1<td>-3.00E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>1.58E+02<td>1<td>-1.58E+02<td>-1<td>3.00E+00<td>1<td>-3.00E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td></td>	1.58E+02 <td>1<td>-1.58E+02<td>-1<td>3.00E+00<td>1<td>-3.00E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td></td>	1 <td>-1.58E+02<td>-1<td>3.00E+00<td>1<td>-3.00E+00<td>-1<th>1.20E+01</th></td></td></td></td></td></td>	-1.58E+02 <td>-1<td>3.00E+00<td>1<td>-3.00E+00<td>-1<th>1.20E+01</th></td></td></td></td></td>	-1 <td>3.00E+00<td>1<td>-3.00E+00<td>-1<th>1.20E+01</th></td></td></td></td>	3.00E+00 <td>1<td>-3.00E+00<td>-1<th>1.20E+01</th></td></td></td>	1 <td>-3.00E+00<td>-1<th>1.20E+01</th></td></td>	-3.00E+00 <td>-1<th>1.20E+01</th></td>	-1 <th>1.20E+01</th>	1.20E+01
			5 <td>5<td>3<td>0.00E+00<td>1.00E+00<td>1.41E+02<td>1<td>-1.41E+02<td>-1<td>2.68E+00<td>1<td>-2.68E+00<td>-0.9998<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	5 <td>3<td>0.00E+00<td>1.00E+00<td>1.41E+02<td>1<td>-1.41E+02<td>-1<td>2.68E+00<td>1<td>-2.68E+00<td>-0.9998<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>1.41E+02<td>1<td>-1.41E+02<td>-1<td>2.68E+00<td>1<td>-2.68E+00<td>-0.9998<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>1.41E+02<td>1<td>-1.41E+02<td>-1<td>2.68E+00<td>1<td>-2.68E+00<td>-0.9998<th>1.20E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>1.41E+02<td>1<td>-1.41E+02<td>-1<td>2.68E+00<td>1<td>-2.68E+00<td>-0.9998<th>1.20E+01</th></td></td></td></td></td></td></td></td>	1.41E+02 <td>1<td>-1.41E+02<td>-1<td>2.68E+00<td>1<td>-2.68E+00<td>-0.9998<th>1.20E+01</th></td></td></td></td></td></td></td>	1 <td>-1.41E+02<td>-1<td>2.68E+00<td>1<td>-2.68E+00<td>-0.9998<th>1.20E+01</th></td></td></td></td></td></td>	-1.41E+02 <td>-1<td>2.68E+00<td>1<td>-2.68E+00<td>-0.9998<th>1.20E+01</th></td></td></td></td></td>	-1 <td>2.68E+00<td>1<td>-2.68E+00<td>-0.9998<th>1.20E+01</th></td></td></td></td>	2.68E+00 <td>1<td>-2.68E+00<td>-0.9998<th>1.20E+01</th></td></td></td>	1 <td>-2.68E+00<td>-0.9998<th>1.20E+01</th></td></td>	-2.68E+00 <td>-0.9998<th>1.20E+01</th></td>	-0.9998 <th>1.20E+01</th>	1.20E+01
			6 <td>6<td>3<td>0.00E+00<td>1.00E+00<td>1.29E+02<td>1<td>-1.29E+02<td>-1<td>2.45E+00<td>0.999<td>-2.45E+00<td>-0.9995<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	6 <td>3<td>0.00E+00<td>1.00E+00<td>1.29E+02<td>1<td>-1.29E+02<td>-1<td>2.45E+00<td>0.999<td>-2.45E+00<td>-0.9995<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>1.29E+02<td>1<td>-1.29E+02<td>-1<td>2.45E+00<td>0.999<td>-2.45E+00<td>-0.9995<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>1.29E+02<td>1<td>-1.29E+02<td>-1<td>2.45E+00<td>0.999<td>-2.45E+00<td>-0.9995<th>1.20E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>1.29E+02<td>1<td>-1.29E+02<td>-1<td>2.45E+00<td>0.999<td>-2.45E+00<td>-0.9995<th>1.20E+01</th></td></td></td></td></td></td></td></td>	1.29E+02 <td>1<td>-1.29E+02<td>-1<td>2.45E+00<td>0.999<td>-2.45E+00<td>-0.9995<th>1.20E+01</th></td></td></td></td></td></td></td>	1 <td>-1.29E+02<td>-1<td>2.45E+00<td>0.999<td>-2.45E+00<td>-0.9995<th>1.20E+01</th></td></td></td></td></td></td>	-1.29E+02 <td>-1<td>2.45E+00<td>0.999<td>-2.45E+00<td>-0.9995<th>1.20E+01</th></td></td></td></td></td>	-1 <td>2.45E+00<td>0.999<td>-2.45E+00<td>-0.9995<th>1.20E+01</th></td></td></td></td>	2.45E+00 <td>0.999<td>-2.45E+00<td>-0.9995<th>1.20E+01</th></td></td></td>	0.999 <td>-2.45E+00<td>-0.9995<th>1.20E+01</th></td></td>	-2.45E+00 <td>-0.9995<th>1.20E+01</th></td>	-0.9995 <th>1.20E+01</th>	1.20E+01
			7 <td>7<td>3<td>0.00E+00<td>1.00E+00<td>1.19E+02<td>1<td>-1.19E+02<td>-1<td>2.26E+00<td>0.999<td>-2.26E+00<td>-0.9986<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	7 <td>3<td>0.00E+00<td>1.00E+00<td>1.19E+02<td>1<td>-1.19E+02<td>-1<td>2.26E+00<td>0.999<td>-2.26E+00<td>-0.9986<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>1.19E+02<td>1<td>-1.19E+02<td>-1<td>2.26E+00<td>0.999<td>-2.26E+00<td>-0.9986<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>1.19E+02<td>1<td>-1.19E+02<td>-1<td>2.26E+00<td>0.999<td>-2.26E+00<td>-0.9986<th>1.20E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>1.19E+02<td>1<td>-1.19E+02<td>-1<td>2.26E+00<td>0.999<td>-2.26E+00<td>-0.9986<th>1.20E+01</th></td></td></td></td></td></td></td></td>	1.19E+02 <td>1<td>-1.19E+02<td>-1<td>2.26E+00<td>0.999<td>-2.26E+00<td>-0.9986<th>1.20E+01</th></td></td></td></td></td></td></td>	1 <td>-1.19E+02<td>-1<td>2.26E+00<td>0.999<td>-2.26E+00<td>-0.9986<th>1.20E+01</th></td></td></td></td></td></td>	-1.19E+02 <td>-1<td>2.26E+00<td>0.999<td>-2.26E+00<td>-0.9986<th>1.20E+01</th></td></td></td></td></td>	-1 <td>2.26E+00<td>0.999<td>-2.26E+00<td>-0.9986<th>1.20E+01</th></td></td></td></td>	2.26E+00 <td>0.999<td>-2.26E+00<td>-0.9986<th>1.20E+01</th></td></td></td>	0.999 <td>-2.26E+00<td>-0.9986<th>1.20E+01</th></td></td>	-2.26E+00 <td>-0.9986<th>1.20E+01</th></td>	-0.9986 <th>1.20E+01</th>	1.20E+01
			8 <td>8<td>3<td>0.00E+00<td>1.00E+00<td>1.12E+02<td>1<td>-1.12E+02<td>-1<td>2.12E+00<td>0.997<td>-2.12E+00<td>-0.9973<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	8 <td>3<td>0.00E+00<td>1.00E+00<td>1.12E+02<td>1<td>-1.12E+02<td>-1<td>2.12E+00<td>0.997<td>-2.12E+00<td>-0.9973<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>1.12E+02<td>1<td>-1.12E+02<td>-1<td>2.12E+00<td>0.997<td>-2.12E+00<td>-0.9973<th>1.20E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>1.12E+02<td>1<td>-1.12E+02<td>-1<td>2.12E+00<td>0.997<td>-2.12E+00<td>-0.9973<th>1.20E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>1.12E+02<td>1<td>-1.12E+02<td>-1<td>2.12E+00<td>0.997<td>-2.12E+00<td>-0.9973<th>1.20E+01</th></td></td></td></td></td></td></td></td>	1.12E+02 <td>1<td>-1.12E+02<td>-1<td>2.12E+00<td>0.997<td>-2.12E+00<td>-0.9973<th>1.20E+01</th></td></td></td></td></td></td></td>	1 <td>-1.12E+02<td>-1<td>2.12E+00<td>0.997<td>-2.12E+00<td>-0.9973<th>1.20E+01</th></td></td></td></td></td></td>	-1.12E+02 <td>-1<td>2.12E+00<td>0.997<td>-2.12E+00<td>-0.9973<th>1.20E+01</th></td></td></td></td></td>	-1 <td>2.12E+00<td>0.997<td>-2.12E+00<td>-0.9973<th>1.20E+01</th></td></td></td></td>	2.12E+00 <td>0.997<td>-2.12E+00<td>-0.9973<th>1.20E+01</th></td></td></td>	0.997 <td>-2.12E+00<td>-0.9973<th>1.20E+01</th></td></td>	-2.12E+00 <td>-0.9973<th>1.20E+01</th></td>	-0.9973 <th>1.20E+01</th>	1.20E+01
			9 <td>9<td>3<td>0.00E+00<td>1.00E+00<td>1.05E+02<td>1<td>-1.05E+02<td>-1<td>2.00E+00<td>0.995<td>-2.00E+00<td>-0.9953<th>1.19E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	9 <td>3<td>0.00E+00<td>1.00E+00<td>1.05E+02<td>1<td>-1.05E+02<td>-1<td>2.00E+00<td>0.995<td>-2.00E+00<td>-0.9953<th>1.19E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>1.05E+02<td>1<td>-1.05E+02<td>-1<td>2.00E+00<td>0.995<td>-2.00E+00<td>-0.9953<th>1.19E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>1.05E+02<td>1<td>-1.05E+02<td>-1<td>2.00E+00<td>0.995<td>-2.00E+00<td>-0.9953<th>1.19E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>1.05E+02<td>1<td>-1.05E+02<td>-1<td>2.00E+00<td>0.995<td>-2.00E+00<td>-0.9953<th>1.19E+01</th></td></td></td></td></td></td></td></td>	1.05E+02 <td>1<td>-1.05E+02<td>-1<td>2.00E+00<td>0.995<td>-2.00E+00<td>-0.9953<th>1.19E+01</th></td></td></td></td></td></td></td>	1 <td>-1.05E+02<td>-1<td>2.00E+00<td>0.995<td>-2.00E+00<td>-0.9953<th>1.19E+01</th></td></td></td></td></td></td>	-1.05E+02 <td>-1<td>2.00E+00<td>0.995<td>-2.00E+00<td>-0.9953<th>1.19E+01</th></td></td></td></td></td>	-1 <td>2.00E+00<td>0.995<td>-2.00E+00<td>-0.9953<th>1.19E+01</th></td></td></td></td>	2.00E+00 <td>0.995<td>-2.00E+00<td>-0.9953<th>1.19E+01</th></td></td></td>	0.995 <td>-2.00E+00<td>-0.9953<th>1.19E+01</th></td></td>	-2.00E+00 <td>-0.9953<th>1.19E+01</th></td>	-0.9953 <th>1.19E+01</th>	1.19E+01
			10 <td>10<td>3<td>0.00E+00<td>1.00E+00<td>9.99E+01<td>1<td>-9.99E+01<td>-1<td>1.89E+00<td>0.993<td>-1.89E+00<td>-0.9926<th>1.19E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	10 <td>3<td>0.00E+00<td>1.00E+00<td>9.99E+01<td>1<td>-9.99E+01<td>-1<td>1.89E+00<td>0.993<td>-1.89E+00<td>-0.9926<th>1.19E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>9.99E+01<td>1<td>-9.99E+01<td>-1<td>1.89E+00<td>0.993<td>-1.89E+00<td>-0.9926<th>1.19E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>9.99E+01<td>1<td>-9.99E+01<td>-1<td>1.89E+00<td>0.993<td>-1.89E+00<td>-0.9926<th>1.19E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>9.99E+01<td>1<td>-9.99E+01<td>-1<td>1.89E+00<td>0.993<td>-1.89E+00<td>-0.9926<th>1.19E+01</th></td></td></td></td></td></td></td></td>	9.99E+01 <td>1<td>-9.99E+01<td>-1<td>1.89E+00<td>0.993<td>-1.89E+00<td>-0.9926<th>1.19E+01</th></td></td></td></td></td></td></td>	1 <td>-9.99E+01<td>-1<td>1.89E+00<td>0.993<td>-1.89E+00<td>-0.9926<th>1.19E+01</th></td></td></td></td></td></td>	-9.99E+01 <td>-1<td>1.89E+00<td>0.993<td>-1.89E+00<td>-0.9926<th>1.19E+01</th></td></td></td></td></td>	-1 <td>1.89E+00<td>0.993<td>-1.89E+00<td>-0.9926<th>1.19E+01</th></td></td></td></td>	1.89E+00 <td>0.993<td>-1.89E+00<td>-0.9926<th>1.19E+01</th></td></td></td>	0.993 <td>-1.89E+00<td>-0.9926<th>1.19E+01</th></td></td>	-1.89E+00 <td>-0.9926<th>1.19E+01</th></td>	-0.9926 <th>1.19E+01</th>	1.19E+01
			11 <td>11<td>3<td>0.00E+00<td>1.00E+00<td>9.52E+01<td>1<td>-9.52E+01<td>-1<td>1.81E+00<td>0.989<td>-1.81E+00<td>-0.9894<th>1.19E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	11 <td>3<td>0.00E+00<td>1.00E+00<td>9.52E+01<td>1<td>-9.52E+01<td>-1<td>1.81E+00<td>0.989<td>-1.81E+00<td>-0.9894<th>1.19E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>9.52E+01<td>1<td>-9.52E+01<td>-1<td>1.81E+00<td>0.989<td>-1.81E+00<td>-0.9894<th>1.19E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>9.52E+01<td>1<td>-9.52E+01<td>-1<td>1.81E+00<td>0.989<td>-1.81E+00<td>-0.9894<th>1.19E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>9.52E+01<td>1<td>-9.52E+01<td>-1<td>1.81E+00<td>0.989<td>-1.81E+00<td>-0.9894<th>1.19E+01</th></td></td></td></td></td></td></td></td>	9.52E+01 <td>1<td>-9.52E+01<td>-1<td>1.81E+00<td>0.989<td>-1.81E+00<td>-0.9894<th>1.19E+01</th></td></td></td></td></td></td></td>	1 <td>-9.52E+01<td>-1<td>1.81E+00<td>0.989<td>-1.81E+00<td>-0.9894<th>1.19E+01</th></td></td></td></td></td></td>	-9.52E+01 <td>-1<td>1.81E+00<td>0.989<td>-1.81E+00<td>-0.9894<th>1.19E+01</th></td></td></td></td></td>	-1 <td>1.81E+00<td>0.989<td>-1.81E+00<td>-0.9894<th>1.19E+01</th></td></td></td></td>	1.81E+00 <td>0.989<td>-1.81E+00<td>-0.9894<th>1.19E+01</th></td></td></td>	0.989 <td>-1.81E+00<td>-0.9894<th>1.19E+01</th></td></td>	-1.81E+00 <td>-0.9894<th>1.19E+01</th></td>	-0.9894 <th>1.19E+01</th>	1.19E+01
			12 <td>12<td>3<td>0.00E+00<td>1.00E+00<td>9.12E+01<td>1<td>-9.12E+01<td>-1<td>1.73E+00<td>0.986<td>-1.73E+00<td>-0.9856<th>1.18E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	12 <td>3<td>0.00E+00<td>1.00E+00<td>9.12E+01<td>1<td>-9.12E+01<td>-1<td>1.73E+00<td>0.986<td>-1.73E+00<td>-0.9856<th>1.18E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>9.12E+01<td>1<td>-9.12E+01<td>-1<td>1.73E+00<td>0.986<td>-1.73E+00<td>-0.9856<th>1.18E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>9.12E+01<td>1<td>-9.12E+01<td>-1<td>1.73E+00<td>0.986<td>-1.73E+00<td>-0.9856<th>1.18E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>9.12E+01<td>1<td>-9.12E+01<td>-1<td>1.73E+00<td>0.986<td>-1.73E+00<td>-0.9856<th>1.18E+01</th></td></td></td></td></td></td></td></td>	9.12E+01 <td>1<td>-9.12E+01<td>-1<td>1.73E+00<td>0.986<td>-1.73E+00<td>-0.9856<th>1.18E+01</th></td></td></td></td></td></td></td>	1 <td>-9.12E+01<td>-1<td>1.73E+00<td>0.986<td>-1.73E+00<td>-0.9856<th>1.18E+01</th></td></td></td></td></td></td>	-9.12E+01 <td>-1<td>1.73E+00<td>0.986<td>-1.73E+00<td>-0.9856<th>1.18E+01</th></td></td></td></td></td>	-1 <td>1.73E+00<td>0.986<td>-1.73E+00<td>-0.9856<th>1.18E+01</th></td></td></td></td>	1.73E+00 <td>0.986<td>-1.73E+00<td>-0.9856<th>1.18E+01</th></td></td></td>	0.986 <td>-1.73E+00<td>-0.9856<th>1.18E+01</th></td></td>	-1.73E+00 <td>-0.9856<th>1.18E+01</th></td>	-0.9856 <th>1.18E+01</th>	1.18E+01
			13 <td>13<td>3<td>0.00E+00<td>1.00E+00<td>8.76E+01<td>1<td>-8.76E+01<td>-1<td>1.66E+00<td>0.981<td>-1.66E+00<td>-0.9812<th>1.18E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	13 <td>3<td>0.00E+00<td>1.00E+00<td>8.76E+01<td>1<td>-8.76E+01<td>-1<td>1.66E+00<td>0.981<td>-1.66E+00<td>-0.9812<th>1.18E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>8.76E+01<td>1<td>-8.76E+01<td>-1<td>1.66E+00<td>0.981<td>-1.66E+00<td>-0.9812<th>1.18E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>8.76E+01<td>1<td>-8.76E+01<td>-1<td>1.66E+00<td>0.981<td>-1.66E+00<td>-0.9812<th>1.18E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>8.76E+01<td>1<td>-8.76E+01<td>-1<td>1.66E+00<td>0.981<td>-1.66E+00<td>-0.9812<th>1.18E+01</th></td></td></td></td></td></td></td></td>	8.76E+01 <td>1<td>-8.76E+01<td>-1<td>1.66E+00<td>0.981<td>-1.66E+00<td>-0.9812<th>1.18E+01</th></td></td></td></td></td></td></td>	1 <td>-8.76E+01<td>-1<td>1.66E+00<td>0.981<td>-1.66E+00<td>-0.9812<th>1.18E+01</th></td></td></td></td></td></td>	-8.76E+01 <td>-1<td>1.66E+00<td>0.981<td>-1.66E+00<td>-0.9812<th>1.18E+01</th></td></td></td></td></td>	-1 <td>1.66E+00<td>0.981<td>-1.66E+00<td>-0.9812<th>1.18E+01</th></td></td></td></td>	1.66E+00 <td>0.981<td>-1.66E+00<td>-0.9812<th>1.18E+01</th></td></td></td>	0.981 <td>-1.66E+00<td>-0.9812<th>1.18E+01</th></td></td>	-1.66E+00 <td>-0.9812<th>1.18E+01</th></td>	-0.9812 <th>1.18E+01</th>	1.18E+01
			14 <td>14<td>3<td>0.00E+00<td>1.00E+00<td>8.44E+01<td>1<td>-8.44E+01<td>-1<td>1.60E+00<td>0.976<td>-1.60E+00<td>-0.9765<th>1.17E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	14 <td>3<td>0.00E+00<td>1.00E+00<td>8.44E+01<td>1<td>-8.44E+01<td>-1<td>1.60E+00<td>0.976<td>-1.60E+00<td>-0.9765<th>1.17E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>8.44E+01<td>1<td>-8.44E+01<td>-1<td>1.60E+00<td>0.976<td>-1.60E+00<td>-0.9765<th>1.17E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>8.44E+01<td>1<td>-8.44E+01<td>-1<td>1.60E+00<td>0.976<td>-1.60E+00<td>-0.9765<th>1.17E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>8.44E+01<td>1<td>-8.44E+01<td>-1<td>1.60E+00<td>0.976<td>-1.60E+00<td>-0.9765<th>1.17E+01</th></td></td></td></td></td></td></td></td>	8.44E+01 <td>1<td>-8.44E+01<td>-1<td>1.60E+00<td>0.976<td>-1.60E+00<td>-0.9765<th>1.17E+01</th></td></td></td></td></td></td></td>	1 <td>-8.44E+01<td>-1<td>1.60E+00<td>0.976<td>-1.60E+00<td>-0.9765<th>1.17E+01</th></td></td></td></td></td></td>	-8.44E+01 <td>-1<td>1.60E+00<td>0.976<td>-1.60E+00<td>-0.9765<th>1.17E+01</th></td></td></td></td></td>	-1 <td>1.60E+00<td>0.976<td>-1.60E+00<td>-0.9765<th>1.17E+01</th></td></td></td></td>	1.60E+00 <td>0.976<td>-1.60E+00<td>-0.9765<th>1.17E+01</th></td></td></td>	0.976 <td>-1.60E+00<td>-0.9765<th>1.17E+01</th></td></td>	-1.60E+00 <td>-0.9765<th>1.17E+01</th></td>	-0.9765 <th>1.17E+01</th>	1.17E+01
			15 <td>15<td>3<td>0.00E+00<td>1.00E+00<td>8.15E+01<td>1<td>-8.15E+01<td>-1<td>1.55E+00<td>0.971<td>-1.55E+00<td>-0.9713<th>1.17E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	15 <td>3<td>0.00E+00<td>1.00E+00<td>8.15E+01<td>1<td>-8.15E+01<td>-1<td>1.55E+00<td>0.971<td>-1.55E+00<td>-0.9713<th>1.17E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>8.15E+01<td>1<td>-8.15E+01<td>-1<td>1.55E+00<td>0.971<td>-1.55E+00<td>-0.9713<th>1.17E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>8.15E+01<td>1<td>-8.15E+01<td>-1<td>1.55E+00<td>0.971<td>-1.55E+00<td>-0.9713<th>1.17E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>8.15E+01<td>1<td>-8.15E+01<td>-1<td>1.55E+00<td>0.971<td>-1.55E+00<td>-0.9713<th>1.17E+01</th></td></td></td></td></td></td></td></td>	8.15E+01 <td>1<td>-8.15E+01<td>-1<td>1.55E+00<td>0.971<td>-1.55E+00<td>-0.9713<th>1.17E+01</th></td></td></td></td></td></td></td>	1 <td>-8.15E+01<td>-1<td>1.55E+00<td>0.971<td>-1.55E+00<td>-0.9713<th>1.17E+01</th></td></td></td></td></td></td>	-8.15E+01 <td>-1<td>1.55E+00<td>0.971<td>-1.55E+00<td>-0.9713<th>1.17E+01</th></td></td></td></td></td>	-1 <td>1.55E+00<td>0.971<td>-1.55E+00<td>-0.9713<th>1.17E+01</th></td></td></td></td>	1.55E+00 <td>0.971<td>-1.55E+00<td>-0.9713<th>1.17E+01</th></td></td></td>	0.971 <td>-1.55E+00<td>-0.9713<th>1.17E+01</th></td></td>	-1.55E+00 <td>-0.9713<th>1.17E+01</th></td>	-0.9713 <th>1.17E+01</th>	1.17E+01
			16 <td>16<td>3<td>0.00E+00<td>1.00E+00<td>7.90E+01<td>1<td>-7.90E+01<td>-1<td>1.50E+00<td>0.966<td>-1.50E+00<td>-0.9659<th>1.16E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	16 <td>3<td>0.00E+00<td>1.00E+00<td>7.90E+01<td>1<td>-7.90E+01<td>-1<td>1.50E+00<td>0.966<td>-1.50E+00<td>-0.9659<th>1.16E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>7.90E+01<td>1<td>-7.90E+01<td>-1<td>1.50E+00<td>0.966<td>-1.50E+00<td>-0.9659<th>1.16E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>7.90E+01<td>1<td>-7.90E+01<td>-1<td>1.50E+00<td>0.966<td>-1.50E+00<td>-0.9659<th>1.16E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>7.90E+01<td>1<td>-7.90E+01<td>-1<td>1.50E+00<td>0.966<td>-1.50E+00<td>-0.9659<th>1.16E+01</th></td></td></td></td></td></td></td></td>	7.90E+01 <td>1<td>-7.90E+01<td>-1<td>1.50E+00<td>0.966<td>-1.50E+00<td>-0.9659<th>1.16E+01</th></td></td></td></td></td></td></td>	1 <td>-7.90E+01<td>-1<td>1.50E+00<td>0.966<td>-1.50E+00<td>-0.9659<th>1.16E+01</th></td></td></td></td></td></td>	-7.90E+01 <td>-1<td>1.50E+00<td>0.966<td>-1.50E+00<td>-0.9659<th>1.16E+01</th></td></td></td></td></td>	-1 <td>1.50E+00<td>0.966<td>-1.50E+00<td>-0.9659<th>1.16E+01</th></td></td></td></td>	1.50E+00 <td>0.966<td>-1.50E+00<td>-0.9659<th>1.16E+01</th></td></td></td>	0.966 <td>-1.50E+00<td>-0.9659<th>1.16E+01</th></td></td>	-1.50E+00 <td>-0.9659<th>1.16E+01</th></td>	-0.9659 <th>1.16E+01</th>	1.16E+01
			17 <td>17<td>3<td>0.00E+00<td>1.00E+00<td>7.66E+01<td>1<td>-7.66E+01<td>-1<td>1.45E+00<td>0.96<td>-1.45E+00<td>-0.9601<th>1.15E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	17 <td>3<td>0.00E+00<td>1.00E+00<td>7.66E+01<td>1<td>-7.66E+01<td>-1<td>1.45E+00<td>0.96<td>-1.45E+00<td>-0.9601<th>1.15E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>7.66E+01<td>1<td>-7.66E+01<td>-1<td>1.45E+00<td>0.96<td>-1.45E+00<td>-0.9601<th>1.15E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>7.66E+01<td>1<td>-7.66E+01<td>-1<td>1.45E+00<td>0.96<td>-1.45E+00<td>-0.9601<th>1.15E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>7.66E+01<td>1<td>-7.66E+01<td>-1<td>1.45E+00<td>0.96<td>-1.45E+00<td>-0.9601<th>1.15E+01</th></td></td></td></td></td></td></td></td>	7.66E+01 <td>1<td>-7.66E+01<td>-1<td>1.45E+00<td>0.96<td>-1.45E+00<td>-0.9601<th>1.15E+01</th></td></td></td></td></td></td></td>	1 <td>-7.66E+01<td>-1<td>1.45E+00<td>0.96<td>-1.45E+00<td>-0.9601<th>1.15E+01</th></td></td></td></td></td></td>	-7.66E+01 <td>-1<td>1.45E+00<td>0.96<td>-1.45E+00<td>-0.9601<th>1.15E+01</th></td></td></td></td></td>	-1 <td>1.45E+00<td>0.96<td>-1.45E+00<td>-0.9601<th>1.15E+01</th></td></td></td></td>	1.45E+00 <td>0.96<td>-1.45E+00<td>-0.9601<th>1.15E+01</th></td></td></td>	0.96 <td>-1.45E+00<td>-0.9601<th>1.15E+01</th></td></td>	-1.45E+00 <td>-0.9601<th>1.15E+01</th></td>	-0.9601 <th>1.15E+01</th>	1.15E+01
			18 <td>18<td>3<td>0.00E+00<td>1.00E+00<td>7.44E+01<td>1<td>-7.44E+01<td>-1<td>1.41E+00<td>0.954<td>-1.41E+00<td>-0.9542<th>1.15E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	18 <td>3<td>0.00E+00<td>1.00E+00<td>7.44E+01<td>1<td>-7.44E+01<td>-1<td>1.41E+00<td>0.954<td>-1.41E+00<td>-0.9542<th>1.15E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>7.44E+01<td>1<td>-7.44E+01<td>-1<td>1.41E+00<td>0.954<td>-1.41E+00<td>-0.9542<th>1.15E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>7.44E+01<td>1<td>-7.44E+01<td>-1<td>1.41E+00<td>0.954<td>-1.41E+00<td>-0.9542<th>1.15E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>7.44E+01<td>1<td>-7.44E+01<td>-1<td>1.41E+00<td>0.954<td>-1.41E+00<td>-0.9542<th>1.15E+01</th></td></td></td></td></td></td></td></td>	7.44E+01 <td>1<td>-7.44E+01<td>-1<td>1.41E+00<td>0.954<td>-1.41E+00<td>-0.9542<th>1.15E+01</th></td></td></td></td></td></td></td>	1 <td>-7.44E+01<td>-1<td>1.41E+00<td>0.954<td>-1.41E+00<td>-0.9542<th>1.15E+01</th></td></td></td></td></td></td>	-7.44E+01 <td>-1<td>1.41E+00<td>0.954<td>-1.41E+00<td>-0.9542<th>1.15E+01</th></td></td></td></td></td>	-1 <td>1.41E+00<td>0.954<td>-1.41E+00<td>-0.9542<th>1.15E+01</th></td></td></td></td>	1.41E+00 <td>0.954<td>-1.41E+00<td>-0.9542<th>1.15E+01</th></td></td></td>	0.954 <td>-1.41E+00<td>-0.9542<th>1.15E+01</th></td></td>	-1.41E+00 <td>-0.9542<th>1.15E+01</th></td>	-0.9542 <th>1.15E+01</th>	1.15E+01
			19 <td>19<td>3<td>0.00E+00<td>1.00E+00<td>7.25E+01<td>1<td>-7.25E+01<td>-1<td>1.37E+00<td>0.948<td>-1.37E+00<td>-0.9481<th>1.14E+01</th></td></td></td></td></td></td></td></td></td></td></td></td>	19 <td>3<td>0.00E+00<td>1.00E+00<td>7.25E+01<td>1<td>-7.25E+01<td>-1<td>1.37E+00<td>0.948<td>-1.37E+00<td>-0.9481<th>1.14E+01</th></td></td></td></td></td></td></td></td></td></td></td>	3 <td>0.00E+00<td>1.00E+00<td>7.25E+01<td>1<td>-7.25E+01<td>-1<td>1.37E+00<td>0.948<td>-1.37E+00<td>-0.9481<th>1.14E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>7.25E+01<td>1<td>-7.25E+01<td>-1<td>1.37E+00<td>0.948<td>-1.37E+00<td>-0.9481<th>1.14E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>7.25E+01<td>1<td>-7.25E+01<td>-1<td>1.37E+00<td>0.948<td>-1.37E+00<td>-0.9481<th>1.14E+01</th></td></td></td></td></td></td></td></td>	7.25E+01 <td>1<td>-7.25E+01<td>-1<td>1.37E+00<td>0.948<td>-1.37E+00<td>-0.9481<th>1.14E+01</th></td></td></td></td></td></td></td>	1 <td>-7.25E+01<td>-1<td>1.37E+00<td>0.948<td>-1.37E+00<td>-0.9481<th>1.14E+01</th></td></td></td></td></td></td>	-7.25E+01 <td>-1<td>1.37E+00<td>0.948<td>-1.37E+00<td>-0.9481<th>1.14E+01</th></td></td></td></td></td>	-1 <td>1.37E+00<td>0.948<td>-1.37E+00<td>-0.9481<th>1.14E+01</th></td></td></td></td>	1.37E+00 <td>0.948<td>-1.37E+00<td>-0.9481<th>1.14E+01</th></td></td></td>	0.948 <td>-1.37E+00<td>-0.9481<th>1.14E+01</th></td></td>	-1.37E+00 <td>-0.9481<th>1.14E+01</th></td>	-0.9481 <th>1.14E+01</th>	1.14E+01
			20	20	3 <td>0.00E+00<td>1.00E+00<td>7.06E+01<td>1<td>-7.06E+01<td>-1<td>1.34E+00<td>0.942<td>-1.34E+00<td>-0.9419<th>1.13E+01</th></td></td></td></td></td></td></td></td></td></td>	0.00E+00 <td>1.00E+00<td>7.06E+01<td>1<td>-7.06E+01<td>-1<td>1.34E+00<td>0.942<td>-1.34E+00<td>-0.9419<th>1.13E+01</th></td></td></td></td></td></td></td></td></td>	1.00E+00 <td>7.06E+01<td>1<td>-7.06E+01<td>-1<td>1.34E+00<td>0.942<td>-1.34E+00<td>-0.9419<th>1.13E+01</th></td></td></td></td></td></td></td></td>	7.06E+01 <td>1<td>-7.06E+01<td>-1<td>1.34E+00<td>0.942<td>-1.34E+00<td>-0.9419<th>1.13E+01</th></td></td></td></td></td></td></td>	1 <td>-7.06E+01<td>-1<td>1.34E+00<td>0.942<td>-1.34E+00<td>-0.9419<th>1.13E+01</th></td></td></td></td></td></td>	-7.06E+01 <td>-1<td>1.34E+00<td>0.942<td>-1.34E+00<td>-0.9419<th>1.13E+01</th></td></td></td></td></td>	-1 <td>1.34E+00<td>0.942<td>-1.34E+00<td>-0.9419<th>1.13E+01</th></td></td></td></td>	1.34E+00 <td>0.942<td>-1.34E+00<td>-0.9419<th>1.13E+01</th></td></td></td>	0.942 <td>-1.34E+00<td>-0.9419<th>1.13E+01</th></td></td>	-1.34E+00 <td>-0.9419<th>1.13E+01</th></td>	-0.9419 <th>1.13E+01</th>	1.13E+01
24/02/2020																
n:	1															



Date: 24/02/2020
Version: 1

DOMENICO (TIME VARIANT)

Contaminant	Manganese		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)															
Input	Value	Units	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration	
C _T	0.123	mg/l	1	1	1.5	0.00E+00	1.00E+00	-1.19E+46	2	3.16E+02	1	-3.16E+02	-1	3.00E+00	1	-3.00E+00	-1	1.20E+01
Co	6.29E-105	days ⁻¹	2	2	1.5	0.00E+00	1.00E+00	-1.19E+46	2	2.23E+02	1	-2.23E+02	-1	2.12E+00	0.9973	-2.12E+00	-0.997	1.20E+01
			3	3	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.82E+02	1	-1.82E+02	-1	1.73E+00	0.9856	-1.73E+00	-0.986	1.18E+01
			4	4	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.58E+02	1	-1.58E+02	-1	1.50E+00	0.9659	-1.50E+00	-0.966	1.16E+01
			5	5	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.41E+02	1	-1.41E+02	-1	1.34E+00	0.9419	-1.34E+00	-0.942	1.13E+01
			6	6	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.29E+02	1	-1.29E+02	-1	1.22E+00	0.9163	-1.22E+00	-0.916	1.10E+01
			7	7	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.19E+02	1	-1.19E+02	-1	1.13E+00	0.8907	-1.13E+00	-0.891	1.07E+01
			8	8	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.12E+02	1	-1.12E+02	-1	1.06E+00	0.8659	-1.06E+00	-0.866	1.04E+01
			9	9	1.5	0.00E+00	1.00E+00	-1.19E+46	2	1.05E+02	1	-1.05E+02	-1	9.99E-01	0.8422	-9.99E-01	-0.842	1.01E+01
			10	10	1.5	0.00E+00	1.00E+00	-1.19E+46	2	9.99E+01	1	-9.99E+01	-1	9.47E-01	0.8197	-9.47E-01	-0.82	9.84E+00
			11	11	1.5	0.00E+00	1.00E+00	-1.19E+46	2	9.52E+01	1	-9.52E+01	-1	9.03E-01	0.7986	-9.03E-01	-0.799	9.58E+00
			12	12	1.5	0.00E+00	1.00E+00	-1.19E+46	2	9.12E+01	1	-9.12E+01	-1	8.65E-01	0.7787	-8.65E-01	-0.779	9.34E+00
			13	13	1.5	0.00E+00	1.00E+00	-1.19E+46	2	8.76E+01	1	-8.76E+01	-1	8.31E-01	0.7601	-8.31E-01	-0.76	9.12E+00
			14	14	1.5	0.00E+00	1.00E+00	-1.19E+46	2	8.44E+01	1	-8.44E+01	-1	8.01E-01	0.7425	-8.01E-01	-0.743	8.91E+00
			15	15	1.5	0.00E+00	1.00E+00	-1.19E+46	2	8.15E+01	1	-8.15E+01	-1	7.74E-01	0.726	-7.74E-01	-0.726	8.71E+00
			16	16	1.5	0.00E+00	1.00E+00	-1.19E+46	2	7.90E+01	1	-7.90E+01	-1	7.49E-01	0.7105	-7.49E-01	-0.711	8.53E+00
			17	17	1.5	0.00E+00	1.00E+00	-1.19E+46	2	7.66E+01	1	-7.66E+01	-1	7.27E-01	0.6959	-7.27E-01	-0.696	8.35E+00
			18	18	1.5	0.00E+00	1.00E+00	-1.19E+46	2	7.44E+01	1	-7.44E+01	-1	7.06E-01	0.6821	-7.06E-01	-0.682	8.18E+00
			19	19	1.5	0.00E+00	1.00E+00	-1.19E+46	2	7.25E+01	1	-7.25E+01	-1	6.87E-01	0.669	-6.87E-01	-0.669	8.03E+00
			20	20	1.5	0.00E+00	1.00E+00	-1.19E+46	2	7.06E+01	1	-7.06E+01	-1	6.70E-01	0.6566	-6.70E-01	-0.657	7.88E+00

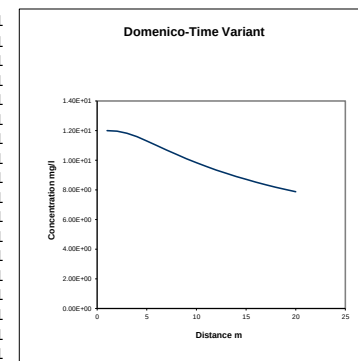
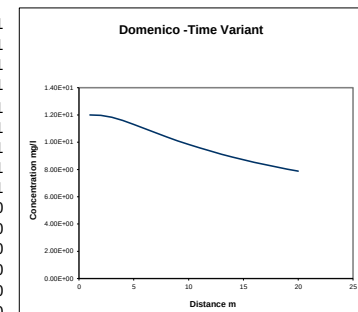
Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc		Value	Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT																
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration		
v	1.08E-03	m/d	m																
Rc	1.22E+04		1	1	1.5	0.00E+00	1.00E+00	2	3.16E+02	1	-3.16E+02	-1	5.99E+00	1	-5.99E+00	-1	1.20E+01		
u	8.82E-08	m/d	2	2	1.5	0.00E+00	1.00E+00	2	2.23E+02	1	-2.23E+02	-1	4.24E+00	1	-4.24E+00	-1	1.20E+01		
			3	3	1.5	0.00E+00	1.00E+00	2	1.82E+02	1	-1.82E+02	-1	3.46E+00	1	-3.46E+00	-1	1.20E+01		
			4	4	1.5	0.00E+00	1.00E+00	2	1.58E+02	1	-1.58E+02	-1	3.00E+00	1	-3.00E+00	-1	1.20E+01		
			5	5	1.5	0.00E+00	1.00E+00	2	1.41E+02	1	-1.41E+02	-1	2.68E+00	0.9998	-2.68E+00	-1	1.20E+01		
			6	6	1.5	0.00E+00	1.00E+00	2	1.29E+02	1	-1.29E+02	-1	2.45E+00	0.9995	-2.45E+00	-0.999	1.20E+01		
			7	7	1.5	0.00E+00	1.00E+00	2	1.19E+02	1	-1.19E+02	-1	2.26E+00	0.9986	-2.26E+00	-0.999	1.20E+01		
			8	8	1.5	0.00E+00	1.00E+00	2	1.12E+02	1	-1.12E+02	-1	2.12E+00	0.9973	-2.12E+00	-0.997	1.20E+01		
			9	9	1.5	0.00E+00	1.00E+00	2	1.05E+02	1	-1.05E+02	-1	2.00E+00	0.9953	-2.00E+00	-0.995	1.19E+01		
			10	10	1.5	0.00E+00	1.00E+00	2	9.99E+01	1	-9.99E+01	-1	1.89E+00	0.9926	-1.89E+00	-0.993	1.19E+01		
			11	11	1.5	0.00E+00	1.00E+00	2	9.52E+01	1	-9.52E+01	-1	1.81E+00	0.9894	-1.81E+00	-0.989	1.19E+01		
			12	12	1.5	0.00E+00	1.00E+00	2	9.12E+01	1	-9.12E+01	-1	1.73E+00	0.9856	-1.73E+00	-0.986	1.18E+01		
			13	13	1.5	0.00E+00	1.00E+00	2	8.76E+01	1	-8.76E+01	-1	1.66E+00	0.9812	-1.66E+00	-0.981	1.18E+01		
			14	14	1.5	0.00E+00	1.00E+00	2	8.44E+01	1	-8.44E+01	-1	1.60E+00	0.9765	-1.60E+00	-0.976	1.17E+01		
			15	15	1.5	0.00E+00	1.00E+00	2	8.15E+01	1	-8.15E+01	-1	1.55E+00	0.9713	-1.55E+00	-0.971	1.17E+01		
			16	16	1.5	0.00E+00	1.00E+00	2	7.90E+01	1	-7.90E+01	-1	1.50E+00	0.9659	-1.50E+00	-0.966	1.16E+01		
			17	17	1.5	0.00E+00	1.00E+00	2	7.66E+01	1	-7.66E+01	-1	1.45E+00	0.9601	-1.45E+00	-0.96	1.15E+01		
			18	18	1.5	0.00E+00	1.00E+00	2	7.44E+01	1	-7.44E+01	-1	1.41E+00	0.9542	-1.41E+00	-0.954	1.15E+01		
			19	19	1.5	0.00E+00	1.00E+00	2	7.25E+01	1	-7.25E+01	-1	1.37E+00	0.9481	-1.37E+00	-0.948	1.14E+01		
			20	20	1.5	0.00E+00	1.00E+00	2	7.06E+01	1	-7.06E+01	-1	1.34E+00	0.9419	-1.34E+00	-0.942	1.13E+01		

Date: 24/02/2020

Version: 1

Date: 24/02/2020
Version: 1





Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions).

Details to be completed for each assessment			
Site Name:	Glan Llyn		
Site Address:	Llanwern		
Completed by:	Ross Cameron		
Date:	24-Feb-20	Version:	1
Contaminant	Naphthalene		
Target Concentration (C_T)	0.002	mg/l	Origin of C_T: Proposed Water Framework Directive EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant
Target concentration

C_T

Naphthalene
0.002 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

0.5

Air filled soil porosity

θ_a

3.70E-01

fraction

0.0037

Bulk density of soil zone material

ρ

1.36E+00

g/cm³

1.36

Henry's Law constant

H

1.00E+00

dimensionless

1

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

1.34E+02

l/kg

1.34E+02

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

fraction

Organic carbon partition coefficient

K_{oc}

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.34E+02

l/kg

Specified value

Level 1 Remedial Target

Level 1 Remedial Target

2.69E-01

mg/kg

(for comparison with soil analyses)

or

0.002

mg/l

(for comparison with leachate test results)

Site being assessed: Glan Llyn
Completed by: Ross Cameron
Date: 24-Feb-20
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Naphthalene
0.002

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	0.00E+00	m/d	
Area of contaminant source	A	0.00E+00	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	0.00E+00	m	
Saturated aquifer thickness	da	0.00E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	0.00E+00	m/d	
Hydraulic gradient of water table	i	0.00E+00	fraction	
Width of contaminant source perpendicular to groundwater flow	w	0.00E+00	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	0.00E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	#DIV/0!	
Level 2 Remedial Target		#DIV/0! or #DIV/0!	mg/l mg/kg
For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration			
For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water			

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		#DIV/0!	mg/l	0

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Naphthalene		from Level 1
Target Concentration	C _T	0.002	mg/l	from Level 1
Dilution Factor	DF	#DIV/0!		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Oqata Banks Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Variable	Value	Unit	Source of parameter value
Enter source concentration			
Enter soil concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+00	days	
Calculated decay rate	6.93E-101	days ⁻¹	calculated
Width of plume in aquifer at source	0.00E+00	m	from Level 2
Plume thickness in aquifer at source	0.00E+00	m	from Level 2
Bulk density of aquifer materials	0.00E+00	g/cm ³	
Effective porosity of aquifer	0.00E+00	fraction	
Hydraulic gradient	1.00E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	0.00E+00	m/d	from Level 2
Distance to compliance point	0.00E+00	m	
to compliance point perpendicular to flow direction		m	
to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	0.00E+00	l/kg	see options
Longitudinal dispersivity	0.000	m	see options
Transverse dispersivity	0.000	m	see options
Vertical dispersivity	0.000	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	#DIV/0!	m/d
Retardation factor	Rf	#DIV/0!	fraction
Decay rate used	λ	6.93E-101	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	#DIV/0!	fraction
Rate of contaminant flow due to retardation	u	#DIV/0!	m/d
Ratio of Compliance Point to Source Concentration	C _{CEP/C_{SP}}	#DIV/0!	fraction
Attenuation factor (C_{CEP/C_{SP}})	AF	#DIV/0!	fraction
Calculated soil leachate concentration	Co	0.00E+00	mol/l

Remedial Targets

Remedial Targets		Level 3 Remedial Target	#DIV/0!	mg/l	For comparison with measured pore water concentration.
		Ogata Banks	#DIV/0!	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point		0	m		For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration		C ₂₀ /C ₀	#DIV/0!	fraction	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd		l/kg
----------------------------------	----	--	------

Entry for non-polar organic chemicals (option)

Entry for non-polymeric chemicals (option)	
Reaction of organic carbon in soil	for [redacted] function

la Entry for ionic organic chemicals (option)

Sorption coefficient for related species	$K_{oc,n}$	0.00E+00	l/kg
Sorption coefficient for ionised species	$K_{oc,i}$	0.00E+00	l/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction

Soil water partition coefficient	Kd	0.00E+00	l/kg
----------------------------------	----	----------	------

Define dispersivity (click brown cell and use pull down list)

User defined values for dispersivity

Longitudinal dispersivity

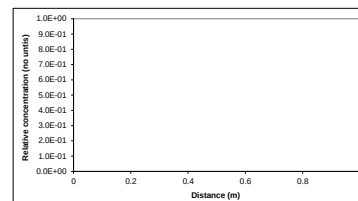
Transverse dispersivity

Vertical dispersivity

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report $\alpha x = 0.83/\log$.

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O_2 , NO_3 , SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#####
Version:	1



Environment
Agency

Calculated (relative) concentrations for distance-concentration graph

[illegible]

R&D Publication 20 Remedial Targets Worksheet, Release 3.2



Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant				
Target Concentration	C _T	Naphthalene	mg/l	from Level 1
		2.00E-03	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	2.31E-01	mg/l	Source of parameter value
Half life for degradation of contaminant in water	t _{1/2}	1.00E+02	days	Based on average soil conc of 8.4mg/kg
Calculated decay rate	λ	6.93E-03	days ⁻¹	100 day half life estimation
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+02	m	Site data
Plume thickness at source	Sy	1.50E+00	m	Thickness of re-engineered MG
Saturated aquifer thickness	da	2.00E+00	m	Based upon proposed total MG and capillary
Bulk density of aquifer materials	ρ	1.38E+00	g/cm ³	Site data
Effective porosity of aquifer	n	8.00E-02	fraction	Estimate
Hydraulic gradient	i	1.00E-02	fraction	Proposed best achievable
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	Site data
Distance to compliance point	x	2.00E+01	m	Site data
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only

Parameters values determined from options				
Partition coefficient	Kd	3.60E+01	l/kg	see options
Longitudinal dispersivity	ax	2.00E+00	m	see options
Transverse dispersivity	az	2.00E-01	m	see options
Vertical dispersivity	ay	2.00E-02	m	see options

Calculated Parameters Variable

Groundwater flow velocity	v	1.08E-03	m/d	
Retardation factor	Rf	6.13E+02	fraction	
Decay rate used	λ	1.13E-05	d ⁻¹	
Rate of contaminant flow due to retardation	u	1.76E-06	m/d	
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	6.05E-15	mg/l	
Attenuation factor (one way vertical dispersion, COICED)	AF	3.82E+13		

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

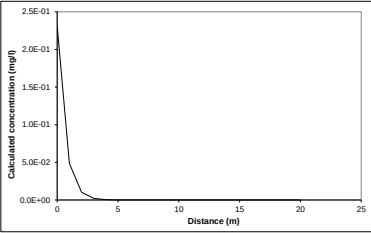
Soil water partition coefficient	Kd	3.60E+01	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	K _{oc,n}		l/kg
Sorption coefficient for ionised species	K _{oc,i}		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.60E+01	l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

Longitudinal dispersivity	ax	Enter value	Calc value Xu & Eckstein	m
Transverse dispersivity	az	0.00E+00	2.00E+00	1.57E+00
Vertical dispersivity	ay	0.00E+00	2.00E-01	1.97E-01
		0.00E+00	2.00E-02	1.97E-02

Note values of dispersivity must be > 0
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}, az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#####
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	2.3E-01
1.0	4.8E-02
2.0	1.02E-02
3.0	2.15E-03
4.0	4.53E-04
5.0	9.52E-05
6.0	2.00E-05
7.0	4.20E-06
8.0	8.80E-07
9.0	1.84E-07
10.0	3.86E-08
11.0	8.06E-09
12.0	1.69E-09
13.0	3.52E-10
14.0	7.35E-11
15.0	1.53E-11
16.0	3.20E-12
17.0	6.67E-13
18.0	1.39E-13
19.0	2.90E-14
20.0	6.05E-15

Remedial Targets

Remedial Target	7.64E+10	mg/l	For comparison with measured groundwater concentration.
Domenico - Steady state			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point	C _{ED} /C ₀	6.05E-15	mg/l Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Porosity Calculator

These results are not carried through to any of the other worksheets

DRY BULK DENSITY DATA

Variable	Value	Unit	justification
Natural Moisture Content	0.00	% wt	(Change this number only if you have specific information)
Particle Density	2.78	tonnes/m ³	
Dry Bulk Density	0.00	tonnes/m ³	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
Initial Saturation	#DIV/0!	%	
Total porosity	1.000	fraction	
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

WET BULK DENSITY DATA

	Variable	Value	Unit	
	Moisture Content	0.00	% wt	(Change this number only if you have specific information)
	Particle Density	2.78	tonnes/m ³	
Actual (wet) Bulk Density (i.e. at natural MC)		0.00	tonnes/m ³	
Calculated Parameters				
	Voids Ratio	#DIV/0!	fraction	
	dry bulk density	0.00	tonnes/m ³	
	Initial Saturation	#DIV/0!	%	
Total porosity				#DIV/0!
Air Filled Porosity				#DIV/0!
Water Filled Porosity				#DIV/0!

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol	unit	justification
Hydraulic conductivity	K	0.00E+00 m/d	
Hydraulic gradient	i	0.00E+00 unitless	
Effective porosity of aquifer	n	0.00E+00 fraction	
Thickness of saturated aquifer	b	0.00E+00 m	
Width of aquifer perpendicular to flow	w	0.00E+00 m	
Distance to receptor	x	0.00E+00 m	
Bulk density of aquifer materials	ρ	0.00E+00 g/cm ³	
Soil-water partition co-efficient	Kd	0.00E+00 l/kg	
Retardation factor of pollutant	R	#DIV/0!	

Groundwater flow velocity	v(GW)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for groundwater to reach receptor	t(GW)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years
Rate of groundwater flow through aquifer	Q	0.00E+00	m ³ /s	0.00E+00	m ³ /day	0.00E+00	m ³ /year

Contaminant flow velocity	v(contam)	#DIV/0!	m/s	#DIV/0!	m/day	#DIV/0!	m/year
Time for contaminant to reach receptor	t(contam)	#DIV/0!	seconds	#DIV/0!	days	#DIV/0!	years

Level 1 Calculation Sheet

Contaminant Naphthalene

Parameter	Value	Units	Calculations (Refer toTable 4.3, R&D Publication 20)			
(carried over from input sheet)			Selected option	User specified value for partition coefficient		
				calc	calc	Calc Kd l/kg
C _T	2.00E-03	mg/l	Calculation of partition coefficient			
Kd	1.34E+02	l/kg	for ionic organic chemical			
foc		fraction				
koc		l/kg	Partition coefficient used in Level 1 Assessment	1.34E+02 l/kg		
θ _w	5.00E-01	fraction				
θ _a	3.70E-01	fraction				
ρ	1.36E+00	g/cm3				
H	1.00E+00	dimensionless	Factor (partitioning between soil and water)	1.35E+02		
Koc,n		l/kg				
Koc,i		l/kg				
pH		pH units				
pKa						
foc (ionic)		fraction				
				</		

Level 2 Calculation Sheet
Contaminant Naphthalene

Site assessed:	Glan Llyn
Date:	24/02/2020
Version:	1

Parameter Value Units
(carried over from input sheet)

Mz	0.00E+00	m
L	0.00E+00	m
da	0.00E+00	m
Inf	0.00E+00	m/d
K	0.00E+00	m/d
i	0.00E+00	m3/d
A	0.00E+00	m2
		m3/d
Cc	0.00E+00	mg/l
C _T	2.00E-03	mg/l
Cu	0.00E+00	mg/l
w	0.00E+00	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Calculated
Dilution Factor

#DIV/0!

#DIV/0!

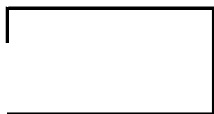
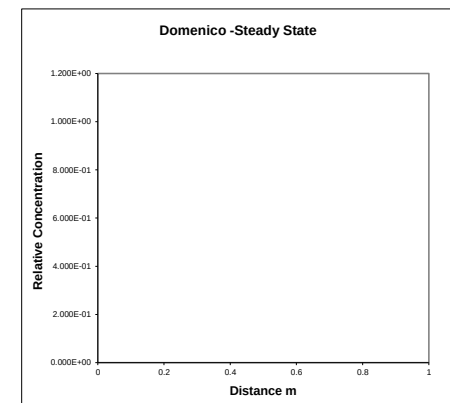
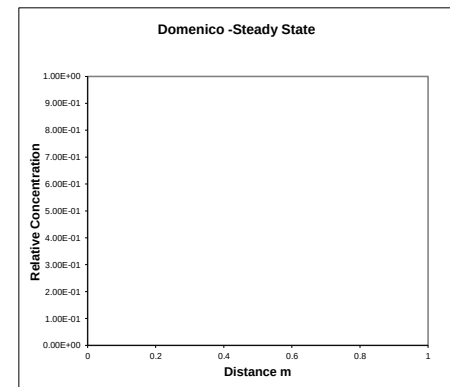


Figure 1 is a line graph titled "Ogata Banks - Time Variant". The Y-axis is labeled "Relative Concentration" and ranges from 0.00E+00 to 1.00E+00 in increments of 0.10E+00. The X-axis is labeled "Distance m" and ranges from 0 to 1 in increments of 0.1. The graph shows a single data series represented by a solid line. The concentration starts at 1.00E+00 at 0m and decreases steadily to approximately 0.25E+00 at 1m.

DOMENICO (STEADY STATE)																
Contaminant	Naphthalene		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)													
			X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration	
Input	Value	Units														
C _T	2.000E-03	mg/l	1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
DF	#DIV/0!		2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
			3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
			4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
λ	6.931E-101	days ⁻¹	5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
Sz	0.000E+00	m	6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
Sy	0.000E+00	m	7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
Kd	0.000E+00	l/kg	8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
ρ	0.000E+00	g/cm3	9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
n	0.000E+00		10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
i	#DIV/0!		11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
K	0.000E+00	m/d	12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
x	0.000E+00	m	13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
z	0.000E+00	m	14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
y	0.000E+00	m	15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
ax	0.000E+00	m	16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
az	0.000E+00	m	17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
ay	0.000E+00	m	18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
			19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	
			20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	



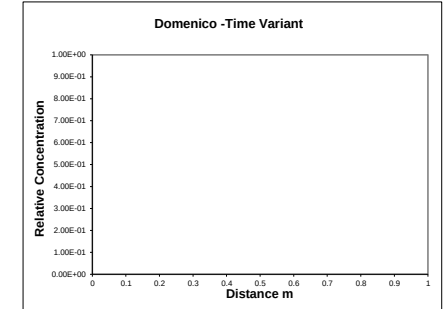
		DOMENICO (STEADY STATE)													
Calc		Naphthalene													
		Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT													
		X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration	
v	#DIV/0!	m/d	1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Rc	#DIV/0!		2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
u	#DIV/0!	m/d	3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



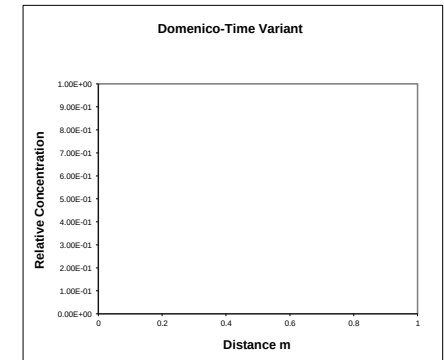
Date: 24/02/2020
Version: 1

DOMENICO (TIME VARIANT)

Contaminant	Naphthalene	Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)															
Input	Value	Units	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
C _T	0.002	mg/l	1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
DF	#DIV/0!		2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
λ	6.931E-101	days ⁻¹	5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Sz	0.000E+00	m	6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Sy	0.000E+00	m	7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Kd	0.000E+00	l/kg	8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
ρ	0.000E+00	g/cm3	9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
n	0.000E+00		10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
i	#DIV/0!		11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
K	0.000E+00	m/d	12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
x	0.000E+00	m	13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
z	0.000E+00	m	14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
y	0.000E+00	m	15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
t	1.000E+99	days	16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
ax	0.000E+00	m	17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
az	0.000E+00	m	18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
ay	0.000E+00	m	19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

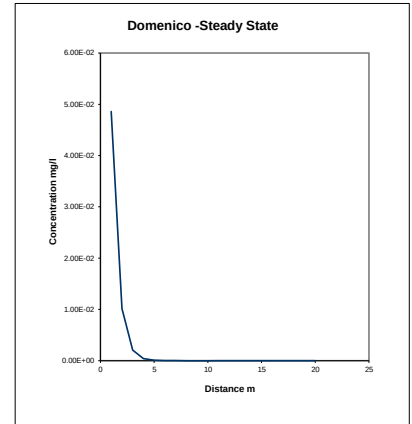


Calc	Value	Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT															
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
v	#DIV/0!	m/d	1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Rc	#DIV/0!		2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
u	#DIV/0!	m/d	3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



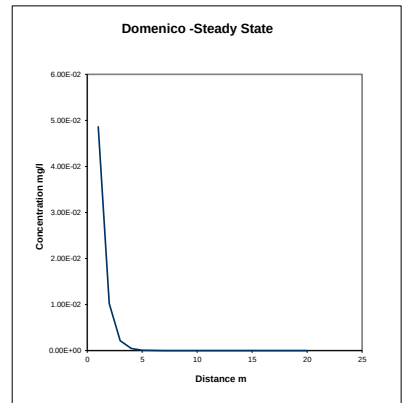
Date: 24/02/2020
Version: 1

Contaminant		DOMENICO (STEADY STATE)														
Naphthalene		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)														
Input	Value	Units		X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
C _T	0.002	mg/l	1	1	0.05775	-1.56E+00	2.10E-01	2.80E+02	1	-2.80E+02	-1	2.65E+00	1	-2.65E+00	-0.9998	4.86E-02
			2	2	0.05775	-3.12E+00	4.43E-02	1.98E+02	1	-1.98E+02	-1	1.88E+00	0.992	-1.88E+00	-0.992	1.01E-02
			3	3	0.05775	-4.68E+00	9.31E-03	1.61E+02	1	-1.61E+02	-1	1.53E+00	0.97	-1.53E+00	-0.9696	2.09E-03
Co	2.31E-01	mg/l	4	4	0.05775	-6.24E+00	1.96E-03	1.40E+02	1	-1.40E+02	-1	1.33E+00	0.939	-1.33E+00	-0.9392	4.25E-04
λ	1.13E-05	days ⁻¹	5	5	0.05775	-7.79E+00	4.12E-04	1.25E+02	1	-1.25E+02	-1	1.19E+00	0.906	-1.19E+00	-0.9065	8.63E-05
Sz	5.00E+02	m	6	6	0.05775	-9.35E+00	8.67E-05	1.14E+02	1	-1.14E+02	-1	1.08E+00	0.874	-1.08E+00	-0.8742	1.75E-05
Sy	1.50E+00	m	7	7	0.05775	-1.09E+01	1.82E-05	1.06E+02	1	-1.06E+02	-1	1.00E+00	0.844	-1.00E+00	-0.8436	3.56E-06
Kd	3.60E+01	l/kg	8	8	0.05775	-1.25E+01	3.84E-06	9.88E+01	1	-9.88E+01	-1	9.38E-01	0.815	-9.38E-01	-0.8151	7.23E-07
ρ	1.36E+00	g/cm3	9	9	0.05775	-1.40E+01	8.08E-07	9.32E+01	1	-9.32E+01	-1	8.84E-01	0.789	-8.84E-01	-0.7887	1.47E-07
n	8.00E-02		10	10	0.05775	-1.56E+01	1.70E-07	8.84E+01	1	-8.84E+01	-1	8.39E-01	0.764	-8.39E-01	-0.7643	3.00E-08
i	1.00E-02		11	11	0.05775	-1.71E+01	3.58E-08	8.43E+01	1	-8.43E+01	-1	8.00E-01	0.742	-8.00E-01	-0.7418	6.13E-09
K	8.64E-03	m/d	12	12	0.05775	-1.87E+01	7.52E-09	8.07E+01	1	-8.07E+01	-1	7.65E-01	0.721	-7.65E-01	-0.721	1.25E-09
x	2.00E+01	m	13	13	0.05775	-2.03E+01	1.58E-09	7.75E+01	1	-7.75E+01	-1	7.35E-01	0.702	-7.35E-01	-0.7017	2.57E-10
z	0.00E+00	m	14	14	0.05775	-2.18E+01	3.33E-10	7.47E+01	1	-7.47E+01	-1	7.09E-01	0.684	-7.09E-01	-0.6838	5.26E-11
y	0.00E+00	m	15	15	0.05775	-2.34E+01	7.01E-11	7.22E+01	1	-7.22E+01	-1	6.85E-01	0.667	-6.85E-01	-0.6671	1.08E-11
			16	16	0.05775	-2.49E+01	1.47E-11	6.99E+01	1	-6.99E+01	-1	6.63E-01	0.651	-6.63E-01	-0.6515	2.22E-12
ax	2.00E+00	m	17	17	0.05775	-2.65E+01	3.10E-12	6.78E+01	1	-6.78E+01	-1	6.43E-01	0.637	-6.43E-01	-0.6369	4.56E-13
az	2.00E-01	m	18	18	0.05775	-2.81E+01	6.53E-13	6.59E+01	1	-6.59E+01	-1	6.25E-01	0.623	-6.25E-01	-0.6232	9.40E-14
ay	2.00E-02	m	19	19	0.05775	-2.96E+01	1.37E-13	6.41E+01	1	-6.41E+01	-1	6.08E-01	0.61	-6.08E-01	-0.6104	1.94E-14
			20	20	0.05775	-3.12E+01	2.89E-14	6.25E+01	1	-6.25E+01	-1	5.93E-01	0.598	-5.93E-01	-0.5983	3.99E-15



Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc		Value	DOMENICO (STEADY STATE)													
			Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT													
			X		Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
v	1.08E-03	m/d	1	1	0.05775	-1.56E+00	2.10E-01	2.80E+02	1	-2.80E+02	-1	5.30E+00	1	-5.30E+00	-1	4.86E-02
Rc	6.13E+02		2	2	0.05775	-3.12E+00	4.43E-02	1.98E+02	1	-1.98E+02	-1	3.75E+00	1	-3.75E+00	-1	1.02E-02
u	1.76E-06	m/d	3	3	0.05775	-4.68E+00	9.31E-03	1.61E+02	1	-1.61E+02	-1	3.06E+00	1	-3.06E+00	-1	2.15E-03
			4	4	0.05775	-6.24E+00	1.96E-03	1.40E+02	1	-1.40E+02	-1	2.65E+00	1	-2.65E+00	-0.9998	4.53E-04
			5	5	0.05775	-7.79E+00	4.12E-04	1.25E+02	1	-1.25E+02	-1	2.37E+00	0.999	-2.37E+00	-0.9992	9.52E-05
			6	6	0.05775	-9.35E+00	8.67E-05	1.14E+02	1	-1.14E+02	-1	2.17E+00	0.998	-2.17E+00	-0.9978	2.00E-05
			7	7	0.05775	-1.09E+01	1.82E-05	1.06E+02	1	-1.06E+02	-1	2.00E+00	0.995	-2.00E+00	-0.9954	4.20E-06
			8	8	0.05775	-1.25E+01	3.84E-06	9.88E+01	1	-9.88E+01	-1	1.88E+00	0.992	-1.88E+00	-0.992	8.80E-07
			9	9	0.05775	-1.40E+01	8.08E-07	9.32E+01	1	-9.32E+01	-1	1.77E+00	0.988	-1.77E+00	-0.9876	1.84E-07
			10	10	0.05775	-1.56E+01	1.70E-07	8.84E+01	1	-8.84E+01	-1	1.68E+00	0.982	-1.68E+00	-0.9823	3.86E-08
			11	11	0.05775	-1.71E+01	3.58E-08	8.43E+01	1	-8.43E+01	-1	1.60E+00	0.976	-1.60E+00	-0.9763	8.06E-09
			12	12	0.05775	-1.87E+01	7.52E-09	8.07E+01	1	-8.07E+01	-1	1.53E+00	0.97	-1.53E+00	-0.9696	1.69E-09
			13	13	0.05775	-2.03E+01	1.58E-09	7.75E+01	1	-7.75E+01	-1	1.47E+00	0.962	-1.47E+00	-0.9625	3.52E-10
			14	14	0.05775	-2.18E+01	3.33E-10	7.47E+01	1	-7.47E+01	-1	1.42E+00	0.955	-1.42E+00	-0.955	7.35E-11
			15	15	0.05775	-2.34E+01	7.01E-11	7.22E+01	1	-7.22E+01	-1	1.37E+00	0.947	-1.37E+00	-0.9472	1.53E-11
			16	16	0.05775	-2.49E+01	1.47E-11	6.99E+01	1	-6.99E+01	-1	1.33E+00	0.939	-1.33E+00	-0.9392	3.20E-12
			17	17	0.05775	-2.65E+01	3.10E-12	6.78E+01	1	-6.78E+01	-1	1.29E+00	0.931	-1.29E+00	-0.9311	6.67E-13
			18	18	0.05775	-2.81E+01	6.53E-13	6.59E+01	1	-6.59E+01	-1	1.25E+00	0.923	-1.25E+00	-0.9229	1.39E-13
			19	19	0.05775	-2.96E+01	1.37E-13	6.41E+01	1	-6.41E+01	-1	1.22E+00	0.915	-1.22E+00	-0.9147	2.90E-14
			20	20	0.05775	-3.12E+01	2.89E-14	6.25E+01	1	-6.25E+01	-1	1.19E+00	0.906	-1.19E+00	-0.9065	6.05E-15



Date: 24/02/2020
Version: 1

DOMENICO (TIME VARIANT)

Contaminant		Naphthalene		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)														
Input	Value	Units	X	m	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
C _T	0.002	mg/l	1	1	0.02888	-1.56E+00	2.10E-01	-3.40E+47	2	2.80E+02	1	-2.80E+02	-1	2.65E+00	0.9998	-2.65E+00	-1	4.86E-02
Co	2.31E-01	mg/l	2	2	0.02888	-3.12E+00	4.43E-02	-3.40E+47	2	1.98E+02	1	-1.98E+02	-1	1.88E+00	0.992	-1.88E+00	-0.992	1.01E-02
			3	3	0.02888	-4.68E+00	9.31E-03	-3.40E+47	2	1.61E+02	1	-1.61E+02	-1	1.53E+00	0.9696	-1.53E+00	-0.97	2.09E-03
			4	4	0.02888	-6.24E+00	1.96E-03	-3.40E+47	2	1.40E+02	1	-1.40E+02	-1	1.33E+00	0.9392	-1.33E+00	-0.939	4.25E-04
λ	1.13E-05	days ⁻¹	5	5	0.02888	-7.79E+00	4.12E-04	-3.40E+47	2	1.25E+02	1	-1.25E+02	-1	1.19E+00	0.9065	-1.19E+00	-0.906	8.63E-05
Sz	5.00E+02	m	6	6	0.02888	-9.35E+00	8.67E-05	-3.40E+47	2	1.14E+02	1	-1.14E+02	-1	1.08E+00	0.8742	-1.08E+00	-0.874	1.75E-05
Sy	1.50E+00	m	7	7	0.02888	-1.09E+01	1.82E-05	-3.40E+47	2	1.06E+02	1	-1.06E+02	-1	1.00E+00	0.8436	-1.00E+00	-0.844	3.56E-06
Kd	3.60E+01	l/kg	8	8	0.02888	-1.25E+01	3.84E-06	-3.40E+47	2	9.88E+01	1	-9.88E+01	-1	9.38E-01	0.8151	-9.38E-01	-0.815	7.23E-07
ρ	1.36E+00	g/cm3	9	9	0.02888	-1.40E+01	8.08E-07	-3.40E+47	2	9.32E+01	1	-9.32E+01	-1	8.84E-01	0.7887	-8.84E-01	-0.789	1.47E-07
n	8.00E-02		10	10	0.02888	-1.56E+01	1.70E-07	-3.40E+47	2	8.84E+01	1	-8.84E+01	-1	8.39E-01	0.7643	-8.39E-01	-0.764	3.00E-08
i	1.00E-02		11	11	0.02888	-1.71E+01	3.58E-08	-3.40E+47	2	8.43E+01	1	-8.43E+01	-1	8.00E-01	0.7418	-8.00E-01	-0.742	6.13E-09
K	8.64E-03	m/d	12	12	0.02888	-1.87E+01	7.52E-09	-3.40E+47	2	8.07E+01	1	-8.07E+01	-1	7.65E-01	0.721	-7.65E-01	-0.721	1.25E-09
x	2.00E+01	m	13	13	0.02888	-2.03E+01	1.58E-09	-3.40E+47	2	7.75E+01	1	-7.75E+01	-1	7.35E-01	0.7017	-7.35E-01	-0.702	2.57E-10
z	0.00E+00	m	14	14	0.02888	-2.18E+01	3.33E-10	-3.40E+47	2	7.47E+01	1	-7.47E+01	-1	7.09E-01	0.6838	-7.09E-01	-0.684	5.26E-11
y	0.00E+00	m	15	15	0.02888	-2.34E+01	7.01E-11	-3.40E+47	2	7.22E+01	1	-7.22E+01	-1	6.85E-01	0.6671	-6.85E-01	-0.667	1.08E-11
t	1.00E+100	days	16	16	0.02888	-2.49E+01	1.47E-11	-3.40E+47	2	6.99E+01	1	-6.99E+01	-1	6.63E-01	0.6515	-6.63E-01	-0.651	2.22E-12
ax	2.00E+00	m	17	17	0.02888	-2.65E+01	3.10E-12	-3.40E+47	2	6.78E+01	1	-6.78E+01	-1	6.43E-01	0.6369	-6.43E-01	-0.637	4.56E-13
az	2.00E-01	m	18	18	0.02888	-2.81E+01	6.53E-13	-3.40E+47	2	6.59E+01	1	-6.59E+01	-1	6.25E-01	0.6232	-6.25E-01	-0.623	9.40E-14
ay	2.00E-02	m	19	19	0.02888	-2.96E+01	1.37E-13	-3.40E+47	2	6.41E+01	1	-6.41E+01	-1	6.08E-01	0.6104	-6.08E-01	-0.61	1.94E-14
			20	20	0.02888	-3.12E+01	2.89E-14	-3.40E+47	2	6.25E+01	1	-6.25E+01	-1	5.93E-01	0.5983	-5.93E-01	-0.598	3.99E-15

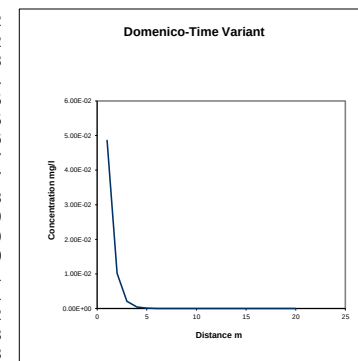
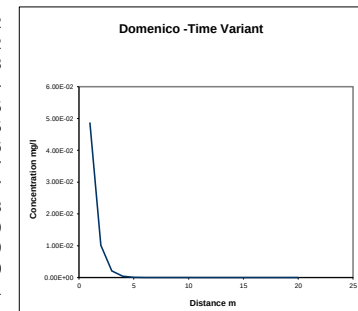
Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc		Value	Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT															
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration	
v	1.08E-03	m/d																
Rc	6.13E+02		1	1	0.02888	-1.56E+00	2.10E-01	-3.40E+47	2	2.80E+02	1	-2.80E+02	-1	5.30E+00	1	-5.30E+00	-1	4.86E-02
u	1.76E-06	m/d	2	2	0.02888	-3.12E+00	4.43E-02	-3.40E+47	2	1.98E+02	1	-1.98E+02	-1	3.75E+00	1	-3.75E+00	-1	1.02E-02
			3	3	0.02888	-4.68E+00	9.31E-03	-3.40E+47	2	1.61E+02	1	-1.61E+02	-1	3.06E+00	1	-3.06E+00	-1	2.15E-03
			4	4	0.02888	-6.24E+00	1.96E-03	-3.40E+47	2	1.40E+02	1	-1.40E+02	-1	2.65E+00	0.9998	-2.65E+00	-1	4.53E-04
			5	5	0.02888	-7.79E+00	4.12E-04	-3.40E+47	2	1.25E+02	1	-1.25E+02	-1	2.37E+00	0.9992	-2.37E+00	-0.999	9.52E-05
			6	6	0.02888	-9.35E+00	8.67E-05	-3.40E+47	2	1.14E+02	1	-1.14E+02	-1	2.17E+00	0.9978	-2.17E+00	-0.998	2.00E-05
			7	7	0.02888	-1.09E+01	1.82E-05	-3.40E+47	2	1.06E+02	1	-1.06E+02	-1	2.00E+00	0.9954	-2.00E+00	-0.995	4.20E-06
			8	8	0.02888	-1.25E+01	3.84E-06	-3.40E+47	2	9.88E+01	1	-9.88E+01	-1	1.88E+00	0.992	-1.88E+00	-0.992	8.80E-07
			9	9	0.02888	-1.40E+01	8.08E-07	-3.40E+47	2	9.32E+01	1	-9.32E+01	-1	1.77E+00	0.9876	-1.77E+00	-0.988	1.84E-07
			10	10	0.02888	-1.56E+01	1.70E-07	-3.40E+47	2	8.84E+01	1	-8.84E+01	-1	1.68E+00	0.9823	-1.68E+00	-0.982	3.86E-08
			11	11	0.02888	-1.71E+01	3.58E-08	-3.40E+47	2	8.43E+01	1	-8.43E+01	-1	1.60E+00	0.9763	-1.60E+00	-0.976	8.06E-09
			12	12	0.02888	-1.87E+01	7.52E-09	-3.40E+47	2	8.07E+01	1	-8.07E+01	-1	1.53E+00	0.9696	-1.53E+00	-0.97	1.69E-09
			13	13	0.02888	-2.03E+01	1.58E-09	-3.40E+47	2	7.75E+01	1	-7.75E+01	-1	1.47E+00	0.9625	-1.47E+00	-0.962	3.52E-10
			14	14	0.02888	-2.18E+01	3.33E-10	-3.40E+47	2	7.47E+01	1	-7.47E+01	-1	1.42E+00	0.955	-1.42E+00	-0.955	7.35E-11
			15	15	0.02888	-2.34E+01	7.01E-11	-3.40E+47	2	7.22E+01	1	-7.22E+01	-1	1.37E+00	0.9472	-1.37E+00	-0.947	1.53E-11
			16	16	0.02888	-2.49E+01	1.47E-11	-3.40E+47	2	6.99E+01	1	-6.99E+01	-1	1.33E+00	0.9392	-1.33E+00	-0.939	3.20E-12
			17	17	0.02888	-2.65E+01	3.10E-12	-3.40E+47	2	6.78E+01	1	-6.78E+01	-1	1.29E+00	0.9311	-1.29E+00	-0.931	6.67E-13
			18	18	0.02888	-2.81E+01	6.53E-13	-3.40E+47	2	6.59E+01	1	-6.59E+01	-1	1.25E+00	0.9229	-1.25E+00	-0.923	1.39E-13
			19	19	0.02888	-2.96E+01	1.37E-13	-3.40E+47	2	6.41E+01	1	-6.41E+01	-1	1.22E+00	0.9147	-1.22E+00	-0.915	2.90E-14
			20	20	0.02888	-3.12E+01	2.89E-14	-3.40E+47	2	6.25E+01	1	-6.25E+01	-1	1.19E+00	0.9065	-1.19E+00	-0.906	6.05E-15

Date: 24/02/2020

Version: 1

Date: 24/02/2020
Version: 1



R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note



Input Parameters (using pull down menu)

Variable	Value	Unit	Source
Contaminant	Vanadium		from Level 1
Target Concentration	2.00E-02	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state	Equations in HRA publication
-------------------------	------------------------------

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Source of parameter value

Based on average soil conc of 206.93mg/kg

Estimation

Initial contaminant concentration in groundwater at plume core	C ₀	9.70E-01	mg/l	
Half life for degradation of contaminant in water	t _{1/2}	9.00E+99	days	
Calculated decay rate	λ	7.70E-101	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+02	m	Site data
Plume thickness at source	Sy	1.50E+00	m	Thickness of re-engineered MG
Saturated aquifer thickness	da	2.00E+00	m	Based upon proposed total MG and caprock
Bulk density of aquifer materials	ρ	1.38E+00	g/cm ³	Site data
Effective porosity of aquifer	n	8.00E-02	fraction	Estimate
Hydraulic gradient	i	1.00E-02	fraction	Proposed best achievable
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	Site data
Distance to compliance point	x	2.00E+01	m	Site data
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	2.13E+02	l/kg	see options
Longitudinal dispersivity	ax	1.57E+00	m	see options
Transverse dispersivity	az	1.57E-01	m	see options
Vertical dispersivity	ay	1.57E-02	m	see options

Calculated Parameters

Groundwater flow velocity	v	1.08E-03	m/d	
Retardation factor	Rf	3.62E+03	fraction	
Decay rate used	λ	2.13E-104	d ⁻¹	
Rate of contaminant flow due to retardation	u	2.98E-07	m/d	
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	9.14E-01	mg/l	
Attenuation factor (one way vertical dispersion, COICED)	AF	1.06E+00		

Remedial Targets

Remedial Target	2.12E-02	mg/l	For comparison with measured groundwater concentration.
Domenico - Steady state			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point	C _{ED} /C ₀	9.14E-01	mg/l Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer

Organic carbon partition coefficient

Entry for ionic organic chemicals (option)

Sorption coefficient for related species

Sorption coefficient for ionised species

pH value

acid dissociation constant

Fraction of organic carbon in aquifer

Soil water partition coefficient

Kd

foc

Koc

K_{oc,n}K_{oc,i}

pKa

foc

Kd

2.13E+02

l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivity based on Xu & Eckstein (1995)

Longitudinal dispersivity

Transverse dispersivity

Vertical dispersivity

Note values of dispersivity must be > 0

For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log₁₀σ)^{2.414}, az = ax/10, ay = ax/100 are assumed

Enter value

Calc value Xu & Eckstein

0.00E+00

0.00E+00

0.00E+00

2.00E+10

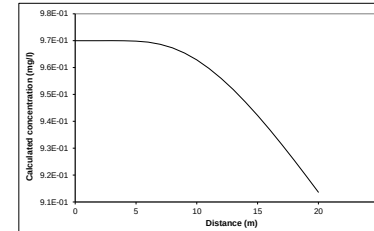
2.00E+01

2.00E+01

1.57E+00

1.57E-01

1.57E-02



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#####
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Steady state

From calculation sheet

Distance

Concentration

mg/l

0

9.7E-01

1.0

9.70E-01

2.0

9.70E-01

3.0

9.70E-01

4.0

9.70E-01

5.0

9.70E-01

6.0

9.69E-01

7.0

9.69E-01

8.0

9.67E-01

9.0

9.65E-01

10.0

9.63E-01

11.0

9.60E-01

12.0

9.56E-01

13.0

9.52E-01

14.0

9.47E-01

15.0

9.42E-01

16.0

9.37E-01

17.0

9.31E-01

18.0

9.26E-01

19.0

9.20E-01

20.0

9.14E-01



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions).

Details to be completed for each assessment			
Site Name:	Glan Llyn		
Site Address:	Llanwern		
Completed by:	Ross Cameron		
Date:	24-Feb-20	Version:	1
Contaminant	Benzo(a)pyrene		
Target Concentration (C_T)	0.00000017	mg/l	Origin of C_T: Proposed Water Framework Directive EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant	Benzo(a)pyrene
Target concentration	C _T 0.00000017 mg/l

Input Parameters

Standard entry

Water filled soil porosity	θ _w	5.00E-01	fraction
Air filled soil porosity	θ _a	3.70E-01	fraction
Bulk density of soil zone material	ρ	1.36E+00	g/cm ³
Henry's Law constant	H	1.00E+00	dimensionless

Source of parameter value	0.5
	0.0037
	1.36
	1

This sheet calculates the Level 1 remedial target for soils(mg/kg) based on a selected target concentration and theoretical calculation of soil water partitioning. Three options are included for determining the partition coefficient. The measured soil concentration as mg/kg should be compared with the Level 1 remedial target to determine the need for further action.

Entry if specify partition coefficient (option)

Soil water partition coefficient	K _d	1.34E+02	l/kg
----------------------------------	----------------	----------	------

Source of parameter value	1.34E+02
---------------------------	----------

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)	f _{oc}		fraction
Organic carbon partition coefficient	K _{oc}		l/kg

Source of parameter value	

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species	K _{oc,n}		l/kg
Sorption coefficient for ionised species	K _{oc,i}		l/kg
pH value	pH		pH units
Acid dissociation constant	pK _a		
Fraction of organic carbon (in soil)	f _{oc}		fraction

Source of parameter value	

Soil water partition coefficient used in Level Assessment K_d 1.34E+02 l/kg Specified value

Level 1 Remedial Target

Level 1 Remedial Target	2.29E-05	mg/kg	(for comparison with soil analyses)
	or		
	0.00000017	mg/l	(for comparison with leachate test results)

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T Benzo(a)pyrene
0.00000017 mg/l

from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	0.00E+00	m/d	
Area of contaminant source	A	0.00E+00	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	0.00E+00	m	
Saturated aquifer thickness	da	0.00E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	0.00E+00	m/d	
Hydraulic gradient of water table	i	0.00E+00	fraction	
Width of contaminant source perpendicular to groundwater flow	w	0.00E+00	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	0.00E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	#DIV/0!	
Level 2 Remedial Target		#DIV/0! or #DIV/0!	mg/l mg/kg
For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration			
For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water			

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		#DIV/0!	mg/l	0

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Level 3 - Soil

See Note

Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(a)pyrene		from Level 1
Target Concentration	C _T	0.00000017	mg/l	from Level 1
Dilution Factor	DF	#DIV/0!		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Oqata Banks Equations in HRA publication

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Enter soil concentration	1.00E+00	days	
Half life for degradation of contaminant in water	6.93E-101	days ⁻¹	calculated
Calculated decay rate	0.00E+00	m	from Level 2
Width of plume in aquifer at source	0.00E+00	m	from Level 2
Plume thickness in aquifer at source	0.00E+00	m	from Level 2
Bulk density of aquifer materials	0.00E+00	g/cm ³	
Effective porosity of aquifer	0.00E+00	fraction	
Hydraulic gradient	0.00E+00	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	0.00E+00	m/d	from Level 2
Distance to compliance point	0.00E+00	m	
to compliance point perpendicular to flow direction	0.00E+00	m	
to compliance point perpendicular to flow direction	0.00E+00	m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	0.00E+00	l/kg	see options
Longitudinal dispersivity	0.000	m	see options
Transverse dispersivity	0.000	m	see options
Vertical dispersivity	0.000	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters	Variable		
Groundwater flow velocity	v	#DIV/0!	m/d
Retardation factor	Rf	#DIV/0!	fraction
Decay rate used	λ	6.93E-101	d ⁻¹
ed in aquifer flow down-gradient	i	#DIV/0!	fraction
aminant flow flow due to retardation	u	#DIV/0!	m/d
Point to Source Concentration	C_{EO}/C_0	#DIV/0!	fraction
Attenuation Factor (C_0/C_{EO})	AF	#DIV/0!	fraction
ated soil leachate concentration	Co	0.00E+00	mg/l

Remedial Targets

Remedial Targets		Level 3 Remedial Target	#DIV/0!	mg/l	For comparison with measured pore water concentration.
		Ogata Banks	#DIV/0!	mg/kg	For comparison with measured soil concentration. This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point		0	m		For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration		C ₂₀ /C ₀	#DIV/0!	fraction	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Enter if you specify partition coefficient (option)	Kd		1/kg
Soil water partition coefficient			
Enter for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		1/kg
Enter for ionic organic chemicals (option)			
Sorption coefficient for related species	K _{oc,rel}	0.00E+00	1/kg
Sorption coefficient for ionised species	K _{oc,i}	0.00E+00	1/kg
pH value	pH	0.00E+00	
Acid dissociation constant	pKa	0.00E+00	
Fraction of organic carbon in aquifer	foc	0.00E+00	fraction
Soil water partition coefficient	Kd	0.00E+00	1/kg

Define dispersivity (click brown cell and use pull down list)

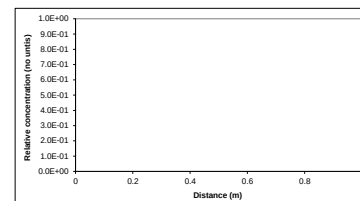
User defined values for dispersivity

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	ax	0.00E+00	0.00E+00	#NUM!	m
Transverse dispersivity	az	0.00E+00	0.00E+00	#NUM!	m
Vertical dispersivity	av	0.00E+00	0.00E+00	#NUM!	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report $ax = 0.83(\log_{10}x)^{2.414}$; $az = ax/10$, $ay = ax/100$ are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O_2 , NO_3 , SO_4 etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#####
Version:	1



Environment
Agency

Calculated (relative) concentrations for distance-concentration graph

[illegible]

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Variable Value Unit Source

Contaminant
Target Concentration
 C_T Benzo(a)pyrene 1.70E-07 mg/l from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Source of parameter value

Initial contaminant concentration in groundwater at plume core	C_0	7.00E-02	mg/l	Based on max soil conc of 714mg/kg
Half life for degradation of contaminant in water	$t_{1/2}$	3.65E+04	days	10 year half life estimation
Calculated decay rate	λ	1.90E-05	days ⁻¹	Site data
Width of plume in aquifer at source (perpendicular to flow)	S_z	5.00E-02	m	Thickness of re-engineered MG
Plume thickness at source	S_y	1.50E+00	m	Based upon proposed total MG and capillary
Saturated aquifer thickness	d_a	2.00E+00	m	Site data
Bulk density of aquifer materials	ρ	1.38E+00	g/cm ³	Estimate
Effective porosity of aquifer	n	8.00E-02	fraction	Proposed best achievable
Hydraulic gradient	i	1.00E-02	fraction	Site data
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	Estimate
Distance to compliance point	x	2.00E+01	m	Site data
Distance (lateral) to compliance point perpendicular to flow direction	z		m	Site data
Distance (depth) to compliance point perpendicular to flow direction	y		m	Site data
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only
Parameters values determined from options				
Partition coefficient	K_d	1.02E+04	l/kg	see options
Longitudinal dispersivity	α_x	2.00E+00	m	see options
Transverse dispersivity	α_z	2.00E-01	m	see options
Vertical dispersivity	α_y	2.00E-02	m	see options

Calculated Parameters Variable

Groundwater flow velocity	v	1.08E-03	m/d
Retardation factor	R_f	1.73E+05	fraction
Decay rate used	λ	1.10E-10	d ⁻¹
Rate of contaminant flow due to retardation	u	6.24E-09	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.52E-02	mg/l
Attenuation factor (one way vertical dispersion, COICED)	AF	1.55E+00	

Remedial Targets

Remedial Target	2.64E-07	mg/l	For comparison with measured groundwater concentration.
Domenico - Steady state			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point	C_{ED}/C_0	4.52E-02	mg/l Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient	K_d	1.02E+04	l/kg
Fraction of organic carbon in aquifer	f_{oc}		fraction
Organic carbon partition coefficient	K_{oc}		l/kg
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	f_{oc}		fraction
Soil water partition coefficient	K_d	1.02E+04	l/kg

Define dispersivity (click brown cell and use pull down list)

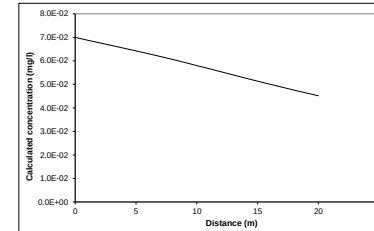
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value Xu & Eckstein	m
Longitudinal dispersivity	α_x	0.00E+00	2.00E+00	1.57E+00
Transverse dispersivity	α_z	0.00E+00	2.00E-01	1.57E-01
Vertical dispersivity	α_y	0.00E+00	2.00E-02	1.57E-02

Note values of dispersivity must be > 0

For calculated value, assumes $\alpha_x = 0.1 \times$, $\alpha_z = 0.01 \times$, $\alpha_y = 0.001 \times$
Xu & Eckstein (1995) report $\alpha_x = 0.83(\log_{10} \mu)^{0.41 \times}$, $\alpha_z = \alpha_{10}$, $\alpha_y = \alpha_{100}$ are assumed

Note values of dispersivity must be > 0
For calculated value, assumes $\alpha_x = 0.1 \cdot x$, $\alpha_z = 0.01 \cdot x$, $\alpha_y = 0.001 \cdot x$
Xu & Eckstein (1995) report $\alpha_x = 0.83(\log_{10} x)^{2.414}$, $\alpha_z = \alpha_x/10$, $\alpha_y = \alpha_x/100$ are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used

Site being assessed: Glan Llyn
Completed by: Ross Cameron
Date: 11/11/2011
Version: 1

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	7.0E-02
1.0	6.88E-02
2.0	6.77E-02
3.0	6.65E-02
4.0	6.54E-02
5.0	6.42E-02
6.0	6.31E-02
7.0	6.19E-02
8.0	6.06E-02
9.0	5.93E-02
10.0	5.80E-02
11.0	5.67E-02
12.0	5.53E-02
13.0	5.40E-02
14.0	5.27E-02
15.0	5.14E-02
16.0	5.01E-02
17.0	4.88E-02
18.0	4.75E-02
19.0	4.63E-02
20.0	4.52E-02

Porosity Calculator

These results are not carried through to any of the other worksheets

DRY BULK DENSITY DATA

Variable	Value	Unit	justification
Natural Moisture Content	0.00	% wt	(Change this number only if you have specific information)
Particle Density	2.78	tonnes/m ³	
Dry Bulk Density	0.00	tonnes/m ³	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
Initial Saturation	#DIV/0!	%	
Total porosity	1.000	fraction	
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

WET BULK DENSITY DATA

	Variable	Value	Unit	
	Moisture Content	0.00	% wt	(Change this number only if you have specific information)
	Particle Density	2.78	tonnes/m ³	
Actual (wet) Bulk Density (i.e. at natural MC)		0.00	tonnes/m ³	
Calculated Parameters				
	Voids Ratio	#DIV/0!	fraction	
	dry bulk density	0.00	tonnes/m ³	
	Initial Saturation	#DIV/0!	%	
Total porosity				#DIV/0!
Air Filled Porosity				#DIV/0!
Water Filled Porosity				#DIV/0!

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol	unit	justification
Hydraulic conductivity	K	0.00E+00 m/d	
Hydraulic gradient	i	0.00E+00 unitless	
Effective porosity of aquifer	n	0.00E+00 fraction	
Thickness of saturated aquifer	b	0.00E+00 m	
Width of aquifer perpendicular to flow	w	0.00E+00 m	
Distance to receptor	x	0.00E+00 m	
Bulk density of aquifer materials	ρ	0.00E+00 g/cm ³	
Soil-water partition co-efficient	Kd	0.00E+00 l/kg	
Retardation factor of pollutant	R	#DIV/0!	

Groundwater flow velocity	v(GW)	#DIV/0! m/s	#DIV/0! m/day	#DIV/0! m/year
Time for groundwater to reach receptor	t(GW)	#DIV/0! seconds	#DIV/0! days	#DIV/0! years
Rate of groundwater flow through aquifer	Q	0.00E+00 m ³ /s	0.00E+00 m ³ /day	0.00E+00 m ³ /year

Contaminant flow velocity	v(contam)	#DIV/0! m/s	#DIV/0! m/day	#DIV/0! m/year
Time for contaminant to reach receptor	t(contam)	#DIV/0! seconds	#DIV/0! days	#DIV/0! years

Level 1 Calculation Sheet
Contaminant Benzo(a)pyrene

Parameter (carried over from input sheet)	Value	Units
C_T	1.70E-07	mg/l
Kd	1.34E+02	l/kg
foc		fraction
koc		l/kg
θ_w	5.00E-01	fraction
θ_a	3.70E-01	fraction
ρ	1.36E+00	g/cm3
H	1.00E+00	dimensionless
Koc,n		l/kg
Koc,i		l/kg
pH		pH units
pKa		
foc (ionic)		fraction

Calculations (Refer to Table 4.3, R&D Publication 20)

Selected option [User specified value for partition coefficient](#)

Calculation of partition coefficient
for ionic organic chemical

Partition coefficient used in Level 1 Assessment 1.34E+02 l/kg

Calculated Remedial Target	2.29E-05 mg/kg	for Benzo(a)pyrene
-----------------------------------	-----------------------	---------------------------

Factor (partitioning between soil and water) 1.35E+02

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24/02/2020
Version:	1

Level 2 Calculation Sheet

Contaminant Benzo(a)pyrene

Site assessed:	Glan Llyn
Date:	24/02/2020
Version:	1

Parameter Value Units
(carried over from input sheet)

Mz	0.00E+00	m
L	0.00E+00	m
da	0.00E+00	m
Inf	0.00E+00	m/d
K	0.00E+00	m/d
i	0.00E+00	m3/d
A	0.00E+00	m2
		m3/d
Cc	0.00E+00	mg/l
C _T	1.70E-07	mg/l
Cu	0.00E+00	mg/l
w	0.00E+00	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Calculated
Dilution Factor

#DIV/0!

#DIV/0!

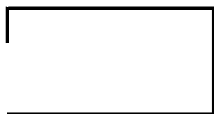
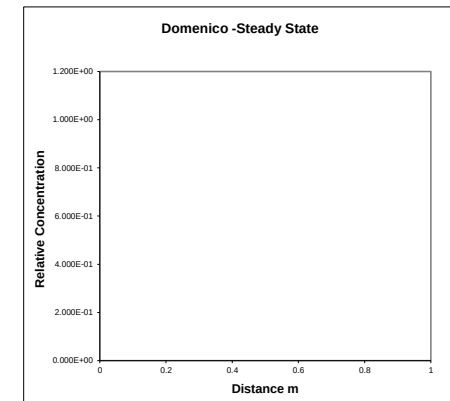
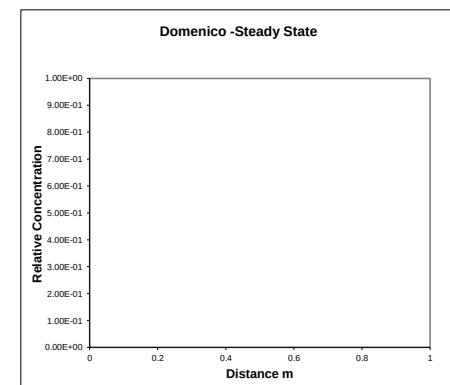


Figure 1 is a line graph titled "Ogata Banks - Time Variant". The Y-axis is labeled "Relative Concentration" and ranges from 0.00E+00 to 1.00E+00 in increments of 0.10E+00. The X-axis is labeled "Distance m" and ranges from 0 to 1 in increments of 0.1. The graph shows a single data series represented by a solid line. The concentration starts at 1.00E+00 at distance 0 and decreases steadily, reaching approximately 0.25E+00 at distance 1.

Contaminant		DOMENICO (STEADY STATE)													
benzo(a)pyrene		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)													
Input	Value	Units	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
C _T	1.700E-07	mg/l	1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
DF	#DIV/0!		2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
λ	6.931E-101	days ⁻¹	5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Sz	0.000E+00	m	6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Sy	0.000E+00	m	7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Kd	0.000E+00	l/kg	8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
ρ	0.000E+00	g/cm3	9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
n	0.000E+00		10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
i	#DIV/0!		11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
K	0.000E+00	m/d	12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
x	0.000E+00	m	13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
z	0.000E+00	m	14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
y	0.000E+00	m	15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
ax	0.000E+00	m	16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
az	0.000E+00	m	17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
ay	0.000E+00	m	18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!



Calc		DOMENICO (STEADY STATE)													
		Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT													
	Value		X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
v	#DIV/0!	m/d	1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Rc	#DIV/0!		2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
u	#DIV/0!	m/d	3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!



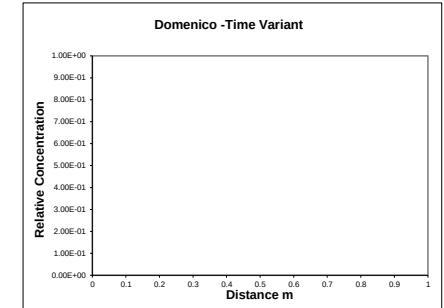
Date: 24/02/2020
Version: 1

DOMENICO (TIME VARIANT)

Contaminant Benzo(a)pyrene

Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)

Input	Value	Units	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
C _T	0.00000017	mg/l	1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
DF	#DIV/0!		2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
λ	6.931E-101	days ⁻¹	5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Sz	0.000E+00	m	6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Sy	0.000E+00	m	7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Kd	0.000E+00	l/kg	8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
ρ	0.000E+00	g/cm3	9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
n	0.000E+00		10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
i	#DIV/0!		11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
K	0.000E+00	m/d	12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
x	0.000E+00	m	13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
z	0.000E+00	m	14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
y	0.000E+00	m	15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
t	1.000E+99	days	16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
ax	0.000E+00	m	17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
az	0.000E+00	m	18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
ay	0.000E+00	m	19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

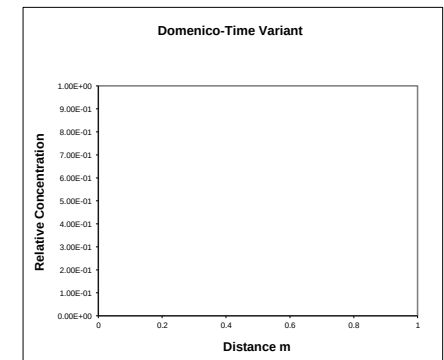


Calc

Value

Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
v	#DIV/0!	m/d	1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Rc	#DIV/0!		2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
u	#DIV/0!	m/d	3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Date: 24/02/2020
Version: 1

OGATA BANKS SOLUTION																						
Contaminant	Benzo(a)pyrene		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)																			
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration	
Input	Value	Units																				
C _T	0.00000017	mg/l	1	1	0.00875	-1.7E-02	9.8E-01	-3.0E+45	2.000	5.2E-01	1.7E+00	3.0E+45	0.000	2.8E+02	1	-2.8E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99982	6.88E-02
			2	2	0.00875	-3.4E-02	9.7E-01	-3.0E+45	2.000	1.0E+00	2.8E+00	3.0E+45	0.000	2.0E+02	1	-2.0E+02	-1	1.9E+00	0.992	-1.9E+00	-0.99199	6.71E-02
			3	3	0.00875	-5.1E-02	9.5E-01	-3.0E+45	2.000	1.6E+00	4.7E+00	3.0E+45	0.000	1.6E+02	1	-1.6E+02	-1	1.5E+00	0.9696	-1.5E+00	-0.96962	6.45E-02
Co	7.00E-02	mg/l	4	4	0.00875	-6.8E-02	9.3E-01	-3.0E+45	2.000	2.1E+00	7.9E+00	3.0E+45	0.000	1.4E+02	1	-1.4E+02	-1	1.3E+00	0.9392	-1.3E+00	-0.93921	6.14E-02
λ	1.10E-10	days ⁻¹	5	5	0.00875	-8.5E-02	9.2E-01	-3.0E+45	2.000	2.6E+00	1.3E+01	3.0E+45	0.000	1.3E+02	1	-1.3E+02	-1	1.2E+00	0.9065	-1.2E+00	-0.90647	5.83E-02
Sz	5.00E+02	m	6	6	0.00875	-1.0E-01	9.0E-01	-3.0E+45	2.000	3.1E+00	2.2E+01	3.0E+45	0.000	1.1E+02	1	-1.1E+02	-1	1.1E+00	0.8742	-1.1E+00	-0.87421	5.53E-02
Sy	1.50E+00	m	7	7	0.00875	-1.2E-01	8.9E-01	-3.0E+45	2.000	3.6E+00	3.7E+01	3.0E+45	0.000	1.1E+02	1	-1.1E+02	-1	1.0E+00	0.8436	-1.0E+00	-0.84362	5.24E-02
Kd	1.02E+04	l/kg	8	8	0.00875	-1.4E-01	8.7E-01	-3.0E+45	2.000	4.1E+00	6.3E+01	3.0E+45	0.000	9.9E+01	1	-9.9E+01	-1	9.4E-01	0.8151	-9.4E-01	-0.8151	4.98E-02
ρ	1.36E+00	g/cm3	9	9	0.00875	-1.5E-01	8.6E-01	-3.0E+45	2.000	4.7E+00	1.0E+02	3.0E+45	0.000	9.3E+01	1	-9.3E+01	-1	8.8E-01	0.7887	-8.8E-01	-0.7887	4.74E-02
n	8.00E-02		10	10	0.00875	-1.7E-01	8.4E-01	-3.0E+45	2.000	5.2E+00	1.8E+02	3.0E+45	0.000	8.8E+01	1	-8.8E+01	-1	8.4E-01	0.7643	-8.4E-01	-0.76432	4.51E-02
i	1.00E-02		11	11	0.00875	-1.9E-01	8.3E-01	-3.0E+45	2.000	5.7E+00	3.0E+02	3.0E+45	0.000	8.4E+01	1	-8.4E+01	-1	8.0E-01	0.7418	-8.0E-01	-0.7418	4.31E-02
K	8.64E-03	m/d	12	12	0.00875	-2.0E-01	8.2E-01	-3.0E+45	2.000	6.2E+00	4.9E+02	3.0E+45	0.000	8.1E+01	1	-8.1E+01	-1	7.7E-01	0.721	-7.7E-01	-0.72098	4.12E-02
x	2.00E+01	m	13	13	0.00875	-2.2E-01	8.0E-01	-3.0E+45	2.000	6.7E+00	8.3E+02	3.0E+45	0.000	7.8E+01	1	-7.8E+01	-1	7.4E-01	0.7017	-7.4E-01	-0.70169	3.94E-02
z	0.00E+00	m	14	14	0.00875	-2.4E-01	7.9E-01	-3.0E+45	2.000	7.2E+00	1.4E+03	3.0E+45	0.000	7.5E+01	1	-7.5E+01	-1	7.1E-01	0.6838	-7.1E-01	-0.68377	3.77E-02
y	0.00E+00	m	15	15	0.00875	-2.6E-01	7.7E-01	-3.0E+45	2.000	7.8E+00	2.3E+03	3.0E+45	0.000	7.2E+01	1	-7.2E+01	-1	6.8E-01	0.6671	-6.8E-01	-0.66708	3.62E-02
t	1.00E+100	days	16	16	0.00875	-2.7E-01	7.6E-01	-3.0E+45	2.000	8.3E+00	3.9E+03	3.0E+45	0.000	7.0E+01	1	-7.0E+01	-1	6.6E-01	0.6515	-6.6E-01	-0.6515	3.47E-02
ax	2.00E+00	m	17	17	0.00875	-2.9E-01	7.5E-01	-3.0E+45	2.000	8.8E+00	6.6E+03	3.0E+45	0.000	6.8E+01	1	-6.8E+01	-1	6.4E-01	0.6369	-6.4E-01	-0.63692	3.34E-02
az	2.00E-01	m	18	18	0.00875	-3.1E-01	7.4E-01	-3.0E+45	2.000	9.3E+00	1.1E+04	3.0E+45	0.000	6.6E+01	1	-6.6E+01	-1	6.3E-01	0.6232	-6.3E-01	-0.62324	3.21E-02
ay	2.00E-02	m	19	19	0.00875	-3.2E-01	7.2E-01	-3.0E+45	2.000	9.8E+00	1.8E+04	3.0E+45	0.000	6.4E+01	1	-6.4E+01	-1	6.1E-01	0.6104	-6.1E-01	-0.61038	3.09E-02
			20	20	0.00875	-3.4E-01	7.1E-01	-3.0E+45	2.000	1.0E+01	3.1E+04	3.0E+45	0.000	6.3E+01	1	-6.3E+01	-1	5.9E-01	0.5983	-5.9E-01	-0.59826	2.98E-02

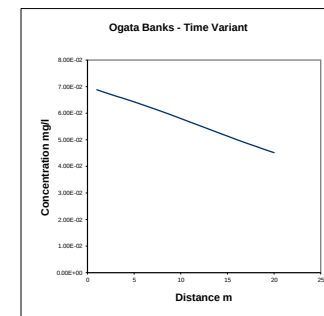
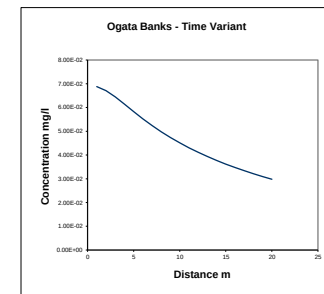
Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc		Value	Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT																			
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration	
v Rc u	1.08E-03	m/d	1	1	0.00875	-1.7E-02	9.8E-01	-3.0E+45	2.000	5.2E-01	1.7E+00	3.0E+45	0.000	2.8E+02	1	-2.8E+02	-1	5.3E+00	1	-5.3E+00	-1	6.88E-02
	1.73E+05		2	2	0.00875	-3.4E-02	9.7E-01	-3.0E+45	2.000	1.0E+00	2.8E+00	3.0E+45	0.000	2.0E+02	1	-2.0E+02	-1	3.8E+00	1	-3.8E+00	-1	6.77E-02
	6.24E-09	m/d	3	3	0.00875	-5.1E-02	9.5E-01	-3.0E+45	2.000	1.6E+00	4.7E+00	3.0E+45	0.000	1.6E+02	1	-1.6E+02	-1	3.1E+00	1	-3.1E+00	-0.99999	6.65E-02
			4	4	0.00875	-6.8E-02	9.3E-01	-3.0E+45	2.000	2.1E+00	7.9E+00	3.0E+45	0.000	1.4E+02	1	-1.4E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99982	6.54E-02
			5	5	0.00875	-8.5E-02	9.2E-01	-3.0E+45	2.000	2.6E+00	1.3E+01	3.0E+45	0.000	1.3E+02	1	-1.3E+02	-1	2.4E+00	0.9992	-2.4E+00	-0.9992	6.42E-02
			6	6	0.00875	-1.0E-01	9.0E-01	-3.0E+45	2.000	3.1E+00	2.2E+01	3.0E+45	0.000	1.1E+02	1	-1.1E+02	-1	2.2E+00	0.9978	-2.2E+00	-0.9978	6.31E-02
			7	7	0.00875	-1.2E-01	8.9E-01	-3.0E+45	2.000	3.6E+00	3.7E+01	3.0E+45	0.000	1.1E+02	1	-1.1E+02	-1	2.0E+00	0.9954	-2.0E+00	-0.99541	6.19E-02
			8	8	0.00875	-1.4E-01	8.7E-01	-3.0E+45	2.000	4.1E+00	6.3E+01	3.0E+45	0.000	9.9E+01	1	-9.9E+01	-1	1.9E+00	0.992	-1.9E+00	-0.99199	6.06E-02
			9	9	0.00875	-1.5E-01	8.6E-01	-3.0E+45	2.000	4.7E+00	1.0E+02	3.0E+45	0.000	9.3E+01	1	-9.3E+01	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	5.93E-02
			10	10	0.00875	-1.7E-01	8.4E-01	-3.0E+45	2.000	5.2E+00	1.8E+02	3.0E+45	0.000	8.8E+01	1	-8.8E+01	-1	1.7E+00	0.9823	-1.7E+00	-0.98229	5.80E-02
			11	11	0.00875	-1.9E-01	8.3E-01	-3.0E+45	2.000	5.7E+00	3.0E+02	3.0E+45	0.000	8.4E+01	1	-8.4E+01	-1	1.6E+00	0.9763	-1.6E+00	-0.97626	5.67E-02
			12	12	0.00875	-2.0E-01	8.2E-01	-3.0E+45	2.000	6.2E+00	4.9E+02	3.0E+45	0.000	8.1E+01	1	-8.1E+01	-1	1.5E+00	0.9696	-1.5E+00	-0.96962	5.53E-02
			13	13	0.00875	-2.2E-01	8.0E-01	-3.0E+45	2.000	6.7E+00	8.3E+02	3.0E+45	0.000	7.8E+01	1	-7.8E+01	-1	1.5E+00	0.9625	-1.5E+00	-0.96249	5.40E-02
			14	14	0.00875	-2.4E-01	7.9E-01	-3.0E+45	2.000	7.2E+00	1.4E+03	3.0E+45	0.000	7.5E+01	1	-7.5E+01	-1	1.4E+00	0.955	-1.4E+00	-0.95498	5.27E-02
			15	15	0.00875	-2.6E-01	7.7E-01	-3.0E+45	2.000	7.8E+00	2.3E+03	3.0E+45	0.000	7.2E+01	1	-7.2E+01	-1	1.4E+00	0.9472	-1.4E+00	-0.94719	5.14E-02
			16	16	0.00875	-2.7E-01	7.6E-01	-3.0E+45	2.000	8.3E+00	3.9E+03	3.0E+45	0.000	7.0E+01	1	-7.0E+01	-1	1.3E+00	0.9392	-1.3E+00	-0.93921	5.01E-02
			17	17	0.00875	-2.9E-01	7.5E-01	-3.0E+45	2.000	8.8E+00	6.6E+03	3.0E+45	0.000	6.8E+01	1	-6.8E+01	-1	1.3E+00	0.9311	-1.3E+00	-0.93109	4.88E-02
			18	18	0.00875	-3.1E-01	7.4E-01	-3.0E+45	2.000	9.3E+00	1.1E+04	3.0E+45	0.000	6.6E+01	1	-6.6E+01	-1	1.3E+00	0.9229	-1.3E+00	-0.9229	4.76E-02
			19	19	0.00875	-3.2E-01	7.2E-01	-3.0E+45	2.000	9.8E+00	1.8E+04	3.0E+45	0.000	6.4E+01	1	-6.4E+01	-1	1.2E+00	0.9147	-1.2E+00	-0.91468	4.63E-02
			20	20	0.00875	-3.4E-01	7.1E-01	-3.0E+45	2.000	1.0E+01	3.1E+04	3.0E+45	0.000	6.3E+01	1	-6.3E+01	-1	1.2E+00	0.9065	-1.2E+00	-0.90647	4.52E-02

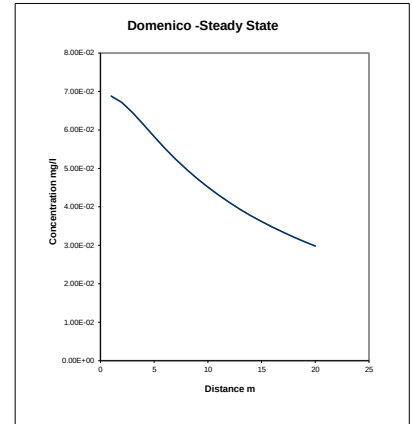
Date: 24/02/2020

Version: 1

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Version: 1

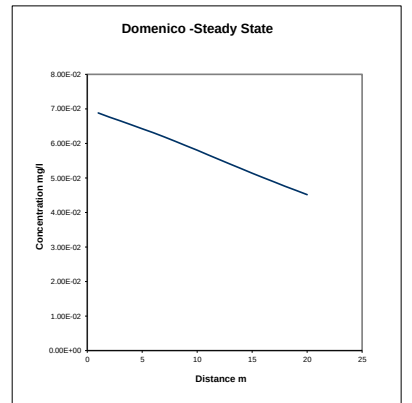


DOMENICO (STEADY STATE)																
Contaminant	Benzo(a)pyrene		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)													
Input	Value	Units		X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
C _T	0.00000017	mg/l	1	1	0.0175	-1.70E-02	9.83E-01	2.80E+02	1	-2.80E+02	-1	2.65E+00	1	-2.65E+00	-0.9998	6.88E-02
			2	2	0.0175	-3.40E-02	9.67E-01	1.98E+02	1	-1.98E+02	-1	1.88E+00	0.992	-1.88E+00	-0.992	6.71E-02
			3	3	0.0175	-5.10E-02	9.50E-01	1.61E+02	1	-1.61E+02	-1	1.53E+00	0.97	-1.53E+00	-0.9696	6.45E-02
Co	7.00E-02	mg/l	4	4	0.0175	-6.80E-02	9.34E-01	1.40E+02	1	-1.40E+02	-1	1.33E+00	0.939	-1.33E+00	-0.9392	6.14E-02
λ	1.10E-10	days ⁻¹	5	5	0.0175	-8.50E-02	9.18E-01	1.25E+02	1	-1.25E+02	-1	1.19E+00	0.906	-1.19E+00	-0.9065	5.83E-02
Sz	5.00E+02	m	6	6	0.0175	-1.02E-01	9.03E-01	1.14E+02	1	-1.14E+02	-1	1.08E+00	0.874	-1.08E+00	-0.8742	5.53E-02
Sy	1.50E+00	m	7	7	0.0175	-1.19E-01	8.88E-01	1.06E+02	1	-1.06E+02	-1	1.00E+00	0.844	-1.00E+00	-0.8436	5.24E-02
Kd	1.02E+04	l/kg	8	8	0.0175	-1.36E-01	8.73E-01	9.88E+01	1	-9.88E+01	-1	9.38E-01	0.815	-9.38E-01	-0.8151	4.98E-02
ρ	1.36E+00	g/cm3	9	9	0.0175	-1.53E-01	8.58E-01	9.32E+01	1	-9.32E+01	-1	8.84E-01	0.789	-8.84E-01	-0.7887	4.74E-02
n	8.00E-02		10	10	0.0175	-1.70E-01	8.44E-01	8.84E+01	1	-8.84E+01	-1	8.39E-01	0.764	-8.39E-01	-0.7643	4.51E-02
i	1.00E-02		11	11	0.0175	-1.87E-01	8.29E-01	8.43E+01	1	-8.43E+01	-1	8.00E-01	0.742	-8.00E-01	-0.7418	4.31E-02
K	8.64E-03	m/d	12	12	0.0175	-2.04E-01	8.15E-01	8.07E+01	1	-8.07E+01	-1	7.65E-01	0.721	-7.65E-01	-0.721	4.12E-02
x	2.00E+01	m	13	13	0.0175	-2.21E-01	8.02E-01	7.75E+01	1	-7.75E+01	-1	7.35E-01	0.702	-7.35E-01	-0.7017	3.94E-02
z	0.00E+00	m	14	14	0.0175	-2.38E-01	7.88E-01	7.47E+01	1	-7.47E+01	-1	7.09E-01	0.684	-7.09E-01	-0.6838	3.77E-02
y	0.00E+00	m	15	15	0.0175	-2.55E-01	7.75E-01	7.22E+01	1	-7.22E+01	-1	6.85E-01	0.667	-6.85E-01	-0.6671	3.62E-02
			16	16	0.0175	-2.72E-01	7.62E-01	6.99E+01	1	-6.99E+01	-1	6.63E-01	0.651	-6.63E-01	-0.6515	3.47E-02
ax	2.00E+00	m	17	17	0.0175	-2.89E-01	7.49E-01	6.78E+01	1	-6.78E+01	-1	6.43E-01	0.637	-6.43E-01	-0.6369	3.34E-02
az	2.00E-01	m	18	18	0.0175	-3.06E-01	7.36E-01	6.59E+01	1	-6.59E+01	-1	6.25E-01	0.623	-6.25E-01	-0.6232	3.21E-02
ay	2.00E-02	m	19	19	0.0175	-3.23E-01	7.24E-01	6.41E+01	1	-6.41E+01	-1	6.08E-01	0.61	-6.08E-01	-0.6104	3.09E-02
			20	20	0.0175	-3.40E-01	7.12E-01	6.25E+01	1	-6.25E+01	-1	5.93E-01	0.598	-5.93E-01	-0.5983	2.98E-02



Vertical dispersion optio Simulate vertical dispersion in 1 direction

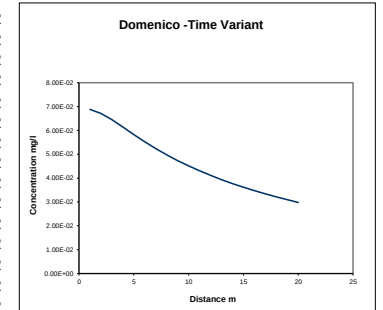
Calc	Value	DOMENICO (STEADY STATE)														
		Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT														
v	1.08E-03	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration	
Rc	1.73E+05															
u	6.24E-09	m/d	1	1	0.0175	-1.70E-02	9.83E-01	2.80E+02	1	-2.80E+02	-1	5.30E+00	1	-5.30E+00	-1	6.88E-02
			2	2	0.0175 <th>-3.40E-02</th> <th>9.67E-01</th> <th>1.98E+02</th> <td>1</td> <td>-1.98E+02</td> <td>-1</td> <th>3.75E+00</th> <td>1</td> <td>-3.75E+00</td> <td>-1</td> <th>6.77E-02</th>	-3.40E-02	9.67E-01	1.98E+02	1	-1.98E+02	-1	3.75E+00	1	-3.75E+00	-1	6.77E-02
			3	3	0.0175 <th>-5.10E-02</th> <th>9.50E-01</th> <th>1.61E+02</th> <td>1</td> <td>-1.61E+02</td> <td>-1</td> <th>3.06E+00</th> <td>1</td> <td>-3.06E+00</td> <td>-1</td> <th>6.65E-02</th>	-5.10E-02	9.50E-01	1.61E+02	1	-1.61E+02	-1	3.06E+00	1	-3.06E+00	-1	6.65E-02
			4	4	0.0175 <th>-6.80E-02</th> <th>9.34E-01</th> <th>1.40E+02</th> <td>1</td> <td>-1.40E+02</td> <td>-1</td> <th>2.65E+00</th> <td>1</td> <td>-2.65E+00</td> <td>-0.9998</td> <th>6.54E-02</th>	-6.80E-02	9.34E-01	1.40E+02	1	-1.40E+02	-1	2.65E+00	1	-2.65E+00	-0.9998	6.54E-02
			5	5	0.0175 <th>-8.50E-02</th> <th>9.18E-01</th> <th>1.25E+02</th> <td>1</td> <td>-1.25E+02</td> <td>-1</td> <th>2.37E+00</th> <td>0.999</td> <td>-2.37E+00</td> <td>-0.9992</td> <th>6.42E-02</th>	-8.50E-02	9.18E-01	1.25E+02	1	-1.25E+02	-1	2.37E+00	0.999	-2.37E+00	-0.9992	6.42E-02
			6	6	0.0175 <th>-1.02E-01</th> <th>9.03E-01</th> <th>1.14E+02</th> <td>1</td> <td>-1.14E+02</td> <td>-1</td> <th>2.17E+00</th> <td>0.998</td> <td>-2.17E+00</td> <td>-0.9978</td> <th>6.31E-02</th>	-1.02E-01	9.03E-01	1.14E+02	1	-1.14E+02	-1	2.17E+00	0.998	-2.17E+00	-0.9978	6.31E-02
			7	7	0.0175 <th>-1.19E-01</th> <th>8.88E-01</th> <th>1.06E+02</th> <td>1</td> <td>-1.06E+02</td> <td>-1</td> <th>2.00E+00</th> <td>0.995</td> <td>-2.00E+00</td> <td>-0.9954</td> <th>6.19E-02</th>	-1.19E-01	8.88E-01	1.06E+02	1	-1.06E+02	-1	2.00E+00	0.995	-2.00E+00	-0.9954	6.19E-02
			8	8	0.0175 <th>-1.36E-01</th> <th>8.73E-01</th> <th>9.88E+01</th> <td>1</td> <td>-9.88E+01</td> <td>-1</td> <th>1.88E+00</th> <td>0.992</td> <td>-1.88E+00</td> <td>-0.992</td> <th>6.06E-02</th>	-1.36E-01	8.73E-01	9.88E+01	1	-9.88E+01	-1	1.88E+00	0.992	-1.88E+00	-0.992	6.06E-02
			9	9	0.0175 <th>-1.53E-01</th> <th>8.58E-01</th> <th>9.32E+01</th> <td>1</td> <td>-9.32E+01</td> <td>-1</td> <th>1.77E+00</th> <td>0.988</td> <td>-1.77E+00</td> <td>-0.9876</td> <th>5.93E-02</th>	-1.53E-01	8.58E-01	9.32E+01	1	-9.32E+01	-1	1.77E+00	0.988	-1.77E+00	-0.9876	5.93E-02
			10	10	0.0175 <th>-1.70E-01</th> <th>8.44E-01</th> <th>8.84E+01</th> <td>1</td> <td>-8.84E+01</td> <td>-1</td> <th>1.68E+00</th> <td>0.982</td> <td>-1.68E+00</td> <td>-0.9823</td> <th>5.80E-02</th>	-1.70E-01	8.44E-01	8.84E+01	1	-8.84E+01	-1	1.68E+00	0.982	-1.68E+00	-0.9823	5.80E-02
			11	11	0.0175 <th>-1.87E-01</th> <th>8.29E-01</th> <th>8.43E+01</th> <td>1</td> <td>-8.43E+01</td> <td>-1</td> <th>1.60E+00</th> <td>0.976</td> <td>-1.60E+00</td> <td>-0.9763</td> <th>5.67E-02</th>	-1.87E-01	8.29E-01	8.43E+01	1	-8.43E+01	-1	1.60E+00	0.976	-1.60E+00	-0.9763	5.67E-02
			12	12	0.0175 <th>-2.04E-01</th> <th>8.15E-01</th> <th>8.07E+01</th> <td>1</td> <td>-8.07E+01</td> <td>-1</td> <th>1.53E+00</th> <td>0.97</td> <td>-1.53E+00</td> <td>-0.9696</td> <th>5.53E-02</th>	-2.04E-01	8.15E-01	8.07E+01	1	-8.07E+01	-1	1.53E+00	0.97	-1.53E+00	-0.9696	5.53E-02
			13	13	0.0175 <th>-2.21E-01</th> <th>8.02E-01</th> <th>7.75E+01</th> <td>1</td> <td>-7.75E+01</td> <td>-1</td> <th>1.47E+00</th> <td>0.962</td> <td>-1.47E+00</td> <td>-0.9625</td> <th>5.40E-02</th>	-2.21E-01	8.02E-01	7.75E+01	1	-7.75E+01	-1	1.47E+00	0.962	-1.47E+00	-0.9625	5.40E-02
			14	14	0.0175 <th>-2.38E-01</th> <th>7.88E-01</th> <th>7.47E+01</th> <td>1</td> <td>-7.47E+01</td> <td>-1</td> <th>1.42E+00</th> <td>0.955</td> <td>-1.42E+00</td> <td>-0.955</td> <th>5.27E-02</th>	-2.38E-01	7.88E-01	7.47E+01	1	-7.47E+01	-1	1.42E+00	0.955	-1.42E+00	-0.955	5.27E-02
			15	15	0.0175 <th>-2.55E-01</th> <th>7.75E-01</th> <th>7.22E+01</th> <td>1</td> <td>-7.22E+01</td> <td>-1</td> <th>1.37E+00</th> <td>0.947</td> <td>-1.37E+00</td> <td>-0.9472</td> <th>5.14E-02</th>	-2.55E-01	7.75E-01	7.22E+01	1	-7.22E+01	-1	1.37E+00	0.947	-1.37E+00	-0.9472	5.14E-02
			16	16	0.0175 <th>-2.72E-01</th> <th>7.62E-01</th> <th>6.99E+01</th> <td>1</td> <td>-6.99E+01</td> <td>-1</td> <th>1.33E+00</th> <td>0.939</td> <td>-1.33E+00</td> <td>-0.9392</td> <th>5.01E-02</th>	-2.72E-01	7.62E-01	6.99E+01	1	-6.99E+01	-1	1.33E+00	0.939	-1.33E+00	-0.9392	5.01E-02
			17	17	0.0175 <th>-2.89E-01</th> <th>7.49E-01</th> <th>6.78E+01</th> <td>1</td> <td>-6.78E+01</td> <td>-1</td> <th>1.29E+00</th> <td>0.931</td> <td>-1.29E+00</td> <td>-0.9311</td> <th>4.88E-02</th>	-2.89E-01	7.49E-01	6.78E+01	1	-6.78E+01	-1	1.29E+00	0.931	-1.29E+00	-0.9311	4.88E-02
			18	18	0.0175 <th>-3.06E-01</th> <th>7.36E-01</th> <th>6.59E+01</th> <td>1</td> <td>-6.59E+01</td> <td>-1</td> <th>1.25E+00</th> <td>0.923</td> <td>-1.25E+00</td> <td>-0.9229</td> <th>4.76E-02</th>	-3.06E-01	7.36E-01	6.59E+01	1	-6.59E+01	-1	1.25E+00	0.923	-1.25E+00	-0.9229	4.76E-02
			19	19	0.0175 <th>-3.23E-01</th> <th>7.24E-01</th> <th>6.41E+01</th> <td>1</td> <td>-6.41E+01</td> <td>-1</td> <th>1.22E+00</th> <td>0.915</td> <td>-1.22E+00</td> <td>-0.9147</td> <th>4.63E-02</th>	-3.23E-01	7.24E-01	6.41E+01	1	-6.41E+01	-1	1.22E+00	0.915	-1.22E+00	-0.9147	4.63E-02
			20	20	0.0175 <th>-3.40E-01</th> <th>7.12E-01</th> <th>6.25E+01</th> <td>1</td> <td>-6.25E+01</td> <td>-1</td> <th>1.19E+00</th> <td>0.906</td> <td>-1.19E+00</td> <td>-0.9065</td> <th>4.52E-02</th>	-3.40E-01	7.12E-01	6.25E+01	1	-6.25E+01	-1	1.19E+00	0.906	-1.19E+00	-0.9065	4.52E-02
24/02/2020																
n:	1															



Date: 24/02/2020
Version: 1

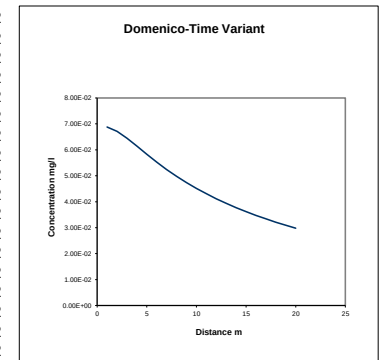
DOMENICO (TIME VARIANT)

Contaminant	benzo(a)pyrene		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)															
Input	Value	Units	X		Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
C _T	0.00000017	mg/l	1	1	0.00875	-1.70E-02	9.83E-01	-2.98E+45	2	2.80E+02	1	-2.80E+02	-1	2.65E+00	0.9998	-2.65E+00	-1	6.88E-02
			2	2	0.00875	-3.40E-02	9.67E-01	-2.98E+45	2	1.98E+02	1	-1.98E+02	-1	1.88E+00	0.992	-1.88E+00	-0.992	6.71E-02
			3	3	0.00875	-5.10E-02	9.50E-01	-2.98E+45	2	1.61E+02	1	-1.61E+02	-1	1.53E+00	0.9696	-1.53E+00	-0.97	6.45E-02
Co	7.00E-02	mg/l	4	4	0.00875	-6.80E-02	9.34E-01	-2.98E+45	2	1.40E+02	1	-1.40E+02	-1	1.33E+00	0.9392	-1.33E+00	-0.939	6.14E-02
λ	1.10E-10	days ⁻¹	5	5	0.00875	-8.50E-02	9.18E-01	-2.98E+45	2	1.25E+02	1	-1.25E+02	-1	1.19E+00	0.9065	-1.19E+00	-0.906	5.83E-02
Sz	5.00E+02	m	6	6	0.00875	-1.02E-01	9.03E-01	-2.98E+45	2	1.14E+02	1	-1.14E+02	-1	1.08E+00	0.8742	-1.08E+00	-0.874	5.53E-02
Sy	1.50E+00	m	7	7	0.00875	-1.19E-01	8.88E-01	-2.98E+45	2	1.06E+02	1	-1.06E+02	-1	1.00E+00	0.8436	-1.00E+00	-0.844	5.24E-02
Kd	1.02E+04	l/kg	8	8	0.00875	-1.36E-01	8.73E-01	-2.98E+45	2	9.88E+01	1	-9.88E+01	-1	9.38E-01	0.8151	-9.38E-01	-0.815	4.98E-02
ρ	1.36E+00	g/cm3	9	9	0.00875	-1.53E-01	8.58E-01	-2.98E+45	2	9.32E+01	1	-9.32E+01	-1	8.84E-01	0.7887	-8.84E-01	-0.789	4.74E-02
n	8.00E-02		10	10	0.00875	-1.70E-01	8.44E-01	-2.98E+45	2	8.84E+01	1	-8.84E+01	-1	8.39E-01	0.7643	-8.39E-01	-0.764	4.51E-02
i	1.00E-02		11	11	0.00875	-1.87E-01	8.29E-01	-2.98E+45	2	8.43E+01	1	-8.43E+01	-1	8.00E-01	0.7418	-8.00E-01	-0.742	4.31E-02
K	8.64E-03	m/d	12	12	0.00875	-2.04E-01	8.15E-01	-2.98E+45	2	8.07E+01	1	-8.07E+01	-1	7.65E-01	0.721	-7.65E-01	-0.721	4.12E-02
x	2.00E+01	m	13	13	0.00875	-2.21E-01	8.02E-01	-2.98E+45	2	7.75E+01	1	-7.75E+01	-1	7.35E-01	0.7017	-7.35E-01	-0.702	3.94E-02
z	0.00E+00	m	14	14	0.00875	-2.38E-01	7.88E-01	-2.98E+45	2	7.47E+01	1	-7.47E+01	-1	7.09E-01	0.6838	-7.09E-01	-0.684	3.77E-02
y	0.00E+00	m	15	15	0.00875	-2.55E-01	7.75E-01	-2.98E+45	2	7.22E+01	1	-7.22E+01	-1	6.85E-01	0.6671	-6.85E-01	-0.667	3.62E-02
t	1.00E+100	days	16	16	0.00875	-2.72E-01	7.62E-01	-2.98E+45	2	6.99E+01	1	-6.99E+01	-1	6.63E-01	0.6515	-6.63E-01	-0.651	3.47E-02
ax	2.00E+00	m	17	17	0.00875	-2.89E-01	7.49E-01	-2.98E+45	2	6.78E+01	1	-6.78E+01	-1	6.43E-01	0.6369	-6.43E-01	-0.637	3.34E-02
az	2.00E-01	m	18	18	0.00875	-3.06E-01	7.36E-01	-2.98E+45	2	6.59E+01	1	-6.59E+01	-1	6.25E-01	0.6232	-6.25E-01	-0.623	3.21E-02
ay	2.00E-02	m	19	19	0.00875	-3.23E-01	7.24E-01	-2.98E+45	2	6.41E+01	1	-6.41E+01	-1	6.08E-01	0.6104	-6.08E-01	-0.61	3.09E-02
			20	20	0.00875	-3.40E-01	7.12E-01	-2.98E+45	2	6.25E+01	1	-6.25E+01	-1	5.93E-01	0.5983	-5.93E-01	-0.598	2.98E-02



Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc	Value	Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT																
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration	
v	1.08E-03	m/d																
Rc	1.73E+05		1	1	0.00875	-1.70E-02	9.83E-01	-2.98E+45	2	2.80E+02	1	-2.80E+02	-1	5.30E+00	1	-5.30E+00	-1	6.88E-02
u	6.24E-09	m/d	2	2	0.00875	-3.40E-02	9.67E-01	-2.98E+45	2	1.98E+02	1	-1.98E+02	-1	3.75E+00	1	-3.75E+00	-1	6.77E-02
			3	3	0.00875	-5.10E-02	9.50E-01	-2.98E+45	2	1.61E+02	1	-1.61E+02	-1	3.06E+00	1	-3.06E+00	-1	6.65E-02
			4	4	0.00875	-6.80E-02	9.34E-01	-2.98E+45	2	1.40E+02	1	-1.40E+02	-1	2.65E+00	0.9998	-2.65E+00	-1	6.54E-02
			5	5	0.00875	-8.50E-02	9.18E-01	-2.98E+45	2	1.25E+02	1	-1.25E+02	-1	2.37E+00	0.9992	-2.37E+00	-0.999	6.42E-02
			6	6	0.00875	-1.02E-01	9.03E-01	-2.98E+45	2	1.14E+02	1	-1.14E+02	-1	2.17E+00	0.9978	-2.17E+00	-0.998	6.31E-02
			7	7	0.00875	-1.19E-01	8.88E-01	-2.98E+45	2	1.06E+02	1	-1.06E+02	-1	2.00E+00	0.9954	-2.00E+00	-0.995	6.19E-02
			8	8	0.00875	-1.36E-01	8.73E-01	-2.98E+45	2	9.88E+01	1	-9.88E+01	-1	1.88E+00	0.992	-1.88E+00	-0.992	6.06E-02
			9	9	0.00875	-1.53E-01	8.58E-01	-2.98E+45	2	9.32E+01	1	-9.32E+01	-1	1.77E+00	0.9876	-1.77E+00	-0.988	5.93E-02
			10	10	0.00875	-1.70E-01	8.44E-01	-2.98E+45	2	8.84E+01	1	-8.84E+01	-1	1.68E+00	0.9823	-1.68E+00	-0.982	5.80E-02
			11	11	0.00875	-1.87E-01	8.29E-01	-2.98E+45	2	8.43E+01	1	-8.43E+01	-1	1.60E+00	0.9763	-1.60E+00	-0.976	5.67E-02
			12	12	0.00875	-2.04E-01	8.15E-01	-2.98E+45	2	8.07E+01	1	-8.07E+01	-1	1.53E+00	0.9696	-1.53E+00	-0.97	5.53E-02
			13	13	0.00875	-2.21E-01	8.02E-01	-2.98E+45	2	7.75E+01	1	-7.75E+01	-1	1.47E+00	0.9625	-1.47E+00	-0.962	5.40E-02
			14	14	0.00875	-2.38E-01	7.88E-01	-2.98E+45	2	7.47E+01	1	-7.47E+01	-1	1.42E+00	0.955	-1.42E+00	-0.955	5.27E-02
			15	15	0.00875	-2.55E-01	7.75E-01	-2.98E+45	2	7.22E+01	1	-7.22E+01	-1	1.37E+00	0.9472	-1.37E+00	-0.947	5.14E-02
			16	16	0.00875	-2.72E-01	7.62E-01	-2.98E+45	2	6.99E+01	1	-6.99E+01	-1	1.33E+00	0.9392	-1.33E+00	-0.939	5.01E-02
			17	17	0.00875	-2.89E-01	7.49E-01	-2.98E+45	2	6.78E+01	1	-6.78E+01	-1	1.29E+00	0.9311	-1.29E+00	-0.931	4.88E-02
			18	18	0.00875	-3.06E-01	7.36E-01	-2.98E+45	2	6.59E+01	1	-6.59E+01	-1	1.25E+00	0.9229	-1.25E+00	-0.923	4.76E-02
			19	19	0.00875	-3.23E-01	7.24E-01	-2.98E+45	2	6.41E+01	1	-6.41E+01	-1	1.22E+00	0.9147	-1.22E+00	-0.915	4.63E-02
			20	20	0.00875	-3.40E-01	7.12E-01	-2.98E+45	2	6.25E+01	1	-6.25E+01	-1	1.19E+00	0.9065	-1.19E+00	-0.906	4.52E-02
Date:	24/02/2020																	
Version:	1																	



Date: 24/02/2020
Version: 1



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions)

Details to be completed for each assessment

Site Name:	Glan Llyn		
Site Address:	Llanwern		
Completed by:	Ross Cameron	Version:	1
Date:	24-Feb-20		
Contaminant	Benzo(b)fluoranthene		
Target Concentration (C _T)	0.0000017	mg/l	Origin of C _T : Proposed Water Framework Directive EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.



Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions).

Details to be completed for each assessment			
Site Name:	Glan Llyn		
Site Address:	Llanwern		
Completed by:	Ross Cameron		
Date:	20-Feb-20	Version:	1
Contaminant	Iron		
Target Concentration (C_T)	1	mg/l	Origin of C_T: Water Framework Directive EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

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It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant
Target concentration

C_T

Iron
1 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

0.5

Air filled soil porosity

θ_a

3.70E-01

fraction

0.0037

Bulk density of soil zone material

ρ

1.36E+00

g/cm³

1.36

Henry's Law constant

H

1.00E+00

dimensionless

1

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

1.34E+02

l/kg

1.34E+02

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

fraction

Organic carbon partition coefficient

K_{oc}

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.34E+02

l/kg

Specified value

Level 1 Remedial Target

Level 1 Remedial Target

1.35E+02

mg/kg

(for comparison with soil analyses)

or

1

mg/l

(for comparison with leachate test results)

Site being assessed: Glan Llyn
Completed by: Ross Cameron
Date: 20-Feb-20
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Iron
1 mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	0.00E+00	m/d	
Area of contaminant source	A	0.00E+00	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	0.00E+00	m	
Saturated aquifer thickness	da	0.00E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	0.00E+00	m/d	
Hydraulic gradient of water table	i	0.00E+00	fraction	
Width of contaminant source perpendicular to groundwater flow	w	0.00E+00	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	0.00E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	#DIV/0!	
Level 2 Remedial Target		#DIV/0! or #DIV/0!	mg/l mg/kg
For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration			
For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water			

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		#DIV/0!	mg/l	0

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	20-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant	Iron			from Level 1
Target Concentration	C _T	1	mg/l	from Level 1
Dilution Factor	DF	#DIV/0!		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks	Equations in HRA publication
-------------	------------------------------

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to pollutants in all phases (e.g. field derived value, then on pull-down menu)

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+100	days	
Calculated decay rate	6.93E-101	days ⁻¹	calculated
Width of plume in aquifer at source	0.00E+00	m	from Level 2
Plume thickness in aquifer at source	0.00E+00	m	from Level 2
Bulk density of aquifer materials	0.00E+00	g/cm ³	
Effective porosity of aquifer	0.00E+00	fraction	
Hydraulic gradient	#DIV/0!	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	0.00E+00	m/d	from Level 2
Distance to compliance point	0.00E+00	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	0.00E+00	l/kg	see options
Longitudinal dispersivity	0.000	m	see options
Transverse dispersivity	0.000	m	see options
Vertical dispersivity	0.000	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	#DIV/0!	m/d
Retardation factor	#DIV/0!	fraction
Decay rate used	6.93E-101	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	#DIV/0!	fraction
Rate of contaminant flow due to retardation	#DIV/0!	m/d
Ratio of Compliance Point to Source Concentration	#DIV/0!	fraction
Attenuation factor (C _p /C ₀)	#DIV/0!	fraction
Calculated soil leachate concentration	0.00E+00	mg/l

Remedial Targets

Level 3 Remedial Target	#DIV/0!	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	0	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _p /C ₀	#DIV/0!	fraction

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)

Soil water partition coefficient K_d l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} fractionOrganic carbon partition coefficient K_{oc} l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n} l/kgSorption coefficient for ionised species K_{oc,i} l/kg

pH value pH

Acid dissociation constant pK_a 0.00E+00Fraction of organic carbon in aquifer f_{oc} 0.00E+00 fractionSoil water partition coefficient K_d 0.00E+00 l/kg

Define dispersivity (click brown cell and use pull down list)

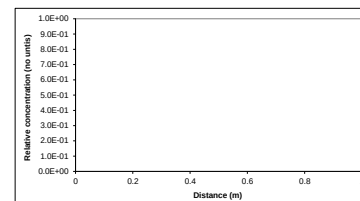
User defined values for dispersivity

		Enter value	Calc value	Xu & Eckstein
Longitudinal dispersivity	ax	0.00E+00	0.00E+00	#NUM!
Transverse dispersivity	az	0.00E+00	0.00E+00	#NUM!
Vertical dispersivity	av	0.00E+00	0.00E+00	#NUM!

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀y)^{-0.44}; az = ax/10, ay = ax/100 are assumed

Note
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used



Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks	From calculation sheet	Relative concentration	Concentration
Distance	0	(No units)	mg/l
	0.0	1.0E+00	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!
	0.0	#DIV/0!	#DIV/0!

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99.

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#####
Version:	1

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Variable	Value	Unit	Source
Contaminant	Iron		from Level 1
Target Concentration	1.00E+00	mg/l	from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	2.95E+03	mg/l	
Half life for degradation of contaminant in water	t _{1/2}	9.00E+99	days	
Calculated decay rate	λ	7.70E-101	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+02	m	
Plume thickness at source	Sy	1.50E+00	m	
Saturated aquifer thickness	da	2.00E+00	m	
Bulk density of aquifer materials	ρ	1.38E+00	g/cm ³	
Effective porosity of aquifer	n	8.00E-02	fraction	
Hydraulic gradient	i	1.00E-02	fraction	
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	
Distance to compliance point	x	2.00E+01	m	
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	8.10E+02	l/kg	see options
Longitudinal dispersivity	ax	1.57E+00	m	see options
Transverse dispersivity	az	1.57E-01	m	see options
Vertical dispersivity	ay	1.57E-02	m	see options

Calculated Parameters Variable

Groundwater flow velocity	v	1.08E-03	m/d
Retardation factor	Rf	1.38E+04	fraction
Decay rate used	λ	5.59E-105	d ⁻¹
Rate of contaminant flow due to retardation	u	7.84E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	2.78E+03	mg/l
Attenuation factor (one way vertical dispersion, COICED)	AF	1.06E+00	

Remedial Targets

Remedial Target	1.06E+00	mg/l	For comparison with measured groundwater concentration.
Domenico - Steady state			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point	C _{ED} /C ₀	2.78E+03	mg/l Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	8.10E+02	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	K _{oc,n}		l/kg
Sorption coefficient for ionised species	K _{oc,i}		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	8.10E+02	l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivity based on Xu & Eckstein (1995)

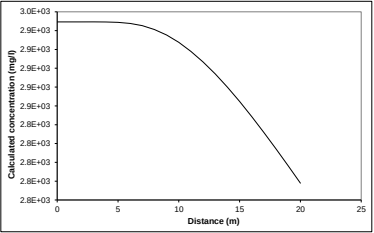
		Enter value	Calc value Xu & Eckstein	m
Longitudinal dispersivity	ax	0.00E+00	2.00E+00	1.57E+00
Transverse dispersivity	az	0.00E+00	2.00E-01	1.57E-01
Vertical dispersivity	ay	0.00E+00	2.00E-02	1.57E-02

Note values of dispersivity must be > 0

For calculated value, assumes $\alpha_x = 0.1^* \times$, $\alpha_z = 0.01^* \times$, $\alpha_y = 0.001^* \times$

Xu & Eckstein (1995) report $\alpha_x = 0.83(\log_{10} \alpha_x)^{4.14}$; $\alpha_z = \alpha_{10}$, $\alpha_y = \alpha_{100}$ are assumed

Note values of dispersivity must be > 0
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{2.414}, az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#####
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Steady state
From calculation sheet

Distance	Concentration
	mg/l
0	2.95E+03
1.0	2.95E+03
2.0	2.95E+03
3.0	2.95E+03
4.0	2.95E+03
5.0	2.95E+03
6.0	2.95E+03
7.0	2.95E+03
8.0	2.94E+03
9.0	2.94E+03
10.0	2.93E+03
11.0	2.92E+03
12.0	2.91E+03
13.0	2.89E+03
14.0	2.88E+03
15.0	2.86E+03
16.0	2.85E+03
17.0	2.83E+03
18.0	2.81E+03
19.0	2.80E+03
20.0	2.78E+03

Porosity Calculator

These results are not carried through to any of the other worksheets

DRY BULK DENSITY DATA

Variable	Value	Unit	justification
Natural Moisture Content	0.00	% wt	(Change this number only if you have specific information)
Particle Density	2.78	tonnes/m ³	
Dry Bulk Density	0.00	tonnes/m ³	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
Initial Saturation	#DIV/0!	%	
Total porosity	1.000	fraction	
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

WET BULK DENSITY DATA

	Variable	Value	Unit	
	Moisture Content	0.00	% wt	(Change this number only if you have specific information)
	Particle Density	2.78	tonnes/m ³	
Actual (wet) Bulk Density (i.e. at natural MC)		0.00	tonnes/m ³	
Calculated Parameters				
	Voids Ratio	#DIV/0!	fraction	
	dry bulk density	0.00	tonnes/m ³	
	Initial Saturation	#DIV/0!	%	
Total porosity				#DIV/0!
Air Filled Porosity				#DIV/0!
Water Filled Porosity				#DIV/0!

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol	unit	justification
Hydraulic conductivity	K	0.00E+00 m/d	
Hydraulic gradient	i	0.00E+00 unitless	
Effective porosity of aquifer	n	0.00E+00 fraction	
Thickness of saturated aquifer	b	0.00E+00 m	
Width of aquifer perpendicular to flow	w	0.00E+00 m	
Distance to receptor	x	0.00E+00 m	
Bulk density of aquifer materials	ρ	0.00E+00 g/cm ³	
Soil-water partition co-efficient	Kd	0.00E+00 l/kg	
Retardation factor of pollutant	R	#DIV/0!	

Groundwater flow velocity	v(GW)	#DIV/0! m/s	#DIV/0! m/day	#DIV/0! m/year
Time for groundwater to reach receptor	t(GW)	#DIV/0! seconds	#DIV/0! days	#DIV/0! years
Rate of groundwater flow through aquifer	Q	0.00E+00 m ³ /s	0.00E+00 m ³ /day	0.00E+00 m ³ /year
Contaminant flow velocity	v(contam)	#DIV/0! m/s	#DIV/0! m/day	#DIV/0! m/year
Time for contaminant to reach receptor	t(contam)	#DIV/0! seconds	#DIV/0! days	#DIV/0! years

Level 1 Calculation Sheet

Contaminant		Iron																				
Parameter	Value	Units	Calculations (Refer toTable 4.3, R&D Publication 20)																			
(carried over from input sheet)			Selected option		User specified value for partition coefficient																	
			calc	calc	Calc Kd	l/kg																
C _T	1.00E+00	mg/l	Calculation of partition coefficient																			
Kd	1.34E+02	l/kg	for ionic organic chemical																			
foc		fraction																				
koc		l/kg	Partition coefficient used in Level 1 Assessment																			
θ _w	5.00E-01	fraction	1.34E+02 l/kg																			
θ _a	3.70E-01	fraction																				
ρ	1.36E+00	g/cm3																				
H	1.00E+00	dimensionless																				
Koc,n		l/kg																				
Koc,i		l/kg																				
pH		pH units																				
pKa																						
foc (ionic)		fraction																				
			<table><tr><td>Calculated Remedial Target</td><td>1.35E+02 mg/kg</td><td>for Iron</td></tr></table>				Calculated Remedial Target	1.35E+02 mg/kg	for Iron													
Calculated Remedial Target	1.35E+02 mg/kg	for Iron																				
			<table><tr><td>Factor (partitioning between soil and water)</td><td colspan="3">1.35E+02</td></tr></table>				Factor (partitioning between soil and water)	1.35E+02														
Factor (partitioning between soil and water)	1.35E+02																					
			<table><tr><td>Site being assessed:</td><td colspan="3">Glan Llyn</td></tr><tr><td>Completed by:</td><td colspan="3">Ross Cameron</td></tr><tr><td>Date:</td><td colspan="3">20/02/2020</td></tr><tr><td>Version:</td><td colspan="3">1</td></tr></table>				Site being assessed:	Glan Llyn			Completed by:	Ross Cameron			Date:	20/02/2020			Version:	1		
Site being assessed:	Glan Llyn																					
Completed by:	Ross Cameron																					
Date:	20/02/2020																					
Version:	1																					

Level 2 Calculation Sheet

Contaminant Iron

Parameter Value Units
(carried over from input sheet)

Mz	0.00E+00	m
L	0.00E+00	m
da	0.00E+00	m
Inf	0.00E+00	m/d
K	0.00E+00	m/d
i	0.00E+00	m3/d
A	0.00E+00	m2
		m3/d
Cc	0.00E+00	mg/l
C _T	1.00E+00	mg/l
Cu	0.00E+00	mg/l
w	0.00E+00	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Site assessed:	Glan Llyn
Date:	20/02/2020
Version:	1

Calculated
Dilution Factor

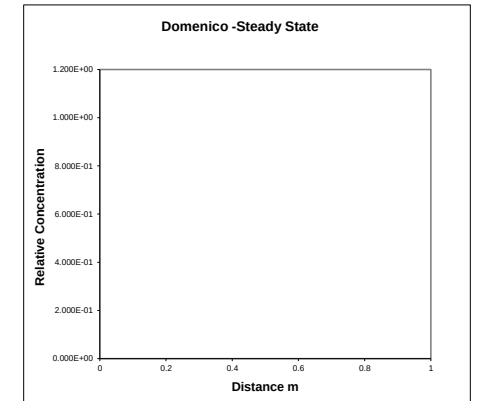
#DIV/0!

#DIV/0!

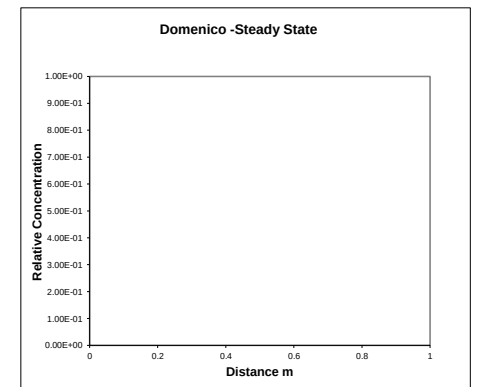


Figure 1 is a line graph titled "Ogata Banks - Time Variant". The Y-axis is labeled "Relative Concentration" and ranges from 0.00E+00 to 1.00E+00 in increments of 0.10E+00. The X-axis is labeled "Distance m" and ranges from 0 to 1 in increments of 0.1. The graph shows a single data series represented by a solid line. The concentration starts at 1.00E+00 at distance 0 and decreases steadily, reaching approximately 0.25E+00 at distance 1.

DOMENICO (STEADY STATE)																
Contaminant			Iron			Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)										
				X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
Input	Value	Units														
C _T	1.000E+00	mg/l	1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
DF	#DIV/0!		2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
λ	6.931E-101	days ⁻¹	5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Sz	0.000E+00	m	6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Sy	0.000E+00	m	7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Kd	0.000E+00	l/kg	8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
ρ	0.000E+00	g/cm3	9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
n	0.000E+00		10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
i	#DIV/0!		11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
K	0.000E+00	m/d	12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
x	0.000E+00	m	13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
z	0.000E+00	m	14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
y	0.000E+00	m	15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
ax	0.000E+00	m	16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
az	0.000E+00	m	17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
ay	0.000E+00	m	18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!



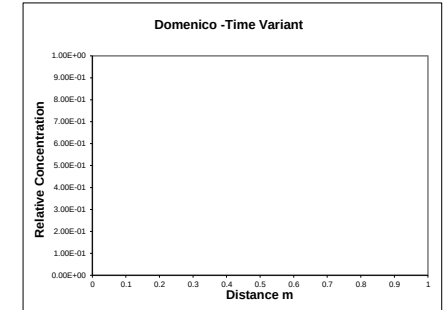
Calc	Value	DOMENICO (STEADY STATE)													
Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT															
v	#DIV/0!	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
Rc	#DIV/0!														
u	#DIV/0!	m/d	1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
n:	20/02/2020		20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
	1														



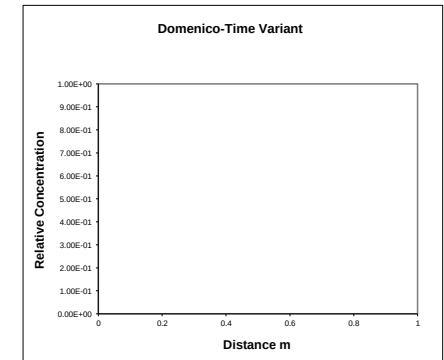
Date: 20/02/2020
Version: 1

DOMENICO (TIME VARIANT)

Contaminant	Iron	Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)																Relative Concentration
Input	Value	Units	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF		
C _T	1	mg/l	1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
DF	#DIV/0!		2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
			3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
			4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
λ	6.931E-101	days ⁻¹	5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
Sz	0.000E+00	m	6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
Sy	0.000E+00	m	7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
Kd	0.000E+00	l/kg	8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
ρ	0.000E+00	g/cm3	9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
n	0.000E+00		10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
i	#DIV/0!		11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
K	0.000E+00	m/d	12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
x	0.000E+00	m	13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
z	0.000E+00	m	14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
y	0.000E+00	m	15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
t	1.000E+99	days	16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
ax	0.000E+00	m	17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
az	0.000E+00	m	18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
ay	0.000E+00	m	19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	
			20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	

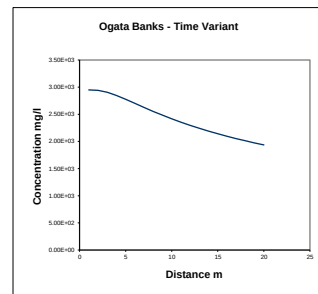


Calc	Value			Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT															
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration		
v	#DIV/0!	m/d	1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
Rc	#DIV/0!		2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
u	#DIV/0!	m/d	3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
			4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
			5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
			6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
			7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
			8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
			9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
			10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
			11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
			12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
			13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
			14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
			15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
			16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
			17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
			18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
e:	20/02/2020		19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		
sion:	1		20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!		



Date: 20/02/2020
Version: 1

Contaminant		OGATA BANKS SOLUTION																				
		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)																				
		Iron	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration	
Input	Value	Units	1																			
Co λ Sz Sy Kd ρ n i K x z 0.00E+00 y t ax az ay	2.95E+03	mg/l	1	1	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	6.4E-01	1.9E+00	1.1E+46	0.000	3.2E+02	1	-3.2E+02	-1	3.0E+00	1	-3.0E+00	-0.99998	2.95E+03
	5.59E-105	days ⁻⁴	2	2	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.3E+00	3.6E+00	1.1E+46	0.000	2.2E+02	1	-2.2E+02	-1	2.1E+00	0.9973	-2.1E+00	-0.99726	2.94E+03
	5.00E+02	m	3	3	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.9E+00	6.8E+00	1.1E+46	0.000	1.8E+02	1	-1.8E+02	-1	1.7E+00	0.9856	-1.7E+00	-0.98557	2.91E+03
	1.50E+00	m	4	4	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	2.6E+00	1.3E+01	1.1E+46	0.000	1.6E+02	1	-1.6E+02	-1	1.5E+00	0.9659	-1.5E+00	-0.96587	2.85E+03
	8.10E+02	l/kg	5	5	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	3.2E+00	2.4E+01	1.1E+46	0.000	1.4E+02	1	-1.4E+02	-1	1.3E+00	0.9419	-1.3E+00	-0.94189	2.78E+03
	1.36E+00	g/cm3	6	6	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	3.8E+00	4.6E+01	1.1E+46	0.000	1.3E+02	1	-1.3E+02	-1	1.2E+00	0.9163	-1.2E+00	-0.91633	2.70E+03
	8.00E-02	m	7	7	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	4.5E+00	8.7E+01	1.1E+46	0.000	1.2E+02	1	-1.2E+02	-1	1.1E+00	0.8907	-1.1E+00	-0.89072	2.63E+03
	1.00E-02	m/d	8	8	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	5.1E+00	1.7E+02	1.1E+46	0.000	1.1E+02	1	-1.1E+02	-1	1.1E+00	0.8659	-1.1E+00	-0.86587	2.55E+03
	8.64E-03	m	9	9	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	5.7E+00	3.1E+02	1.1E+46	0.000	1.1E+02	1	-1.1E+02	-1	1.0E+00	0.8422	-1.0E+00	-0.84215	2.48E+03
	2.00E+01	m	10	10	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	6.4E+00	5.9E+02	1.1E+46	0.000	1.0E+02	1	-1.0E+02	-1	9.5E-01	0.8197	-9.5E-01	-0.81971	2.42E+03
	0.00E+00	m	11	11	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	7.0E+00	1.1E+03	1.1E+46	0.000	9.5E+01	1	-9.5E+01	-1	9.0E-01	0.7986	-9.0E-01	-0.79858	2.36E+03
	0.00E+00	m	12	12	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	7.7E+00	2.1E+03	1.1E+46	0.000	9.1E+01	1	-9.1E+01	-1	8.6E-01	0.7787	-8.6E-01	-0.77872	2.30E+03
	0.00E+00	m	13	13	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	8.3E+00	4.0E+03	1.1E+46	0.000	8.8E+01	1	-8.8E+01	-1	8.3E-01	0.7601	-8.3E-01	-0.76006	2.24E+03
	0.00E+00	m	14	14	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	8.9E+00	7.6E+03	1.1E+46	0.000	8.4E+01	1	-8.4E+01	-1	8.0E-01	0.7425	-8.0E-01	-0.74253	2.19E+03
	0.00E+00	m	15	15	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	9.6E+00	1.4E+04	1.1E+46	0.000	8.2E+01	1	-8.2E+01	-1	7.7E-01	0.726	-7.7E-01	-0.72604	2.14E+03
	1.00E+100	days	16	16	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.0E+01	2.7E+04	1.1E+46	0.000	7.9E+01	1	-7.9E+01	-1	7.5E-01	0.7105	-7.5E-01	-0.71052	2.10E+03
	1.57E+00	m	17	17	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.1E+01	5.2E+04	1.1E+46	0.000	7.7E+01	1	-7.7E+01	-1	7.3E-01	0.6959	-7.3E-01	-0.69588	2.05E+03
	1.57E-01	m	18	18	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.1E+01	9.8E+04	1.1E+46	0.000	7.4E+01	1	-7.4E+01	-1	7.1E-01	0.6821	-7.1E-01	-0.68205	2.01E+03
	1.57E-02	m	19	19	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.2E+01	1.8E+05	1.1E+46	0.000	7.2E+01	1	-7.2E+01	-1	6.9E-01	0.669	-6.9E-01	-0.66897	1.97E+03
			20	20	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.3E+01	3.5E+05	1.1E+46	0.000	7.1E+01	1	-7.1E+01	-1	6.7E-01	0.6566	-6.7E-01	-0.65658	1.94E+03

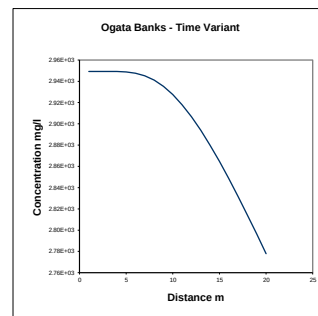


Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc		Value	Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT																			Concentration
v	Rc		X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF		
v Rc u	1.08E-03	m/d	1	1	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	6.4E-01	1.9E+00	1.1E+46	0.000	3.2E+02	1	-3.2E+02	-1	6.0E+00	1	-6.0E+00	-1	2.95E+03
	1.38E+04		2	2	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.3E+00	3.6E+00	1.1E+46	0.000	2.2E+02	1	-2.2E+02	-1	4.2E+00	1	-4.2E+00	-1	2.95E+03
	7.84E-08	m/d	3	3	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.9E+00	6.8E+00	1.1E+46	0.000	1.8E+02	1	-1.8E+02	-1	3.5E+00	1	-3.5E+00	-1	2.95E+03
			4	4	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	2.6E+00	1.3E+01	1.1E+46	0.000	1.6E+02	1	-1.6E+02	-1	3.0E+00	1	-3.0E+00	-0.99998	2.95E+03
			5	5	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	3.2E+00	2.4E+01	1.1E+46	0.000	1.4E+02	1	-1.4E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99985	2.95E+03
			6	6	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	3.8E+00	4.6E+01	1.1E+46	0.000	1.3E+02	1	-1.3E+02	-1	2.4E+00	0.9995	-2.4E+00	-0.99946	2.95E+03
			7	7	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	4.5E+00	8.7E+01	1.1E+46	0.000	1.2E+02	1	-1.2E+02	-1	2.3E+00	0.9986	-2.3E+00	-0.99864	2.95E+03
			8	8	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	5.1E+00	1.7E+02	1.1E+46	0.000	1.1E+02	1	-1.1E+02	-1	2.1E+00	0.9973	-2.1E+00	-0.99726	2.94E+03
			9	9	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	5.7E+00	3.1E+02	1.1E+46	0.000	1.1E+02	1	-1.1E+02	-1	2.0E+00	0.9953	-2.0E+00	-0.99527	2.94E+03
			10	10	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	6.4E+00	5.9E+02	1.1E+46	0.000	1.0E+02	1	-1.0E+02	-1	1.9E+00	0.9926	-1.9E+00	-0.99263	2.93E+03
			11	11	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	7.0E+00	1.1E+03	1.1E+46	0.000	9.5E+01	1	-9.5E+01	-1	1.8E+00	0.9894	-1.8E+00	-0.98938	2.92E+03
			12	12	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	7.7E+00	2.1E+03	1.1E+46	0.000	9.1E+01	1	-9.1E+01	-1	1.7E+00	0.9856	-1.7E+00	-0.98557	2.91E+03
			13	13	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	8.3E+00	4.0E+03	1.1E+46	0.000	8.8E+01	1	-8.8E+01	-1	1.7E+00	0.9812	-1.7E+00	-0.98124	2.89E+03
			14	14	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	8.9E+00	7.6E+03	1.1E+46	0.000	8.4E+01	1	-8.4E+01	-1	1.6E+00	0.9765	-1.6E+00	-0.97647	2.88E+03
			15	15	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	9.6E+00	1.4E+04	1.1E+46	0.000	8.2E+01	1	-8.2E+01	-1	1.5E+00	0.9713	-1.5E+00	-0.97133	2.86E+03
			16	16	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.0E+01	2.7E+04	1.1E+46	0.000	7.9E+01	1	-7.9E+01	-1	1.5E+00	0.9659	-1.5E+00	-0.96587	2.85E+03
			17	17	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.1E+01	5.2E+04	1.1E+46	0.000	7.7E+01	1	-7.7E+01	-1	1.5E+00	0.9601	-1.5E+00	-0.96015	2.83E+03
			18	18	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.1E+01	9.8E+04	1.1E+46	0.000	7.4E+01	1	-7.4E+01	-1	1.4E+00	0.9542	-1.4E+00	-0.95421	2.81E+03
			19	19	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.2E+01	1.8E+05	1.1E+46	0.000	7.2E+01	1	-7.2E+01	-1	1.4E+00	0.9481	-1.4E+00	-0.94812	2.80E+03
			20	20	368.659	0.0E+00	1.0E+00	-1.1E+46	2.000	1.3E+01	3.5E+05	1.1E+46	0.000	7.1E+01	1	-7.1E+01	-1	1.3E+00	0.9419	-1.3E+00	-0.94189	2.78E+03

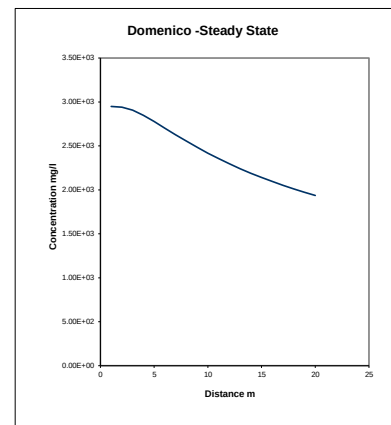
Date: 20/02/2020

Version: 1



Date: 20/02/2020
Version: 1

Contaminant		DOMENICO (STEADY STATE)														
Iron		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)														
Input	Value	Units	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration	
C _T	1	mg/l	1	1	737.318	0.00E+00	1.00E+00	3.16E+02	1	-3.16E+02	-1	3.00E+00	1	-3.00E+00	-1	2.95E+03
			2	2	737.318	0.00E+00	1.00E+00	2.23E+02	1	-2.23E+02	-1	2.12E+00	0.997	-2.12E+00	-0.9973	2.94E+03
			3	3	737.318	0.00E+00	1.00E+00	1.82E+02	1	-1.82E+02	-1	1.73E+00	0.986	-1.73E+00	-0.9856	2.91E+03
Co	2.95E+03	mg/l	4	4	737.318	0.00E+00	1.00E+00	1.58E+02	1	-1.58E+02	-1	1.50E+00	0.966	-1.50E+00	-0.9659	2.85E+03
λ	5.59E-105	days ⁻¹	5	5	737.318	0.00E+00	1.00E+00	1.41E+02	1	-1.41E+02	-1	1.34E+00	0.942	-1.34E+00	-0.9419	2.78E+03
Sz	5.00E+02	m	6	6	737.318	0.00E+00	1.00E+00	1.29E+02	1	-1.29E+02	-1	1.22E+00	0.916	-1.22E+00	-0.9163	2.70E+03
Sy	1.50E+00	m	7	7	737.318	0.00E+00	1.00E+00	1.19E+02	1	-1.19E+02	-1	1.13E+00	0.891	-1.13E+00	-0.8907	2.63E+03
Kd	8.10E+02	l/kg	8	8	737.318	0.00E+00	1.00E+00	1.12E+02	1	-1.12E+02	-1	1.06E+00	0.866	-1.06E+00	-0.8659	2.55E+03
ρ	1.36E+00	g/cm3	9	9	737.318	0.00E+00	1.00E+00	1.05E+02	1	-1.05E+02	-1	9.99E-01	0.842	-9.99E-01	-0.8422	2.48E+03
n	8.00E-02		10	10	737.318	0.00E+00	1.00E+00	9.99E+01	1	-9.99E+01	-1	9.47E-01	0.82	-9.47E-01	-0.8197	2.42E+03
i	1.00E-02		11	11	737.318	0.00E+00	1.00E+00	9.52E+01	1	-9.52E+01	-1	9.03E-01	0.799	-9.03E-01	-0.7986	2.36E+03
K	8.64E-03	m/d	12	12	737.318	0.00E+00	1.00E+00	9.12E+01	1	-9.12E+01	-1	8.65E-01	0.779	-8.65E-01	-0.7787	2.30E+03
x	2.00E+01	m	13	13	737.318	0.00E+00	1.00E+00	8.76E+01	1	-8.76E+01	-1	8.31E-01	0.76	-8.31E-01	-0.7601	2.24E+03
z	0.00E+00	m	14	14	737.318	0.00E+00	1.00E+00	8.44E+01	1	-8.44E+01	-1	8.01E-01	0.743	-8.01E-01	-0.7425	2.19E+03
y	0.00E+00	m	15	15	737.318	0.00E+00	1.00E+00	8.15E+01	1	-8.15E+01	-1	7.74E-01	0.726	-7.74E-01	-0.726	2.14E+03
			16	16	737.318	0.00E+00	1.00E+00	7.90E+01	1	-7.90E+01	-1	7.49E-01	0.711	-7.49E-01	-0.7105	2.10E+03
ax	1.57E+00	m	17	17	737.318	0.00E+00	1.00E+00	7.66E+01	1	-7.66E+01	-1	7.27E-01	0.696	-7.27E-01	-0.6959	2.05E+03
az	1.57E-01	m	18	18	737.318	0.00E+00	1.00E+00	7.44E+01	1	-7.44E+01	-1	7.06E-01	0.682	-7.06E-01	-0.6821	2.01E+03
ay	1.57E-02	m	19	19	737.318	0.00E+00	1.00E+00	7.25E+01	1	-7.25E+01	-1	6.87E-01	0.669	-6.87E-01	-0.669	1.97E+03
			20	20	737.318	0.00E+00	1.00E+00	7.06E+01	1	-7.06E+01	-1	6.70E-01	0.657	-6.70E-01	-0.6566	1.94E+03

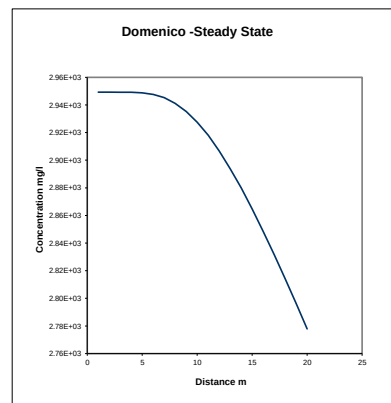


Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc		Value	DOMENICO (STEADY STATE)													
Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT																
v	Rc	u		X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
	1.08E-03	m/d														
	1.38E+04															
	7.84E-08	m/d	1	1	737.318	0.00E+00	1.00E+00	3.16E+02	1	-3.16E+02	-1	5.99E+00	1	-5.99E+00	-1	2.95E+03
			2	2	737.318	0.00E+00	1.00E+00	2.23E+02	1	-2.23E+02	-1	4.24E+00	1	-4.24E+00	-1	2.95E+03
			3	3	737.318	0.00E+00	1.00E+00	1.82E+02	1	-1.82E+02	-1	3.46E+00	1	-3.46E+00	-1	2.95E+03
			4	4	737.318	0.00E+00	1.00E+00	1.58E+02	1	-1.58E+02	-1	3.00E+00	1	-3.00E+00	-1	2.95E+03
			5	5	737.318	0.00E+00	1.00E+00	1.41E+02	1	-1.41E+02	-1	2.68E+00	1	-2.68E+00	-0.9998	2.95E+03
			6	6	737.318	0.00E+00	1.00E+00	1.29E+02	1	-1.29E+02	-1	2.45E+00	0.999	-2.45E+00	-0.9995	2.95E+03
			7	7	737.318	0.00E+00	1.00E+00	1.19E+02	1	-1.19E+02	-1	2.26E+00	0.999	-2.26E+00	-0.9986	2.95E+03
			8	8	737.318	0.00E+00	1.00E+00	1.12E+02	1	-1.12E+02	-1	2.12E+00	0.997	-2.12E+00	-0.9973	2.94E+03
			9	9	737.318	0.00E+00	1.00E+00	1.05E+02	1	-1.05E+02	-1	2.00E+00	0.995	-2.00E+00	-0.9953	2.94E+03
			10	10	737.318	0.00E+00	1.00E+00	9.99E+01	1	-9.99E+01	-1	1.89E+00	0.993	-1.89E+00	-0.9926	2.93E+03
			11	11	737.318	0.00E+00	1.00E+00	9.52E+01	1	-9.52E+01	-1	1.81E+00	0.989	-1.81E+00	-0.9894	2.92E+03
			12	12	737.318	0.00E+00	1.00E+00	9.12E+01	1	-9.12E+01	-1	1.73E+00	0.986	-1.73E+00	-0.9856	2.91E+03
			13	13	737.318	0.00E+00	1.00E+00	8.76E+01	1	-8.76E+01	-1	1.66E+00	0.981	-1.66E+00	-0.9812	2.89E+03
			14	14	737.318	0.00E+00	1.00E+00	8.44E+01	1	-8.44E+01	-1	1.60E+00	0.976	-1.60E+00	-0.9765	2.88E+03
			15	15	737.318	0.00E+00	1.00E+00	8.15E+01	1	-8.15E+01	-1	1.55E+00	0.971	-1.55E+00	-0.9713	2.86E+03
			16	16	737.318	0.00E+00	1.00E+00	7.90E+01	1	-7.90E+01	-1	1.50E+00	0.966	-1.50E+00	-0.9659	2.85E+03
			17	17	737.318	0.00E+00	1.00E+00	7.66E+01	1	-7.66E+01	-1	1.45E+00	0.96	-1.45E+00	-0.9601	2.83E+03
			18	18	737.318	0.00E+00	1.00E+00	7.44E+01	1	-7.44E+01	-1	1.41E+00	0.954	-1.41E+00	-0.9542	2.81E+03
			19	19	737.318	0.00E+00	1.00E+00	7.25E+01	1	-7.25E+01	-1	1.37E+00	0.948	-1.37E+00	-0.9481	2.80E+03
			20	20	737.318	0.00E+00	1.00E+00	7.06E+01	1	-7.06E+01	-1	1.34E+00	0.942	-1.34E+00	-0.9419	2.78E+03

Date:20/02/2020

Version:1



DOMENICO (TIME VARIANT)

Contaminant	Iron		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)															
Input	Value	Units	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration	
C _T	1	mg/l	1	1	368.659	0.00E+00	1.00E+00	-1.12E+46	2	3.16E+02	1	-3.16E+02	-1	3.00E+00	1	-3.00E+00	-1	2.95E+03
Co λ Sz Sy Kd ρ n i K x z y t ax az ay			2	2	368.659	0.00E+00	1.00E+00	-1.12E+46	2	2.23E+02	1	-2.23E+02	-1	2.12E+00	0.9973	-2.12E+00	-0.997	2.94E+03
			3	3	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.82E+02	1	-1.82E+02	-1	1.73E+00	0.9856	-1.73E+00 <td>-0.986</td> <td>2.91E+03</td>	-0.986	2.91E+03
	2.95E+03	mg/l	4	4	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.58E+02	1	-1.58E+02	-1	1.50E+00	0.9659	-1.50E+00	-0.966	2.85E+03
	5.59E-105	days ⁻¹	5	5	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.41E+02	1	-1.41E+02	-1	1.34E+00	0.9419	-1.34E+00	-0.942	2.78E+03
	5.00E+02	m	6	6	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.29E+02	1	-1.29E+02	-1	1.22E+00	0.9163	-1.22E+00	-0.916	2.70E+03
	1.50E+00	m	7	7	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.19E+02	1	-1.19E+02	-1	1.13E+00	0.8907	-1.13E+00	-0.891	2.63E+03
	8.10E+02	l/kg	8	8	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.12E+02	1	-1.12E+02	-1	1.06E+00	0.8659	-1.06E+00	-0.866	2.55E+03
	1.36E+00	g/cm3	9	9	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.05E+02	1	-1.05E+02	-1	9.99E-01	0.8422	-9.99E-01	-0.842	2.48E+03
	8.00E-02		10	10	368.659	0.00E+00	1.00E+00	-1.12E+46	2	9.99E+01	1	-9.99E+01	-1	9.47E-01	0.8197	-9.47E-01	-0.82	2.42E+03
	1.00E-02		11	11	368.659	0.00E+00	1.00E+00	-1.12E+46	2	9.52E+01	1	-9.52E+01	-1	9.03E-01	0.7986	-9.03E-01	-0.799	2.36E+03
	8.64E-03	m/d	12	12	368.659	0.00E+00	1.00E+00	-1.12E+46	2	9.12E+01	1	-9.12E+01	-1	8.65E-01	0.7787	-8.65E-01	-0.779	2.30E+03
	2.00E+01	m	13	13	368.659	0.00E+00	1.00E+00	-1.12E+46	2	8.76E+01	1	-8.76E+01	-1	8.31E-01	0.7601	-8.31E-01	-0.76	2.24E+03
	0.00E+00	m	14	14	368.659	0.00E+00	1.00E+00	-1.12E+46	2	8.44E+01	1	-8.44E+01	-1	8.01E-01	0.7425	-8.01E-01	-0.743	2.19E+03
	0.00E+00	m	15	15	368.659	0.00E+00	1.00E+00	-1.12E+46	2	8.15E+01	1	-8.15E+01	-1	7.74E-01	0.726	-7.74E-01	-0.726	2.14E+03
	1.00E+100	days	16	16	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.90E+01	1	-7.90E+01	-1	7.49E-01	0.7105	-7.49E-01	-0.711	2.10E+03
	1.57E+00	m	17	17	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.66E+01	1	-7.66E+01	-1	7.27E-01	0.6959	-7.27E-01	-0.696	2.05E+03
	1.57E-01	m	18	18	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.44E+01	1	-7.44E+01	-1	7.06E-01	0.6821	-7.06E-01	-0.682	2.01E+03
	1.57E-02	m	19	19	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.25E+01	1	-7.25E+01	-1	6.87E-01	0.669	-6.87E-01	-0.669	1.97E+03
			20	20	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.06E+01	1	-7.06E+01	-1	6.70E-01	0.6566	-6.70E-01	-0.657	1.94E+03

Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc			Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT															
	Value		X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration	
v	1.08E-03	m/d	m															
Rc	1.38E+04		1	1	368.659	0.00E+00	1.00E+00	-1.12E+46	2	3.16E+02	1	-3.16E+02	-1	5.99E+00	1	-5.99E+00	-1	2.95E+03
u	7.84E-08	m/d	2	2	368.659	0.00E+00	1.00E+00	-1.12E+46	2	2.23E+02	1	-2.23E+02	-1	4.24E+00	1	-4.24E+00	-1	2.95E+03
			3	3	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.82E+02	1	-1.82E+02	-1	3.46E+00	1	-3.46E+00	-1	2.95E+03
			4	4	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.58E+02	1	-1.58E+02	-1	3.00E+00	1	-3.00E+00	-1	2.95E+03
			5	5	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.41E+02	1	-1.41E+02	-1	2.68E+00	0.9998	-2.68E+00	-1	2.95E+03
			6	6	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.29E+02	1	-1.29E+02	-1	2.45E+00	0.9995	-2.45E+00	-0.999	2.95E+03
			7	7	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.19E+02	1	-1.19E+02	-1	2.26E+00	0.9986	-2.26E+00	-0.999	2.95E+03
			8	8	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.12E+02	1	-1.12E+02	-1	2.12E+00	0.9973	-2.12E+00	-0.997	2.94E+03
			9	9	368.659	0.00E+00	1.00E+00	-1.12E+46	2	1.05E+02	1	-1.05E+02	-1	2.00E+00	0.9953	-2.00E+00	-0.995	2.94E+03
			10	10	368.659	0.00E+00	1.00E+00	-1.12E+46	2	9.99E+01	1	-9.99E+01	-1	1.89E+00	0.9926	-1.89E+00	-0.993	2.93E+03
			11	11	368.659	0.00E+00	1.00E+00	-1.12E+46	2	9.52E+01	1	-9.52E+01	-1	1.81E+00	0.9894	-1.81E+00	-0.989	2.92E+03
			12	12	368.659	0.00E+00	1.00E+00	-1.12E+46	2	9.12E+01	1	-9.12E+01	-1	1.73E+00	0.9856	-1.73E+00	-0.986	2.91E+03
			13	13	368.659	0.00E+00	1.00E+00	-1.12E+46	2	8.76E+01	1	-8.76E+01	-1	1.66E+00	0.9812	-1.66E+00	-0.981	2.89E+03
			14	14	368.659	0.00E+00	1.00E+00	-1.12E+46	2	8.44E+01	1	-8.44E+01	-1	1.60E+00	0.9765	-1.60E+00	-0.976	2.88E+03
			15	15	368.659	0.00E+00	1.00E+00	-1.12E+46	2	8.15E+01	1	-8.15E+01	-1	1.55E+00	0.9713	-1.55E+00	-0.971	2.86E+03
			16	16	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.90E+01	1	-7.90E+01	-1	1.50E+00	0.9659	-1.50E+00	-0.966	2.85E+03
			17	17	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.66E+01	1	-7.66E+01	-1	1.45E+00	0.9601	-1.45E+00	-0.96	2.83E+03
			18	18	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.44E+01	1	-7.44E+01	-1	1.41E+00	0.9542	-1.41E+00	-0.954	2.81E+03
			19	19	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.25E+01	1	-7.25E+01	-1	1.37E+00	0.9481	-1.37E+00	-0.948	2.80E+03
			20	20	368.659	0.00E+00	1.00E+00	-1.12E+46	2	7.06E+01	1	-7.06E+01	-1	1.34E+00	0.9419	-1.34E+00	-0.942	2.78E+03

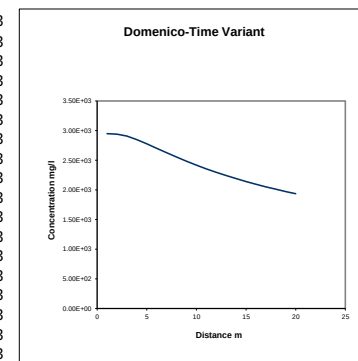
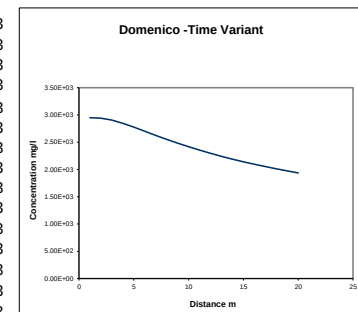
Date:

Version:

20/02/2020

1

Date: 20/02/2020
Version: 1





Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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IMPORTANT: To enable MS Excel worksheet, click Tools, Add -Ins, Analysis Tool Pak and Analysis Tool Pak-VBA (to calculate error functions)

Details to be completed for each assessment

Site Name:	Glan Llyn		
Site Address:	Llanwern		
Completed by:	Ross Cameron	Version:	3
Date:	24-Feb-20		
Contaminant	Naphthalene		
Target Concentration (C _T)	0.002	mg/l	Origin of C _T : Proposed Water Framework Directive EQS

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant
Target concentration

C_T

Naphthalene
0.002 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

0.5

Air filled soil porosity

θ_a

3.70E-01

fraction

0.0037

Bulk density of soil zone material

ρ

1.36E+00

g/cm³

1.36

Henry's Law constant

H

1.00E+00

dimensionless

1

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

1.34E+02

l/kg

1.34E+02

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

fraction

Organic carbon partition coefficient

K_{oc}

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.34E+02

l/kg

Specified value

Level 1 Remedial Target

Level 1 Remedial Target

2.69E-01

mg/kg

(for comparison with soil analyses)

or

0.002

mg/l

(for comparison with leachate test results)

Site being assessed: Glan Llyn
Completed by: Ross Cameron
Date: 24-Feb-20
Version: 3

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Naphthalene
0.002

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	0.00E+00	m/d	
Area of contaminant source	A	0.00E+00	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	0.00E+00	m	
Saturated aquifer thickness	da	0.00E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	0.00E+00	m/d	
Hydraulic gradient of water table	i	0.00E+00	fraction	
Width of contaminant source perpendicular to groundwater flow	w	0.00E+00	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	0.00E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	#DIV/0!	
Level 2 Remedial Target		#DIV/0! or #DIV/0!	mg/l mg/kg
For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration			
For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water			

Additional option

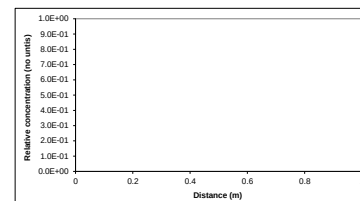
Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		#DIV/0!	mg/l	0

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	3

Level 3 - Soil

See Note

[illegible]

Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

[illegible]

This sheet calculates the Level 3 remedial target for soils(mg/kg) or for pore water (mg/l), based on the distance to the receptor or compliance located down hydraulic gradient of the source Three solution methods are included, the preferred option is Ogata Banks. By setting a long travel time (e.g. 9E99) it will give the steady state solution, which should always be used when calculating remedial targets.

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.9E+99

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#####
Version:	3

Remedial Targets			
Calculated soil leachate concentration	C ₀	0.00E+00	mg/l
Level 3 Remedial Target Ogata Banks	#DIV/0! or #DIV/0!	mg/l or mg/kg	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration. For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Distance to compliance point	0	m	
Ratio of Compliance Point to Source Concentration	C ₂₅ /C ₀	#DIV/0!	fraction Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Naphthalene	from Level 1
Target Concentration	C _r	2.00E-03 mg/l from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state	Equations in HRA publication
-------------------------	------------------------------

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Source of parameter value

Initial contaminant concentration in groundwater at plume core	C ₀	1.29E+02	mg/l	Based on maximum soil conc of 4680mg/kg
Half life for degradation of contaminant in water	t _{1/2}	1.00E+02	days	100 day half life estimation
Calculated decay rate	λ	6.93E-03	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+02	m	Site data
Plume thickness at source	Sy	1.50E+00	m	Thickness of re-engineered MG
Saturated aquifer thickness	da	2.00E+00	m	Based upon proposed total MG and caprock
Bulk density of aquifer materials	ρ	1.36E+00	g/cm ³	Site data
Effective porosity of aquifer	n	8.00E-02	fraction	Estimate
Hydraulic gradient	i	1.00E-02	fraction	
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	Proposed best achievable
Distance to compliance point	x	2.00E+01	m	Site data
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only
Parameters values determined from options				
Partition coefficient	Kd	3.60E+01	l/kg	see options
Longitudinal dispersivity	ax	2.00E+00	m	see options
Transverse dispersivity	az	2.00E-01	m	see options
Vertical dispersivity	ay	2.00E-02	m	see options

Calculated Parameters

Groundwater flow velocity	v	1.08E-03	m/d
Retardation factor	Rf	6.13E+02	fraction
Decay rate used	λ	1.13E-05	d ⁻¹
Rate of contaminant flow due to retardation	u	1.76E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	3.37E-12	mg/l
Attenuation factor (one way vertical dispersion, COI/CEd)	AF	3.82E+13	

Remedial Targets

Remedial Target	7.64E+10	mg/l	For comparison with measured groundwater concentration.
Domenico - Steady state			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point	C _{ED} /C ₀	3.37E-12	Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

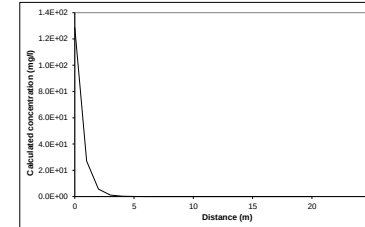
Entry if specify partition coefficient (option)		
Soil water partition coefficient	Kd	3.60E+01 l/kg
Entry for non-polar organic chemicals (option)		
Fraction of organic carbon in aquifer	foc	
Organic carbon partition coefficient	Koc	
Entry for ionic organic chemicals (option)		
Sorption coefficient for related species	K _{oc,n}	
Sorption coefficient for ionised species	K _{oc,i}	
pH value	pH	
acid dissociation constant	pKa	
Fraction of organic carbon in aquifer	foc	
Soil water partition coefficient	Kd	3.60E+01 l/kg

Define dispersivity (click brown cell and use pull down list)

Dispersivities 10%, 1%, 0.1% of pathway length

	Enter value	Calc value Xu & Eckstein	
Longitudinal dispersivity	ax	0.00E+00	2.00E+00 1.37E+00 m
Transverse dispersivity	az	0.00E+00	2.00E-01 1.67E-01 m
Vertical dispersivity	ay	0.00E+00	2.00E-02 1.97E-02 m

Note values of dispersivity must be > 0
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log₁₀x)^{0.414}, az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action. Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used

Calculated concentrations for distance-concentration graph

Domenico - Steady state

From calculation sheet

Distance Concentration

	mg/l
0	1.3E+02
1.0	2.71E+01
2.0	5.70E+00
3.0	1.20E+00
4.0	2.52E-01
5.0	5.30E-02
6.0	1.11E-02
7.0	2.34E-03
8.0	4.90E-04
9.0	1.03E-04
10.0	2.15E-05
11.0	4.49E-06
12.0	9.39E-07
13.0	1.95E-07
14.0	4.09E-08
15.0	8.54E-09
16.0	1.78E-09
17.0	3.72E-10
18.0	7.75E-11
19.0	1.62E-11
20.0	3.37E-12

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#####
Version:	3

Porosity Calculator

These results are not carried through to any of the other worksheets

DRY BULK DENSITY DATA

Variable	Value	Unit	justification
Natural Moisture Content	0.00	% wt	(Change this number only if you have specific information)
Particle Density	2.78	tonnes/m ³	
Dry Bulk Density	0.00	tonnes/m ³	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
Initial Saturation	#DIV/0!	%	
Total porosity	1.000	fraction	
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

WET BULK DENSITY DATA

	Variable	Value	Unit	
	Moisture Content	0.00	% wt	(Change this number only if you have specific information)
	Particle Density	2.78	tonnes/m ³	
Actual (wet) Bulk Density (i.e. at natural MC)		0.00	tonnes/m ³	
Calculated Parameters				
	Voids Ratio	#DIV/0!	fraction	
	dry bulk density	0.00	tonnes/m ³	
	Initial Saturation	#DIV/0!	%	
Total porosity				#DIV/0!
Air Filled Porosity				#DIV/0!
Water Filled Porosity				#DIV/0!

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol	unit	justification
Hydraulic conductivity	K	0.00E+00 m/d	
Hydraulic gradient	i	0.00E+00 unitless	
Effective porosity of aquifer	n	0.00E+00 fraction	
Thickness of saturated aquifer	b	0.00E+00 m	
Width of aquifer perpendicular to flow	w	0.00E+00 m	
Distance to receptor	x	0.00E+00 m	
Bulk density of aquifer materials	ρ	0.00E+00 g/cm ³	
Soil-water partition co-efficient	Kd	0.00E+00 l/kg	
Retardation factor of pollutant	R	#DIV/0!	

Groundwater flow velocity	v(GW)	#DIV/0! m/s	#DIV/0! m/day	#DIV/0! m/year
Time for groundwater to reach receptor	t(GW)	#DIV/0! seconds	#DIV/0! days	#DIV/0! years
Rate of groundwater flow through aquifer	Q	0.00E+00 m ³ /s	0.00E+00 m ³ /day	0.00E+00 m ³ /year
Contaminant flow velocity	v(contam)	#DIV/0! m/s	#DIV/0! m/day	#DIV/0! m/year
Time for contaminant to reach receptor	t(contam)	#DIV/0! seconds	#DIV/0! days	#DIV/0! years

Level 1 Calculation Sheet

Contaminant Naphthalene

Parameter (carried over from input sheet)	Value	Units	Calculations (Refer toTable 4.3, R&D Publication 20)											
			Selected option	User specified value for partition coefficient										
				calc	calc	Calc Kd l/kg								
C _T	2.00E-03	mg/l	Calculation of partition coefficient											
Kd	1.34E+02	l/kg	for ionic organic chemical											
foc		fraction												
koc		l/kg	Partition coefficient used in Level 1 Assessment	1.34E+02 l/kg										
θ _w	5.00E-01	fraction												
θ _a	3.70E-01	fraction												
ρ	1.36E+00	g/cm3												
H	1.00E+00	dimensionless	Factor (partitioning between soil and water)	1.35E+02										
Koc,n		l/kg												
Koc,i		l/kg												
pH		pH units												
pKa														
foc (ionic)		fraction												
			<table><tr><td>Calculated Remedial Target</td><td>2.69E-01 mg/kg</td><td>for Naphthalene</td></tr></table>				Calculated Remedial Target	2.69E-01 mg/kg	for Naphthalene					
Calculated Remedial Target	2.69E-01 mg/kg	for Naphthalene												
			Factor (partitioning between soil and water)											
			<table><tr><td>Site being assessed:</td><td>Glan Llyn</td></tr><tr><td>Completed by:</td><td>Ross Cameron</td></tr><tr><td>Date:</td><td>24/02/2020</td></tr><tr><td>Version:</td><td>3</td></tr></table>				Site being assessed:	Glan Llyn	Completed by:	Ross Cameron	Date:	24/02/2020	Version:	3
Site being assessed:	Glan Llyn													
Completed by:	Ross Cameron													
Date:	24/02/2020													
Version:	3													

Level 2 Calculation Sheet
Contaminant Naphthalene

Site assessed:	Glan Llyn
Date:	24/02/2020
Version:	3

Parameter Value Units
(carried over from input sheet)

Mz	0.00E+00	m
L	0.00E+00	m
da	0.00E+00	m
Inf	0.00E+00	m/d
K	0.00E+00	m/d
i	0.00E+00	m3/d
A	0.00E+00	m2
		m3/d
Cc	0.00E+00	mg/l
C _T	2.00E-03	mg/l
Cu	0.00E+00	mg/l
w	0.00E+00	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Calculated
Dilution Factor

#DIV/0!

#DIV/0!

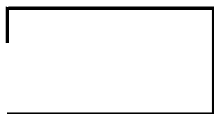
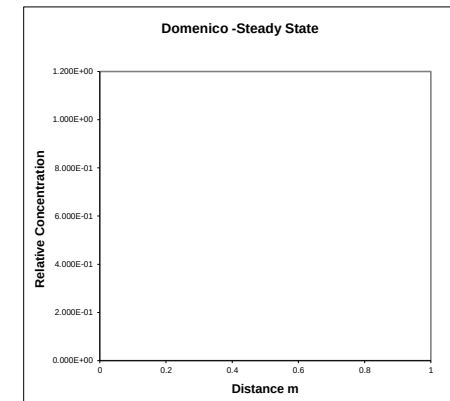
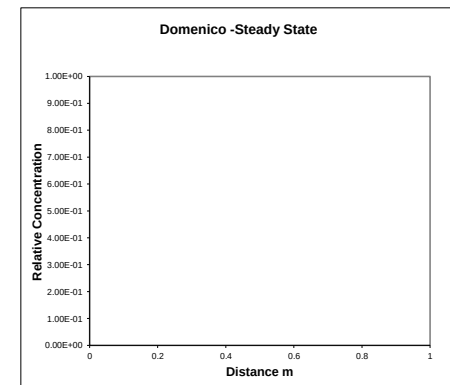


Figure 1 is a line graph titled "Ogata Banks - Time Variant". The Y-axis is labeled "Relative Concentration" and ranges from 0.00E+00 to 1.00E+00 in increments of 0.10E+00. The X-axis is labeled "Distance m" and ranges from 0 to 1 in increments of 0.1. The graph shows a single data series represented by a solid line. The concentration starts at 1.00E+00 at distance 0 and decreases steadily, reaching approximately 0.25E+00 at distance 1.

		DOMENICO (STEADY STATE)													
Contaminant	Naphthalene	Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)													
Input	Value	Units	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
C _T	2.000E-03	mg/l	1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
DF	#DIV/0!		2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
λ	6.931E-101	days ⁻¹	5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Sz	0.000E+00	m	6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Sy	0.000E+00	m	7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Kd	0.000E+00	l/kg	8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
ρ	0.000E+00	g/cm3	9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
n	0.000E+00		10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
i	#DIV/0!		11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
K	0.000E+00	m/d	12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
x	0.000E+00	m	13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
z	0.000E+00	m	14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
y	0.000E+00	m	15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
ax	0.000E+00	m	16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
az	0.000E+00	m	17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
ay	0.000E+00	m	18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!



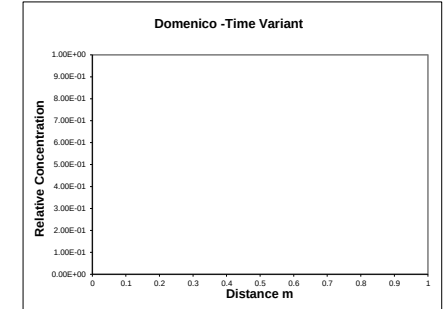
Calc	Value	DOMENICO (STEADY STATE)													
Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT															
v	#DIV/0!	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
Rc	#DIV/0!														
u	#DIV/0!	m/d	1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
n:	24/02/2020		20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
	3														



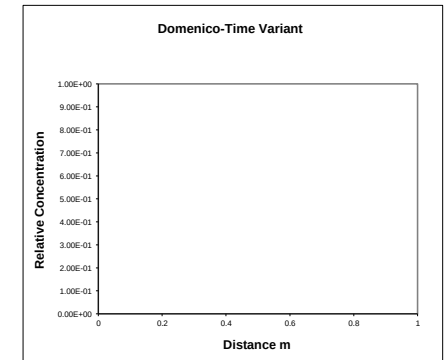
Date: 24/02/2020
Version: 3

DOMENICO (TIME VARIANT)

Contaminant	Naphthalene	Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)															
Input	Value	Units	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
C _T	0.002	mg/l	1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
DF	#DIV/0!		2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
λ	6.931E-101	days ⁻¹	5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Sz	0.000E+00	m	6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Sy	0.000E+00	m	7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Kd	0.000E+00	l/kg	8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
ρ	0.000E+00	g/cm3	9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
n	0.000E+00		10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
i	#DIV/0!		11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
K	0.000E+00	m/d	12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
x	0.000E+00	m	13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
z	0.000E+00	m	14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
y	0.000E+00	m	15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
t	1.000E+99	days	16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
ax	0.000E+00	m	17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
az	0.000E+00	m	18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
ay	0.000E+00	m	19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calc	Value	Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT															
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
v	#DIV/0!	m/d	1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Rc	#DIV/0!		2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
u	#DIV/0!	m/d	3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!

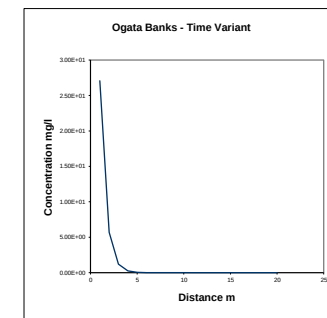
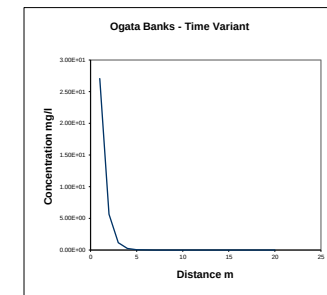


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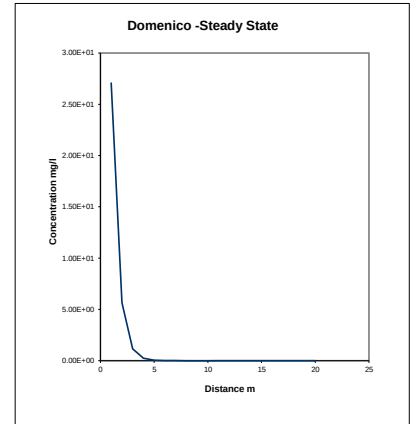
OGATA BANKS SOLUTION																						
Contaminant		Naphthalene		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)																		
		X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration		
Input	Value	Units																				
C _T	0.002	mg/l	1	1	16.085	-1.6E+00	2.1E-01	-3.4E+47	2.000	2.1E+00	7.8E+00	3.4E+47	0.000	2.8E+02	1	-2.8E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99982	2.71E+01
			2	2	16.085	-3.1E+00	4.4E-02	-3.4E+47	2.000	4.1E+00	6.1E+01	3.4E+47	0.000	2.0E+02	1	-2.0E+02	-1	1.9E+00	0.992	-1.9E+00	-0.99199	5.65E+00
			3	3	16.085	-4.7E+00	9.3E-03	-3.4E+47	2.000	6.2E+00	4.8E+02	3.4E+47	0.000	1.6E+02	1	-1.6E+02	-1	1.5E+00	0.9696	-1.5E+00	-0.96962	1.16E+00
Co	1.29E+02	mg/l	4	4	16.085	-6.2E+00	2.0E-03	-3.4E+47	2.000	8.2E+00	3.8E+03	3.4E+47	0.000	1.4E+02	1	-1.4E+02	-1	1.3E+00	0.9392	-1.3E+00	-0.93921	2.37E-01
λ	1.13E-05	days ⁻¹	5	5	16.085	-7.8E+00	4.1E-04	-3.4E+47	2.000	1.0E+01	3.0E+04	3.4E+47	0.000	1.3E+02	1	-1.3E+02	-1	1.2E+00	0.9065	-1.2E+00	-0.90647	4.81E-02
Sz	5.00E+02	m	6	6	16.085	-9.4E+00	8.7E-05	-3.4E+47	2.000	1.2E+01	2.3E+05	3.4E+47	0.000	1.1E+02	1	-1.1E+02	-1	1.1E+00	0.8742	-1.1E+00	-0.87421	9.76E-03
Sy	1.50E+00	m	7	7	16.085	-1.1E+01	1.8E-05	-3.4E+47	2.000	1.4E+01	1.8E+06	3.4E+47	0.000	1.1E+02	1	-1.1E+02	-1	1.0E+00	0.8436	-1.0E+00	-0.84362	1.98E-03
Kd	3.60E+01	l/kg	8	8	16.085	-1.2E+01	3.8E-06	-3.4E+47	2.000	1.6E+01	1.4E+07	3.4E+47	0.000	9.9E+01	1	-9.9E+01	-1	9.4E-01	0.8151	-9.4E-01	-0.8151	4.03E-04
ρ	1.36E+00	g/cm ³	9	9	16.085	-1.4E+01	8.1E-07	-3.4E+47	2.000	1.9E+01	1.1E+08	3.4E+47	0.000	9.3E+01	1	-9.3E+01	-1	8.8E-01	0.7887	-8.8E-01	-0.7887	8.20E-05
n	8.00E-02		10	10	16.085	-1.6E+01	1.7E-07	-3.4E+47	2.000	2.1E+01	8.7E+08	3.4E+47	0.000	8.8E+01	1	-8.8E+01	-1	8.4E-01	0.7643	-8.4E-01	-0.76432	1.67E-05
i	1.00E-02		11	11	16.085	-1.7E+01	3.6E-08	-3.4E+47	2.000	2.3E+01	6.8E+09	3.4E+47	0.000	8.4E+01	1	-8.4E+01	-1	8.0E-01	0.7418	-8.0E-01	-0.7418	3.41E-06
K	8.64E-03	m/d	12	12	16.085	-1.9E+01	7.5E-09	-3.4E+47	2.000	2.5E+01	5.4E+10	3.4E+47	0.000	8.1E+01	1	-8.1E+01	-1	7.7E-01	0.721	-7.7E-01	-0.72098	6.98E-07
x	2.00E+01	m	13	13	16.085	-2.0E+01	1.6E-09	-3.4E+47	2.000	2.7E+01	4.2E+11	3.4E+47	0.000	7.8E+01	1	-7.8E+01	-1	7.4E-01	0.7017	-7.4E-01	-0.70169	1.43E-07
z	0.00E+00	m	14	14	16.085	-2.2E+01	3.3E-10	-3.4E+47	2.000	2.9E+01	3.3E+12	3.4E+47	0.000	7.5E+01	1	-7.5E+01	-1	7.1E-01	0.6838	-7.1E-01	-0.68377	2.93E-08
y	0.00E+00	m	15	15	16.085	-2.3E+01	7.0E-11	-3.4E+47	2.000	3.1E+01	2.6E+13	3.4E+47	0.000	7.2E+01	1	-7.2E+01	-1	6.8E-01	0.6671	-6.8E-01	-0.66708	6.01E-09
t	1.00E+100	days	16	16	16.085	-2.5E+01	1.5E-11	-3.4E+47	2.000	3.3E+01	2.0E+14	3.4E+47	0.000	7.0E+01	1	-7.0E+01	-1	6.6E-01	0.6515	-6.6E-01	-0.6515	1.24E-09
ax	2.00E+00	m	17	17	16.085	-2.6E+01	3.1E-12	-3.4E+47	2.000	3.5E+01	1.6E+15	3.4E+47	0.000	6.8E+01	1	-6.8E+01	-1	6.4E-01	0.6369	-6.4E-01	-0.63692	2.54E-10
az	2.00E-01	m	18	18	16.085	-2.8E+01	6.5E-13	-3.4E+47	2.000	3.7E+01	1.2E+16	3.4E+47	0.000	6.6E+01	1	-6.6E+01	-1	6.3E-01	0.6232	-6.3E-01	-0.62324	5.23E-11
ay	2.00E-02	m	19	19	16.085	-3.0E+01	1.4E-13	-3.4E+47	2.000	3.9E+01	9.7E+16	3.4E+47	0.000	6.4E+01	1	-6.4E+01	-1	6.1E-01	0.6104	-6.1E-01	-0.61038	1.08E-11
			20	20	16.085	-3.1E+01	2.9E-14	-3.4E+47	2.000	4.1E+01	7.6E+17	3.4E+47	0.000	6.3E+01	1	-6.3E+01	-1	5.9E-01	0.5983	-5.9E-01	-0.59826	2.22E-12
Vertical dispersion option Simulate vertical dispersion in 1 direction																						
Calc	Value	Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT																				
		X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration		
v	1.08E-03	m/d	1	1	16.085	-1.6E+00	2.1E-01	-3.4E+47	2.000	2.1E+00	7.8E+00	3.4E+47	0.000	2.8E+02	1	-2.8E+02	-1	5.3E+00	1	-5.3E+00	-1	2.71E+01
Rc	6.13E+02		2	2	16.085	-3.1E+00	4.4E-02	-3.4E+47	2.000	4.1E+00	6.1E+01	3.4E+47	0.000	2.0E+02	1	-2.0E+02	-1	3.8E+00	1	-3.8E+00	-1	5.70E+00
u	1.76E-06	m/d	3	3	16.085	-4.7E+00	9.3E-03	-3.4E+47	2.000	6.2E+00	4.8E+02	3.4E+47	0.000	1.6E+02	1	-1.6E+02	-1	3.1E+00	1	-3.1E+00	-0.99999	1.20E+00
			4	4	16.085	-6.2E+00	2.0E-03	-3.4E+47	2.000	8.2E+00	3.8E+03	3.4E+47	0.000	1.4E+02	1	-1.4E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99982	2.52E-01
			5	5	16.085	-7.8E+00	4.1E-04	-3.4E+47	2.000	1.0E+01	3.0E+04	3.4E+47	0.000	1.3E+02	1	-1.3E+02	-1	2.4E+00	0.9992	-2.4E+00	-0.9992	5.30E-02
			6	6	16.085	-9.4E+00	8.7E-05	-3.4E+47	2.000	1.2E+01	2.3E+05	3.4E+47	0.000	1.1E+02	1	-1.1E+02	-1	2.2E+00	0.9978	-2.2E+00	-0.9978	1.11E-02
			7	7	16.085	-1.1E+01	1.8E-05	-3.4E+47	2.000	1.4E+01	1.8E+06	3.4E+47	0.000	1.1E+02	1	-1.1E+02	-1	2.0E+00	0.9954	-2.0E+00	-0.99541	2.34E-03
			8	8	16.085	-1.2E+01	3.8E-06	-3.4E+47	2.000	1.6E+01	1.4E+07	3.4E+47	0.000	9.9E+01	1	-9.9E+01	-1	1.9E+00	0.992	-1.9E+00	-0.99199	4.90E-04
			9	9	16.085	-1.4E+01	8.1E-07	-3.4E+47	2.000	1.9E+01	1.1E+08	3.4E+47	0.000	9.3E+01	1	-9.3E+01	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	1.03E-04
			10	10	16.085	-1.6E+01	1.7E-07	-3.4E+47	2.000	2.1E+01	8.7E+08	3.4E+47	0.000	8.8E+01	1	-8.8E+01	-1	1.7E+00	0.9823	-1.7E+00	-0.98229	2.15E-05
			11	11	16.085	-1.7E+01	3.6E-08	-3.4E+47	2.000	2.3E+01	6.8E+09	3.4E+47	0.000	8.4E+01	1	-8.4E+01	-1	1.6E+00	0.9763	-1.6E+00	-0.97626	4.49E-06
			12	12	16.085	-1.9E+01	7.5E-09	-3.4E+47	2.000	2.5E+01	5.4E+10	3.4E+47	0.000	8.1E+01	1	-8.1E+01	-1	1.5E+00	0.9696	-1.5E+00	-0.96962	9.39E-07
			13	13	16.085	-2.0E+01	1.6E-09	-3.4E+47	2.000	2.7E+01	4.2E+11	3.4E+47	0.000	7.8E+01	1	-7.8E+01	-1	1.5E+00	0.9625	-1.5E+00	-0.96249	1.96E-07
			14	14	16.085	-2.2E+01	3.3E-10	-3.4E+47	2.000	2.9E+01	3.3E+12	3.4E+47	0.000	7.5E+01	1	-7.5E+01	-1	1.4E+00	0.955	-1.4E+00	-0.95498	4.09E-08
			15	15	16.085	-2.3E+01	7.0E-11	-3.4E+47	2.000	3.1E+01	2.6E+13	3.4E+47	0.000	7.2E+01	1	-7.2E+01	-1	1.4E+00	0.9472	-1.4E+00	-0.94719	8.54E-09
			16	16	16.085	-2.5E+01	1.5E-11	-3.4E+47	2.000	3.3E+01	2.0E+14	3.4E+47	0.000	7.0E+01	1	-7.0E+01	-1	1.3E+00	0.9392	-1.3E+00	-0.93921	1.78E-09
			17	17	16.085	-2.6E+01	3.1E-12	-3.4E+47	2.000	3.5E+01	1.6E+15	3.4E+47	0.000	6.8E+01	1	-6.8E+01	-1	1.3E+00	0.9311	-1.3E+00	-0.93109	3.72E-10
			18	18	16.085	-2.8E+01	6.5E-13	-3.4E+47	2.000	3.7E+01	1.2E+16	3.4E+47	0.000	6.6E+01	1	-6.6E+01	-1	1.3E+00	0.9229	-1.3E+00	-0.9229	7.75E-11
			19	19	16.085	-3.0E+01	1.4E-13	-3.4E+47	2.000	3.9E+01	9.7E+16	3.4E+47	0.000	6.4E+01	1	-6.4E+01	-1	1.2E+00	0.9147	-1.2E+00	-0.91468	1.62E-11
			20	20	16.085	-3.1E+01	2.9E-14	-3.4E+47	2.000	4.1E+01	7.6E+17	3.4E+47	0.000	6.3E+01	1	-6.3E+01	-1	1.2E+00	0.9065	-1.2E+00	-0.90647	3.37E-12

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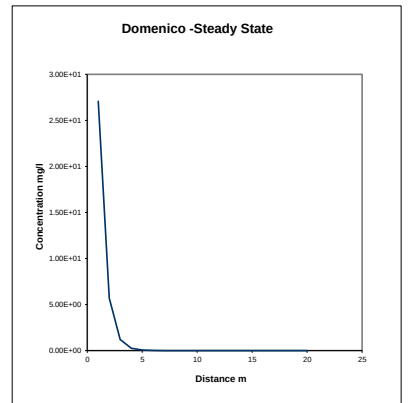


Contaminant		DOMENICO (STEADY STATE)														
Naphthalene		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)														
Input	Value	Units	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration	
C _T	0.002	mg/l	1	1	32.17	-1.56E+00	2.10E-01	2.80E+02	1	-2.80E+02	-1	2.65E+00	1	-2.65E+00	-0.9998	2.71E+01
Co	1.29E+02	mg/l	2	2	32.17	-3.12E+00	4.43E-02	1.98E+02	1	-1.98E+02	-1	1.88E+00	0.992	-1.88E+00	-0.992	5.65E+00
			3	3	32.17	-4.68E+00	9.31E-03	1.61E+02	1	-1.61E+02	-1	1.53E+00	0.97	-1.53E+00	-0.9696	1.16E+00
			4	4	32.17	-6.24E+00	1.96E-03	1.40E+02	1	-1.40E+02	-1	1.33E+00	0.939	-1.33E+00	-0.9392	2.37E-01
λ	1.13E-05	days ⁻¹	5	5	32.17	-7.79E+00	4.12E-04	1.25E+02	1	-1.25E+02	-1	1.19E+00	0.906	-1.19E+00	-0.9065	4.81E-02
Sz	5.00E+02	m	6	6	32.17	-9.35E+00	8.67E-05	1.14E+02	1	-1.14E+02	-1	1.08E+00	0.874	-1.08E+00	-0.8742	9.76E-03
Sy	1.50E+00	m	7	7	32.17	-1.09E+01	1.82E-05	1.06E+02	1	-1.06E+02	-1	1.00E+00	0.844	-1.00E+00	-0.8436	1.98E-03
Kd	3.60E+01	l/kg	8	8	32.17	-1.25E+01	3.84E-06	9.88E+01	1	-9.88E+01	-1	9.38E-01	0.815	-9.38E-01	-0.8151	4.03E-04
ρ	1.36E+00	g/cm3	9	9	32.17	-1.40E+01	8.08E-07	9.32E+01	1	-9.32E+01	-1	8.84E-01	0.789	-8.84E-01	-0.7887	8.20E-05
n	8.00E-02		10	10	32.17	-1.56E+01	1.70E-07	8.84E+01	1	-8.84E+01	-1	8.39E-01	0.764	-8.39E-01	-0.7643	1.67E-05
i	1.00E-02		11	11	32.17	-1.71E+01	3.58E-08	8.43E+01	1	-8.43E+01	-1	8.00E-01	0.742	-8.00E-01	-0.7418	3.41E-06
K	8.64E-03	m/d	12	12	32.17	-1.87E+01	7.52E-09	8.07E+01	1	-8.07E+01	-1	7.65E-01	0.721	-7.65E-01	-0.721	6.98E-07
x	2.00E+01	m	13	13	32.17	-2.03E+01	1.58E-09	7.75E+01	1	-7.75E+01	-1	7.35E-01	0.702	-7.35E-01	-0.7017	1.43E-07
z	0.00E+00	m	14	14	32.17	-2.18E+01	3.33E-10	7.47E+01	1	-7.47E+01	-1	7.09E-01	0.684	-7.09E-01	-0.6838	2.93E-08
y	0.00E+00	m	15	15	32.17	-2.34E+01	7.01E-11	7.22E+01	1	-7.22E+01	-1	6.85E-01	0.667	-6.85E-01	-0.6671	6.01E-09
			16	16	32.17	-2.49E+01	1.47E-11	6.99E+01	1	-6.99E+01	-1	6.63E-01	0.651	-6.63E-01	-0.6515	1.24E-09
ax	2.00E+00	m	17	17	32.17	-2.65E+01	3.10E-12	6.78E+01	1	-6.78E+01	-1	6.43E-01	0.637	-6.43E-01	-0.6369	2.54E-10
az	2.00E-01	m	18	18	32.17	-2.81E+01	6.53E-13	6.59E+01	1	-6.59E+01	-1	6.25E-01	0.623	-6.25E-01	-0.6232	5.23E-11
ay	2.00E-02	m	19	19	32.17	-2.96E+01	1.37E-13	6.41E+01	1	-6.41E+01	-1	6.08E-01	0.61	-6.08E-01	-0.6104	1.08E-11
			20	20	32.17	-3.12E+01	2.89E-14	6.25E+01	1	-6.25E+01	-1	5.93E-01	0.598	-5.93E-01	-0.5983	2.22E-12



Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc	Value	DOMENICO (STEADY STATE)														
		Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT														
v	1.08E-03	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration	
Rc	6.13E+02															
u	1.76E-06	m/d	1	1	32.17	-1.56E+00	2.10E-01	2.80E+02	1	-2.80E+02	-1	5.30E+00	1	-5.30E+00	-1	2.71E+01
			2	2	32.17 <th>-3.12E+00</th> <th>4.43E-02</th> <th>1.98E+02</th> <td>1</td> <td>-1.98E+02</td> <td>-1</td> <th>3.75E+00</th> <td>1</td> <td>-3.75E+00</td> <td>-1</td> <th>5.70E+00</th>	-3.12E+00	4.43E-02	1.98E+02	1	-1.98E+02	-1	3.75E+00	1	-3.75E+00	-1	5.70E+00
			3	3	32.17 <th>-4.68E+00</th> <th>9.31E-03</th> <th>1.61E+02</th> <td>1</td> <td>-1.61E+02</td> <td>-1</td> <th>3.06E+00</th> <td>1</td> <td>-3.06E+00</td> <td>-1</td> <th>1.20E+00</th>	-4.68E+00	9.31E-03	1.61E+02	1	-1.61E+02	-1	3.06E+00	1	-3.06E+00	-1	1.20E+00
			4	4	32.17 <th>-6.24E+00</th> <th>1.96E-03</th> <th>1.40E+02</th> <td>1</td> <td>-1.40E+02</td> <td>-1</td> <th>2.65E+00</th> <td>1</td> <td>-2.65E+00</td> <td>-0.9998</td> <th>2.52E-01</th>	-6.24E+00	1.96E-03	1.40E+02	1	-1.40E+02	-1	2.65E+00	1	-2.65E+00	-0.9998	2.52E-01
			5	5	32.17 <th>-7.79E+00</th> <th>4.12E-04</th> <th>1.25E+02</th> <td>1</td> <td>-1.25E+02</td> <td>-1</td> <th>2.37E+00</th> <td>0.999</td> <td>-2.37E+00</td> <td>-0.9992</td> <th>5.30E-02</th>	-7.79E+00	4.12E-04	1.25E+02	1	-1.25E+02	-1	2.37E+00	0.999	-2.37E+00	-0.9992	5.30E-02
			6	6	32.17 <th>-9.35E+00</th> <th>8.67E-05</th> <th>1.14E+02</th> <td>1</td> <td>-1.14E+02</td> <td>-1</td> <th>2.17E+00</th> <td>0.998</td> <td>-2.17E+00</td> <td>-0.9978</td> <th>1.11E-02</th>	-9.35E+00	8.67E-05	1.14E+02	1	-1.14E+02	-1	2.17E+00	0.998	-2.17E+00	-0.9978	1.11E-02
			7	7	32.17 <th>-1.09E+01</th> <th>1.82E-05</th> <th>1.06E+02</th> <td>1</td> <td>-1.06E+02</td> <td>-1</td> <th>2.00E+00</th> <td>0.995</td> <td>-2.00E+00</td> <td>-0.9954</td> <th>2.34E-03</th>	-1.09E+01	1.82E-05	1.06E+02	1	-1.06E+02	-1	2.00E+00	0.995	-2.00E+00	-0.9954	2.34E-03
			8	8	32.17 <th>-1.25E+01</th> <th>3.84E-06</th> <th>9.88E+01</th> <td>1</td> <td>-9.88E+01</td> <td>-1</td> <th>1.88E+00</th> <td>0.992</td> <td>-1.88E+00</td> <td>-0.992</td> <th>4.90E-04</th>	-1.25E+01	3.84E-06	9.88E+01	1	-9.88E+01	-1	1.88E+00	0.992	-1.88E+00	-0.992	4.90E-04
			9	9	32.17 <th>-1.40E+01</th> <th>8.08E-07</th> <th>9.32E+01</th> <td>1</td> <td>-9.32E+01</td> <td>-1</td> <th>1.77E+00</th> <td>0.988</td> <td>-1.77E+00</td> <td>-0.9876</td> <th>1.03E-04</th>	-1.40E+01	8.08E-07	9.32E+01	1	-9.32E+01	-1	1.77E+00	0.988	-1.77E+00	-0.9876	1.03E-04
			10	10	32.17 <th>-1.56E+01</th> <th>1.70E-07</th> <th>8.84E+01</th> <td>1</td> <td>-8.84E+01</td> <td>-1</td> <th>1.68E+00</th> <td>0.982</td> <td>-1.68E+00</td> <td>-0.9823</td> <th>2.15E-05</th>	-1.56E+01	1.70E-07	8.84E+01	1	-8.84E+01	-1	1.68E+00	0.982	-1.68E+00	-0.9823	2.15E-05
			11	11	32.17 <th>-1.71E+01</th> <th>3.58E-08</th> <th>8.43E+01</th> <td>1</td> <td>-8.43E+01</td> <td>-1</td> <th>1.60E+00</th> <td>0.976</td> <td>-1.60E+00</td> <td>-0.9763</td> <th>4.49E-06</th>	-1.71E+01	3.58E-08	8.43E+01	1	-8.43E+01	-1	1.60E+00	0.976	-1.60E+00	-0.9763	4.49E-06
			12	12	32.17 <th>-1.87E+01</th> <th>7.52E-09</th> <th>8.07E+01</th> <td>1</td> <td>-8.07E+01</td> <td>-1</td> <th>1.53E+00</th> <td>0.97</td> <td>-1.53E+00</td> <td>-0.9696</td> <th>9.39E-07</th>	-1.87E+01	7.52E-09	8.07E+01	1	-8.07E+01	-1	1.53E+00	0.97	-1.53E+00	-0.9696	9.39E-07
			13	13	32.17 <th>-2.03E+01</th> <th>1.58E-09</th> <th>7.75E+01</th> <td>1</td> <td>-7.75E+01</td> <td>-1</td> <th>1.47E+00</th> <td>0.962</td> <td>-1.47E+00</td> <td>-0.9625</td> <th>1.96E-07</th>	-2.03E+01	1.58E-09	7.75E+01	1	-7.75E+01	-1	1.47E+00	0.962	-1.47E+00	-0.9625	1.96E-07
			14	14	32.17 <th>-2.18E+01</th> <th>3.33E-10</th> <th>7.47E+01</th> <td>1</td> <td>-7.47E+01</td> <td>-1</td> <th>1.42E+00</th> <td>0.955</td> <td>-1.42E+00</td> <td>-0.955</td> <th>4.09E-08</th>	-2.18E+01	3.33E-10	7.47E+01	1	-7.47E+01	-1	1.42E+00	0.955	-1.42E+00	-0.955	4.09E-08
			15	15	32.17 <th>-2.34E+01</th> <th>7.01E-11</th> <th>7.22E+01</th> <td>1</td> <td>-7.22E+01</td> <td>-1</td> <th>1.37E+00</th> <td>0.947</td> <td>-1.37E+00</td> <td>-0.9472</td> <th>8.54E-09</th>	-2.34E+01	7.01E-11	7.22E+01	1	-7.22E+01	-1	1.37E+00	0.947	-1.37E+00	-0.9472	8.54E-09
			16	16	32.17 <th>-2.49E+01</th> <th>1.47E-11</th> <th>6.99E+01</th> <td>1</td> <td>-6.99E+01</td> <td>-1</td> <th>1.33E+00</th> <td>0.939</td> <td>-1.33E+00</td> <td>-0.9392</td> <th>1.78E-09</th>	-2.49E+01	1.47E-11	6.99E+01	1	-6.99E+01	-1	1.33E+00	0.939	-1.33E+00	-0.9392	1.78E-09
			17	17	32.17 <th>-2.65E+01</th> <th>3.10E-12</th> <th>6.78E+01</th> <td>1</td> <td>-6.78E+01</td> <td>-1</td> <th>1.29E+00</th> <td>0.931</td> <td>-1.29E+00</td> <td>-0.9311</td> <th>3.72E-10</th>	-2.65E+01	3.10E-12	6.78E+01	1	-6.78E+01	-1	1.29E+00	0.931	-1.29E+00	-0.9311	3.72E-10
			18	18	32.17 <th>-2.81E+01</th> <th>6.53E-13</th> <th>6.59E+01</th> <td>1</td> <td>-6.59E+01</td> <td>-1</td> <th>1.25E+00</th> <td>0.923</td> <td>-1.25E+00</td> <td>-0.9229</td> <th>7.75E-11</th>	-2.81E+01	6.53E-13	6.59E+01	1	-6.59E+01	-1	1.25E+00	0.923	-1.25E+00	-0.9229	7.75E-11
			19	19	32.17 <th>-2.96E+01</th> <th>1.37E-13</th> <th>6.41E+01</th> <td>1</td> <td>-6.41E+01</td> <td>-1</td> <th>1.22E+00</th> <td>0.915</td> <td>-1.22E+00</td> <td>-0.9147</td> <th>1.62E-11</th>	-2.96E+01	1.37E-13	6.41E+01	1	-6.41E+01	-1	1.22E+00	0.915	-1.22E+00	-0.9147	1.62E-11
			20	20	32.17 <th>-3.12E+01</th> <th>2.89E-14</th> <th>6.25E+01</th> <td>1</td> <td>-6.25E+01</td> <td>-1</td> <th>1.19E+00</th> <td>0.906</td> <td>-1.19E+00</td> <td>-0.9065</td> <th>3.37E-12</th>	-3.12E+01	2.89E-14	6.25E+01	1	-6.25E+01	-1	1.19E+00	0.906	-1.19E+00	-0.9065	3.37E-12
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DOMENICO (TIME VARIANT)

Contaminant	Naphthalene		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)															
Input	Value	Units	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration	
C _T	0.002	mg/l	1	1	16.085	-1.56E+00	2.10E-01	-3.40E+47	2	2.80E+02	1	-2.80E+02	-1	2.65E+00	0.9998	-2.65E+00	-1	2.71E+01
Co	1.29E+02	mg/l	2	2	16.085	-3.12E+00	4.43E-02	-3.40E+47	2	1.98E+02	1	-1.98E+02	-1	1.88E+00	0.992	-1.88E+00	-0.992	5.65E+00
			3	3	16.085	-4.68E+00	9.31E-03	-3.40E+47	2	1.61E+02	1	-1.61E+02	-1	1.53E+00	0.9696	-1.53E+00	-0.97	1.16E+00
			4	4	16.085	-6.24E+00	1.96E-03	-3.40E+47	2	1.40E+02	1	-1.40E+02	-1	1.33E+00	0.9392	-1.33E+00	-0.939	2.37E-01
λ	1.13E-05	days ⁻¹	5	5	16.085	-7.79E+00	4.12E-04	-3.40E+47	2	1.25E+02	1	-1.25E+02	-1	1.19E+00	0.9065	-1.19E+00	-0.906	4.81E-02
Sz	5.00E+02	m	6	6	16.085	-9.35E+00	8.67E-05	-3.40E+47	2	1.14E+02	1	-1.14E+02	-1	1.08E+00	0.8742	-1.08E+00	-0.874	9.76E-03
Sy	1.50E+00	m	7	7	16.085	-1.09E+01	1.82E-05	-3.40E+47	2	1.06E+02	1	-1.06E+02	-1	1.00E+00	0.8436	-1.00E+00	-0.844	1.98E-03
K _d	3.60E+01	l/kg	8	8	16.085	-1.25E+01	3.84E-06	-3.40E+47	2	9.88E+01	1	-9.88E+01	-1	9.38E-01	0.8151	-9.38E-01	-0.815	4.03E-04
ρ	1.36E+00	g/cm3	9	9	16.085	-1.40E+01	8.08E-07	-3.40E+47	2	9.32E+01	1	-9.32E+01	-1	8.84E-01	0.7887	-8.84E-01	-0.789	8.20E-05
n	8.00E-02		10	10	16.085	-1.56E+01	1.70E-07	-3.40E+47	2	8.84E+01	1	-8.84E+01	-1	8.39E-01	0.7643	-8.39E-01	-0.764	1.67E-05
i	1.00E-02		11	11	16.085	-1.71E+01	3.58E-08	-3.40E+47	2	8.43E+01	1	-8.43E+01	-1	8.00E-01	0.7418	-8.00E-01	-0.742	3.41E-06
K	8.64E-03	m/d	12	12	16.085	-1.87E+01	7.52E-09	-3.40E+47	2	8.07E+01	1	-8.07E+01	-1	7.65E-01	0.721	-7.65E-01	-0.721	6.98E-07
x	2.00E+01	m	13	13	16.085	-2.03E+01	1.58E-09	-3.40E+47	2	7.75E+01	1	-7.75E+01	-1	7.35E-01	0.7017	-7.35E-01	-0.702	1.43E-07
z	0.00E+00	m	14	14	16.085	-2.18E+01	3.33E-10	-3.40E+47	2	7.47E+01	1	-7.47E+01	-1	7.09E-01	0.6838	-7.09E-01	-0.684	2.93E-08
y	0.00E+00	m	15	15	16.085	-2.34E+01	7.01E-11	-3.40E+47	2	7.22E+01	1	-7.22E+01	-1	6.85E-01	0.6671	-6.85E-01	-0.667	6.01E-09
t	1.00E+100	days	16	16	16.085	-2.49E+01	1.47E-11	-3.40E+47	2	6.99E+01	1	-6.99E+01	-1	6.63E-01	0.6515	-6.63E-01	-0.651	1.24E-09
ax	2.00E+00	m	17	17	16.085	-2.65E+01	3.10E-12	-3.40E+47	2	6.78E+01	1	-6.78E+01	-1	6.43E-01	0.6369	-6.43E-01	-0.637	2.54E-10
az	2.00E-01	m	18	18	16.085	-2.81E+01	6.53E-13	-3.40E+47	2	6.59E+01	1	-6.59E+01	-1	6.25E-01	0.6232	-6.25E-01	-0.623	5.23E-11
ay	2.00E-02	m	19	19	16.085	-2.96E+01	1.37E-13	-3.40E+47	2	6.41E+01	1	-6.41E+01	-1	6.08E-01	0.6104	-6.08E-01	-0.61	1.08E-11
			20	20	16.085	-3.12E+01	2.89E-14	-3.40E+47	2	6.25E+01	1	-6.25E+01	-1	5.93E-01	0.5983	-5.93E-01	-0.598	2.22E-12

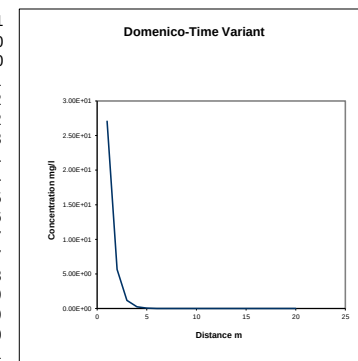
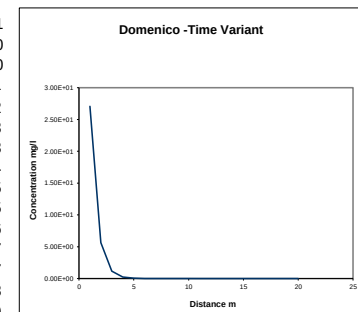
Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc		Value	Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT															
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration	
v	1.08E-03	m/d	m															
Rc	6.13E+02		1	16.085	-1.56E+00	2.10E-01	-3.40E+47	2	2.80E+02	1	-2.80E+02	-1	5.30E+00	1	-5.30E+00	-1	2.71E+01	
u	1.76E-06	m/d	2	2	16.085	-3.12E+00	4.43E-02	-3.40E+47	2	1.98E+02	1	-1.98E+02	-1	3.75E+00	1	-3.75E+00	-1	5.70E+00
			3	3	16.085	-4.68E+00	9.31E-03	-3.40E+47	2	1.61E+02	1	-1.61E+02	-1	3.06E+00	1	-3.06E+00	-1	1.20E+00
			4	4	16.085	-6.24E+00	1.96E-03	-3.40E+47	2	1.40E+02	1	-1.40E+02	-1	2.65E+00	0.9998	-2.65E+00	-1	2.52E-01
			5	5	16.085	-7.79E+00	4.12E-04	-3.40E+47	2	1.25E+02	1	-1.25E+02	-1	2.37E+00	0.9992	-2.37E+00	-0.999	5.30E-02
			6	6	16.085	-9.35E+00	8.67E-05	-3.40E+47	2	1.14E+02	1	-1.14E+02	-1	2.17E+00	0.9978	-2.17E+00	-0.998	1.11E-02
			7	7	16.085	-1.09E+01	1.82E-05	-3.40E+47	2	1.06E+02	1	-1.06E+02	-1	2.00E+00	0.9954	-2.00E+00	-0.995	2.34E-03
			8	8	16.085	-1.25E+01	3.84E-06	-3.40E+47	2	9.88E+01	1	-9.88E+01	-1	1.88E+00	0.992	-1.88E+00	-0.992	4.90E-04
			9	9	16.085	-1.40E+01	8.08E-07	-3.40E+47	2	9.32E+01	1	-9.32E+01	-1	1.77E+00	0.9876	-1.77E+00	-0.988	1.03E-04
			10	10	16.085	-1.56E+01	1.70E-07	-3.40E+47	2	8.84E+01	1	-8.84E+01	-1	1.68E+00	0.9823	-1.68E+00	-0.982	2.15E-05
			11	11	16.085	-1.71E+01	3.58E-08	-3.40E+47	2	8.43E+01	1	-8.43E+01	-1	1.60E+00	0.9763	-1.60E+00	-0.976	4.49E-06
			12	12	16.085	-1.87E+01	7.52E-09	-3.40E+47	2	8.07E+01	1	-8.07E+01	-1	1.53E+00	0.9696	-1.53E+00	-0.97	9.39E-07
			13	13	16.085	-2.03E+01	1.58E-09	-3.40E+47	2	7.75E+01	1	-7.75E+01	-1	1.47E+00	0.9625	-1.47E+00	-0.962	1.96E-07
			14	14	16.085	-2.18E+01	3.33E-10	-3.40E+47	2	7.47E+01	1	-7.47E+01	-1	1.42E+00	0.955	-1.42E+00	-0.955	4.09E-08
			15	15	16.085	-2.34E+01	7.01E-11	-3.40E+47	2	7.22E+01	1	-7.22E+01	-1	1.37E+00	0.9472	-1.37E+00	-0.947	8.54E-09
			16	16	16.085	-2.49E+01	1.47E-11	-3.40E+47	2	6.99E+01	1	-6.99E+01	-1	1.33E+00	0.9392	-1.33E+00	-0.939	1.78E-09
			17	17	16.085	-2.65E+01	3.10E-12	-3.40E+47	2	6.78E+01	1	-6.78E+01	-1	1.29E+00	0.9311	-1.29E+00	-0.931	3.72E-10
			18	18	16.085	-2.81E+01	6.53E-13	-3.40E+47	2	6.59E+01	1	-6.59E+01	-1	1.25E+00	0.9229	-1.25E+00	-0.923	7.75E-11
			19	19	16.085	-2.96E+01	1.37E-13	-3.40E+47	2	6.41E+01	1	-6.41E+01	-1	1.22E+00	0.9147	-1.22E+00	-0.915	1.62E-11
			20	20	16.085	-3.12E+01	2.89E-14	-3.40E+47	2	6.25E+01	1	-6.25E+01	-1	1.19E+00	0.9065	-1.19E+00	-0.906	3.37E-12

Date: 24/02/2020

Version: 3

Date: 24/02/2020
Version: 3





Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

This worksheet has been produced in combination with the document 'Remedial Targets Methodology: Hydrogeological risk assessment for land contamination (Environment Agency 2006).

Users of this worksheet should always refer to the User Manual to the Remedial Targets Methodology and to relevant guidance on UK legislation and policy, in order to understand how this procedure should be applied in an appropriate context.

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The calculation of equations in this worksheet has been independently checked by Entec (UK) Ltd on behalf of the Environment Agency.

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Details to be completed for each assessment			
Site Name:	Glan Llyn		
Site Address:	Llanwern		
Completed by:	Ross Cameron		
Date:	24-Feb-20	Version:	1
Contaminant	Vanadium		
Target Concentration (C_T)	0.02	mg/l	Origin of C_T: UK Standard (Statutory): Protection of Aquatic Life (Co

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for comparison with soil measurements) or mg/l (for comparison with leaching tests or pore water concentrations).

Site details entered on this page are automatically copied to Level 1, 2 and 3 Worksheets.

Worksheet options are identified by brown background and employ a pull-down menus. Data entry are identified as blue background.

Data origin / justification should be noted in cells coloured yellow and fully documented in subsequent reports.

Data carried forward from an earlier worksheet are identified by a light green background

It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

The spreadsheet also includes a porosity calculation worksheet, a soil impact calculation worksheet and a worksheet that performs some simple hydrogeological calculations.

Remedial Targets Worksheet , Release 3.2

Level 1 - Soil



Select the method of calculating the soil water
Partition Co-efficient by using the pull down menu
below

User specified value for partition coefficient

Contaminant
Target concentration

C_T

Vanadium
0.02 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

5.00E-01

fraction

0.5

Air filled soil porosity

θ_a

3.70E-01

fraction

0.0037

Bulk density of soil zone material

ρ

1.36E+00

g/cm³

1.36

Henry's Law constant

H

1.00E+00

dimensionless

1

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

1.34E+02

l/kg

1.34E+02

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

fraction

Organic carbon partition coefficient

K_{oc}

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

pH units

Acid dissociation constant

pK_a

Fraction of organic carbon (in soil)

f_{oc}

fraction

Soil water partition coefficient used in Level Assessment

K_d

1.34E+02

l/kg

Specified value

Level 1 Remedial Target

Level 1 Remedial Target

2.69E+00

mg/kg

(for comparison with soil analyses)

or

0.02

mg/l

(for comparison with leachate test results)

Site being assessed: Glan Llyn
Completed by: Ross Cameron
Date: 24-Feb-20
Version: 1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Vanadium
0.02

mg/l
from Level 1
from Level 1

This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).

The measured soil concentration as mg/kg or pore water concentration should be compared with the Level 2 remedial target to determine the need for further action. Equations presented in 'Hydrogeological risk assessment for land contamination' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value
Standard entry				
Infiltration	Inf	0.00E+00	m/d	
Area of contaminant source	A	0.00E+00	m ²	Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	0.00E+00	m	
Saturated aquifer thickness	da	0.00E+00	m	
Hydraulic Conductivity of aquifer in which dilution occurs	K	0.00E+00	m/d	
Hydraulic gradient of water table	i	0.00E+00	fraction	
Width of contaminant source perpendicular to groundwater flow	w	0.00E+00	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	
Define mixing zone depth by specifying or calculating depth (using pull down list)		Specify		
Enter mixing zone thickness	Mz	0.00E+00	m	
Calculated mixing zone thickness	Mz		m	

Calculated Parameters

Dilution Factor	DF	#DIV/0!	
Level 2 Remedial Target		#DIV/0! or #DIV/0!	mg/l mg/kg
For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration			
For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water			

Additional option

Calculation of impact on receptor

Concentration of contaminant in contaminated discharge (entering receptor)	Cc	0.00E+00	mg/l	
Calculated concentration within receptor (dilution only)		#DIV/0!	mg/l	0

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	24-Feb-20
Version:	1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant	Vanadium			from Level 1
Target Concentration	C _T	0.02	mg/l	from Level 1
Dilution Factor	DF	#DIV/0!		from Level 2

Select analytical solution (click on brown cell below, then on pull-down menu)

Ogata Banks	Equations in HRA publication
-------------	------------------------------

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to pollutants in all phases (e.g. field derived value, then on pull-down menu)

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	0	mg/kg	
Half life for degradation of contaminant in water	1.00E+100	days	
Calculated decay rate	6.93E-101	days ⁻¹	calculated
Width of plume in aquifer at source	0.00E+00	m	from Level 2
Plume thickness in aquifer at source	0.00E+00	m	from Level 2
Bulk density of aquifer materials	0.00E+00	g/cm ³	
Effective porosity of aquifer	0.00E+00	fraction	
Hydraulic gradient	#DIV/0!	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	0.00E+00	m/d	from Level 2
Distance to compliance point	0.00E+00	m	
Distance (lateral) to compliance point perpendicular to flow direction		m	
Distance (depth) to compliance point perpendicular to flow direction		m	
Time since pollutant entered groundwater	1.00E+99	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	0.00E+00	l/kg see options
Longitudinal dispersivity	ax	0.000	m see options
Transverse dispersivity	az	0.000	m see options
Vertical dispersivity	ay	0.000	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	v	#DIV/0! m/d
Retardation factor	Rf	#DIV/0! fraction
Decay rate used	λ	6.93E-101 d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	#DIV/0! fraction
Rate of contaminant flow due to retardation	u	#DIV/0! m/d
Ratio of Compliance Point to Source Concentration	C _{CP} /C ₀	#DIV/0! fraction
Attenuation factor (C ₀ /C _{CP})	AF	#DIV/0! fraction
Calculated soil leachate concentration	Co	0.00E+00 mg/l

Remedial Targets

Level 3 Remedial Target	#DIV/0!	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	0	m	For comparison with measured soil concentration. This assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{CP} /C ₀	#DIV/0! fraction	Ogata Banks

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99

Enter method of defining partition co-efficient (using pull down list)

Calculate for ionic organic chemicals (acids)

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer foc

Organic carbon partition coefficient Koc

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,n}Sorption coefficient for ionised species K_{oc,i}

pH value pH

Acid dissociation constant pKa

Fraction of organic carbon in aquifer foc

Soil water partition coefficient Kd

Define dispersivity (click brown cell and use pull down list)

User defined values for dispersivity

Enter value Calc value Xu & Eckstein

Longitudinal dispersivity ax

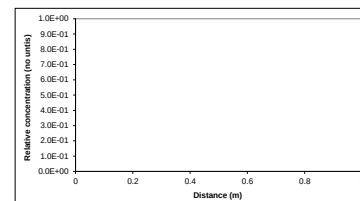
Transverse dispersivity az

Vertical dispersivity ay

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀γ^{-0.44}; az = ax/10, ay = ax/100 are assumed

Note

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used

Note: 'Relative concentration' is the ratio of calculated concentration at a given position compared to the source concentration. The calculations assume plume disperses from the top of the aquifer. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Calculated (relative) concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Relative

Concentration

Distance

concentration

Concentration

(No units)

mg/l

0

1.0E+00

#DIV/0!

#DIV/0!

#DIV/0!

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R&D Publication 20 Remedial Targets Worksheet, Release 3.2



Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	Variable	Value	Unit	Source
Target Concentration	C _T	Vanadium 2.00E-02	mg/l	from Level 1 from Level 1

Select analytical solution (click on brown cell below, then on pull-down menu)

Domenico - Steady state Equations in HRA publication

Approach for simulating vertical dispersion:

Simulate vertical dispersion in 1 direction

Select nature of decay rate (click on brown cell below, then on pull-down menu)

Approach for simulating degradation of pollutants:

Apply degradation rate to dissolved pollutants only

Initial contaminant concentration in groundwater at plume core	C ₀	1.35E+01	mg/l	
Half life for degradation of contaminant in water	t _{1/2}	9.00E+99	days	
Calculated decay rate	λ	7.70E-101	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	5.00E+02	m	Site data
Plume thickness at source	Sy	1.50E+00	m	Thickness of re-engineered MG
Saturated aquifer thickness	da	2.00E+00	m	Based upon proposed total MG and caprock
Bulk density of aquifer materials	ρ	1.36E+00	g/cm ³	Site data
Effective porosity of aquifer	n	8.00E-02	fraction	Estimate
Hydraulic gradient	i	1.00E-02	fraction	Proposed best achievable
Hydraulic conductivity of aquifer	K	8.64E-03	m/d	Site data
Distance to compliance point	x	2.00E+01	m	Site data
Distance (lateral) to compliance point perpendicular to flow direction	z		m	
Distance (depth) to compliance point perpendicular to flow direction	y		m	
Time since pollutant entered groundwater	t	1.00E+100	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	2.13E+02	l/kg	see options
Longitudinal dispersivity	ax	1.57E+00	m	see options
Transverse dispersivity	az	1.57E-01	m	see options
Vertical dispersivity	ay	1.57E-02	m	see options

Calculated Parameters Variable

Groundwater flow velocity	v	1.08E-03	m/d
Retardation factor	Rf	3.62E+03	fraction
Decay rate used	λ	2.13E-104	d ⁻¹
Rate of contaminant flow due to retardation	u	2.98E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	1.27E+01	mg/l
Attenuation factor (one way vertical dispersion, COICED)	AF	1.06E+00	

Select Method for deriving Partition Co-efficient (using pull down menu)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

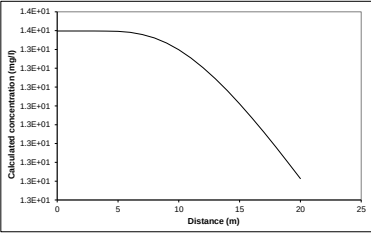
Soil water partition coefficient	Kd	2.13E+02	l/kg
Entry for non-polar organic chemicals (option)	foc		fraction
Fraction of organic carbon in aquifer	Koc		l/kg
Organic carbon partition coefficient	K _{oc,n}		l/kg
Sorption coefficient for related species	K _{oc,r}		l/kg
Sorption coefficient for ionised species	pH		fraction
pH value	pKa		fraction
acid dissociation constant	foc		fraction
Fraction of organic carbon in aquifer	Kd	2.13E+02	l/kg
Soil water partition coefficient			

Define dispersivity (click brown cell and use pull down list)

Dispersivity based on Xu & Eckstein (1995)

Longitudinal dispersivity	ax	Enter value 0.00E+00	Calc value Xu & Eckstein 2.00E+00	1.57E+00	m
Transverse dispersivity	az	0.00E+00	2.00E-01	1.57E-01	m
Vertical dispersivity	ay	0.00E+00	2.00E-02	1.57E-02	m

Note values of dispersivity must be > 0
For calculated value, assumes ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x
Xu & Eckstein (1995) report ax = 0.83(log₁₀ x)^{2.414}, az = ax/10, ay = ax/100 are assumed



Note graph assumes plume disperses vertically in one direction only. An alternative solution assuming the centre of the plume is located at the mid-depth of the aquifer is presented in the calculation sheets.

Note

This sheet calculates the Level 3 remedial target for groundwater, based on the distance to the receptor or compliance located down hydraulic gradient of the source. Three solution methods are included, the preferred option is Ogata Banks.

By setting a long travel time it will give the steady state solution, which should be used to calculate remedial targets.

The measured groundwater concentration should be compared with the Level 3 remedial target to determine the need for further action.

Note if contaminant is not subject to first order degradation, then set half life as 9.0E+99.

This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best described by an electron limited degradation such as oxidation by O₂, NO₃, SO₄ etc than an alternative solution should be used

Site being assessed:	Glan Llyn
Completed by:	Ross Cameron
Date:	#####
Version:	1

Calculated concentrations for distance-concentration graph

Domenico - Steady state

From calculation sheet

Distance	Concentration
	mg/l
0	1.35E+01
1.0	1.35E+01
2.0	1.35E+01
3.0	1.35E+01
4.0	1.35E+01
5.0	1.35E+01
6.0	1.35E+01
7.0	1.35E+01
8.0	1.35E+01
9.0	1.34E+01
10.0	1.34E+01
11.0	1.34E+01
12.0	1.33E+01
13.0	1.32E+01
14.0	1.32E+01
15.0	1.31E+01
16.0	1.30E+01
17.0	1.30E+01
18.0	1.29E+01
19.0	1.28E+01
20.0	1.27E+01

Remedial Targets

Remedial Target	2.12E-02	mg/l	For comparison with measured groundwater concentration.
Domenico - Steady state			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point	C _{ED} /C ₀	1.27E+01	mg/l Domenico - Steady state

Care should be used when calculating remedial targets using the time variant options as this may result in an overestimate of the remedial target. The recommended value for time when calculating the remedial target is 9.9E+99.

Porosity Calculator

These results are not carried through to any of the other worksheets

DRY BULK DENSITY DATA

Variable	Value	Unit	justification
Natural Moisture Content	0.00	% wt	(Change this number only if you have specific information)
Particle Density	2.78	tonnes/m ³	
Dry Bulk Density	0.00	tonnes/m ³	
Calculated Parameters			
Voids Ratio	#DIV/0!	fraction	
Initial Saturation	#DIV/0!	%	
Total porosity	1.000	fraction	
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

WET BULK DENSITY DATA

	Variable	Value	Unit	
	Moisture Content	0.00	% wt	(Change this number only if you have specific information)
	Particle Density	2.78	tonnes/m ³	
Actual (wet) Bulk Density (i.e. at natural MC)		0.00	tonnes/m ³	
Calculated Parameters				
	Voids Ratio	#DIV/0!	fraction	
	dry bulk density	0.00	tonnes/m ³	
	Initial Saturation	#DIV/0!	%	
Total porosity				#DIV/0!
Air Filled Porosity				#DIV/0!
Water Filled Porosity				#DIV/0!

Simple hydrogeological calculations

(These are not specific to, or required in, the Remedial Targets Methodology)

Parameter	symbol	unit	justification
Hydraulic conductivity	K	0.00E+00 m/d	
Hydraulic gradient	i	0.00E+00 unitless	
Effective porosity of aquifer	n	0.00E+00 fraction	
Thickness of saturated aquifer	b	0.00E+00 m	
Width of aquifer perpendicular to flow	w	0.00E+00 m	
Distance to receptor	x	0.00E+00 m	
Bulk density of aquifer materials	ρ	0.00E+00 g/cm ³	
Soil-water partition co-efficient	Kd	0.00E+00 l/kg	
Retardation factor of pollutant	R	#DIV/0!	

Groundwater flow velocity	v(GW)	#DIV/0! m/s	#DIV/0! m/day	#DIV/0! m/year
Time for groundwater to reach receptor	t(GW)	#DIV/0! seconds	#DIV/0! days	#DIV/0! years
Rate of groundwater flow through aquifer	Q	0.00E+00 m ³ /s	0.00E+00 m ³ /day	0.00E+00 m ³ /year
Contaminant flow velocity	v(contam)	#DIV/0! m/s	#DIV/0! m/day	#DIV/0! m/year
Time for contaminant to reach receptor	t(contam)	#DIV/0! seconds	#DIV/0! days	#DIV/0! years

Level 1 Calculation Sheet

Contaminant Vanadium

Parameter (carried over from input sheet)	Value	Units
C_T	2.00E-02	mg/l
Kd	1.34E+02	l/kg
foc		fraction
koc		l/kg
θ_w	5.00E-01	fraction
θ_a	3.70E-01	fraction
ρ	1.36E+00	g/cm3
H	1.00E+00	dimensionless
Koc,n		l/kg
Koc,i		l/kg
pH		pH units
pKa		
foc (ionic)		fraction

Calculations (Refer to Table 4.3, R&D Publication 20)

Selected option [User specified value for partition coefficient](#)

Calculation of partition coefficient
for ionic organic chemical

Partition coefficient used in Level 1 Assessment

1.34E+02 l/kg

Calculated Remedial Target **2.69E+00 mg/kg** **for Vanadium**

Factor (partitioning between soil and water)

1.35E+02

Site being assessed: Glan Llyn
Completed by: Ross Cameron
Date: 24/02/2020
Version: 1

Level 2 Calculation Sheet
Contaminant Vanadium

Parameter Value Units
(carried over from input sheet)

Mz	0.00E+00	m
L	0.00E+00	m
da	0.00E+00	m
Inf	0.00E+00	m/d
K	0.00E+00	m/d
i	0.00E+00	m3/d
A	0.00E+00	m2
		m3/d
Cc	0.00E+00	mg/l
C _T	2.00E-02	mg/l
Cu	0.00E+00	mg/l
w	0.00E+00	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Site assessed:	Glan Llyn
Date:	24/02/2020
Version:	1

Calculated
Dilution Factor

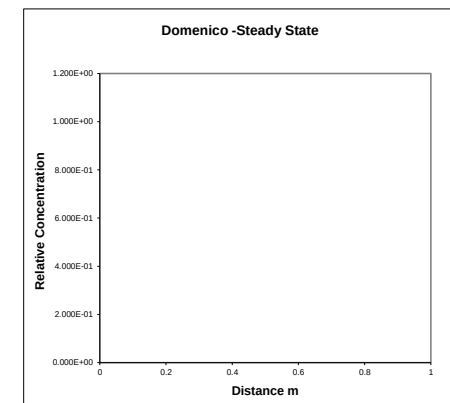
#DIV/0!

#DIV/0!

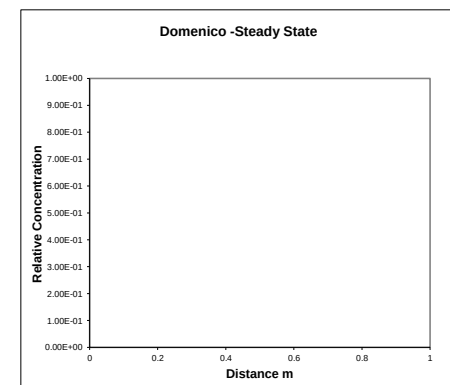


Figure 1 is a line graph titled "Ogata Banks - Time Variant". The Y-axis is labeled "Relative Concentration" and ranges from 0.00E+00 to 1.00E+00 in increments of 1.00E-01. The X-axis is labeled "Distance m" and ranges from 0 to 1 in increments of 0.1. The graph shows a single data series represented by a solid black line. The line starts at a relative concentration of 1.00E+00 at distance 0 and decreases linearly to 0.00E+00 at distance 1.

		DOMENICO (STEADY STATE)														
Contaminant		Vanadium		Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)												
Input	Value	Units		X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
C _T	2.000E-02	mg/l	1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
DF	#DIV/0!		2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
λ	6.931E-101	days ⁻¹	5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Sz	0.000E+00	m	6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Sy	0.000E+00	m	7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
Kd	0.000E+00	l/kg	8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
ρ	0.000E+00	g/cm3	9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
n	0.000E+00		10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
i	#DIV/0!		11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
K	0.000E+00	m/d	12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
x	0.000E+00	m	13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
z	0.000E+00	m	14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
y	0.000E+00	m	15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
ax	0.000E+00	m	16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
az	0.000E+00	m	17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
ay	0.000E+00	m	18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!



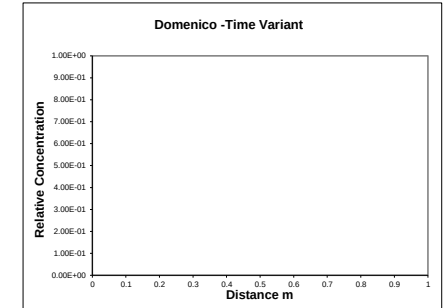
Calc	Value	DOMENICO (STEADY STATE)													
Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT															
v	#DIV/0!	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
Rc	#DIV/0!														
u	#DIV/0!	m/d	1	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			2	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			3	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			5	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			6	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			7	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			8	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			9	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			10	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			11	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			12	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			13	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			14	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			15	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			16	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			17	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
			18	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
	24/02/2020		19	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!
n:	1		20	0	0.25	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#####	#DIV/0!	#DIV/0!	#DIV/0!



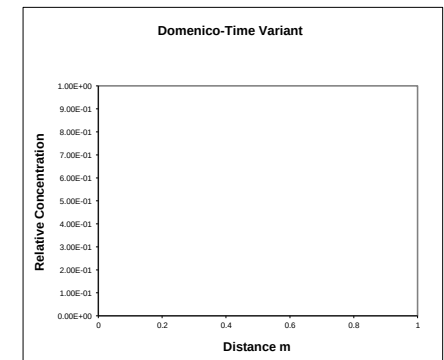
Date: 24/02/2020
Version: 1

DOMENICO (TIME VARIANT)

Contaminant	Vanadium	Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)															
Input	Value	Units	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
C _T	0.02	mg/l	1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
DF	#DIV/0!		2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
λ	6.931E-101	days ⁻¹	5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Sz	0.000E+00	m	6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Sy	0.000E+00	m	7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Kd	0.000E+00	l/kg	8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
ρ	0.000E+00	g/cm3	9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
n	0.000E+00		10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
i	#DIV/0!		11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
K	0.000E+00	m/d	12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
x	0.000E+00	m	13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
z	0.000E+00	m	14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
y	0.000E+00	m	15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
t	1.000E+99	days	16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
ax	0.000E+00	m	17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
az	0.000E+00	m	18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
ay	0.000E+00	m	19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



Calc	Value	Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT															
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
v	#DIV/0!	m/d	1	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
Rc	#DIV/0!		2	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
u	#DIV/0!	m/d	3	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			4	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			5	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			6	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			7	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			8	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			9	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			10	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			11	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			12	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			13	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			14	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			15	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			16	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			17	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			18	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			19	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!
			20	0	0.125	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!	#DIV/0!



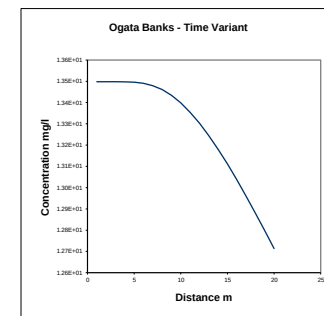
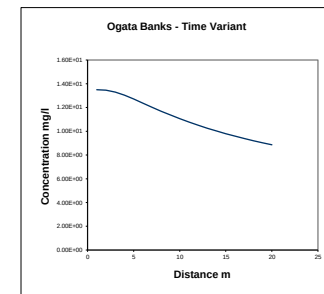
Date: 24/02/2020
Version: 1

OGATA BANKS SOLUTION																						
Contaminant		Vanadium	Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)																			
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration	
Input	Value	Units																				
C _T	0.02	mg/l	1	1	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	6.4E-01	1.9E+00	2.2E+46	0.000	3.2E+02	1	-3.2E+02	-1	3.0E+00	1	-3.0E+00	-0.99998	1.35E+01
			2	2	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.3E+00	3.6E+00	2.2E+46	0.000	2.2E+02	1	-2.2E+02	-1	2.1E+00	0.9973	-2.1E+00	-0.99726	1.35E+01
			3	3	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.9E+00	6.8E+00	2.2E+46	0.000	1.8E+02	1	-1.8E+02	-1	1.7E+00	0.9856	-1.7E+00	-0.98557	1.33E+01
Co	1.35E+01	mg/l	4	4	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	2.6E+00	1.3E+01	2.2E+46	0.000	1.6E+02	1	-1.6E+02	-1	1.5E+00	0.9659	-1.5E+00	-0.96587	1.30E+01
λ	2.13E-104	days ⁻¹	5	5	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	3.2E+00	2.4E+01	2.2E+46	0.000	1.4E+02	1	-1.4E+02	-1	1.3E+00	0.9419	-1.3E+00	-0.94189	1.27E+01
Sz	5.00E+02	m	6	6	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	3.8E+00	4.6E+01	2.2E+46	0.000	1.3E+02	1	-1.3E+02	-1	1.2E+00	0.9163	-1.2E+00	-0.91633	1.24E+01
Sy	1.50E+00	m	7	7	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	4.5E+00	8.7E+01	2.2E+46	0.000	1.2E+02	1	-1.2E+02	-1	1.1E+00	0.8907	-1.1E+00	-0.89072	1.20E+01
K _d	2.13E+02	l/kg	8	8	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	5.1E+00	1.7E+02	2.2E+46	0.000	1.1E+02	1	-1.1E+02	-1	1.1E+00	0.8659	-1.1E+00	-0.86587	1.17E+01
ρ	1.36E+00	g/cm3	9	9	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	5.7E+00	3.1E+02	2.2E+46	0.000	1.1E+02	1	-1.1E+02	-1	1.0E+00	0.8422	-1.0E+00	-0.84215	1.14E+01
n	8.00E-02		10	10	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	6.4E+00	5.9E+02	2.2E+46	0.000	1.0E+02	1	-1.0E+02	-1	9.5E-01	0.8197	-9.5E-01	-0.81971	1.11E+01
i	1.00E-02		11	11	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	7.0E+00	1.1E+03	2.2E+46	0.000	9.5E+01	1	-9.5E+01	-1	9.0E-01	0.7986	-9.0E-01	-0.79858	1.08E+01
K	8.64E-03	m/d	12	12	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	7.7E+00	2.1E+03	2.2E+46	0.000	9.1E+01	1	-9.1E+01	-1	8.6E-01	0.7787	-8.6E-01	-0.77872	1.05E+01
x	2.00E+01	m	13	13	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	8.3E+00	4.0E+03	2.2E+46	0.000	8.8E+01	1	-8.8E+01	-1	8.3E-01	0.7601	-8.3E-01	-0.76006	1.03E+01
z	0.00E+00	m	14	14	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	8.9E+00	7.6E+03	2.2E+46	0.000	8.4E+01	1	-8.4E+01	-1	8.0E-01	0.7425	-8.0E-01	-0.74253	1.00E+01
y	0.00E+00	m	15	15	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	9.6E+00	1.4E+04	2.2E+46	0.000	8.2E+01	1	-8.2E+01	-1	7.7E-01	0.726	-7.7E-01	-0.72604	9.80E+00
t	1.00E+100	days	16	16	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.0E+01	2.7E+04	2.2E+46	0.000	7.9E+01	1	-7.9E+01	-1	7.5E-01	0.7105	-7.5E-01	-0.71052	9.59E+00
ax	1.57E+00	m	17	17	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.1E+01	5.2E+04	2.2E+46	0.000	7.7E+01	1	-7.7E+01	-1	7.3E-01	0.6959	-7.3E-01	-0.69588	9.39E+00
az	1.57E-01	m	18	18	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.1E+01	9.8E+04	2.2E+46	0.000	7.4E+01	1	-7.4E+01	-1	7.1E-01	0.6821	-7.1E-01	-0.68205	9.21E+00
ay	1.57E-02	m	19	19	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.2E+01	1.8E+05	2.2E+46	0.000	7.2E+01	1	-7.2E+01	-1	6.9E-01	0.669	-6.9E-01	-0.66897	9.03E+00
			20	20	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.3E+01	3.5E+05	2.2E+46	0.000	7.1E+01	1	-7.1E+01	-1	6.7E-01	0.6566	-6.7E-01	-0.65658	8.86E+00

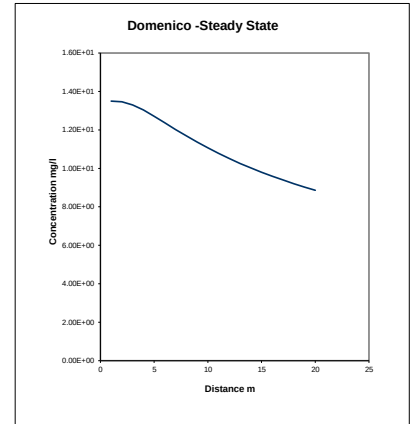
Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc			Value		Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT																		
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Concentration		
Date: 24/02/2020 Version: 1	v	1.08E-03	m/d	1	1	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	6.4E-01	1.9E+00	2.2E+46	0.000	3.2E+02	1	-3.2E+02	-1	6.0E+00	1	-6.0E+00	-1	1.35E+01
	Rc	3.62E+03		2	2	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.3E+00	3.6E+00	2.2E+46	0.000	2.2E+02	1	-2.2E+02	-1	4.2E+00	1	-4.2E+00	-1	1.35E+01
	u	2.98E-07	m/d	3	3	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.9E+00	6.8E+00	2.2E+46	0.000	1.8E+02	1	-1.8E+02	-1	3.5E+00	1	-3.5E+00	-1	1.35E+01
				4	4	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	2.6E+00	1.3E+01	2.2E+46	0.000	1.6E+02	1	-1.6E+02	-1	3.0E+00	1	-3.0E+00	-0.99998	1.35E+01
				5	5	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	3.2E+00	2.4E+01	2.2E+46	0.000	1.4E+02	1	-1.4E+02	-1	2.7E+00	0.9998	-2.7E+00	-0.99985	1.35E+01
				6	6	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	3.8E+00	4.6E+01	2.2E+46	0.000	1.3E+02	1	-1.3E+02	-1	2.4E+00	0.9995	-2.4E+00	-0.99946	1.35E+01
				7	7	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	4.5E+00	8.7E+01	2.2E+46	0.000	1.2E+02	1	-1.2E+02	-1	2.3E+00	0.9986	-2.3E+00	-0.99864	1.35E+01
				8	8	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	5.1E+00	1.7E+02	2.2E+46	0.000	1.1E+02	1	-1.1E+02	-1	2.1E+00	0.9973	-2.1E+00	-0.99726	1.35E+01
				9	9	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	5.7E+00	3.1E+02	2.2E+46	0.000	1.1E+02	1	-1.1E+02	-1	2.0E+00	0.9953	-2.0E+00	-0.99527	1.34E+01
				10	10	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	6.4E+00	5.9E+02	2.2E+46	0.000	1.0E+02	1	-1.0E+02	-1	1.9E+00	0.9926	-1.9E+00	-0.99263	1.34E+01
				11	11	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	7.0E+00	1.1E+03	2.2E+46	0.000	9.5E+01	1	-9.5E+01	-1	1.8E+00	0.9894	-1.8E+00	-0.98938	1.34E+01
				12	12	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	7.7E+00	2.1E+03	2.2E+46	0.000	9.1E+01	1	-9.1E+01	-1	1.7E+00	0.9856	-1.7E+00	-0.98557	1.33E+01
				13	13	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	8.3E+00	4.0E+03	2.2E+46	0.000	8.8E+01	1	-8.8E+01	-1	1.7E+00	0.9812	-1.7E+00	-0.98124	1.32E+01
				14	14	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	8.9E+00	7.6E+03	2.2E+46	0.000	8.4E+01	1	-8.4E+01	-1	1.6E+00	0.9765	-1.6E+00	-0.97647	1.32E+01
				15	15	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	9.6E+00	1.4E+04	2.2E+46	0.000	8.2E+01	1	-8.2E+01	-1	1.5E+00	0.9713	-1.5E+00	-0.97133	1.31E+01
				16	16	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.0E+01	2.7E+04	2.2E+46	0.000	7.9E+01	1	-7.9E+01	-1	1.5E+00	0.9659	-1.5E+00	-0.96587	1.30E+01
				17	17	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.1E+01	5.2E+04	2.2E+46	0.000	7.7E+01	1	-7.7E+01	-1	1.5E+00	0.9601	-1.5E+00	-0.96015	1.30E+01
				18	18	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.1E+01	9.8E+04	2.2E+46	0.000	7.4E+01	1	-7.4E+01	-1	1.4E+00	0.9542	-1.4E+00	-0.95421	1.29E+01
				19	19	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.2E+01	1.8E+05	2.2E+46	0.000	7.2E+01	1	-7.2E+01	-1	1.4E+00	0.9481	-1.4E+00	-0.94812	1.28E+01
				20	20	1.68725	0.0E+00	1.0E+00	-2.2E+46	2.000	1.3E+01	3.5E+05	2.2E+46	0.000	7.1E+01	1	-7.1E+01	-1	1.3E+00	0.9419	-1.3E+00	-0.94189	1.27E+01

Date: 24/02/2020
Version: 1

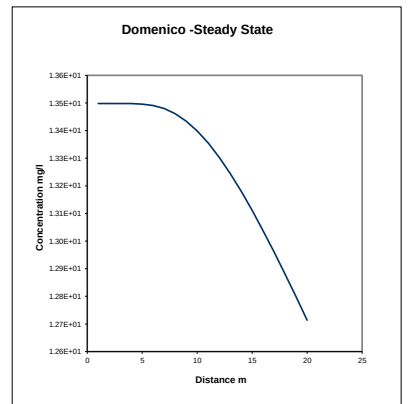


		DOMENICO (STEADY STATE)														
Contaminant	Vanadium	Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)														
Input	Value	Units	X		Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
C _T	0.02	mg/l	1	1	3.3745	0.00E+00	1.00E+00	3.16E+02	1	-3.16E+02	-1	3.00E+00	1	-3.00E+00	-1	1.35E+01
Co	2.13E-104	days ⁻¹	2	2	3.3745	0.00E+00	1.00E+00	2.23E+02	1	-2.23E+02	-1	2.12E+00	0.997	-2.12E+00	-0.9973	1.35E+01
			3	3	3.3745	0.00E+00	1.00E+00	1.82E+02	1	-1.82E+02	-1	1.73E+00	0.986	-1.73E+00	-0.9856	1.33E+01
			4	4	3.3745	0.00E+00	1.00E+00	1.58E+02	1	-1.58E+02	-1	1.50E+00	0.966	-1.50E+00	-0.9659	1.30E+01
λ	5.00E+02	m	5	5	3.3745	0.00E+00	1.00E+00	1.41E+02	1	-1.41E+02	-1	1.34E+00	0.942	-1.34E+00	-0.9419	1.27E+01
Sz	1.50E+00	m	6	6	3.3745	0.00E+00	1.00E+00	1.29E+02	1	-1.29E+02	-1	1.22E+00	0.916	-1.22E+00	-0.9163	1.24E+01
Sy	2.13E+02	l/kg	7	7	3.3745	0.00E+00	1.00E+00	1.19E+02	1	-1.19E+02	-1	1.13E+00	0.891	-1.13E+00	-0.8907	1.20E+01
Kd	1.36E+00	g/cm3	8	8	3.3745	0.00E+00	1.00E+00	1.12E+02	1	-1.12E+02	-1	1.06E+00	0.866	-1.06E+00	-0.8659	1.17E+01
ρ	8.00E-02		9	9	3.3745	0.00E+00	1.00E+00	1.05E+02	1	-1.05E+02	-1	9.99E-01	0.842	-9.99E-01	-0.8422	1.14E+01
n	1.00E-02		10	10	3.3745	0.00E+00	1.00E+00	9.99E+01	1	-9.99E+01	-1	9.47E-01	0.82	-9.47E-01	-0.8197	1.11E+01
i	8.64E-03	m/d	11	11	3.3745	0.00E+00	1.00E+00	9.52E+01	1	-9.52E+01	-1	9.03E-01	0.799	-9.03E-01	-0.7986	1.08E+01
K	2.00E+01	m	12	12	3.3745	0.00E+00	1.00E+00	9.12E+01	1	-9.12E+01	-1	8.65E-01	0.779	-8.65E-01	-0.7787	1.05E+01
x	0.00E+00	m	13	13	3.3745	0.00E+00	1.00E+00	8.76E+01	1	-8.76E+01	-1	8.31E-01	0.76	-8.31E-01	-0.7601	1.03E+01
z	0.00E+00	m	14	14	3.3745	0.00E+00	1.00E+00	8.44E+01	1	-8.44E+01	-1	8.01E-01	0.743	-8.01E-01	-0.7425	1.00E+01
y	0.00E+00	m	15	15	3.3745	0.00E+00	1.00E+00	8.15E+01	1	-8.15E+01	-1	7.74E-01	0.726	-7.74E-01	-0.726	9.80E+00
			16	16	3.3745	0.00E+00	1.00E+00	7.90E+01	1	-7.90E+01	-1	7.49E-01	0.711	-7.49E-01	-0.7105	9.59E+00
ax	1.57E+00	m	17	17	3.3745	0.00E+00	1.00E+00	7.66E+01	1	-7.66E+01	-1	7.27E-01	0.696	-7.27E-01	-0.6959	9.39E+00
az	1.57E-01	m	18	18	3.3745	0.00E+00	1.00E+00	7.44E+01	1	-7.44E+01	-1	7.06E-01	0.682	-7.06E-01	-0.6821	9.21E+00
ay	1.57E-02	m	19	19	3.3745	0.00E+00	1.00E+00	7.25E+01	1	-7.25E+01	-1	6.87E-01	0.669	-6.87E-01	-0.669	9.03E+00
			20	20	3.3745	0.00E+00	1.00E+00	7.06E+01	1	-7.06E+01	-1	6.70E-01	0.657	-6.70E-01	-0.6566	8.86E+00



Vertical dispersion optio Simulate vertical dispersion in 1 direction

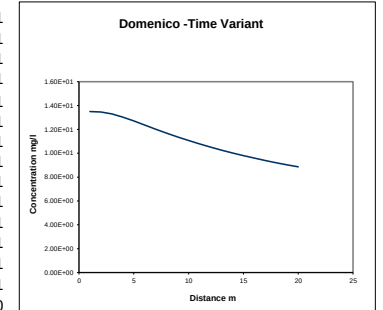
Calc	Value	DOMENICO (STEADY STATE)														
		Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT														
v	1.08E-03	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration	
Rc	3.62E+03															
u	2.98E-07	m/d	1	1	3.3745	0.00E+00	1.00E+00	3.16E+02	1	-3.16E+02	-1	5.99E+00	1	-5.99E+00	-1	1.35E+01
			2	2	3.3745	0.00E+00	1.00E+00	2.23E+02	1	-2.23E+02	-1	4.24E+00	1	-4.24E+00	-1	1.35E+01
			3	3	3.3745	0.00E+00	1.00E+00	1.82E+02	1	-1.82E+02	-1	3.46E+00	1	-3.46E+00	-1	1.35E+01
			4	4	3.3745	0.00E+00	1.00E+00	1.58E+02	1	-1.58E+02	-1	3.00E+00	1	-3.00E+00	-1	1.35E+01
			5	5	3.3745	0.00E+00	1.00E+00	1.41E+02	1	-1.41E+02	-1	2.68E+00	1	-2.68E+00	-0.9998	1.35E+01
			6	6	3.3745	0.00E+00	1.00E+00	1.29E+02	1	-1.29E+02	-1	2.45E+00	0.999	-2.45E+00	-0.9995	1.35E+01
			7	7	3.3745	0.00E+00	1.00E+00	1.19E+02	1	-1.19E+02	-1	2.26E+00	0.999	-2.26E+00	-0.9986	1.35E+01
			8	8	3.3745	0.00E+00	1.00E+00	1.12E+02	1	-1.12E+02	-1	2.12E+00	0.997	-2.12E+00	-0.9973	1.35E+01
			9	9	3.3745	0.00E+00	1.00E+00	1.05E+02	1	-1.05E+02	-1	2.00E+00	0.995	-2.00E+00	-0.9953	1.34E+01
			10	10	3.3745	0.00E+00	1.00E+00	9.99E+01	1	-9.99E+01	-1	1.89E+00	0.993	-1.89E+00	-0.9926	1.34E+01
			11	11	3.3745	0.00E+00	1.00E+00	9.52E+01	1	-9.52E+01	-1	1.81E+00	0.989	-1.81E+00	-0.9894	1.34E+01
			12	12	3.3745	0.00E+00	1.00E+00	9.12E+01	1	-9.12E+01	-1	1.73E+00	0.986	-1.73E+00	-0.9856	1.33E+01
			13	13	3.3745	0.00E+00	1.00E+00	8.76E+01	1	-8.76E+01	-1	1.66E+00	0.981	-1.66E+00	-0.9812	1.32E+01
			14	14	3.3745	0.00E+00	1.00E+00	8.44E+01	1	-8.44E+01	-1	1.60E+00	0.976	-1.60E+00	-0.9765	1.32E+01
			15	15	3.3745	0.00E+00	1.00E+00	8.15E+01	1	-8.15E+01	-1	1.55E+00	0.971	-1.55E+00	-0.9713	1.31E+01
			16	16	3.3745	0.00E+00	1.00E+00	7.90E+01	1	-7.90E+01	-1	1.50E+00	0.966	-1.50E+00	-0.9659	1.30E+01
			17	17	3.3745	0.00E+00	1.00E+00	7.66E+01	1	-7.66E+01	-1	1.45E+00	0.96	-1.45E+00	-0.9601	1.30E+01
			18	18	3.3745	0.00E+00	1.00E+00	7.44E+01	1	-7.44E+01	-1	1.41E+00	0.954	-1.41E+00	-0.9542	1.29E+01
			19	19	3.3745	0.00E+00	1.00E+00	7.25E+01	1	-7.25E+01	-1	1.37E+00	0.948	-1.37E+00	-0.9481	1.28E+01
			20	20	3.3745	0.00E+00	1.00E+00	7.06E+01	1	-7.06E+01	-1	1.34E+00	0.942	-1.34E+00	-0.9419	1.27E+01
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Version: 1

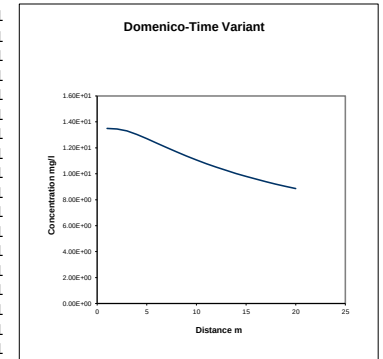
DOMENICO (TIME VARIANT)

Contaminant		Vanadium	Calculations for source located in centre of aquifer (ie vertical dispersion in two directions)														Concentration
Input	Value	Units	X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	
C _T	0.02	mg/l	m														
			1	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	3.16E+02	1	-3.16E+02	-1	3.00E+00	1	-3.00E+00	-1	1.35E+01
			2	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	2.23E+02	1	-2.23E+02	-1	2.12E+00	0.9973	-2.12E+00	-0.997	1.35E+01
			3	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.82E+02	1	-1.82E+02	-1	1.73E+00	0.9856	-1.73E+00	-0.986	1.33E+01
Co	1.35E+01	mg/l	4	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.58E+02	1	-1.58E+02	-1	1.50E+00	0.9659	-1.50E+00	-0.966	1.30E+01
λ	2.13E-104	days ⁻¹	5	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.41E+02	1	-1.41E+02	-1	1.34E+00	0.9419	-1.34E+00	-0.942	1.27E+01
Sz	5.00E+02	m	6	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.29E+02	1	-1.29E+02	-1	1.22E+00	0.9163	-1.22E+00	-0.916	1.24E+01
Sy	1.50E+00	m	7	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.19E+02	1	-1.19E+02	-1	1.13E+00	0.8907	-1.13E+00	-0.891	1.20E+01
Kd	2.13E+02	l/kg	8	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.12E+02	1	-1.12E+02	-1	1.06E+00	0.8659	-1.06E+00	-0.866	1.17E+01
ρ	1.36E+00	g/cm3	9	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.05E+02	1	-1.05E+02	-1	9.99E-01	0.8422	-9.99E-01	-0.842	1.14E+01
n	8.00E-02		10	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	9.99E+01	1	-9.99E+01	-1	9.47E-01	0.8197	-9.47E-01	-0.82	1.11E+01
i	1.00E-02		11	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	9.52E+01	1	-9.52E+01	-1	9.03E-01	0.7986	-9.03E-01	-0.799	1.08E+01
K	8.64E-03	m/d	12	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	9.12E+01	1	-9.12E+01	-1	8.65E-01	0.7787	-8.65E-01	-0.779	1.05E+01
x	2.00E+01	m	13	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	8.76E+01	1	-8.76E+01	-1	8.31E-01	0.7601	-8.31E-01	-0.76	1.03E+01
z	0.00E+00	m	14	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	8.44E+01	1	-8.44E+01	-1	8.01E-01	0.7425	-8.01E-01	-0.743	1.00E+01
y	0.00E+00	m	15	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	8.15E+01	1	-8.15E+01	-1	7.74E-01	0.726	-7.74E-01	-0.726	9.80E+00
t	1.00E+100	days	16	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.90E+01	1	-7.90E+01	-1	7.49E-01	0.7105	-7.49E-01	-0.711	9.59E+00
ax	1.57E+00	m	17	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.66E+01	1	-7.66E+01	-1	7.27E-01	0.6959	-7.27E-01	-0.696	9.39E+00
az	1.57E-01	m	18	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.44E+01	1	-7.44E+01	-1	7.06E-01	0.6821	-7.06E-01	-0.682	9.21E+00
ay	1.57E-02	m	19	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.25E+01	1	-7.25E+01	-1	6.87E-01	0.669	-6.87E-01	-0.669	9.03E+00
			20	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.06E+01	1	-7.06E+01	-1	6.70E-01	0.6566	-6.70E-01	-0.657	8.86E+00



Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc	Value	Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT																
		X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration		
v	1.08E-03	m/d	1	1	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	3.16E+02	1	-3.16E+02	-1	5.99E+00	1	-5.99E+00	-1	1.35E+01
Rc	3.62E+03		2	2	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	2.23E+02	1	-2.23E+02	-1	4.24E+00	1	-4.24E+00	-1	1.35E+01
u	2.98E-07	m/d	3	3	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.82E+02	1	-1.82E+02	-1	3.46E+00	1	-3.46E+00	-1	1.35E+01
			4	4	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.58E+02	1	-1.58E+02	-1	3.00E+00	1	-3.00E+00	-1	1.35E+01
			5	5	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.41E+02	1	-1.41E+02	-1	2.68E+00	0.9998	-2.68E+00	-1	1.35E+01
			6	6	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.29E+02	1	-1.29E+02	-1	2.45E+00	0.9995	-2.45E+00	-0.999	1.35E+01
			7	7	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.19E+02	1	-1.19E+02	-1	2.26E+00	0.9986	-2.26E+00	-0.999	1.35E+01
			8	8	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.12E+02	1	-1.12E+02	-1	2.12E+00	0.9973	-2.12E+00	-0.997	1.35E+01
			9	9	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	1.05E+02	1	-1.05E+02	-1	2.00E+00	0.9953	-2.00E+00	-0.995	1.34E+01
			10	10	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	9.99E+01	1	-9.99E+01	-1	1.89E+00	0.9926	-1.89E+00	-0.993	1.34E+01
			11	11	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	9.52E+01	1	-9.52E+01	-1	1.81E+00	0.9894	-1.81E+00	-0.989	1.34E+01
			12	12	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	9.12E+01	1	-9.12E+01	-1	1.73E+00	0.9856	-1.73E+00	-0.986	1.33E+01
			13	13	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	8.76E+01	1	-8.76E+01	-1	1.66E+00	0.9812	-1.66E+00	-0.981	1.32E+01
			14	14	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	8.44E+01	1	-8.44E+01	-1	1.60E+00	0.9765	-1.60E+00	-0.976	1.32E+01
			15	15	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	8.15E+01	1	-8.15E+01	-1	1.55E+00	0.9713	-1.55E+00	-0.971	1.31E+01
			16	16	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.90E+01	1	-7.90E+01	-1	1.50E+00	0.9659	-1.50E+00	-0.966	1.30E+01
			17	17	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.66E+01	1	-7.66E+01	-1	1.45E+00	0.9601	-1.45E+00	-0.96	1.30E+01
			18	18	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.44E+01	1	-7.44E+01	-1	1.41E+00	0.9542	-1.41E+00	-0.954	1.29E+01
			19	19	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.25E+01	1	-7.25E+01	-1	1.37E+00	0.9481	-1.37E+00	-0.948	1.28E+01
			20	20	1.68725	0.00E+00	1.00E+00	-2.18E+46	2	7.06E+01	1	-7.06E+01	-1	1.34E+00	0.9419	-1.34E+00	-0.942	1.27E+01
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Version:	1																	



Date: 24/02/2020
Version: 1



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Appendix D – Phase 4G CWDQRA

Technical Note

Project:	P18-669 Llanwern – Phase 4G		
Subject:	Phase 4G Controlled Waters Detailed Quantitative Risk Assessment Addendum		
Prepared by:	Aimee Meredith-Smith – Geo-Environmental Consultant	Date:	14/07/2025
Authorised by:	Chris Wilson – Principal Geo-Environmental Consultant	Status:	S2 - Information
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1 Introduction

1.1 General

Rodgers Leask Ltd (RLL) has been commissioned by Revantage Real Estate Ltd (Revantage) to develop a phase specific addendum Controlled Waters Detailed Quantitative Risk Assessment (CWDQRA) to assess the potential risk to Controlled Waters for Phase 4G of the Glan Llyn development at Llanwern, Newport (herein referred to as the Site).

In July 2024 the Client, St Modwen Developments was rebranded to be called Revantage Real Estate. Any reference to the previous company name in this report should be referred to accordingly.

1.2 Purpose

This report has been prepared to support the discharge of Planning Condition 27 of the Outline Planning Permission Reference 06/0471 for the proposed development of residential development Phase 4G as part of a wider mixed-use development at Llanwern, Newport.

Planning Condition 27 states the following.

“(27) Prior to the commencement of each phase of development as defined by Condition 03 (or at such other date or stage in development or for such specified activities or works as may be agreed in writing with the Local Planning Authority), the following components of a scheme to deal with the risks associated with contamination relating to that phase or activity shall each be submitted to and approved, in writing, by the Local Planning Authority:

- (1) A preliminary risk assessment which has identified:
 - (a) all previous uses;*
 - (b) potential contaminants associated with those uses;*
 - (c) a conceptual model of the site indicating sources, pathways and receptors;*
 - (d) potentially unacceptable risks arising from contamination at the site.**
- (2) A site investigation scheme, based on (1) to provide information for a detailed assessment of the risk to all receptors that may be affected, including those off site.*
- (3) The site investigation results and the detailed risk assessment (2) and, based on these, an options appraisal and remediation strategy giving full details of the remediation measures required and how they are to be undertaken.*
- (4) A verification plan providing details of the data that will be collected in order to demonstrate that the works set out in (3) are complete and identifying any requirements for longer term monitoring of pollutant linkages, maintenance and arrangements for contingency action. Any changes to these components require the express consent of the Local Planning Authority.*

Reason: To ensure that the proposed development will not cause pollution of the environment or harm to human health."

1.3 Objectives and Scope

The objectives and scope of this report are to assess the soil chemical testing results obtained during previous ground investigations, within the Site, against the soil re-use criteria presented in H F Consulting's Soils Validation Strategy and to discuss the suitability of the soils for retention as part of the proposed remedial works.

1.4 Sources of Information

The following documents have been reviewed in preparation of this technical note, and should be read in conjunction with it:

- RLL, Updated Controlled Waters Detailed Quantitative Risk Assessment, Glan Llyn, ref. 18669-RLE-19-RP-O-0006, dated June 2022
- RLL, Phase 4G Desk Study & Phase 2 Geo-Environmental Report, ref. 18669-RLL-25-XX-RP-O-0753-P01, dated July 2025.
- H F Consulting, Glan Llyn: Soils validation strategy for protection of controlled waters (30937 R2), dated December 2024.

2 Site Information

2.1 Site Setting

The Site is located within the Glan Llyn development at the former Llanwern Steelworks, approximately 5.3km to the east of Newport City Centre at approximate National Grid Reference 336106E, 186676N. The wider Glan Llyn development covers approximately 250 hectares and is proposed to be redeveloped for residential, commercial and open space use.

The Site covers an area of approximately 4.70ha and is located in the approximate centre of the wider Glan Llyn development. The Site historically comprised agricultural land segregated into three fields by hedgerows and drains, until 1967 when the Site formed part of Llanwern Steelworks. The Site housed a sinter plant along with associated infrastructure and various conveyors and pipelines, in addition to roads and an open space area. Drain 3, a historical below ground box culvert, was located on the western side of the Site orientated north-south. The Site was partially demolished by 2004 and fully demolished by 2021.

The Site boundary is shown on Drawing 18669-RLL-22-XX-DR-O-0388, the site illustrative masterplan is presented on Drawing ref. 8111-08-A012, both presented in **Appendix A**.

2.2 Geology

Information pertaining to the underlying ground conditions at the Site has been obtained via the BGS Onshore Geoindex¹. The published geological information shows the Site to be void of Made Ground. However, due to the Site's history, Made Ground is likely to be present associated with the previous development and subsequent demolition.

Superficial deposits are shown to comprise Tidal Flat Deposits.

Tidal Flat Deposits are described by the BGS as *'unconsolidated sediment, mainly mud and/or sand. They may form the top surface of a deltaic deposit. Normally a consolidated soft silty clay, with layers of sand, gravel and peat.'*

The underlying bedrock is shown to be the Mercia Mudstone Group.

The Mercia Mudstone Group is described by the BGS as comprising *'predominantly red, less commonly green-grey, mudstones and subordinate siltstones with thick halite bearing units in some basinal areas. Thin beds of gypsum/anhydrite are widespread; sandstones are also present'*.

¹ <http://mapapps2.bgs.ac.uk/geoindex/home.html>

There is an inferred fault approximately 900m northeast of the Site which trends roughly north to south and extends northwards away from Site.

2.3 Encountered Ground Conditions

One ground investigation has been undertaken by Atkins in 2018 which covered the Site and two neighbouring phases. As part of this ground investigation 46 trial pits were excavated within the Site area. Detailed information is available in the RLL Phase 4G Desk Study and Ground Investigation Report (**Appendix C**).

The following table provides a summary of the exploratory holes that were situated within the Site boundary.

Summary of Historical Exploratory Holes within the Site Boundary	
Report	Exploratory Holes
Atkins (2018)	46 Trial Pits (4C-G4, 4C-G5, 4C-G6, 4C-H1, 4C-H2, 4C-H4, 4C-H5, 4C-H6, 4C-I1, 4C-I2, 4C-I3, 4C-I4, 4C-I5, 4C-I6, 4C-I7, 4C-J1, 4C-J2, 4C-J3, 4C-J4, 4C-J5, 4C-K2, 4E-C1, 4E-C2, 4E-D1, 4E-D2, 4E-E2, 4E-B4, 4E-C4, 4E-D4, 4E-E4, 4E-E5, 4E-E6, 4E-E7, 4E-G4, 4E-F6, 4E-A8, 4G-B8, 4G-A7, 4G-B9, 4E-A7, 4E-B7, 4E-D7, 4E-C7, 4G-A6, 4G-B5 and 4G-B6)

The ground investigation found the Site to be underlain by Made Ground overlying Tidal Flat Deposits, encountered from ground level to 3.30m depth.

Surfacing of tarmac was encountered in two locations from ground level to 0.10m.

The general Made Ground typically comprised gravelly occasionally ashy SAND, sandy clayey GRAVEL, sandy SILT or sandy gravelly and occasionally loamy CLAY, with occasional to frequent cobbles. Gravel and cobble components typically comprised concrete, brick, iron ore, slag, mudstone, coke, tarmac, siltstone, steel slag and furnace slag.

Tidal Flat Deposits were generally described as soft brown PEAT or soft to firm silty CLAY.

The Mercia Mudstone Group bedrock was not encountered during the intrusive investigation.

2.4 Post-construction ground conditions

The following table provides an anticipated post-construction ground model.

Post-Development Ground Conditions		
Unit	Approximate Thickness	Description
Impermeable Construction Materials/	0.6m	Imported clean topsoil/

Housing Sub-base/Permeable Topsoil		construction materials
Piling Mat*	0.5m	Imported 6F2 (*may be included within 600mm of construction materials)
Made Ground	1.5 – 2.0m	Excavated and re-compacted Made Ground
Tidal Flat Deposits	7.0 – 10.0m	No change from current conditions
Bedrock (Mercia Mudstone Group)	>1,350m	No change from current conditions

In accordance with the assumptions of the 2019 RLL CWDQRA, further mitigation to promote lateral flow is the provision of a drainage blanket to cap the reengineered material (including piling mat) which will increase the fall from the centre of a plot to periphery.

2.5 Historical Groundwater Monitoring and Wider Site Hydrogeology

A summary of pre-reclamation groundwater levels is presented in the Phase 4G Desk Study & Phase 2 Geo-Environmental Report. Groundwater levels recorded during the pre-reclamation ground investigations across the development suggest that the groundwater is present beneath the wider Glan Llyn development as follows:

- Shallow/ perched groundwater within the Made Ground (shallow boreholes); and
- Groundwater within the Tidal Flat Deposits (confined to the basal sand layers) and Mercia Mudstone (deep boreholes).

The shallow perched groundwater described above was recorded during pre-reclamation conditions. The earthworks on the phase include the reengineering of the Made Ground, this shallow perched groundwater shall no longer be present.

Groundwater monitoring within the deep boreholes was considered to be primarily derived from the bedrock geology, and hydraulic continuity between the upper perched shallow groundwater and 'regional' groundwater was considered likely to be limited. Post-development, the excavation and re-compaction of the Made Ground was recognised as likely to reduce its permeability, lowering still further, the hydraulic continuity.

3 Controlled Waters Detailed Quantitative Risk Assessment

3.1 Introduction

In 2019 RLL were commissioned by St Modwen to prepare a Controlled Waters Detailed Quantitative Risk Assessment (CWDQRA) for the wider Glan Llyn development, report reference 18669-RLE-19-RP-O-0006, dated June 2022. This assessment was considered to be an update to and further development of Atkins Limited (Atkins), CWDQRA, Document Reference: 5111373-LLA-OUT-0257, Version: 3, dated February 2017.

The principal objectives of the 2019 RLL CWDQRA, as practicably as possible, was to provide compliant future surface water flow contributions from private drainage system on the wider Glan Llyn development (following the redevelopment for mixed residential and commercial end use) upon entry into the Monks' Ditch. It was also to improve sustainability and further limit the amount of material which requires off-site removal by virtue of its contaminative potential towards local Controlled Waters.

With the aim generating a streamlined and consistent process for the Phase-by-Phase reporting process, in 2024 H Fraser Consulting Ltd. were commissioned to build on the findings of the CWDQRA and produce a Soils Validation Strategy for the Protection of Controlled Waters (30937 R2).

A summary of the reporting relating to controlled waters on the development are presented in the following sections.

The area of the development this assessment covers, which includes the Site, is presented on RLL drawing reference 18669-RLE-19-XX-DR-O-0004 in **Appendix A**.

3.2 RLL CWDQRA Summary

In 2019 RLL prepared a Controlled Waters Detailed Quantitative Risk Assessment (CWDQRA) for the wider Glan Llyn development site. This assessment incorporated a comprehensive dataset of concentrations of contamination recorded in soils across the development, included data taken from the 2018 investigations within the Site. Screening analysis of soil, soil leachate, groundwater and surface water data revealed potential moderate to low levels of inorganic and organic contamination present onsite in line with contaminants associated with former steelworks sites. Made Ground comprising clayey sandy gravels with local slag, burnt shale, tarmac, concrete, brick and mudstone was found to be a potential source of contamination. Calculation of representative re-use criteria for a residential with plant uptake end use was undertaken using a dilution assessment methodology based on the site-wide water balance, incorporating site specific permeability and infiltration parameters. No allowance was made for dilution of

discharged waters within Monks' Ditch itself as part of this calculation as, this being the receptor, it is proposed that the water quality in this Controlled Water be maintained (as far as possible) at EQS values.

Comparison of re-use criteria against available soil chemical testing established that the much of the Made Ground was likely to be suitable for re-use onsite, however, localised source materials existed containing higher concentrations of contamination (particularly elevated concentrations of iron, manganese and vanadium), and ammoniacal and cyanide components, may require remediation, or offsite disposal.

Further modelling of these contaminants was undertaken using Remedial Target Methodology (RTM) to assess the potential extent of attenuation of these specific determinands within the ground where these soils may be placed, with the receiving surface waters being assumed to be existing blueways (reens), which were considered as the Compliance Points. The compliance point for the Residential Development has been assigned to the point of discharge into the receptor Monks' Ditch and will require an enacted permit for discharge to occur.

Initial modelling was carried out by Atkins (Glan Llyn, Llanwern Controlled Waters Detailed Quantitative Risk Assessment dated February 2017), with this approach being adopted within later revisions of this Report in the Rodgers Leask, Controlled Waters Detailed Quantitative Risk Assessment, Glan Llyn (sitewide) Update (2019), using the Equation presented in the EA Table 5.2 – soil-water partitioning of the EA Remedial Targets Methodology Guidance (2006) where a pore-water concentration (C_p) was determined from soil concentration analyses to derive soil reuse criteria at the site as a whole. Subsequently, and purely to gauge the potential distance that re-engineered Made Ground could be placed from the respective Compliance Point(s), further modelling was carried out for specific determinands using the EA RT Excel Worksheets, based on maximum and average soils concentrations determined within samples of re-engineered Made Ground and available site derived data.

Further modelling was carried out for specific determinands (including specific PAHs) using the EA Remedial Target Excel Worksheets, based on maximum and average soils concentrations did indicate that there was little attenuation of the initial porewater PAH concentrations on migration within the re-engineered Made Ground toward the nearest reen Receptors. However, the presence of elevated porewater PAH concentrations was only theoretical and based on calculated values derived using the Equation presented in the EA Table 5.2 – soil-water partitioning of the EA Remedial Targets Methodology Guidance (2006). Actual PAH concentrations determined more recently in groundwater samples recovered (where sufficient groundwater was available for sampling purposes), were generally lower, and potentially significantly lower, than the calculated values which were derived using soils analyses data. Additionally, as previously mentioned, there was little evidence obtained of hydraulically continuous groundwater horizon(s) within the re-engineered Made Ground beneath areas proposed for residential and commercial

development. Therefore, there have been no proven PAH (or other contaminant) migration pathways towards the reens.

As the data used within the CWDQRA has utilised ground investigation data taken from within the Site, it is therefore considered that the findings of this assessment are representative of the Site and therefore adoption of the calculated re-use criteria and recommendations presented within the CWQRA are appropriate.

3.3 HFCL Glan Llyn: Soils Validation Strategy for Protection of Controlled Waters

Following queries from Natural Resources Wales (NRW), H Fraser Consulting Limited (HFCL) were commissioned by RLL to assist with NRW liaison and reporting pursuant to the discharge of PC28. Following discussion with NRW, RLL and the developer, HFCL prepared a revised methodology for the validation of soils in relation to the protection of controlled waters.

The assessment does not rely on groundwater analysis, being dependent rather on soil re-use values. It included distance specific remedial targets that model the attenuation of contaminants in the saturated zone allowing for advection, dispersion, retardation and decay during transport. In addition to the inclusion of distance specific remedial targets, further statistical and spatial analysis was carried out on contaminants of concern.

More detail is provided in the HFC Glan Llyn: Soils Validation Strategy for the Protection of Controlled Waters (30937 R2).

4 Comparison of Phase 4G and CWDQRA Dataset

The dataset utilised in the RLL CWDQRA was taken from soil samples from the wider Glan Llyn development site which included the Site area. A comparison of the residential CWDQRA dataset with the soil samples taken from within the Site has been undertaken.

The purpose of this comparison is to establish if the residential dataset used in the CWDQRA is representative of concentrations of contamination present within Site and therefore whether the derived re-use criteria and recommendations of this assessment are applicable to the Site or whether further assessment is required.

4.1 Phase 4G Sampling

140 soil samples were collected from the Site during the 2018 Atkins ground investigation for contamination testing, taken from the Made Ground and Superficial Deposits. The works comprised trial pitting to collect soil samples for chemical and geotechnical testing. Of the 140 soil samples collected, 103 were taken from the Made Ground and 37 of the natural ground (Tidal Flat Deposits).

The samples were tested for heavy metals, polycyclic aromatic hydrocarbons (PAH), total petroleum hydrocarbon (TPH), gasoline range organics (GROs), BTEX, pH, soil organic matter (SOM), cyanide, phenols, ammoniacal nitrogen and select samples were also tested for asbestos.

4.2 Comparison of Results

Determinand	Samples from Phase 4G – Residential Area			Samples from CWDQRA - Residential Area			Considered Representative e of CWDQRA data (Yes/No)
	Maximum Soil Sample Value* (mg/kg)	Average Soil Sample Value* (mg/kg)	95 th Percentile Soil Sample Value* (mg/kg)	Maximum Soil Sample Value (mg/kg)	Average Soil Sample Value* (mg/kg)	95 th Percentile Soil Sample Value* (mg/kg)	
Inorganic Metals and Metalloids							
Arsenic	141.00	11.78	18.43	397.00	12.18	21.89	Y
Cadmium	3.48	0.31	1.20	31.30	0.65	2.37	Y
Chromium	810.00	129.11	466.05	3090.00	138.89	590.80	Y
Copper	286.00	23.48	44.48	1790.00	25.19	52.07	Y
Iron	352000	97927	217150	2390000	103039	277000	Y
Lead	144.00	40.67	98.07	4220.00	91.58	231.85	Y
Manganese	49400	9218	32430	408000	9574	33520	Y
Mercury	2.17	0.62	1.40	6.24	0.68	1.40	Y
Nickel	238.00	24.80	43.00	313.00	25.73	44.90	Y
Selenium	24.30	6.10	16.57	51.70	6.09	16.67	Y
Vanadium	1890.00	181.60	512.15	2880.00	206.93	693.10	Y
Zinc	864.00	165.68	423.20	13300.00	291.45	784.75	Y

Determinand	Samples from Phase 4G – Residential Area			Samples from CWDQRA - Residential Area			Considered Representative e of CWDQRA data (Yes/No)
	Maximum Soil Sample Value* (mg/kg)	Average Soil Sample Value* (mg/kg)	95 th Percentile Soil Sample Value* (mg/kg)	Maximum Soil Sample Value (mg/kg)	Average Soil Sample Value* (mg/kg)	95 th Percentile Soil Sample Value* (mg/kg)	
Other Inorganics							
Ammoniacal Nitrogen	141.00	11.78	18.53	1590.00	60.97	263.00	Y
Cyanide	20.90	1.54	1.45	272.00	2.32	4.05	Y
Organics							
Benzene	0.18	0.09	0.10	0.12	0.04	0.04	Y
Toluene	0.14	0.07	0.14	0.07	0.01	0.02	Y
Ethylbenzene	0.10	0.04	0.80	0.02	0.01	0.01	Y
Xylene	0.21	0.10	0.20	0.11	0.01	0.01	Y
Phenol	0.10	0.01	0.01	1.21	0.02	0.03	Y
TPH Criteria Working Group							
Aliphatics >C5-C6	0.20	0.02	0.02	0.92	0.03	0.04	Y
Aliphatics >C6-C8	3.32	0.05	0.06	3.32	0.04	0.09	Y
Aliphatics >C8-C10	46.70	0.39	0.20	74.20	0.20	0.12	Y
Aliphatics >C10-C12	112.00	0.93	0.75	987.00	2.55	0.35	Y
Aliphatics >C12-C16	177.00	6.76	34.35	514.00	5.26	16.47	Y
Aliphatics >C16-C21	194.00	19.07	83.86	3530.00	26.92	83.07	Y
Aliphatics >C21-C35	821.00	79.37	341.45	2980.00	64.53	174.70	Y
Aliphatics >C35-C44	417.00	31.19	99.18	913.00	20.37	68.99	Y
Aromatics >EC5-EC7	0.20	0.02	0.02	5.26	0.03	0.04	Y
Aromatics >EC7-EC8	0.37	0.02	0.02	20.30	0.05	0.04	Y
Aromatics >EC8-EC10	31.10	0.26	0.13	49.50	0.14	0.10	Y
Aromatics >EC10-EC12	112.00	0.91	0.50	658.00	1.71	0.24	Y
Aromatics >EC12-EC16	177.00	4.83	10.55	5280.00	13.62	24.72	Y
Aromatics >EC16-EC21	213.00	18.36	57.83	9800.00	56.85	165.55	Y
Aromatics >EC21-EC35	561.00	92.00	361.35	9010.00	122.76	440.85	Y
Aromatics >EC35-EC44	597.00	49.49	151.4	1580.00	40.69	150.00	Y
Polyaromatic Hydrocarbons							
Acenaphthylene	1.39	0.11	0.45	2100.00	3.08	3.18	Y
Acenaphthene	0.49	0.05	0.16	193.00	0.47	0.41	Y
Anthracene	2.83	0.20	0.67	1860.00	3.61	5.48	Y
Benz(a)anthracene	8.90	0.79	2.59	1150.00	4.64	1.61	Y
Benzo(a)pyrene	8.46	0.83	2.94	714.00	3.73	10.58	Y
Benzo(b)fluoranthene	12.90	1.15	4.43	1110.00	5.28	15.87	Y
Benzo(k)fluoranthene	3.69	0.42	1.59	373.00	2.08	5.96	Y
Benzo(g,h,i)perylene	5.81	0.62	2.00	333.00	2.51	7.27	Y
Chrysene	7.02	0.78	2.74	1090.00	4.22	11.47	Y
Dibenzo(a,h)anthracene	1.49	0.17	0.54	177.00	0.74	1.86	Y
Indeno(1,2,3-cd)pyrene	5.77	0.62	2.06	374.00	2.61	7.46	Y
Fluoranthene	16.60	1.42	5.19	2940.00	11.59	29.56	Y
Fluorene	1.11	0.08	0.26	1890.00	2.81	2.72	Y
Naphthalene	1.21	0.17	0.46	4680.00	10.98	5.66	Y
Phenanthrene	10.30	0.77	2.76	3810.00	9.79	18.03	Y
Pyrene	13.10	1.16	3.93	1.95	0.01	0.03	Y

A review of the datasets has shown that the contaminants largely show similar or lower concentration ranges for the Site and for the wider Glan Llyn development site utilised within the CWDQRA. The results are therefore considered to be representative of the levels of contamination present within the Site and therefore adoption of the calculated

re-use criteria and recommendations presented within the CWDQRA are appropriate for the Site.

Occasional contaminants have higher 95th percentile concentrations within the Site when compared to the DQRA dataset, however given the marginal difference this is not considered to affect the conclusions of the CWDQRA.

In addition, given the values were lower than the relevant reuse criteria, their relatively low mobility and the distance of the Site from existing and future surface waters then it is considered that this shouldn't have a detrimental impact on the conclusions of the CWDQRA.

4.3 Comparison to H Fraser Consulting re-use criteria

The samples collected for the Site, as part of the RLL ground investigation, have subsequently been assessed against the H F Consulting agreed soil re-use values for a residential end use as outlined in the Soils Validation Strategy for the Protection of Controlled Waters. A summary of exceedances is presented in the table below, and the chemical screening results are presented in full in **Appendix B**.

Summary of Exceedances of H Fraser Consulting Reuse Criteria for a Residential End Use				
Contaminant	No. of Exceedances	Location of Exceedances (Depth in m)	Concentration Range (mg/kg)	Screening Value (mg/kg)
Cyanide (Total)	6	4E-D2 (0.25), 4E-D2 (1.00), 4E-E4 (0.50), 4E-E4 (1.00), 4E-E4 (1.50), 4E-E6 (0.80)	3.56 – 20.90	2.02
Iron (Total)	1	4C-G6 (1.00)	352000.00	30500.00
Manganese	6	4C-G4 (1.80), 4C-J4 (1.00), 4C-J4 (1.40), 4E-D2 (1.00), 4E-D4 (1.20), 4E-E7 (0.80)	34400.00 – 49400.00	33300.00
Vanadium	1	4C-G4 (1.80)	1890.00	1606.00

The results show that with the exception of total cyanide, iron (total), manganese and vanadium there are no exceedances of the reuse criteria recorded during the 2018 ground investigation. The location of exceedances are shown on RLL Drawing 18669-RLL-25-XX-DR-O-0762-P01, **Appendix A**.

Recorded exceedances shall be managed, via the earthworks operation, in accordance with the HFC Glan Llyn: Soils Validation Strategy for the Protection of Controlled Waters.

Soil chemical testing certificates are presented within the RLL Phase 4G Desk Study and Ground Investigation Report (18669-RLL-25-XX-RP-O-0753-P01).

5 Conclusion

In 2021 RLL submitted a CWDQRA for the wider Glan Llyn development site. This assessment incorporated a comprehensive dataset of concentrations of contamination recorded in soils across the development. Further assessment has been undertaken comparing soil concentrations recorded within the Site area with those of the wider residential Glan Llyn development site used in the CWDQRA.

This assessment has concluded that the dataset used in the CWDQRA is largely representative of the levels of contamination present within the Site and therefore adoption of the calculated re-use criteria and recommendations presented within the CWDQRA are appropriate for the Site.

Following an assessment of soil chemical testing data from within the Site, exceedances of the reuse criteria for total cyanide, iron (total), manganese and vanadium have been identified that may represent a risk to Controlled Waters.

The soil reuse criteria have been conservatively calculated considering only dilution of contamination by intercepted surface water from the finished development. In reality subsurface degradation and attenuation will occur as these contaminants migrate laterally through the ground, further reducing their concentrations prior to dilution within the on-site private drainage system.

It is recommended that further delineation and assessment of the identified exceedances of total cyanide, iron (total), manganese and vanadium (as shown on RLL Drawing 18669-RLL-25-XX-DR-O-0762-P01) are undertaken as part of the remediation works, with unsuitable material being removed as necessary, in order to ensure that they do not present a risk to controlled waters.

A Remediation Strategy has been prepared for Phase 4G (18669-RLL-25-XX-RP-O-0757-P01) outlining required remedial measures for the Site.

Appendix A: Drawings



GENERAL NOTES

NO DIMENSIONS TO BE SCALED OFF THIS DRAWING.
THIS DRAWING TO BE READ IN CONJUNCTION WITH ALL RELEVANT ARCHITECT'S AND ENGINEER'S DRAWINGS.
ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
ALL LEVELS ARE IN METRES UNLESS NOTED OTHERWISE.
ANY DISCREPANCIES NOTED ON SITE ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.

KEY:

Approximate Site Boundary

Rev	Date	Amendments	By	Chk



Client
St Modwen Developments

Project
P18-669 Llanwern Reclamation

Drawing Title
Phase 4G
Site Location Plan

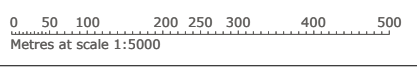
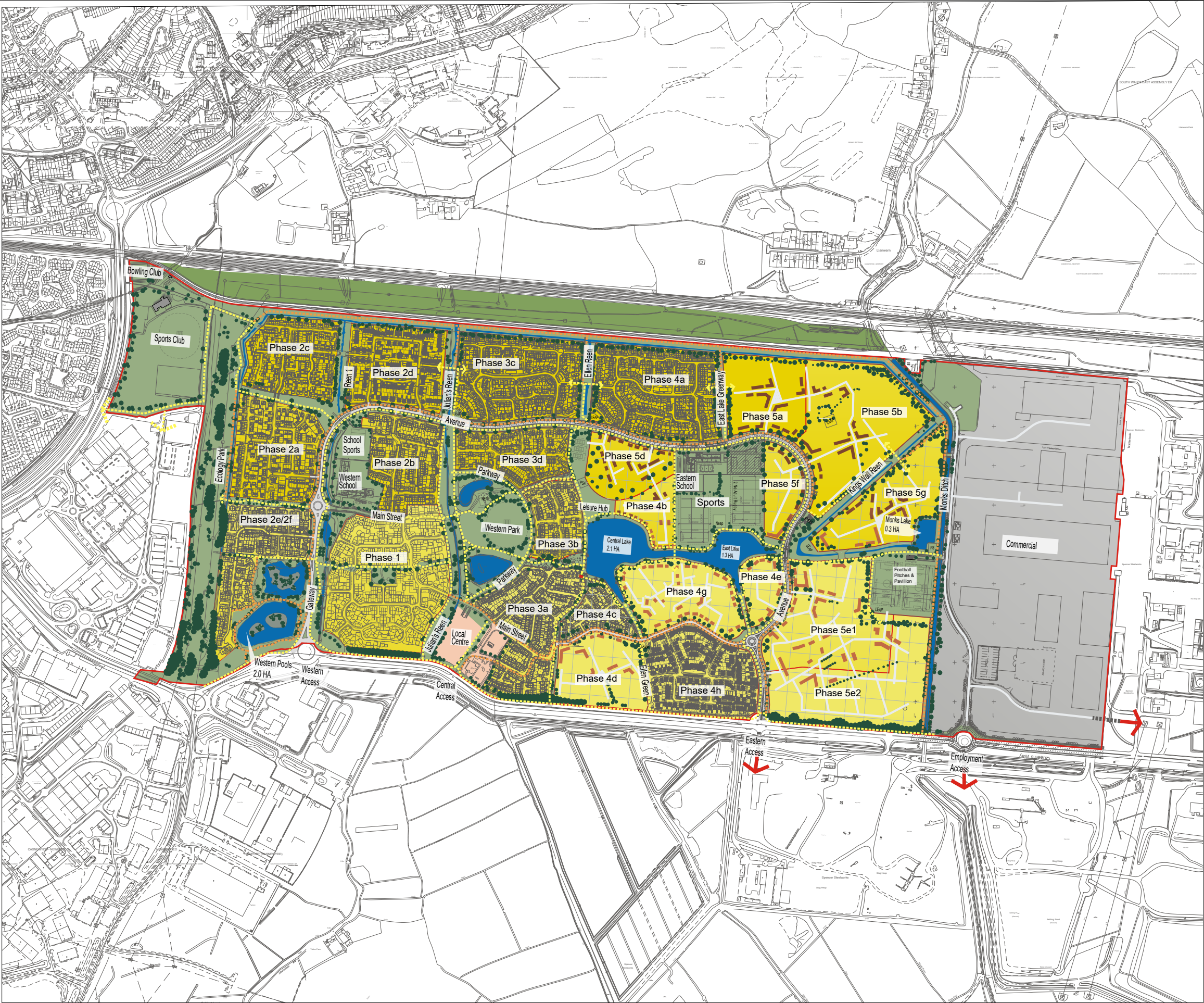
INFORMATION

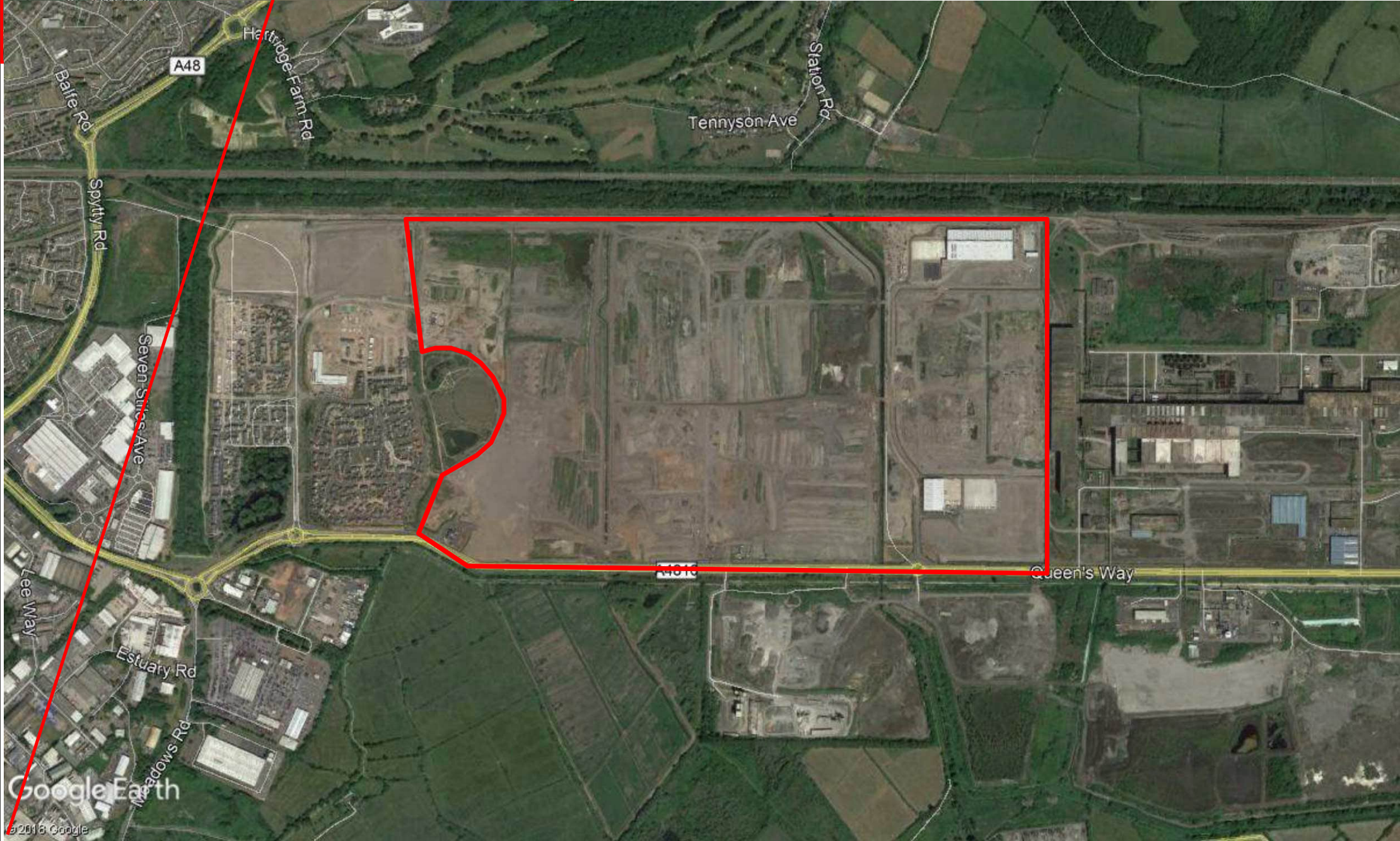
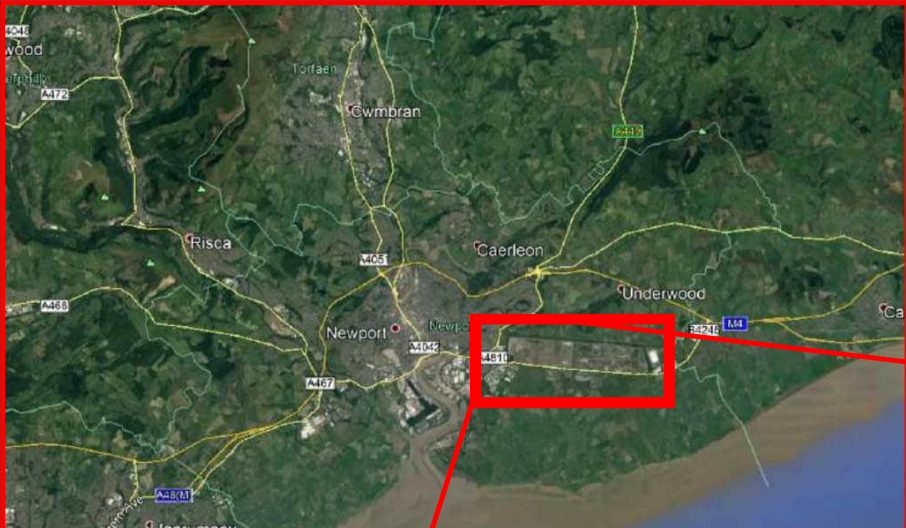
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1:1250 @ A1	SR	CW	20.12.22

Drawing No.
18669-RLL-22-XX-DR-O-0388

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Glan Llyn -ESAMP Indicative Masterplan





GENERAL NOTES

NO DIMENSIONS TO BE SCALED OFF THIS DRAWING

THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL RELEVANT RCHITECTS AND ENGINEER'S DRAWINGS

ANY DISCREPANCIES NOTED ON SITE ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY

Key

 Redline boundary



CLIENT

ST. MODWEN DEVELOPMENTS

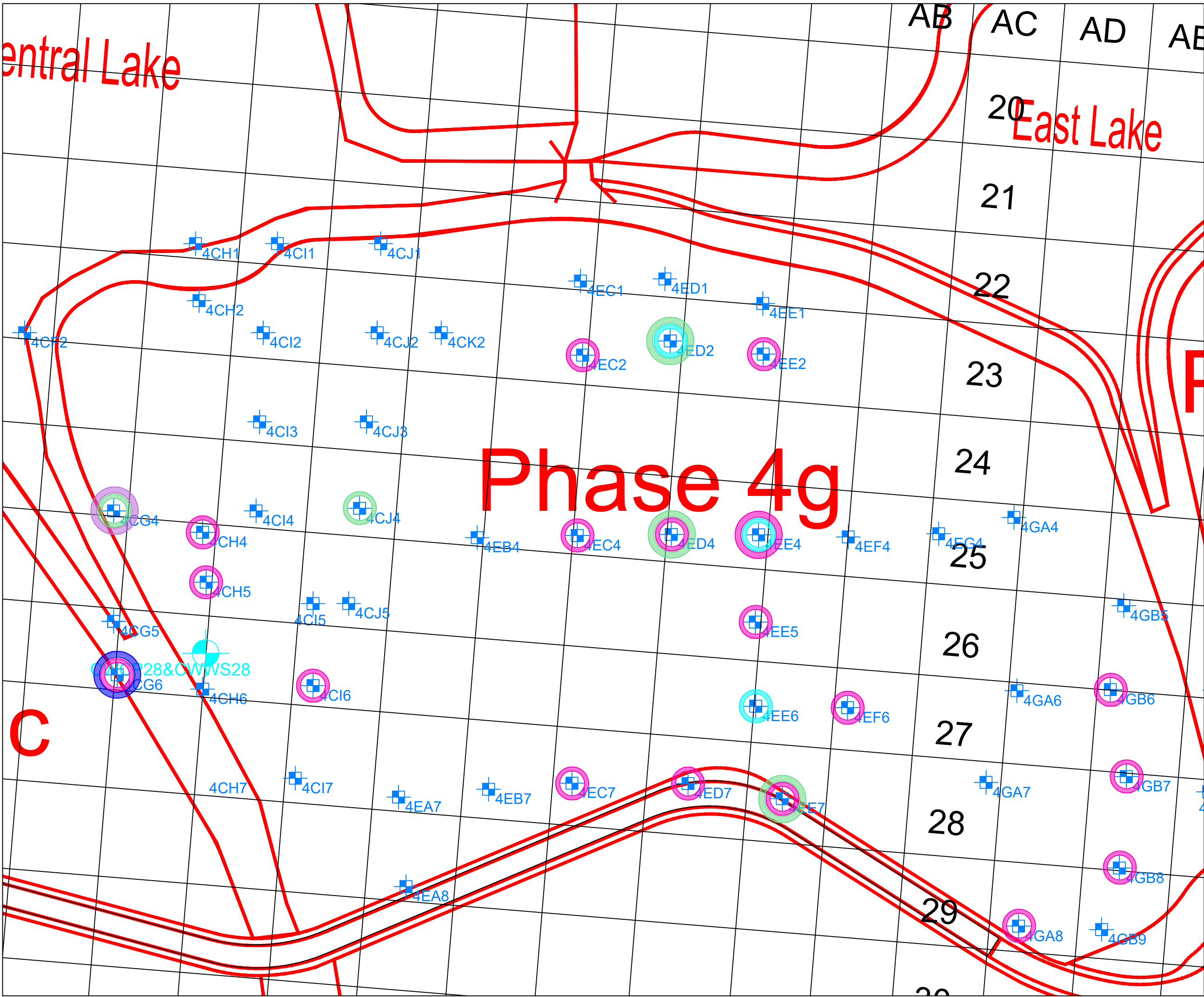
PROJECT

LLANWERN SITE LOCATION PLAN

STATUS

FOR INFORMATION

DRAWN	CHECKED	DATE
ET	CW	19/08/2019
PROJECT NUMBER	DRAWING NUMBER	REV.
P18-669	18669-RLE-19-XX-DR-O-0004	



GENERAL NOTES

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ALL DIMENSIONS ARE IN MILLIMETRES UNLESS NOTED OTHERWISE.
ALL LEVELS ARE IN METRES UNLESS NOTED OTHERWISE.
ANY DISCREPANCIES NOTED ON SITE ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.

KEY:

- PHASE BOUNDARY
- CWCP31& CWWS31 CWRA BOREHOLE
- TP-AJ21 ATKINS 2018 TRIAL PIT
- CYANIDE (TOTAL)
- AMMONIACAL NITROGEN
- IRON (TOTAL)
- MANGANESE
- VANADIUM

Rev	Date	Amendments	By	Chk



Client
Revantage Real Estate

Project
P18-669 Llanwern Reclamation

Drawing Title
Phase 4G Exploratory Hole
HFC Exceedance Location Plan

INFORMATION

Drawn	Checked	Date
NTS	AMS	CW
		04/07/25
Drawing No.	Rev.	
18669-RLL-25-XX-DR-O-0762	P01	

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Appendix B: Chemical Screening

P18-669 Llanwern Phase 4G Soil Chemical Screening Results

Project: P18-669										RLL Grid Ref:		S25	S25	S25	S25	S27	S27	S27	S27	T27	T27	T27	T27	T22	T22	T22	T23	T23	T23	T26	T26															
Client: Rodgers Leask Environmental		Job No.:	HFC Soil Reuse Criteria (mg/kg)							Number of Exceedances	Maximum Concentration Check	Minimum Exceedance Concentration	95th Percentile Concentration	95th Percentile Check	Maximum Concentration	Average Concentration	Minimum Concentration	181012-49	181012-49	181012-49	181012-49	181003-43	181003-43	181003-43	181003-43	181003-43	181003-43	181012-49	181012-49	181012-49	181012-49	181012-49	181012-49	181012-49												
Quotation No.: Q21-24056		Sample ID.:																18512158	18511962	18511966	18511972	18449389	18449394	18449398	18449417	18449372	18449376	18449380	18449385	18512075	18512084	18512113	18512054	18512064	18512064	18512103	18512129	18512129	18512129	18512129	18512129	18512129	18512129	18512129	18512129	
Order No.:		Client Sample Ref.:																4C-G4	4C-G4	4C-G4	4C-G4-V	4C-G5	4C-G5	4C-G5	4C-G5-V	4C-G6	4C-G6	4C-G6	4C-G6-V	4C-H1	4C-H1	4C-H1-V	4C-H2	4C-H2	4C-H2	4C-H2-V	4C-H4	4C-H4								
		Sample Type:																0.50-0.50	1.20-1.20	1.80-1.80	2.40-2.40	0.50-0.50	1.00-1.00	1.50-1.50	2.80-2.80	0.30-0.30	1.00-1.00	1.50-1.50	2.90-2.90	0.50-0.50	1.00-1.00	1.60-1.60	0.50-0.50	1.00-1.00	1.60-1.60	0.50-0.50	1.00-1.00	1.80-1.80	0.50-0.50	1.00-1.00	1.80-1.80	0.50-0.50	1.00-1.00	1.80-1.80	0.50-0.50	1.00-1.00
		Bottom Depth (m):																11/10/2018	11/10/2018	11/10/2018	11/10/2018	02/10/2018	02/10/2018	02/10/2018	02/10/2018	02/10/2018	02/10/2018	02/10/2018	02/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018
		Date Sampled:																																												
		Asbestos Lab:																																												
Determinand	Accred.	SOP	Units	LOD																																										
ACM Type	U	2192		N/A																																										
Asbestos Identification	U	2192		N/A																																										
Asbestos by Gravimetry	U	2192	%	0.001																																										
Total Asbestos	U	2192	%	0.001																																										
Moisture	N	2030	%	0.020																																										
Soil Colour	N	2040		N/A																																										
Other Material	N	2040		N/A																																										
Soil Texture	N	2040		N/A																																										
pH	M	2010		4.0																																										
Cyanide (Total)	M	2300	mg/kg	0.5	2.02	6	20.90	3.56	1.45	no exc.	20.90	1.54	1.00	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1															
Ammoniacal Nitrogen	M	2425	mg/kg	0.5	154	18	376.00	164.00	234.05	234.05	378.00	51.99	12.00	<12	<12	<12	138	<12	<12	<12	116	<12	<12	175	<12	<12	<12	<12	62.5	<12	<12															
Iron (Total)	N	2430	mg/kg	100	305000	1	352000.00	352000.00	217150.00	no exc.	352000.00	97927.86	13200.00	133000.00	121000	154000	32400	157000	155000	299000	32300	249000	352000	23500	189000	150000	34100	136000	73800	38000	187000	196000														
Arsenic	M	2450	mg/kg	1	2533	9	141.00	0.00	18.43	no exc.	141.00	11.78	2.33	7.22	8.6	6.66	16.7	8.55	12.1	10.4	13.3	6.4	9.75	13.4	27.4	10.1	12.2	17.8	10.9	13.3	5.71	4.29														
Cadmium	M	2450	mg/kg	0.1	73	0	3.48	0.00	1.20	no exc.	3.48	0.31	0.02	0.94	<0.02	1.18	0.432	0.261	<0.2	0.711	<0.02	0.154	0.966	<0.02	<0.02	<0.02	0.998	<0.2	0.541	<0.2	<0.2															
Chromium	M	2450	mg/kg	1	9431	0	810.00	0.00	466.05	no exc.	810.00	129.11	0.90	232.00	348	467	49.5	127	342	7.82	35.8	19.1	8.19	38.7	12.1	103	106	27.8	<0.9	<9	32.7	23.8														
Manganese	M	2450	mg/kg	5	33300	6	49400.00	34400.00	32430.00	no exc.	49400.00	9218.15	188.00	21100.00	26500	46100	915	13100	22000	6530	967	6670	10000	10400	708	9020	10600	719	3490	1690	782	10400	7880													
Copper	M	2450	mg/kg	0.5	451	0	286.00	0.00	44.48	no exc.	286.00	23.48	4.45	18.30	27.7	29.7	11.9	14.6	23.1	20.8	17.1	10.3	24.7	14.9	20.7	16.1	32.5	10.5	19.5	23.9	11.2	20.6	19.1													
Mercury	M	2450	mg/kg	0.1	132	0	no exc.	0.00	1.40	no exc.	2.17	0.62	0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14														
Nickel	M	2450	mg/kg	0.5	11500	0	238.00	0.00	43.00	no exc.	238.00	24.80	2.88	14.80	15.6	12.8	33	13.7	57.8	15.1	42.8	41.5	14.3	4.71	27.3	23.7	22.1	34.3	27.1	33.7	43	49.7	28													
Lead	M	2450	mg/kg	0.5	15700	0	144.00	0.00	98.07	no exc.	144.00	40.67	0.70	17.90	15.1	15.6	26.1	57.4	31.2	25	29.6	14.9	20.5	4.47	20.2	45.3	45.8	25.4	35.8	47.2	28.7	64.3	51.3													
Selenium	M	2450	mg/kg	0.2	702	0	24.30	0.00	16.57	no exc.	24.30	6.10	1.00	7.09	7.8	12.3	<1	7.04	12.8	5.22	1.45	4.66	7.14	5.1	1.81	<10	1.71	<1	<10	<1	<10	<10														
Vanadium	U	2450	mg/kg	5	1606	1	1890.00	1890.00	512.15	no exc.	1890.00	181.60	10.50	911.00	941	1890	84.6	363	894	169	57	250	143	121	37.6	148	143	48.4	56.4	49.4	62.1	142	132													
Zinc	M	2450	mg/kg	0.5	138000	0	864.00	0.00	423.20	no exc.	864.00	165.68	14.60	73.60	50.6	61.4	102	275	131	99.4	135	344	126	53.7	130	133	133	184	115	221	185	128	179	174												
Organic Matter	M	2625	%	0.4			59.80	0.44	44.06	44.06	59.80	11.06	0.35	5.05	6.62	0.436	2.69	5.45	7.9	2.21	1.72	2.83	0.974	1.44	43.6	9.78	7.02	1.07	26	10.9	1.33	5.71	4.29													
Aliphatic TPH >C5-C6	N	2680	mg/kg	1	73000	0	no exc.	0.00	0.02	no exc.	0.20	0.02	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01													
Aliphatic TPH >C6-C8	N	2680	mg/kg	1	359000	0	3.32	0.00	0.06	no exc.	3.32	0.05	0.00	<0.01	<0.01	<0.01	<0.01	0.0132	<0.01	0.0239	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01														
Aliphatic TPH >C8-C10	M	2680	mg/kg	1	2841000	0	46.70	0.00	0.20	no exc.	46.70	0.39	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.0239	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01														
Aliphatic TPH >C10-C12	M	2680	mg/kg	1	22500000	0	112.00	0.00	0.75	no exc.	112.00	0.93	0.01	<0.01	<0.01	<0.01	<0.01	0.0121	<0.01	0.0559	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01														
Aliphatic TPH >C12-C16	M	2680	mg/kg	1	4.50E+08	0	177.00	0.00	34.35	no exc.	177.00	6.76	0.10	1.29	<0.1	<0.1	<0.1	21	29.2	43.3	<0.1	1.99																								

P18-669 Llanwern Phase 4G Soil Chemical Screening Results

Project: P18-669																																																																					
Client: Rodgers Leask Environmental					Job No.:		T26	T26	U26	U26	U26	U26	U27	U27	U27	U27	U22	U22	U22	U22	U22	U24	U24	U25	U25	U25	V26	V26	V27	V27	V27	V28	V28	V28																																			
Sample ID:					181012-49	181012-49	181012-49	181012-49	181012-49	181012-49	181012-49	181003-43	181003-43	181003-43	181003-43	181012-49	181012-49	181012-49	181012-49	181012-49	181012-49	181012-49	181012-49	181012-49	181012-49	181012-49	181018-22	181018-22	181018-22	181018-22	181018-22	181018-22	181018-22	181018-22																																			
Quotation No.: Q21-24056					18512148	18512154	18511954	18512026	18512107	18512119	18449507	18449354	18449358	18449368	18512091	18512095	18512005	18512042	18512048	18511995	18511999	18511978	18511985	18511989	18548126	18548131	18548150	18548155	18548160	18548171	18548185	18548198	18548220																																				
Order No.:					Client Sample Ref.:					4C-H4	4C-H4-V	4C-H5	4C-H5	4C-H5	4C-H5-V	4C-H6	4C-H6	4C-H6	4C-H6-V	4C-I1	4C-I1	4C-I2	4C-I2	4C-I2	4C-I2-V	4C-I3	4C-I3	4C-I4	4C-I4	4C-I4-V	4C-I5	4C-I5	4C-I6	4C-I6	4C-I7	4C-I7-V																																	
					Sample Type																																																																
					Top Depth (m)					1.60-1.60	2.00-2.00	0.50-0.50	1.00-1.00	1.80-1.80	2.50-2.50	0.50-0.50	1.00-1.00	1.50-1.50	3.30-3.30	0.50-0.50	1.10-1.10	0.50-0.50	1.00-1.00	1.50-1.50	1.70-1.70	0.50-0.50	0.80-0.80	0.50-0.50	1.00-1.00	2.50-2.50	0.50-0.50	1.00-1.00	0.50-0.50	1.00-1.00	2.20-2.20	0.50-0.50	1.00-1.00	1.80-1.80																															
					Bottom Depth (m)																																																																
					Date Sampled:					11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	02/10/2018	02/10/2018	02/10/2018	02/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	11/10/2018	10/17/2018	10/17/2018	10/17/2018	10/17/2018	10/17/2018	10/17/2018	10/17/2018	10/17/2018	10/17/2018	10/17/2018																															
					Asbestos Lab:																																																																
Determinand	Accred.	SOP	Units	LOD																																																																	
ACM Type	U	2192		N/A																																																																	
Asbestos Identification	U	2192		N/A	-	-	-	Not Detected	Not Detected	-	Not Detected	-	Not Detected	-	Not Detected	-	-	Not Detected	Not Detected	-	-	Not Detected	-	-	Not Detected	-	Not Detected	Not Detected	Not Detected	-	-	Not Detected	-	-	-	-																																	
Asbestos by Gravimetry	U	2192	%	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																																		
Total Asbestos	U	2192	%	0.001	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-																																		
Moisture	N	2030	%	0.020	4.31	5.5	4.59	6.15	4.21	7.98	4.9	29.8	8.22	3.81	47.8	7.83	26.4	27.1	10.1	1.26	4.19	4.22	4.38	3.78	1.02	9.3	11	7.2	10	28	6.9	10	24																																				
Soil Colour	N	2040		N/A	Dark Brown	Grey	Dark Brown	Dark Brown	Dark Brown	Black	Dark Brown	Dark Brown	Dark Brown	Black	Black	Black	Black	Black	Grey	Dark Brown	Black	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown																																		
Other Material	N	2040		N/A	Stones	Vegetation	Stones	Stones	Stones	Vegetation	Crushed Brick	Stones	Crushed Brick	Vegetation	Brick	Vegetation	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones																																			
Soil Texture	N	2040		N/A	Sand	Sandy Silt Loam	Sand	Sand	Sandy Loam	Sandy Silt Loam	Sandy Loam	Sandy Loam	Sandy Loam	Silty Clay Loam	Stone/Silt	Stone/Soil	Sand	Sand	Sand	Silty Clay	Stone/Soil	Stone/Soil	Stone/Soil	Stone/Soil	Sandy Clay Loam	Sandy Loam	Sandy Loam	Loamy Sand	Sandy Loam	Sand	Sandy Loam	Sandy Loam	Sandy Loam																																				
pH	M	2010		4.0	8.98	7.4	9.58	9.03	8.89	6.69	10.4	10.8	9.86	7.22	8.81	11.7	9.1	8.64	9.5	8.56	11.6	10.9	10.8	9.21	8.21	10.6	9.19	10.5	12.3	7.85	9.86	10.7	6.91																																				
Cyanide (Total)	M	2300	mg/kg	0.5	2.02	<1	<1	<1	<1	<1	<1	<1	<1	<1	1.42	<1	<1	1.41	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1																																			
Ammoniacal Nitrogen	M	2425	mg/kg	0.5	154	<12	200	<12	<12	<12	234	<12	<12	<12	141	<12	<12	<12	<12	73.3	<12	<12	<12	<12	<12	<12	<12	<12	<12	<12	194	<12	<12	144																																			
Iron (Total)	N	2430	mg/kg	100	305000	127000	28200	206000	164000	83300	24100	226000	123000	166000	28300	108000	83100	134000	134000	63500	36700	169000	90900	95900	281000	39300	22800	43000	93400	98000	29600	57000	108000	29900																																			
Arsenic	M	2450	mg/kg	1	2533	10	14.2	16.8	13.8	12.4	16.1	16.1	10.7	11.1	12.3	8.45	<6	21.3	10.1	8.37	12.6	11.6	16.1	9.11	21.6	14.3	4.13	6.28	9.64	7.28	13.6	7.39	5.68	14.9																																			
Cadmium	M	2450	mg/kg	0.1	73	<0.02	0.475	<0.2	<0.2	<0.2	0.219	0.558	<0.2	0.174	<0.02	1.19	<0.2	1.56	0.774	0.397	1.46	1.86	<0.02	3.48	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02																																			
Chromium	M	2450	mg/kg	1	9431	30.5	35	115	101	34.4	39.8	99.3	369	49.5	36.3	36.4	109	214	12.5	171	28.5	91.8	116	52.1	54.4	30.1	19.6	22.3	21.7	462	33.1	41.5	207	31.6																																			
Manganese	M	2450	mg/kg	5	33300	5960	271	11800	9690	3000	422	10500	15500	6130	289	3360	18200	11800	5070	7050	638	7680	9750	8740	6840	1380	6680	4520	4630	29500	575	5450	19100	547																																			
Copper	M	2450	mg/kg	0.5	451	12.5	14.6	38.8	25.9	28.6	17.6	43.4	42.6	17.7	16	21.7	17	27.8	36	22.6	17.96	17.8	17.4	25.7	32.7	11.6	4.45	22.2	12.1	18.8	15.4	11.1	10.4	12.6																																			
Mercury	M	2450	mg/kg	0.1	132	<0.14	<0.14	<1.4	<1.4	<1.4	<0.14	<0.14	<1.4	<0.14	<0.14	<1.4	<1.4	<1.4	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14	<1.4	<1.4	<1.4	<0.14	<1.4	<0.14	<0.14	<0.14	<0.14	<0.14	<0.14																																		
Nickel	M	2450	mg/kg	0.5	11500	13.3	27.1	47.3	27.5	27.2	29.7	27	238	18	37.2	25.1	11.5	28.6	22.6	15.1	37.3	18.7	19.6	37.9	39.5	2.96	18.6	16	13.1	31.6	8.84	6.72	30.9																																				
Lead	M	2450	mg/kg	0.5	15700	26	33.7	55.9	66.2	36.1	45	67.6	26.7	41.6	52.2	76.9	25	113	127	25.5	23.5	53.1	34.4	49.9	96.7	24.1	3.53	8.16	29.1	24.4	30.4	45.8	23.2	25.5																																			
Selenium	M	2450	mg/kg	0.2	702	1.25	<1	<10	<10	<10	<1	6.15	<10	3.89	<1	1.02	<10	<10	<10	3.7	4.02	<1	1.76	<10	<10	<10	<1	4.58	2.93	<1	13.7	<1	2.56	4.94	<1																																		
Vanadium	U	2450	mg/kg	5	1606	87.5	56.1	205	176	104	60.6	309	281	92.1	57.3	50.8	134	375	12.3	124	54.2	143	129	116	116	51.6	64.3	59.3	79	330	53.3	72.4	223	57																																			
Zinc	M	2450	mg/kg	0.5	138000	103	111	195	251	114	153	301	138	180	143	261	68.3	394	593	117	117	223	137	163	315	118	32.8	49.4	154	60	113	203	138	107																																			
Organic Matter	M	2625	%	0.4		4.31	5.5	4.59	6.15	4.21	7.98	4.9	29.8	8.22	3.81	47.8	7.83	26.4	27.1	10.1	1.26	4.19	4.22	4.38	3.78	1.02	0.94	1.68	1.68	3.26	3.88	6.47	5.14	1.61																																			
Aliphatic TPH >C5-C6	N	2680	mg/kg	1	73000	<0.01	0.0274	<0.01	<0.01	<0.01	0.0116	<0.01	<0.01	<0.01	<0.01	0.0167	0.011	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.012	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01																																			
Aliphatic TPH >C6-C8	N	2680	mg/kg	1	359000	<0.01	0.0638	<0.01	<0.01	<0.01	0.0231	<0.01	0.0231	<0.01	0.0231	0.0622	0.0594	<0.01	<0.01	<0.01	<0.01	0.0344	0.0343	0.0469	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01																																			
Aliphatic TPH >C8-C10	M	2680	mg/kg	1	2841000	<0.01	0.0851	<0.01	<0.01	<0.01	0.0544	<0.01	0.0147	<0.01	0.0544	0.0583	<0.01	<0.01	<0.01	<0.01	0.025	0.0231	0.0992	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01																																		
Aliphatic TPH >C10-C12	M	2680	mg/kg	1	22500000	<0.01	0.0623	<0.01	<0.01	<0.01	0.0198	<0.01	0.0274	<0.01	0.0896	0.0759	<0.01	<0.01	<0.01	<0.01	0.0594	1.48	0.306	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.0138	0.0236	<0.01	<0.01																																			
Aliphatic TPH >C12-C16	M	2680	mg/kg	1	4.50E+08	1.96	<0.1	0.453	1.39	<0.1	<0.1	4.72	37.2	2.05	<0.1	46.4	22.4	6.49	5.67	2.84	<0.1	3.95	23.3	9.82	2.77	<0.1	<0.1	2.54	<0.1	11.5	<0.1	41	12	<0.1																																			
Aliphatic TPH >C16-C21	M	2680	mg/kg	1	5.66E+10	19.3	<0.1	4.12	6.57	<0.1	<0.1	18.9	114	11.9	<0.1	194	83.7	18.7	13.9	11.2	<0.1	13.9	15.4	11.8	11.2	<0.1	2.1	4.18	11.4	27	<0.1	116	59	<0.1																																			
Aliphatic TPH >C21-C35	M	2680	mg/kg	1	5.66E+10	339	<0.1	53.4	57.3	11.8	4.21	83.8	92.5	60.5	1.99	154	543	394	215	89.1	<0.1	135	78.8	93.1	83.7	<0.1	30.9	28.9	110	85.1	5.78	821	388	3.64																																			
Aliphatic TPH >C35-C44	N	2680	mg/kg	1	5.66E+10	203	<0.1	23.2	33.6	4.98	<0.1	56.4	5.85	10.9	<0.1	58.5	330	417	205	43.8	<0.1	54.9	44.1	60.6	28.8	<0.1	33.9	8.43	38.2	26.2	<0.1	226	98.3	<0.1																																			
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5		564	<0.1	81.2	98.8	16.8	4.21	164	250	85.3	1.99	452	979	837	439	147	<0.1	20																																															

P18-669 Llanwern Phase 4G Soil Chemical Screening Results

[illegible]

P18-669 Llanwern Phase 4G Soil Chemical Screening Results

[illegible]

P18-669 Llanwern Phase 4G Soil Chemical Screening Results

Project: P18-669					AB27	W29	W29	W29	AE27	AE27	AE27	AE27	AC28	AD29	AD29	AC28	AD29	AE29	AE29	W28	W28	X28	X28	Z28	Z28	X28	X28	X28	AD25	AD25	AD25	AE25	AE25		
Client: Rodgers Leask Environmental	Job No.:	181031-51	181101-44	181101-44	181101-44	181107-11	181107-11	181107-11	181107-11	181107-11	181107-11	181107-11	181121-47	181121-47	181121-47	181121-47	181121-47	181121-47	181121-47	181121-47	181102-43	181102-43	181102-43	181102-43	181102-43	181102-43	181102-43	181102-43	181102-43	181102-43	181102-43	181102-43	181102-43		
Quotation No.: Q21-24056	Sample ID.:	18639188	18646138	18646160	18646164	18681153	18681237	18681247	18786527	18786511	18786517	18786535	18786522	18786500	18786505	18653991	18653998	18654016	18654023	18654118	18653985	18654030	18654036	18654042	18673542	18673546	18673558	18673497	18673509						
Order No.:	Client Sample Ref.:	4E-F6-V	4E-A8	4E-AB	4E-AB	4G-B7-V	4G-B8	4G-B8	4G-B8-V	4G-A7	4G-A8	4G-A8	4G-A7-V	4G-B9	4G-B9-V	4E-A7	4E-A7	4E-B7	4E-B7V	4E-D7	4E-D7V	4E-C7	4E-C7	4E-C7V	4G-A6	4G-A6	4G-A6-V	4G-B5	4G-B5						
	Sample Type:	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID	SOLID			
	Top Depth (m):	1.55-1.55	0.50-0.50	1.00-1.00	1.70-1.70	1.20-1.20	0.40-0.40	0.80-0.80	1.60-1.60	0.50-0.50	0.40-0.40	0.70-0.70	1.80-1.80	2.10-2.10	0.50-0.50	1.60-1.60	0.40-0.40	0.90-0.90	0.50-0.50	1.60-1.60	0.50-0.50	1.90-1.90	0.50-0.50	1.00-1.00	1.80-1.80	0.50-0.50	0.70-0.70	2.80-2.80	0.50-0.50	1.00-1.00					
	Bottom Depth (m):																																		
	Date Sampled:	30/10/2018	10/31/2018	10/31/2018	10/31/2018	11/6/2018	11/6/2018	11/6/2018	11/6/2018	20/11/2018	20/11/2018	20/11/2018	20/11/2018	20/11/2018	20/11/2018	20/11/2018	20/11/2018	20/11/2018	20/11/2018	01/11/2018	01/11/2018	01/11/2018	01/11/2018	01/11/2018	01/11/2018	01/11/2018	01/11/2018	01/11/2018	05/11/2018	05/11/2018	05/11/2018	05/11/2018	05/11/2018		
	Asbestos Lab:																																		
Determinand	Accred.	SOP	Units	LOD																															
ACM Type	U	2192		N/A			Chrysotile		Chrysotile																										
Asbestos Identification	U	2192		N/A	-	-	Detected	-	-	-	Detected	-	Not Detected	Not Detected	-	-	-	Not Detected	-	-	Not Detected	Not Detected	-	Not Detected	-	Not Detected	-	-	-	Not Detected	-	-	Not Detected		
Asbestos by Gravimetry	U	2192	%	0.001	-	-	<0.001	-	-	-	0.0028	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Total Asbestos	U	2192	%	0.001	-	-	<0.001	-	-	-	0.0028	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-		
Moisture	N	2030	%	0.020	31	7.5	7.7	23	30	6	6.7	34	9.2	8.2	4.6	22	28	7.6	22	9.4	14	7.2	24	15	31	7.7	13	38	14	14	72	7.7	7.1		
Soil Colour	N	2040		N/A	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Black	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Light Brown	Dark Brown	Grey	Grey	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown	Dark Brown		
Other Material	N	2040		N/A	Vegetation	Stones	Stones	Vegetation	Stones	Stones	Vegetation	Stones	Stones	Stones	Stones	None	None	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones	Stones			
Soil Texture	N	2040		N/A	Sandy Clay	Sand	Loamy Sand	Silty Clay	Clay	Loamy Sand	Loamy Sand	Clay	Sandy Loam	Loamy Sand	Sand	Clay	Clay	Sandy Loam	Silty Clay Loam	Sandy Loam	Stone/Soil	Stone/Soil	Silty Clay Loam	Loamy Sand	Sandy Loam	Sand	Sand	Clay	Sand	Sandy Clay	Loamy Sand	Sand	Loamy Sand		
pH	M	2010		4.0	6.87	10.8	12.5	8.14	7.43	10.6	12.2	7.54	10.7	10.1	11.4	8.76	7.48	11.7	8.48	10.3	11.6	12.7	7.89	10.3	7.87	10.4	11.4	8.25	11.9	11.6	6.85	8.81	12.3		
Cyanide (Total)	M	2300	mg/kg	0.5	2.02	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1		
Ammoniacal Nitrogen	M	2425	mg/kg	0.5	154	216	<12	<12	76.4	235	22.5	<12	264	<12	<12	59.7	202	<12	113	<12	<12	21	130	28.2	262	13.6	<12	269	22.7	<12	97.3	<12	<12		
Iron (Total)	N	2430	mg/kg	100	305000	39800	133000	66500	38900	27900	205000	177000	28000	43400	91800	26700	38300	22300	196000	23600	183000	134000	220000	38200	77100	42200	174000	152000	68100	165000	159000	13200	25000	207000	
Arsenic	M	2450	mg/kg	1	2533	11.9	<6	5.52	18.9	9.92	12	<6	10.8	6.83	7.85	2.33	12.4	11	7.56	8.08	13.6	<6	10.5	19.1	12.2	15	15.3	9.98	15.5	13.8	<6	10.2	8.81	<6	
Cadmium	M	2450	mg/kg	0.1	73	<0.02	<0.2	<0.02	0.3	<0.02	<0.2	<0.2	<0.02	0.886	0.804	0.287	0.264	1.84	<0.02	<0.2	<0.2	0.316	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	1.19	<0.2	0.222	0.245	<0.2	
Chromium	M	2450	mg/kg	1	9431	41.4	<9	115	27	33.3	65.8	397	31	33	245	49.4	74.3	33.1	403	25.9	188	359	775	40.8	<9	39.8	63.2	168	115	240	533	3.2	21.7	763	
Manganese	M	2450	mg/kg	5	33300	639	2070	13100	1750	277	7300	413	274	4350	15700	2950	2710	328	3380	650	11500	26600	33000	523	1940	1300	11400	7850	6170	23700	30100	292	1110	4310	
Copper	M	2450	mg/kg	0.5	451	13.7	<14	11.1	12.1	19.6	84.5	26.4	12.9	10.7	19.2	4.82	12	14.7	62.8	7.73	25.1	20	34.4	11.4	<14	<14	25.3	24.9	23.3	32.3	15.9	15.6	26.5	28.3	
Mercury	M	2450	mg/kg	0.1	132	<0.14	<1.4	<0.14	<0.14	<0.14	<1.4	<1.4	<0.14	<0.14	<1.4	<0.14	<0.14	<1.4	<1.4	<0.14	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<1.4	<0.14	<0.14	<1.4		
Nickel	M	2450	mg/kg	0.5	11500	30.3	37.5	7.78	42.1	28	54.3	15.4	24.3	13.1	18.9	2.88	36	30.9	24.3	31.1	21.6	14.6	28.4	39.3	14.3	29.4	31.6	24.2	22.1	22.3	12.7	9.29	25.5	12	
Lead	M	2450	mg/kg	0.5	15700	32	41.9	48.9	28.8	32	107	26.2	34.3	32.4	28.5	24.6	29.7	30.4	39.8	20	86.7	36	31.2	29.4	94.4	39.8	116	91.6	45.3	30.1	14.3	4.61	24.2	19.4	
Selenium	M	2450	mg/kg	0.2	702	<1	<10	6.07	<1	<1	20.9	<1	1.3	<10	<1	1.04	<1	15.6	<1	<1	<10	10.9	22	<1	<10	<10	<10	<10	2.88	6.38	15.5	1.55	<1	24.3	
Vanadium	U	2450	mg/kg	5	1606	65.9	163	117	54.2	47.4	106	416	48.6	58.8	225	38.8	89.4	54.1	453	43.3	276	419	591	66.9	43.7	63.9	226	140	108	430	985	10.5	40.4	702	
Zinc	M	2450	mg/kg	0.5	138000	114	145	201	116	142	446	89.5	101	114	112	109	97.8	108	69.1	83.5	346	85.9	97.6	108	270	106	422	323	149	99.3	50.6	47.1	45.1	51.8	
Organic Matter	M	2625	%	0.4		3.78	51.4	4.91	0.905	3.64	14.3	<0.35	6.26	24.8	6.1	10.8	1.56	4.14	9.64	0.85	6.81	8.45	1.56	1.61	2.78	5.07	6.84	27.1	9.19	5.69	3.22	59.8	9.03	1.08	
Aliphatic TPH >C5-C6	N	2680	mg/kg	1	73000	<0.01	<0.02	0.0336	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.01	<0.2	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	
Aliphatic TPH >C6-C8	N	2680	mg/kg	1	359000	<0.01	<0.02	0.137	<0.02	<0.02	<0.02	0	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.172	3.32	0.0377	<0.02	<0.02	0.0526	0.0314	<0.02	0.219	<0.02	<0.02	<0.02	<0.02	<0.02	
Aliphatic TPH >C8-C10	M	2680	mg/kg	1	2841000	<0.01	<0.02	0.444	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	2.5	46.7	0.0237	<0.02	<0.02	0.092	0.0238	<0.02	0.481	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	
Aliphatic TPH >C10-C12	M	2680	mg/kg	1	22500000	<0.01	<0.02	2.04	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	7.19	112	0.109	<0.02	<0.02	0.139	<0.02	0.881	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	
Aliphatic TPH >C12-C16	M	2680	mg/kg	1	4.50E+08	<0.1	5.47	34.2	<0.1	<0.1	2.6	2.13	<0.1	0.793	2.71	0.593	<0.1	0.156	1.85	<0.1	77.4	177	1.71	0.174	<0.1	0.53	4.01	2.92	1.63	2.03	1.5	0.546	1.67	1.81	
Aliphatic TPH >C16-C21	M	2680	mg/kg	1	5.86E+10	<0.1	23.9	79.4	<0.1	<0.1	21.8	9.8	<0.1	4.98	26.9	5.21	<0.1	9.2	<0.1	39.8	20	86.7	36	31.2	29.4	94.4	39.8	116	91.6	45.3	30.1	14.3	4.61	24.2	19.4
Aliphatic TPH >C21-C35	M	2680	mg/kg	1	5.66E+10	1.71	131	404	<0.1	7.61	226	60.1	6.58	60.5	167	24.7	<0.1	0.692	60.7	<0.1	425	561	90.5	0.296	17.7	16.1	97.9	42	55.3	53.5	21.9	42.8	11.9	51.5	
Aliphatic TPH >C35-C44	N	2680	mg/kg	1	5.66E+10	<0.1	27.3	91.4	<0.1	<0.1	76.7	23.4	<0.1	17.2	45.8	4.74	<0.1	0.235	13.7	<0.1	86.1	178	38												

P18-669 Llanwern Phase 4G Soil Chemical Screening Results

Project: P18-669					AE25	AE26	AE26	AE26
Client: Rodgers Leask Environmental	Job No.:				181106-25	181106-25	181106-25	181106-25
Quotation No.: Q21-24056	Sample ID.:				18673513	18673527	18673532	18673538
Order No.:	Client Sample Ref.:				4G-B5-V	4G-B6	4G-B6	4G-B6-V
	Sample Type:				SOLID	SOLID	SOLID	SOLID
	Top Depth (m):				2.10-2.10	0.50-0.50	0.90-0.90	1.80-1.80
	Bottom Depth (m):							
	Date Sampled:				05/11/2018	05/11/2018	05/11/2018	05/11/2018
	Asbestos Lab:							
Determinand	Accred.	SOP	Units	LOD				
ACM Type	U	2192		N/A				
Asbestos Identification	U	2192		N/A		-	-	Not Detected
Asbestos by Gravimetry	U	2192	%	0.001				
Total Asbestos	U	2192	%	0.001				
Moisture	N	2030	%	0.020		21	9.7	9.4
Soil Colour	N	2040		N/A		Dark Brown	Dark Brown	Dark Brown
Other Material	N	2040		N/A		None	Vegetation	Vegetation
Soil Texture	N	2040		N/A		Silty Clay	Sandy Loam	Sandy Loam
pH	M	2010		4.0		8.16	10.5	11.9
Cyanide (Total)	M	2300	mg/kg	0.5	2.02	<1	<1	<1
Ammoniacal Nitrogen	M	2425	mg/kg	0.5	154	<12	15.6	<12
Iron (Total)	N	2430	mg/kg	100	305000	31500	58700	115000
Arsenic	M	2450	mg/kg	1	2533	141	10.7	<6
Cadmium	M	2450	mg/kg	0.1	73	0.408	0.932	<0.2
Chromium	M	2450	mg/kg	1	9431	26.9	79.1	421
Manganese	M	2450	mg/kg	5	33300	1050	6010	2070
Copper	M	2450	mg/kg	0.5	451	66	23	16.1
Mercury	M	2450	mg/kg	0.1	132	<0.14	<0.14	<1.4
Nickel	M	2450	mg/kg	0.5	11500	33	17.5	12.2
Lead	M	2450	mg/kg	0.5	15700	29.4	54.8	18.3
Selenium	M	2450	mg/kg	0.2	702	<1	2.33	12
Vanadium	U	2450	mg/kg	5	1606	48.4	113	286
Zinc	M	2450	mg/kg	0.5	138000	130	332	75.2
Organic Matter	M	2625	%	0.4		0.926	6.47	4.26
Aliphatic TPH >C5-C6	N	2680	mg/kg	1	73000	<0.02	<0.02	<0.02
Aliphatic TPH >C6-C8	N	2680	mg/kg	1	359000	<0.02	<0.02	<0.02
Aliphatic TPH >C8-C10	M	2680	mg/kg	1	2841000	<0.02	<0.02	<0.02
Aliphatic TPH >C10-C12	M	2680	mg/kg	1	22500000	<0.02	<0.02	<0.02
Aliphatic TPH >C12-C16	M	2680	mg/kg	1	4.50E+08	<0.1	15	2.03
Aliphatic TPH >C16-C21	M	2680	mg/kg	1	5.66E+10	<0.1	13.4	9.5
Aliphatic TPH >C21-C35	M	2680	mg/kg	1	5.66E+10	<0.1	121	74.1
Aliphatic TPH >C35-C44	N	2680	mg/kg	1	5.66E+10	<0.1	91.6	47.5
Total Aliphatic Hydrocarbons	N	2680	mg/kg	5		<0.1	241	133
Aromatic TPH >C5-C7	N	2680	mg/kg	1	8510	<0.02	<0.02	<0.02
Aromatic TPH >C7-C8	N	2680	mg/kg	1	177000	<0.02	<0.02	<0.02
Aromatic TPH >C8-C10	M	2680	mg/kg	1	144000	<0.02	<0.02	<0.02
Aromatic TPH >C10-C12	M	2680	mg/kg	1	227000	<0.02	<0.02	<0.02
Aromatic TPH >C12-C16	M	2680	mg/kg	1	451000	<0.1	5.94	2.16
Aromatic TPH >C16-C21	U	2680	mg/kg	1	1424000	0.34	13.9	10.7
Aromatic TPH >C21-C35	M	2680	mg/kg	1	11300000	3.05	229	108
Aromatic TPH >C35-C44	N	2680	mg/kg	1	11300000	0.95	228	74.8
Total Aromatic Hydrocarbons	N	2680	mg/kg	5		4.34	476	196
Total Petroleum Hydrocarbons	N	2680	mg/kg	10		4.34	717	329
Benzene	M	2760	µg/kg	1	3800	<90	<90	<90
Toluene	M	2760	µg/kg	1	128000	<70	<70	<70
Ethylbenzene	M	2760	µg/kg	1	80000	<40	<40	<40
m & p-Xylene	M	2760	µg/kg	1	74000	<100	<100	<100
o-Xylene	M	2760	µg/kg	1	74000	<100	<100	<100
Methyl Tert-Butyl Ether	M	2760	µg/kg	1		<100	<100	<100
Naphthalene	M	2800	mg/kg	0.1	27000	<0.009	0.243	0.141
Acenaphthylene	N	2800	mg/kg	0.1	16700	<0.012	0.21	0.0648
Acenaphthene	M	2800	mg/kg	0.1	30000	<0.008	0.0287	0.0184
Fluorene	M	2800	mg/kg	0.1	27000	<0.01	0.126	0.0337
Phenanthrene	M	2800	mg/kg	0.1	27000	<0.015	0.999	0.393
Anthracene	M	2800	mg/kg	0.1	34000	<0.016	0.374	0.119
Fluoranthene	M	2800	mg/kg	0.1	6640	<0.017	2.13	0.966
Pyrene	M	2800	mg/kg	0.1	76000	<0.015	1.67	0.88
Benzo[a]anthracene	M	2800	mg/kg	0.1	607000	<0.014	1.15	0.662
Chrysene	M	2800	mg/kg	0.1	621000	<0.01	1.05	0.714
Benzo[b]fluoranthene	M	2800	mg/kg	0.1	3420	<0.015	1.24	0.747
Benzo[k]fluoranthene	M	2800	mg/kg	0.1	5050	<0.014	0.47	0.373
Benzo[a]pyrene	M	2800	mg/kg	0.1	34000	<0.015	1.13	0.775
Indeno[1,2,3-c,d]Pyrene	M	2800	mg/kg	0.1	25000	<0.018	0.729	0.614
Dibenz[a,h]Anthracene	N	2800	mg/kg	0.1	838000	<0.023	0.209	0.135
Benzo[g,h,i]perylene	M	2800	mg/kg	0.1	13000	<0.024	0.862	0.638
Total Of 16 PAH's	N	2800	mg/kg	2				
Resorcinol	M	2920	mg/kg	0.02				
Phenol	M	2920	mg/kg	0.02	3.05	<0.01	<0.01	<0.01
Cresols	M	2920	mg/kg	0.02		<0.01	<0.01	<0.01
Xylenols	M	2920	mg/kg	0.02	74	<0.015	<0.015	<0.015
1-Naphthol	N	2920	mg/kg	0.02				
Trimethylphenols	M	2920	mg/kg	0.02				
Total Phenols	M	2920	mg/kg	0.1		<0.035	<0.035	<0.035

Appendix E – H F Consulting Soild Validation Strategy

Glan Llyn: Soils validation strategy for protection of controlled waters

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Date: 17/12/2024

Status: FINAL

Reference: 30937 R2

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Prepared by: H Fraser Consulting Ltd

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Version History

Version	Author	Approved by	Issue date	Comment
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APPENDICES

Appendix A	RTM modelling spreadsheet outputs (electronic)
Appendix B	Example RTM spreadsheets (electronic)



1. BACKGROUND

Glan Llyn is a major residential and commercial development in Llanwern, South Wales, on the site of a former steelworks. Planning permission for the development includes planning conditions PC27 and PC28, which relate to the remediation strategy for the on-site soils and the validation of the remediation once achieved.

The initial risk assessment and remediation strategy report was produced by Atkins (2017) and this was subsequently updated by Rodgers Leask (2019-22), as described in Section 2. These documents have been accepted as satisfying PC27 for a number of development phases that are already completed or are currently being developed. Recent efforts to satisfy the requirements of PC28, which relate to the validation of the soil quality following remediation, for the protection of controlled waters, have been subject to considerable discussion with the regulator, NRW, and the planning authority, Newport City Council.

Recent meetings and discussion involving H Fraser Consulting Ltd (HFCL) resulted in agreement in principle on a revised approach to validation reporting, with regard to protection of controlled waters.

1.1 Objective

The objective of this report is to present the revised approach referred to above. This will provide a standard methodology and reference for all future phase validations and thus enable validation to proceed efficiently for all parties.

1.2 Scope of report

The report summarises the remediation work and validation at Glan Llyn to date (Section 2) and presents the updated approach and methodology (Section 3). Section 4 contains reference tables for contaminants of concern, to be applied to validation of soil quality in future validation reporting.

Additional planning conditions related to surface water are not part of the scope of this validation strategy.

This report considers only the elements of the remediation that relate to protection of controlled waters; elements of the remediation strategy that protect human health receptors (for example, placement of vapour membranes) are outside the scope of this report.

2 REMEDIATION WORKS AND VALIDATION TO DATE

2.1 Remediation strategy

The agreed remediation strategy and risk assessment for controlled waters at the site is detailed in Rodgers Leask (2019-22). The remediation strategy is briefly summarised here.

The remediation comprises excavation of Made Ground materials, removal of materials unsuitable for re-use in the development platform, and re-compaction of suitable Made Ground materials as an engineered fill. A drainage layer, formed as part of the normal construction phase, will then be installed above the engineered fill layer, to reduce infiltration to the Made Ground.

The Site has been divided into two strategies broadly responding to the division of the site between residential use and commercial use, referred to as the 'Full Turnover Specification' and the 'One Metre Turnover Specification'. The Full Turnover Specification comprises the excavation of Made Ground to a depth where the natural underlying Tidal Flat Deposits are exposed before a minimum of 2 m of suitable material is placed and reengineered. The One Meter Turnover Specification requires a trim and chase process excavating material to a depth minimum of 5.3 m aOD before approximately 2 m of suitable material is placed and reengineered to a formation level of 7.25 m aOD. Practical measures to identify, remove and validate the absence of gross contamination and known and potential obstructions extending below 5.3 m aOD shall be undertaken.

Several phases of trial pitting have been undertaken across the Site to assess and characterise the Made Ground for suitability for reuse. Material present within the proposed residential area that exceeds residential soil re-use values shall be transferred and re-used in the commercial phase of the development. Where material is not suitable for either a residential or commercial end use, the material will either be treated to allow re-use on site (at the supervising engineers discretion), or arrangements made for off-site disposal.

The remediation work and development are proceeding in phases as shown in Figure 2.1 for the residential area, and Figure 2.2 for the commercial area.



Figure 2.1 Residential phases



Figure 2.2 Commercial phases

Two planning conditions apply to the site remediation work.

- PC27 requires that, prior to commencement of each phase of development, a risk assessment, remediation strategy and verification plan are submitted to and approved in writing by the Local Authority.
- PC28 requires that prior to commencement of each phase of development (excluding works required for the remediation strategy) a verification report is submitted to and approved in writing by the Local Authority, to demonstrate completion of the remediation strategy and the effectiveness of the remediation.

The site is drained by a number of deep drainage ditches, referred to as reens. Soil re-use values (SRVs) for the protection of controlled waters were derived by Atkins and amended by Rogers Leask, assuming the following conceptual model.

- 60% of the residential site surface and 95% of the commercial site surface is impermeable. 100% of incident rainfall on impermeable areas either evaporates or is routed via the drainage system directly to the reens.
- 40% of the residential site and 5% of the commercial site has soft landscaping. In these areas infiltration was calculated as 12.85 mm/a, by subtracting evapotranspiration and runoff from the total rainfall figure. Runoff from these areas also passes to the reens.
- 12.85 mm/a infiltrates the drainage layer overlying the engineered fill.
- In the soft landscaping areas, 60% of infiltration drains laterally through the drainage layer into a reen and does not enter the engineered fill.
- 40% of infiltration drains into the engineered fill and migrates through the fill to a reen, dissolving potential contaminants from the fill materials.
- The infiltration that travels through the fill is diluted on reaching the reens by runoff and infiltration through the drainage layer. The relative fluxes of water passing through the fill to clean runoff provides the dilution factor.
- SRVs are calculated by multiplying the Environmental Quality Standard (EQS) by the dilution factor and converting this water concentration into a soil concentration using a partition co-efficient.

This approach was set out originally by Atkins (2017), modified by Rogers Leask (2019-22) and approved by the Local Authority under discharge of PC27 for a number of development phases. The commercial area and the residential area have different remedial targets due to the different ratio of soft landscaping to hardstanding.

Soils re-use values (SRVs) were set out in Rogers Leask (2019-22). A minor update to correct an error in calculation for the residential area was provided by HFCL (2024). The SRVs are reproduced here in Table 2.1.

Table 2.1 Agreed soil re-use values (SRVs)

Determinand	Soil re-use values (mg/kg)	
	Commercial area	Residential area ¹
Inorganic Metals and Metalloids		
Arsenic	1.15E+4	2533
Cadmium	331	73.0
Chromium	4.27E+4	9431
Copper	2042	451
Iron	1.38E+6	3.05E+5
Lead	7.12E+4	1.57E+4
Manganese	1.51E+5	3.33E+4
Mercury	596	132
Nickel	5.21E+4	1.15E+4
Selenium	3178	702
Vanadium	7271	1606
Zinc	6.23E+5	1.38E+5
Other Inorganics		
Ammoniacal Nitrogen	699	154
Cyanide	9.14	2.02
Organics		
Benzene	17.2	3.80
Toluene	582	128
Ethylbenzene	364	80.0
Xylene	336	74.0
Phenol	13.8	3.05
TPH Criteria Working Group		
Aliphatics >C5-C6	331	73.0
Aliphatics >C6-C8	1626	359
Aliphatics >C8-C10	1.29E+4	2841
Aliphatics >C10-C12	1.02E+5	2.25E+4
Aliphatics >C12-C16	2.04E+6	4.50E+5
Aliphatics >C16-C21	2.56E+8	5.66E+7
Aliphatics >C21-C35	2.56E+8	5.66E+7
Aliphatics >C35-C44	2.56E+8	5.66E+7
Aromatics >EC5-EC7	38.5	8.51
Aromatics >EC7-EC8	802	177
Aromatics >EC8-EC10	650	144
Aromatics >EC10-EC12	1027	227
Aromatics >EC12-EC16	2043	451
Aromatics >EC16-EC21	6447	1424
Aromatics >EC21-EC35	5.12E+4	1.13E+4
Aromatics >EC35-EC44	5.12E+4	1.13E+4
Aromatics >EC40-EC44	5.12E+4	1.13E+4
Polyaromatic Hydrocarbons		
Acenaphthylene	75.7	16.7

¹ Updated per H Fraser Consulting 2024; 30937 TN1D1 Glan Llyn, Llanwern: Soil Quality Verification

Determinand	Soil re-use values (mg/kg)	
	Commercial area	Residential area ¹
Acenaphthene	135	30.0
Anthracene	155	34.0
Benz(a)anthracene	2748	607
Benzo(a)pyrene	156	34.0
Benzo(b)fluoranthene	15.5	3.42
Benzo(k)fluoranthene	22.9	5.05
Benzo(g,h,i)perylene	60.2	13.0
Chrysene	2812	621
Dibenzo(a,h)anthracene	3793	838
Indeno(1,2,3-cd)pyrene	115	25.0
Fluoranthene	30.1	6.64
Fluorene	123	27.0
Naphthalene	124	27.0
Phenanthrene	123	27.0
Pyrene	346	76.0

2.2 Remediation

Remediation has taken place in phases as shown in Figure 2.1 (residential) and Figure 2.2 (commercial). As of October 2024, remediation has been completed across the majority of the site. Remediation has been validated and approved for Phases 1 to 3 of the residential development and Phases 1 to 3 of the commercial development. These phases were remediated and validated under the site model, risk assessment and remediation strategy developed by Atkins (2017), and therefore had different validation requirements to Phase 4 onwards.

The remediation and verification work on each of the phases includes the following:

- Complete excavation of Made Ground materials to the underlying Tidal Flat Deposits in the residential areas and to a depth minimum of 5.3 m aOD in the commercial area;
- Screening and stockpiling of the excavated material;
- Sampling of stockpile materials;
- Removal of material unsuitable for use;
- Subdivision of the site into backfill zones, generally in a 25x25 m grid;
- Placement of engineered fill in 300 mm layers, zone by zone;
- Sampling of surface materials, post-placement, to provide additional verification data.

As noted in Section 2.1, material originating from the site that was unsuitable for use in the residential area was to be re-used on the commercial area (where agreed SRVs are higher) or, if necessary, removed from site. In practice, all excavated material was stockpiled and tested, and the above criterion applied. That is, if testing of stockpiled material showed it to be unsuitable for residential area backfill, it was moved to the commercial area or removed from the site, in accordance with the stipulations of the remediation strategy (Rodgers Leask, 2019-22).

Table 2.2 shows a summary of where each phase is in the remediation and verification process. Table 2.2 also indicates whether the planning conditions for each phase have been discharged, and whether this was in accordance with the Atkins remediation strategy (RS) or the Rogers Leask RS. Note that part of the residential area that was formerly a coking works has been remediated by

Vertase FLI Ltd (Vertase); HFCL has not reviewed the remediation strategy or soil re-use values for this part of the site. The coking works area includes parts of Phases 4A, 4B, 5A and 5D, as well as the proposed school.

Table 2.2 Summary of phase progress

Phase	Remediation works complete	Discharge of planning conditions *	
		PC27	PC28
Residential			
Phase 1	Yes	Atkins RS	Atkins RS
Phase 2	Yes	Atkins RS	Atkins RS
Phase 3	Yes	Atkins RS	Atkins RS
Coking works	Yes	Vertase	Pending
Phase 4A (compound)	Yes	RL RS / Vertase	Pending
Phase 4B	Yes	Pending	Pending
Phase 4C	Yes	RL RS	Pending
Phase 4D	Yes	RL RS, parts 1 and 2	Pending
Phase 4E	Yes	Pending	Pending
Phase 4G	Yes	Pending	Pending
Phase 4H	Yes	RL RS	Pending
Phase 5A	Yes	Pending	Pending
Phase 5B	Yes	Pending	Pending
Phase 5G	Yes	Pending	Pending
Phase 5D	Yes	Pending	Pending
Phase 5E1	Yes	RL RS	Pending
Phase 5E2	Yes	Pending	Pending
Phase 5F	Ongoing	Pending	Pending
Commercial			
Phase 1 (Amazon)	Yes	Atkins RS	Atkins RS
Phase 2 (CAF)	Yes	Atkins RS	Atkins RS
Phase 3 (Units 4-7)	Yes	Atkins RS	Atkins RS
Phase 4 (Unit 8)	Yes	RL RS	Pending
Phase 5 (Units 9-10)	Yes	RL RS	Pending
Phase 6a (Units 11-14)	Yes	RL RS	Pending
Phase 6b (Units 15 and 16)	Yes	RL RS	Pending
Phase 7 (Park and Ride)	Yes	RL RS	Pending
Phase 8 (Unit 17)	Ongoing	Pending	Pending

* "Pending" indicates that the application has not yet been made.

2.3 Soil testing and validation

Soil samples are taken from each stockpile and sent to an accredited laboratory for analysis of the soil re-use determinands as listed in Table 2.1. An average soil concentration is then obtained for each stockpile. During the placement of the engineering fill each 300 mm layer is taken from a specific stockpile. Each stockpile may be used for multiple layers in one backfill zone, or across

multiple zones. Rogers Leask maintains a materials management database, so that there is a record of the soil analytical results for each stockpile and which stockpile was used for each layer in each backfill zone. A variable number of layers is laid down in each zone to achieve the desired ground surface level.

Surface verification samples may be taken upon completion of the engineered fill placement, principally for validation of human health criteria rather than controlled waters.

All samples are sent to an accredited laboratory for analysis of the determinands listed in Table 2.1. It is assumed the surface verification samples are representative of the top 100 mm of soil, since they are taken using a trowel.

Hundreds of soil samples are relevant to each backfill zone, and these can be taken as a group to represent the quality of soils used in the remediation.

A database of all the soil analytical results for each phase is developed. This includes all the surface verification samples taken across the phase, and all soil samples from any stockpiles used in the engineered fill. The 95%ile of all the analytical results is compared to the soil re-use values. Any determinands where the 95%ile exceeds the SRV is taken forward as a Contaminant of Concern (CoC) for that phase.

2.4 Issues arising

During the remediation verification for Phase 4H (residential) and Phases 4 and 5 (Units 8-10, commercial) exceedances of the SRVs were identified for certain parameters in specific areas of backfill during the verification process. It was therefore not possible to validate the remediation in those cases. An updated approach was consequently developed which combined a more detailed statistical analysis and enhanced data presentation, supplemented where needed by contaminant transport modelling. Where data presentation was unable to show that a contaminant presented no risk, modelling was applied to predict the concentration that would reach the surface water receptors. This updated approach allows for advection, dispersion, retardation and decay that act to reduce contaminant concentrations along a transport pathway.

The approach was agreed with NRW for Phase 4H and Units 8-10. This report sets out a streamlined approach to applying the same methodology, which involves the derivation of zoned reference values for all identified contaminants of concern across the site. This updated methodology, which will be applied to verification of future phases, is described in detail in Section 3.

As long as a sufficient number of robust sample analyses is available to represent the backfill material in each phase, the updated approach can be used to provide appropriate validation against the agreed soil criteria, without the need for additional consideration of subsurface water quality within the fill.

The updated SRVs derived by Rodgers Leask depend on the existence of a drainage layer above the fill. The drainage layer needs to be composed of appropriate granular material and evidence of its installation layer will form part of the requirement for the discharge of PC28.

3 UPDATED APPROACH AND METHODOLOGY

The following methodology is recommended for the future phases going forward. This methodology has been developed following discussion with NRW and agreement on the principles to be followed. An overview of the process is given here first, with further clarification of each stage in the following sub-sections.

Distance-specific reference values have been derived using Remedial Targets Methodology spreadsheets (RTM, see Environment Agency, 2006) to model the attenuation of contaminants during transport in the saturated zone. This allows for advection, dispersion, retardation and decay that act to reduce contaminant concentrations along a transport pathway. Reference values have been tabulated for three different travel distances to the compliance point. Comparison of reference values against measured soil concentrations can then determine whether contaminants are expected to reach the receptors at unacceptable concentrations. Full details of the derivation of the reference tables are provided in Sections 3.1 to 3.3.

For each development phase, a screening exercise will be carried out on all the contaminants of concern identified in the site-wide RL Remediation Strategy, as described in Section 3.4. Contaminants of Concern (CoCs) for that phase will be defined as determinands for which the 95%ile of the analytical results from the fill materials exceeded the SRV. (This maintains consistency with previous validation reporting.) The remaining CoCs will then be moved forward for further assessment.

In this further assessment a thorough statistical and spatial analysis will be carried out on the stockpile verification samples for these contaminants. This will include a calculation of the Upper Confidence Limit of the mean (UCL_{mean}) for each backfill zone across the Phase (see Section 3.4). The UCL_{mean} for each backfill area will then be compared to the tabulated reference values.

3.1 Development of reference tables

The agreed SRVs (Rodgers Leask, 2019-22) were calculated assuming that water infiltrates the engineered fill and travels to a reën, where it is then diluted in the volume of runoff across the site. The calculation only allows for dilution in the reën and does not allow for transport processes such as advection, dispersion, retardation and decay that act to reduce contaminant concentrations along a transport pathway. The site drainage strategy (Rodgers Leask, 2017) requires that a minimum depth of 300 mm of water always remains in the reëns. This serves various purposes including dilution of groundwater from the Made Ground.

New reference values have now been derived using RTM spreadsheets to model the attenuation of contaminants during transport in the saturated zone. This allows for advection, dispersion, retardation and decay that act to reduce contaminant concentrations along a transport pathway.

Generic modelling reference tables are developed, so that modelling is not required for each individual phase. Instead, the concentration for each CoC in each backfill zone can be checked against the reference tables. Reference values in the tables are given for three specific distances (12.5 m, 37.5 m and 62.5 m)².

² 12.5 m was selected because it represents the half of the distance across a standard remediation grid square. Grid squares measure 25 m square and were used across most of the Glan Llyn site as backfill zones. 37.5 m represents the distance across one and a half grid squares, i.e. the travel distance from a backfill zone that is one removed from the

The RTM has been used to assess the attenuation of contaminant concentrations through the engineered fill. To do this a 'Level 3' groundwater assessment has been undertaken as follows.

- The target concentration at the compliance point is taken to be the pore water concentration in equilibrium with the previously calculated SRV (Table 2.1). This is representative of the groundwater concentration before dilution at the point of discharge into the reen.
- The source area has been taken as the area of a standard backfill zone (25 m by 25 m).
- A time period of 1,000 years has been used.³
- The reference value is calculated as the target soil concentration in equilibrium with the groundwater remedial target taken from the RTM Level 3 groundwater assessment.

Equivalent pore water concentrations for a given soil concentration, and vice versa, are calculated using the equation below.

$$C_p = \frac{C_s}{\left(K_d + \frac{\theta_w + \theta_a H}{\rho}\right)}$$

Where:

- C_s = soil concentration (mg/kg)
- C_p = pore water concentration (mg/l)
- K_d = soil-water partition coefficient (l/kg)
- θ_w = water-filled soil porosity (fraction)
- θ_a = air-filled soil porosity (fraction)
- ρ = bulk density (g/cm³)
- H = Henry's Law constant (dimensionless)

3.2 Input parameters

The model input parameters are shown in Table 3.1 (general parameters) and Table 3.2 (contaminant-specific input parameters). The models were run with no degradation in the sorbed phase (i.e. degradation was only allowed in the dissolved phase), which is a conservative approach.

When considering contaminant degradation, a range of values is usually provided by reference books, dependent on conditions such as the redox state of the environment. In these cases we conservatively assumed the longest given half-life, which usually corresponds to anaerobic conditions.

In general, model input parameters were based on those adopted by Atkins in the earliest derivation of soil re-use values, to provide consistency with previous approaches.

reen. 62.5 m represents the distance across 2 and a half grid squares, i.e. the travel distance from a backfill zone that is two removed from the reen.

³ One thousand years is considered to represent a reasonably conservative time scale for any impacts to become apparent, and to allow a proportionate approach to contaminants that sorb to the extent that travel times are very long, in accordance with section 5.5 of the Remedial Targets Methodology (Environment Agency, 2006).

Table 3.1 General model parameters

Input parameters	symbol	value	Unit	Source
Plume thickness at source	Sy	1.98	m	Table 2-2 Atkins
Saturated aquifer thickness	da	2.1	m	Table 2-2 Atkins
Bulk density of aquifer materials	r	1.36	g/cm ³	Table 5-3 Atkins
Effective porosity of aquifer	n	0.08	fraction	Table 5.3.1 RL Remediation strategy
Water filled porosity	θ_w	0.5	fraction	Table 5-3 Atkins
Air filled porosity	θ_a	0.0037	fraction	Table 5-3 Atkins
Hydraulic gradient	i	0.0133	fraction	Table 5.3.1 RL Remediation strategy
Hydraulic conductivity of aquifer	K	1.00E-06	m/s	Hydraulic conductivity data given in RL, 2024 ⁴
Width of plume	S _z	25	m	Size of backfill zone
Distance to compliance point	x	12.5 37.5 62.5	m	
Time since pollutant entered groundwater	t	365,000	days	1,000 years

⁴ Rodgers Leask, 2024, Phase 4H, Glan Llyn, Newport, Chemical Validation Report draft. Similar values have been reported from Phase 4A compound and Units 8-10 in the Commercial area.

Table 3.2 Contaminant-specific model parameters

Determinand	Commercial RL Soil re-use criteria ¹	Residential RL Soil re- use criteria ²	Henry's Law Constant (H) ³	Soil Organic Carbon-Water Partitioning Coefficient (K _{oc}) ³	Solid/Liquid Partition Coefficient (K _d) ³	Half life ⁴	Commercial Compliance Target	Residential Compliance Target
Units	mg/kg	mg/kg	(cm ³ /cm ³)	(-)	l/kg	Days	mg/l	mg/l
Inorganic Metals and Metalloids								
Arsenic	11,469	2,533	1	-	134	1.00E+99	85.352	18.851
Cadmium	331	73	1	-	776	1.00E+99	0.426	0.094
Chromium	42,699	9,431	1	-	5,336	1.00E+99	8.002	1.767
Copper	2,042	451	1	-	1,199	1.00E+99	1.703	0.376
Iron	1,379,516	304,690	1	-	810	1.00E+99	1,702.328	375.989
Lead	71,246	15,736	1	-	34,877	1.00E+99	2.043	0.451
Manganese	150,836	33,315	1	-	720	1.00E+99	209.386	46.247
Mercury	596	132	1	-	5,000	1.00E+99	0.119	0.026
Nickel	52,109	11,509	1	-	7,652	1.00E+99	6.810	1.504
Selenium	3,178	702	1	-	186	1.00E+99	17.051	3.767
Vanadium	7,271	1,606	1	-	213	1.00E+99	34.076	7.527
Zinc	622,690	137,532	1	-	33,558	1.00E+99	18.555	4.098
Other Inorganics								
Ammoniacal Nitrogen	699	154	1	-	1	1,095 ⁵	510.284	112.379
Cyanide	9	2	1	-	5	15 ⁶	1.702	0.372
Organics								
Benzene	17	4	0.182	27	1	720	17.081	3.769
Toluene	582	128	0.221	178	4	28	125.920	27.716
Ethylbenzene	364	80	0.300	432	10	228	34.051	7.492
Xylene	336	74	0.220	260	6	365	51.113	11.27

Determinand	Commercial RL Soil re-use criteria ¹	Residential RL Soil re- use criteria ²	Henry's Law Constant (H) ³	Soil Organic Carbon-Water Partitioning Coefficient (K _{oc}) ³	Solid/Liquid Partition Coefficient (K _d) ³	Half life ⁴	Commercial Compliance Target	Residential Compliance Target
Units	mg/kg	mg/kg	(cm ³ /cm ³)	(-)	l/kg	Days	mg/l	mg/l
Phenol	14	3	0.000068	29	1	28	13.063	2.836
TPH Criteria Working Group								
TPH Aliphatic C5-C6	331	73	33	794	19	8	16.989	3.752
TPH Aliphatic C6-C8	1,626	359	50	3,981	95	8	17.029	3.759
TPH Aliphatic C8-C10	12,861	2,841	80	31,623	755	8	17.021	3.760
TPH Aliphatic C10-C12	102,089	22,548	120	25,1189	5,996	365	17.024	3.760
TPH Aliphatic C12-C16	2,036,743	449,851	520	501,1872	119,643	730	17.023	3.760
TPH Aliphatic C16-C21	256,407,138	56,632,055	4,900	630,957,344	15,062,116	1.00E+99	17.023	3.760
TPH Aliphatic C21-C35	256,407,138	56,632,055	4,900	630,957,344	15,062,116	1.00E+99	17.023	3.760
TPH Aliphatic C35-C44	256,407,138	56,632,055	4,900	630,957,344	15,062,116	1.00E+99	17.023	3.760
TPH Aromatic C5-C7	39	9	0.230	79	2	730	16.269	3.589
TPH Aromatic C7-C8	802	177	0.270	251	6	28	125.878	27.79
TPH Aromatic C8-C10	650	144	0.480	1,585	38	365	16.949	3.753
TPH Aromatic C10-C12	1,027	227	0.140	2,512	60	258	17.013	3.760
TPH Aromatic C12-C16	2,043	451	0.0500	5,012	120	800	16.973	3.747
TPH Aromatic C16-C21	6,447	1,424	0.0100	15,849	378	120	17.039	3.764
TPH Aromatic C21-C35	51,166	11,301	0.000670	125,893	3,005	1,059	17.025	3.760
TPH Aromatic C35-C44	51,166	11,301	0.000670	125,893	3,005	1.00E+99	17.025	3.760
TPH Aromatic C40-C44	51,166	11,301	0.000670	125,893	3,005	1.00E+99	17.025	3.760
Polyaromatic Hydrocarbons								
Acenaphthene	76	17	0.00490	18,621	445	204	0.170	0.0375

Determinand	Commercial RL Soil re-use criteria ¹	Residential RL Soil re- use criteria ²	Henry's Law Constant (H) ³	Soil Organic Carbon-Water Partitioning Coefficient (K _{oc}) ³	Solid/Liquid Partition Coefficient (K _d) ³	Half life ⁴	Commercial Compliance Target	Residential Compliance Target
Units	mg/kg	mg/kg	(cm ³ /cm ³)	(-)	l/kg	Days	mg/l	mg/l
Acenaphthylene	135	30	0.00340	33,113	791	120	0.170	0.0379
Anthracene	155	34	0.00160	38,019	908	920	0.170	0.0374
Benzo(a)anthracene	2,748	607	0.000240	676,083	16,139	1,360	0.170	0.0376
Benzo(a)pyrene	156	34	0.0000190	426,580	10,183	2,120	0.0153	0.00334
Benzo(b)fluoranthene	15	3	0.000200	2,238,721	53,442	1,219	0.000289	0.0000636
Benzo(k)fluoranthene	23	5	0.0000340	3,311,311	79,047	4,280	0.000289	0.0000645
Benzo(g,h,i)perylene	60	13	0.0000300	8,709,636	207,915	1,300	0.000289	0.0000625
Chrysene	2,812	621	0.0000260	691,831	16,515	2,000	0.170	0.0376
Di- benz(a,h)anthracene	3,793	838	0.000000600	933,254	22,279	1,880	0.170	0.0376
Indeno(1,2,3- cd)pyrene	115	25	0.0000660	16,595,869	396,174	1,460	0.000289	0.0000631
Fluoranthene	30	7	0.000420	117,490	2,805	880	0.0107	0.00235
Fluorene	123	27	0.00320	30,200	721	120	0.170	0.0374
Naphthalene	124	27	0.0170	1,514	36	258	3.417	0.742
Phenanthrene	123	27	0.00130	30,200	721	402	0.170	0.0374
Pyrene	346	76	0.000370	85,114	2,032	3,796	0.170	0.0374

¹ Rodgers Leask (2019-22); ² H Fraser Consulting (2024); ³ Rodgers Leask (2019-22), Appendix; ⁴ Howard et al. (1991); ⁵ Buss et al. (2004); ⁶ WFD UK Technical Advisory Group

3.3 Results

The RTM spreadsheet model can be applied to one contaminant and one transport distance at a time. With 59 contaminants and three distances, and different SRVs for the residential and commercial sites, the total number of models that were required for this report is therefore 354. The resulting reference values are given in Section 4. Appendix A provides the summarised outputs of the RTM assessments in more detail.

In both Section 4 and Appendix A, for each contaminant the remedial soil target is given at a distance of 12.5 m, 37.5 m, and 62.5 m from the compliance point. Two reference tables have been produced, one for the commercial site, and one for the residential site.

Some examples of the RTM spreadsheet calculations are provided electronically in Appendix B.

3.4 Statistical methodology

A summary of the general statistical methods referred to in the methodology is given here.

Box plots and histograms are used to present the range of data visually. Box plots show the minimum value of the data set, the range of data falling between the 25th and 75th percentile, the mean value and the maximum value. They are useful to visually assess whether the data points are evenly distributed throughout the range. Histograms show the data distributed by the number of data points within specific ranges and are useful for identifying the distribution of data across the range, and for identifying whether higher values are common or rare in the data set.

The 95th percentile of a dataset is the highest value in a set of data after removing the top 5% of values. Referred to in this report as the “95%ile”.

For any data set, there is uncertainty associated with the estimate of the mean value; a conservative assessment of the mean value can be made by calculating a 95 % Upper Confidence Limit (UCL) in the mean. This will be done using Student’s t-distribution method, which is appropriate for distributions with a small number of samples. The 95% upper confidence limit (UCL) is a probability statement that indicates a 95% confidence that the true population mean is less than or equal to the calculated UCL. This report refers to the 95% upper confidence limit in the mean value as “UCLmean”.

For each 25x25 m backfill zone the UCLmean will be calculated by taking the average stockpile value for each 300 mm layer, and the average of any surface verification samples (taken from the top 100 mm) falling within that backfill zone. An overall weighted average and UCLmean will then be calculated for that whole soil profile in each backfill zone, with the layer and surface verification samples weighted by thickness (300 mm for each layer and 100 mm for the surface verification samples).

3.5 Summary of the approach

Generic modelling reference tables are developed in the next section, so that modelling is not required for each individual phase – rather the recorded values for each CoC can be checked against the reference tables.

Reference values in the tables are given for specific distances.

For each of the remaining site phases the following methodology will be implemented.

1. The 95%ile of all analytical results across the entire phase area (including stockpile and surface verification samples) will be calculated for all contaminants identified in the site-wide Remediation Strategy. These contaminants are as listed in Table 2.1.
2. The 95%ile value will be screened against the SRVs (Table 2.1). Any exceedances will be shortlisted as Contaminants of Concern (CoCs) for this phase and further assessment will be carried out.
3. Some CoCs are shown by the reference tables to have such slow travel times that they will not travel 12.5 m in the 1,000-year assessment period. These are marked “no impact” in the reference tables and they will be eliminated from the CoC shortlist.
4. For each remaining shortlisted CoC a thorough statistical and spatial analysis will be carried out. This will include the following:
 - Presentation of the entire data set as a box plot;
 - Presentation of the entire data set as a histogram; and
 - Spatial assessment of the data, with an average concentration and UCLmean concentration calculated for each 25x25 m backfill zone.
5. The UCLmean concentration for each 25x25 m backfill zone will be compared to the 12.5 m reference values. If any of the backfill zones exceed the reference values for 12.5 m, the UCLmean will be compared to the 37.5 m and the 62.5 m reference values tables as appropriate given the distance of the backfill zone from the nearest reën.

Table 4.1 and Table 4.2 in the following section set out the reference values for the residential and commercial parts of the site respectively. If any backfill zones are found to fail the relevant reference value checks, contingency actions will be required, as discussed in Section 3.6.

3.6 Contingency actions

Failure of backfilled soils to meet the appropriate reference values will require additional contingency action. Any such eventualities would need to be agreed on a case-by-case basis, since the appropriate actions may be different in each case.

The first contingency action would therefore be for the site owner to propose and for NRW to agree the appropriate work, given the specific circumstances of the failure. Appropriate works are likely to include one or more from the following list:

- further monitoring actions and additional soils testing to more closely define the soils in question;
- isolation of a volume of soils deemed to have failed the criteria;
- excavation and replacement of soils deemed to have failed the criteria; and
- installation of flow barriers (such as low permeability clays) to appropriately lengthen the flow pathway from such a source area to the reën system.

3.7 Validation of drainage layer

The Rogers Leask SRVs (and hence the new reference values in this report) were derived assuming that 60% of infiltration is intercepted by a drainage layer above the engineered fill. It is therefore important that the presence of a drainage layer comprising clean granular material (e.g. 6F5 or Type 1) is evidenced as follows:

- Materials import receipts including description of the materials
- Photographic evidence of the extent of the materials (e.g. aerial photographs)
- Photographic evidence of the type and depth of the materials on a 75 m x 75 m grid

The sequencing of site works is such that the drainage layer will be placed post-commencement of construction works, and will therefore need to be validated separately from the engineered fill materials.

3.8 Validation of hydraulic conductivity

The Rogers Leask SRVs assume that there is a sufficient contrast between the hydraulic conductivity of the drainage layer (high) and the engineered fill (low) that most of the infiltration travels laterally through the drainage layer. The calculations do not however specify a value for hydraulic conductivity. The reference values derived in this report assume a hydraulic conductivity of 1×10^{-6} m/d or less for the engineered fill.

It is proposed that the hydraulic conductivity of the fill is validated by taking at least three hydraulic conductivity measurements per phase, with a guide density of one test per 6.25 ha.

3.9 Groundwater sampling

Provided that there are sufficient soil samples available to have confidence in the quality of the soils materials, it is not considered necessary to provide groundwater sampling data to support discharge of PC28.⁵

⁵ Note that groundwater monitoring may be required to support an application to discharge PC29, or to support an application for an environmental permit to discharge water from the reens to the wider environment. However, that is outside the scope of this report and will be dealt with separately.

4 REFERENCE TABLES FOR CONTAMINANTS OF CONCERN

In these tables the reference values shown are for comparison with UCLMean calculated soil concentrations in backfill zones at Glan Llyn.

Where a cell shows "No impact", the RTM spreadsheet predicts that the contaminant will not travel the indicated distance within the modelled time frame. (Where this occurs it results from a combination of the slow groundwater velocity, the degradation of the contaminant and its retardation (sorption) within the fill material.)

Other cell values show the remedial target for soil, calculated by the spreadsheet to meet the agreed soil reuse value at the reem margin. Where a cell shows ">1E+06" this means that the remedial target calculated is greater than 10⁶ mg/kg, which cannot plausibly be reached.

4.1 Residential

Table 4.1 Residential phase reference tables, by distance from reem

Contaminant	Remedial Target (Residential) mg/kg		
	12.5 m	37.5 m	62.5 m
Metals and metalloids			
Arsenic	>1E+06	No impact	No impact
Cadmium	No impact	No impact	No impact
Chromium	No impact	No impact	No impact
Copper	No impact	No impact	No impact
Iron	No impact	No impact	No impact
Lead	No impact	No impact	No impact
Manganese	No impact	No impact	No impact
Mercury	No impact	No impact	No impact
Nickel	No impact	No impact	No impact
Selenium	>1E+06	No impact	No impact
Vanadium	No impact	No impact	No impact
Zinc	No impact	No impact	No impact
Other inorganics			
Ammoniacal Nitrogen	260.0	872.3	3,322
Cyanide	>1E+06	>1E+06	>1E+06
Organics			
Benzene	8.271	40.68	207.7
Ethylbenzene	703.5	20,947	466,939
Phenol	109,647	>1E+06	>1E+06
Toluene	>1E+06	>1E+06	>1E+06
Xylene	313.7	3,777	38,464
Petroleum hydrocarbons			
TPH Aliphatic C5-C6	>1E+06	>1E+06	>1E+06
TPH Aliphatic C6-C8	>1E+06	>1E+06	>1E+06
TPH Aliphatic C8-C10	No impact	No impact	No impact
TPH Aliphatic C10-C12	No impact	No impact	No impact
TPH Aliphatic C12-C16	No impact	No impact	No impact
TPH Aliphatic C16-C21	No impact	No impact	No impact
TPH Aliphatic C21-C35	No impact	No impact	No impact

Contaminant	Remedial Target (Residential) mg/kg		
	12.5 m	37.5 m	62.5 m
TPH Aliphatic C35-C44	No impact	No impact	No impact
TPH Aromatic C5-C7	18.32	88.80	448.6
TPH Aromatic C7-C8	>1E+06	>1E+06	>1E+06
TPH Aromatic C8-C10	1,558	>1E+06	>1E+06
TPH Aromatic C10-C12	17,730	>1E+06	No impact
TPH Aromatic C12-C16	>1E+06	No impact	No impact
TPH Aromatic C16-C21	No impact	No impact	No impact
TPH Aromatic C21-C35	No impact	No impact	No impact
TPH Aromatic C35-C44	No impact	No impact	No impact
TPH Aromatic C40-C44	No impact	No impact	No impact
Polyaromatic hydrocarbons			
Acenaphthene	No impact	No impact	No impact
Acenaphthylene	No impact	No impact	No impact
Anthracene	No impact	No impact	No impact
Benzo(a)anthracene	No impact	No impact	No impact
Benzo(a)pyrene	No impact	No impact	No impact
Benzo(b)fluoranthene	No impact	No impact	No impact
Benzo(g,h,i)perylene	No impact	No impact	No impact
Benzo(k)fluoranthene	No impact	No impact	No impact
Chrysene	No impact	No impact	No impact
Di-benz(a,h)anthracene	No impact	No impact	No impact
Fluoranthene	No impact	No impact	No impact
Fluorene	No impact	No impact	No impact
Indeno(1,2,3-cd)pyrene	No impact	No impact	No impact
Naphthalene	366.6	895,675	>1E+06
Phenanthrene	No impact	No impact	No impact
Pyrene	No impact	No impact	No impact

4.2 Commercial

Table 4.2 Commercial phase reference tables, by distance from ree

Contaminant	Remedial Target (Commercial) mg/kg		
	12.5 m	37.5 m	62.5 m
Metals and metalloids			
Arsenic	>1E+06	No impact	No impact
Cadmium	No impact	No impact	No impact
Chromium	No impact	No impact	No impact
Copper	No impact	No impact	No impact
Iron	No impact	No impact	No impact
Lead	No impact	No impact	No impact
Manganese	No impact	No impact	No impact
Mercury	No impact	No impact	No impact
Nickel	No impact	No impact	No impact
Selenium	>1E+06	No impact	No impact

Contaminant	Remedial Target (Commercial) mg/kg		
	12.5 m	37.5 m	62.5 m
Vanadium	No impact	No impact	No impact
Zinc	No impact	No impact	No impact
Other inorganics			
Ammoniacal Nitrogen	1,181	3,961	15,084
Cyanide	>1E+06	>1E+06	>1E+06
Organics			
Benzene	37.48	184.3	941.3
Toluene	>1E+06	>1E+06	>1E+06
Ethylbenzene	3,197	95,209	>1E+06
Xylene	1,423	17,137	174,505
Phenol	504,959	>1E+06	>1E+06
Petroleum hydrocarbons			
TPH Aliphatic C5-C6	>1E+06	>1E+06	>1E+06
TPH Aliphatic C6-C8	>1E+06	>1E+06	>1E+06
TPH Aliphatic C8-C10	No impact	No impact	No impact
TPH Aliphatic C10-C12	No impact	No impact	No impact
TPH Aliphatic C12-C16	No impact	No impact	No impact
TPH Aliphatic C16-C21	No impact	No impact	No impact
TPH Aliphatic C21-C35	No impact	No impact	No impact
TPH Aliphatic C35-C44	No impact	No impact	No impact
TPH Aromatic C5-C7	83.04	402.5	2,034
TPH Aromatic C7-C8	>1E+06	>1E+06	>1E+06
TPH Aromatic C8-C10	7,035	>1E+06	>1E+06
TPH Aromatic C10-C12	80,215	>1E+06	No impact
TPH Aromatic C12-C16	>1E+06	No impact	No impact
TPH Aromatic C16-C21	No impact	No impact	No impact
TPH Aromatic C21-C35	No impact	No impact	No impact
TPH Aromatic C35-C44	No impact	No impact	No impact
TPH Aromatic C40-C44	No impact	No impact	No impact
Polyaromatic hydrocarbons			
Acenaphthene	No impact	No impact	No impact
Acenaphthylene	No impact	No impact	No impact
Anthracene	No impact	No impact	No impact
Benzo(a)anthracene	No impact	No impact	No impact
Benzo(a)pyrene	No impact	No impact	No impact
Benzo(b)fluoranthene	No impact	No impact	No impact
Benzo(k)fluoranthene	No impact	No impact	No impact
Benzo(g,h,i)perylene	No impact	No impact	No impact
Chrysene	No impact	No impact	No impact
Di-benz(a,h)anthracene	No impact	No impact	No impact
Fluoranthene	No impact	No impact	No impact
Fluorene	No impact	No impact	No impact
Indeno(1,2,3-cd)pyrene	No impact	No impact	No impact
Naphthalene	1,687	>1E+06	>1E+06
Phenanthrene	No impact	No impact	No impact

Contaminant	Remedial Target (Commercial) mg/kg		
	12.5 m	37.5 m	62.5 m
Pyrene	No impact	No impact	No impact

5 VALIDATION REPORT AND DISCHARGE OF PLANNING CONDITION 28

It is proposed that, for each Phase, the discharge of PC28 is split into two parts as follows.

5.1 Discharge of PC28 Part 1

A validation report is to be submitted to demonstrate the quality of the engineered fill materials to include:

- Description of remediation activities
- Summary of soil movements (tickets for import and export of materials to be provided if relevant)
- Presentation of soils validation data (laboratory certificates and summary tables)
- Screening against RL SRVs to identify CoCs
- Statistical assessment and screening against reference values for CoCs
- Presentation of hydraulic conductivity data for the engineered fill

5.2 Discharge of PC28 Part 2

A validation report is to be submitted to demonstrate the presence, thickness and nature of the drainage layer, to include:

- A description of the works undertaken
- Materials import receipts including description of the materials (typically 6F2 or Type 1 materials)
- Photographic evidence of the extent of the materials (e.g. aerial photographs)
- Photographic evidence of the type and depth of the materials on a 75 m x 75 m grid (or finer grid as appropriate for the size of the plot)

6 REFERENCES

Atkins, 2017, Glan Llyn, Llanwern: Llanwern Controlled Waters Detailed Quantitative Risk Assessment.

Buss, SR, Herbert, AW, Morgan, P et al, 2004. A review of ammonium attenuation in soil and groundwater. *QJEG* v 37.

Environment Agency, 2006. Remedial Targets Methodology: hydrogeological risk assessment for land contamination.

HFCL, 2024. Glan Llyn, Llanwern: soil quality verification. Correction to calculated re-use criteria for soils at Glan Llyn (residential).

Howard, PH, Boethling, RS, Jarvis, WF, Meylan, WM and Michalenko, EM, 1991. Handbook of environmental degradation rates.

Rodgers Leask, 2019-2022: Glan Llyn Llanwern Sitewide: Controlled Waters DQRA 2019 Update.

Rodgers Leask, 2017: Glan Llyn surface water drainage strategy.

APPENDIX A

RTM modelling spreadsheet outputs (electronic)

APPENDIX B

Example RTM spreadsheets (electronic)

Appendix F – Remediation Strategy Addendum Information

Technical Note

Project:	P18-669 Glan Llyn, Newport
Subject:	Remediation Strategy Addendum Information
Date:	January 2022
Document Reference:	18669-RLL-22-XX-RP-O-0192
Prepared by	Chris Wilson BSc (Hons) MCIWEM
Reviewed by	Howel Morris BSc (Hons) MSc CGeol FGS

A site wide Remediation Strategy was submitted by Rodgers Leask Limited (RLL) in November 2021 for the Glan Llyn development in Newport pursuant to the discharge of condition 27 of outline planning approval 06/0471. The Senior Scientific Officer (Steve Manning) at Newport City Council (NCC) reviewed and provided a response. This note provides addendum information to the Remediation Strategy following correspondence with the Senior Scientific Officer. The paragraphs numbered below relate to the points raised by NCC and discussed in the correspondence between NCC and RLL (Technical Note 187), presented in **Appendix A**.

1. Pictorial versions of the earthworks process intended to enhance the conceptual site model (CSM) for the residential and commercial parts of the development have been prepared and are presented in **Drawings**. The Made Ground in the residential areas will be cleared to the natural underlying clay before placement of suitable material from within the phase and from pre validated stockpiles to achieve the required formation level. Photographs of the process are inserted. The commercial area will undergo an excavation/ trim to 2m below formation level with obstructions and unsuitable material removed to natural clay before suitable material from the trim exercise and the residential site is re-engineered to achieve formation level.

2. The removal of unsuitable material from the residential phases and the turnover and placement of retained suitable Made Ground in 300mm layers is intended reduce the contamination risks (Phase 4h – vapour) by thinly spreading and compacting source material to improve consistency and reduce permeability. Monitoring (chemical surface validation sampling, gas monitoring and, where appropriate, vapour monitoring in each residential phase) will be undertaken following the remedial earthworks to assess the remediated condition and the contamination status of the formation surface. The Validation Report (submitted pursuant to the approval of NCC & partial discharge of planning condition 28) will recommend appropriate mitigation measures, if required, in addition to the clean cover as part of the listed developer actions.

3. The post remedial earthworks formation in residential areas will undergo chemical sampling (greater than 1 per 50m²) in addition to the pre-remediation testing to comply with the recommended testing frequency but also provide information to assess the contamination status of the formation surface as recommended by NCC. The surface contamination status,

in addition to earthworks validation, will be assessed to recommend the form of mitigation measures in addition to the clean cover.

4. A clean cover provision of 600mm in landscape areas is accepted. The landscape areas will also undergo formation surface chemical sampling to assess the contamination status and whether mitigation measures are required in addition to 600mm of clean cover.

5. The trim and chase strategy (also referred to as the 1m turnover) within the Remediation Strategy applies only to the central business park. The business park will have the benefit of at least 2m of re-engineered material underlying the construction material before the hardstanding or floor slabs area constructed. This is presented in the commercial area pictorial earthworks CSM (**Drawings**). The re-engineered material will have a reduced permeability in comparison with undisturbed in situ Made Ground and the hydraulic gradient would likely be away from the engineered material towards the undisturbed Made Ground. The hydraulic gradient would protect the engineered profile.

6. The Validation Report for each phase includes a section on the developer actions. The actions typically comprise the provision of clean cover and gas protection measures. The final form of the developer actions are to be confirmed following the post remedial works monitoring and validation sampling.

General Items

It is noted that the LPA and the project team await the comments from Natural Resources Wales (NRW) regarding the controlled waters.

The NRW and NCC have accepted an invite to attend site on 26th January 2022.

It is hoped that a greater understanding of the proposed Remediation Strategy has been provided in the correspondence. It is understood that the potential mitigation measures (to break pathways) will be reviewed following the assessment of the contamination status of the surface formation. This will comprise chemical sampling of the formation surface, shallow gas monitoring of the phase and, where appropriate, vapour monitoring.

Llanwern Residential Phases, Conceptual Site Model

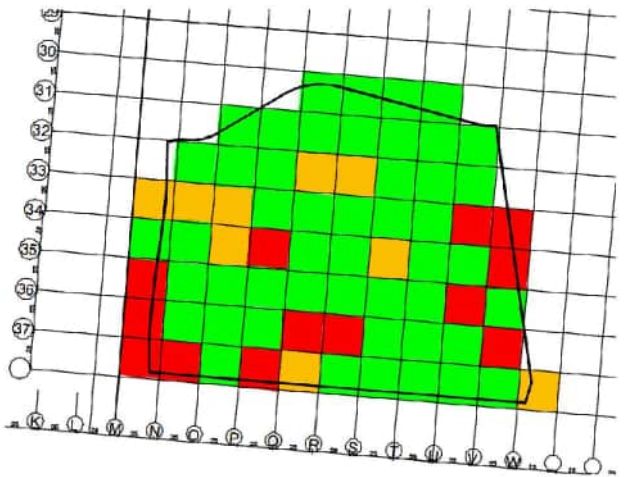
1. Pre-Reclamation Sampling Exercise

Chemical assessment undertaken on in-situ made ground and stockpiled material. Sampling across a 25m grid identifies chemically unsuitable material within phase.

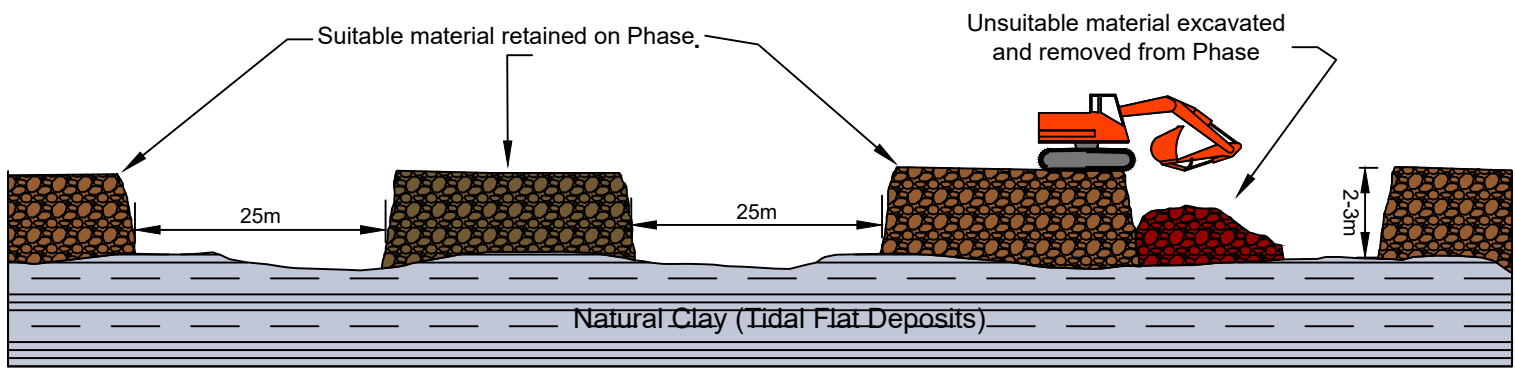
Made Ground to be excavated to natural Clay and removed for treatment or re-use on commercial area.

Potential for re-use within plot following turnover.

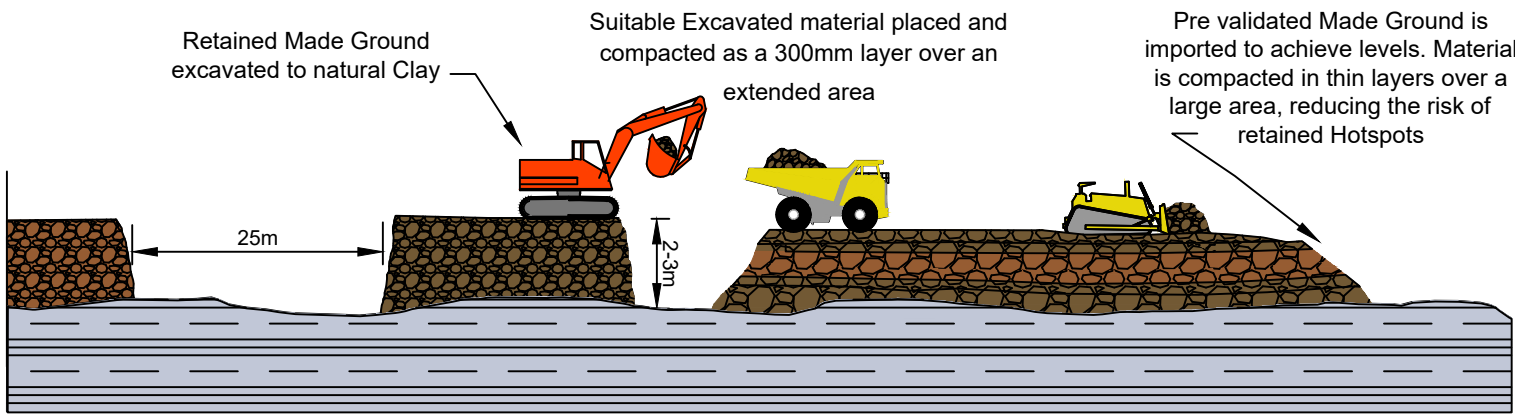
Made Ground to be turned over for re use within plot.



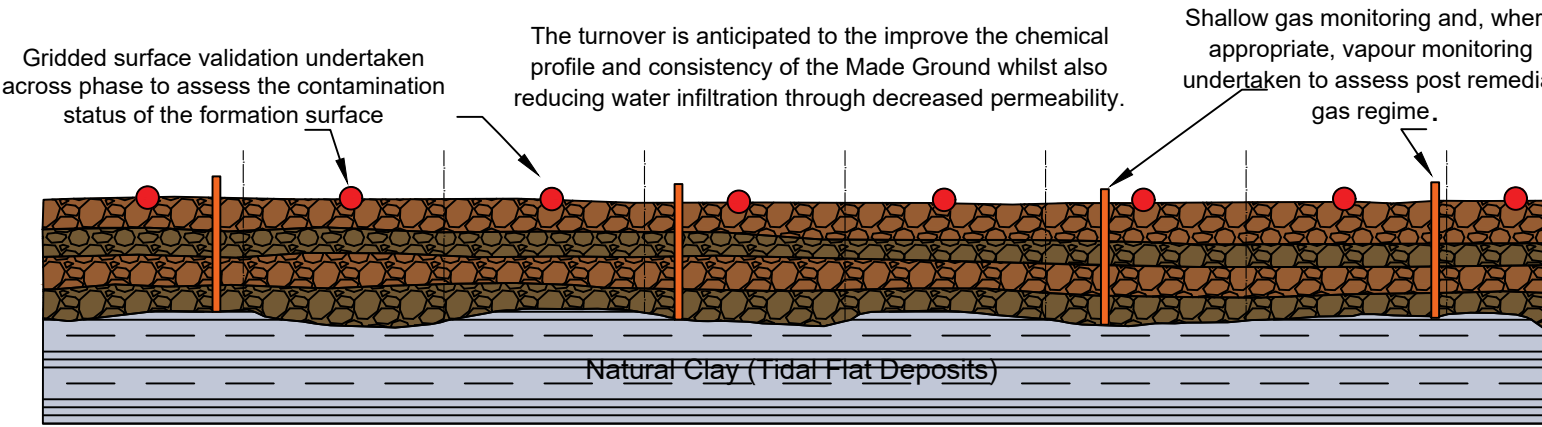
2. Unsuitable material removed from Site. Phase ready for turnover.



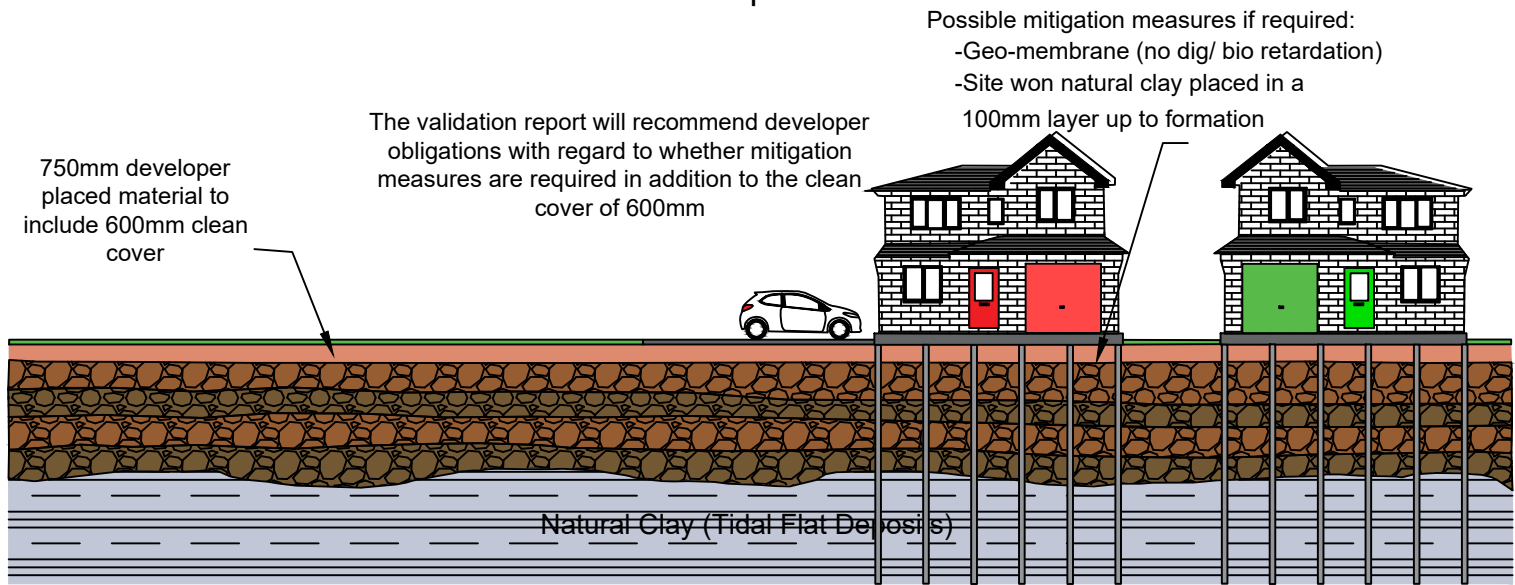
3. Turnover Exercise



4. Post Earthworks Additional Surface Validation

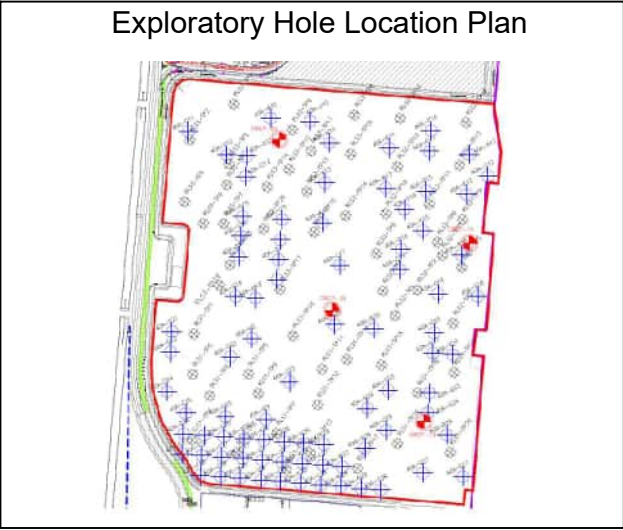
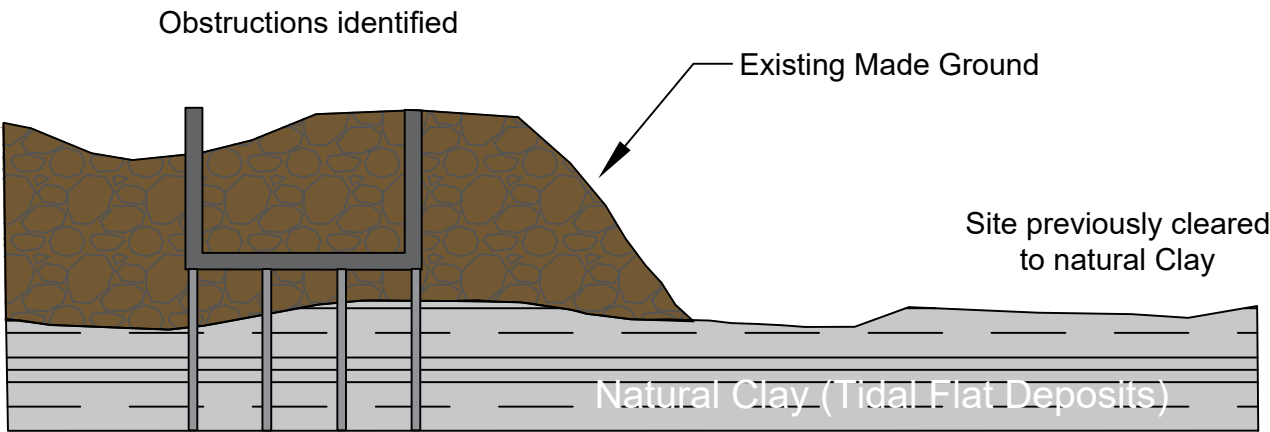


5. Developed Site

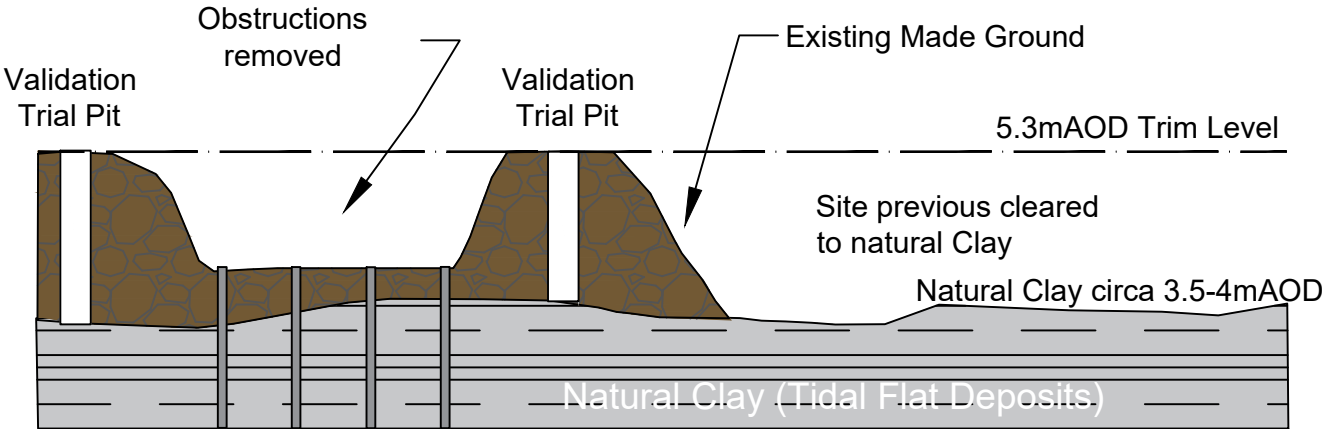


Llanwern Business Park, Conceptual Site Model

1. Site Pre-Trim



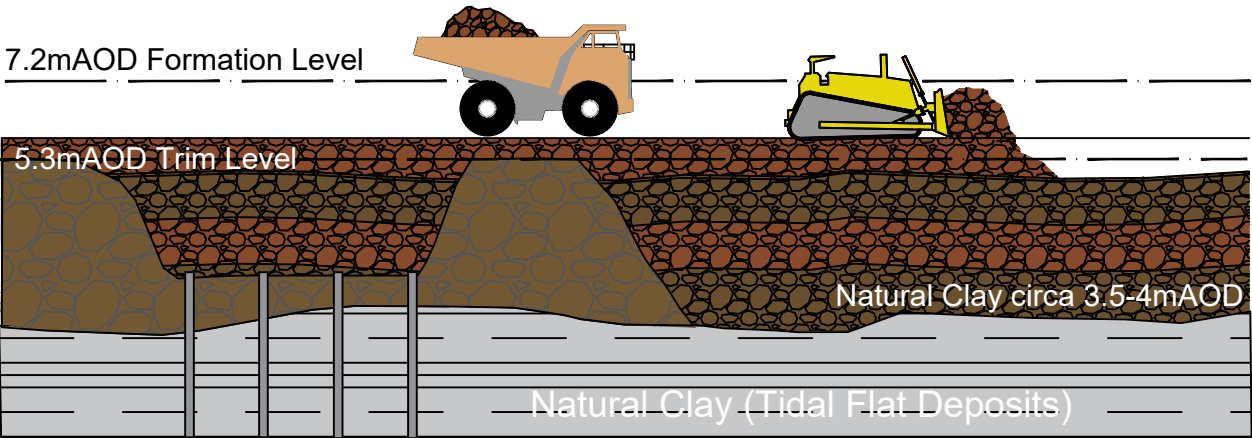
2. Site Trimmed to 5.3mAOD and obstructions removed



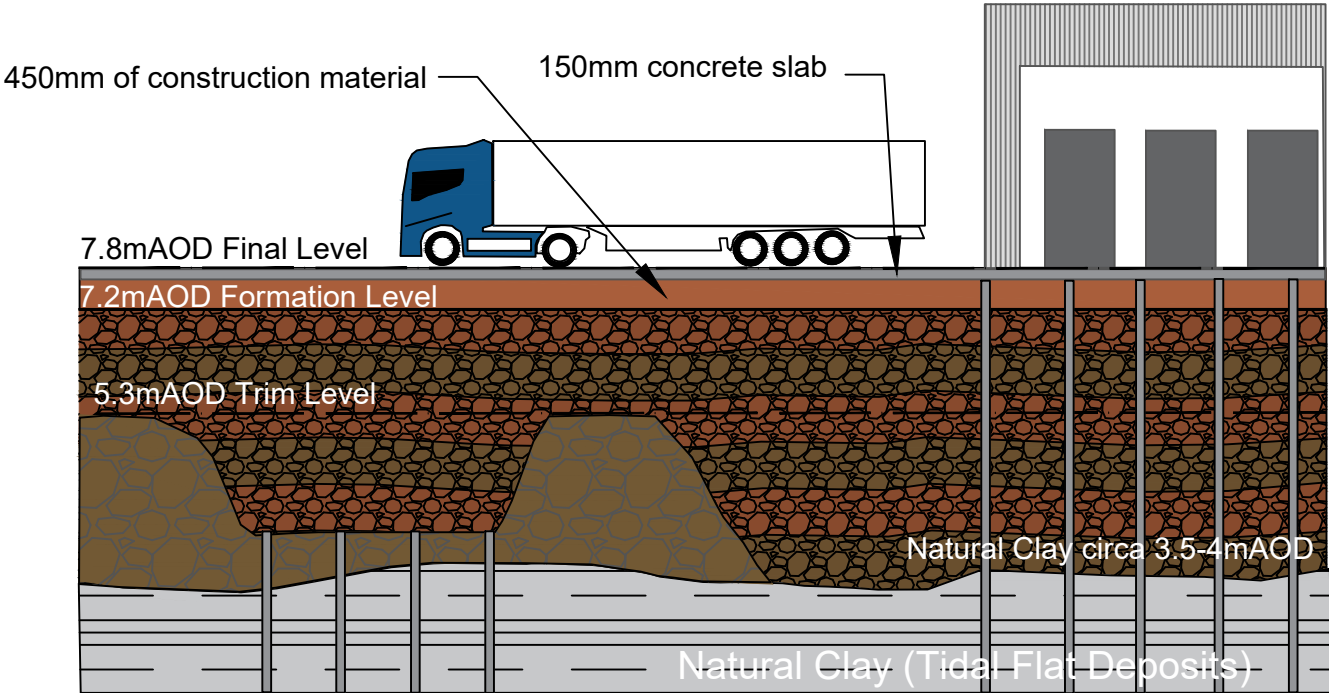
3. Fill engineered across site to formation level.

Suitable material from the trim exercise and material from the residential site placed and compacted as a 300mm layer over an extended area

Made Ground is imported to achieve levels. Material is compacted in thin layers over a large area, reducing the risk of retained Hotspots



3. Developed Site Including 0.6m of clean cover material





Appendix A – TN187, LPA Comments

Technical Note

Project:	P18-669 Glan Llyn, Newport
Subject:	Phase 4h Response to LPA Comments
Date:	December 2021
Document Reference:	18669-RLE-21-XX-RP-O-0187
Prepared by	Chris Wilson BSc (Hons) MCIWEM
Reviewed by	Howel Morris BSc (Hons) MSc CGeol FGS

It is worth stating that all made ground will be removed and only suitable material will be used in the formation of the plot. The Phase II report for Phase 4h reports the pre remediation conditions and all of the made ground will have been excavated to a validated natural clay. The full turnover of the made ground is exceptional and hugely conservative as it allows for the visual and olfactory assessment of all of the made ground in addition to chemical assessment. Approximately 40% of the made ground from Phase 4h has already been removed and stockpiled for treatment or reuse in the commercial area.

Comments:

1. Detailed cut and fill/reuse drawings for all areas requiring remediation are sought so that extents and depths can be better understood prior to works.

The site will have all unsuitable made ground removed and the remaining made ground assessed as suitable for retention will be turned over to the underlying natural clay. The removal or turnover of all of the made ground is a conservative approach where 100% of the made ground is excavated. A normal ground investigation would cover less than 1% of the material and therefore there is confidence in the consistency and suitability of the material. The natural clay will be sampled as a part of the validation testing. *A base of excavation drawing showing the surface of the natural deposits and relevant validation information will be provided within the validation report.* Is there an existing drawing which confirms this conceptually? it is important NCC has a clear picture of what is intended as well as what is done.

2. Will the removal of contaminated material be sufficient to remove the vapour pathway for hydrocarbons into dwellings/garden areas? *Yes, although as a precaution we will undertake vapour monitoring post earthworks.* The CSM in appendix D makes no reference to this. a vapour pathways will remain after made ground remediation then full protection of dwellings, services and garden areas needs to be considered for the benefit of future developers and the onward developer documentation trail. It is noted that a post remedial vapour assessment is proposed however this pathway needs to be included in the CSM for completeness. *Accepted, we will update the CSM as an addendum to the report.* Both items in red text are supported.

3. The Reuse Criteria for 40% Infiltration of Incident Rainfall into Engineered Made Ground are noted and cause concern given their high levels at a what will be depth of only 600mm below residential gardens. Engineered cover systems appear to be warranted and not simple cover systems; in view of significantly elevated levels that will exist below cover. *The*

earthworks will provide an engineered difficult dig layer of low permeability which will be validated to assess compliance with the earthworks specification. The formation created would prove a difficult dig for a JCB even without the 600mm above. This aspect is noted however it is the contamination status of the final formations surface that will dictate the degree to which additional separation from domestic digging activity contact is required through engineered cover. The use of a semi permeable or impermeable membrane incorporating a bright orange geomembrane should be considered as part of engineered cover to deter against digging beneath clean material – a combined anti-dig/capillary break layer should also be considered as part of the remedial approach for final development. This is considered necessary to prevent both the upward migration of any contamination into cover systems and contact with material beneath them. The use of a 'Bentomat' type system (geotextiles with bentonite clay layer) to prevent infiltration may be warranted in this situation given the nature of contaminated material being proposed for reuse beneath cover and proposals regarding this are sought. Although 600mm is specified in the remediation strategy the formation level is set 750mm below the final ground level. Could the proposed developer actions regarding cover be recommended following review of the validation report. It is anticipated that the average concentrations will be well below the proposed thresholds. The remedial criteria is based on an average approach and the complete removal of made ground across the plot with placement of validated site won made ground. The turnover of the made ground will cause improvement of the material, where the organic concentrations are likely to be reduced, from the pre remediated state reported in the phase II report. The post remedial conditions are designed to be much improved and we can provide an isopachyte of concentrations to assist in zoning the site should enhanced protection measure be required. This appears to be a suitably pragmatic approach to specifying final developer cover and must take the form of an engineered cover system design with detailed drawings so that requirements are clear to all when available.

4. The proposed cover of only 300mm in landscaped areas does not appear sufficient given the level of contamination that will remain as a result of the proposed Reuse Criteria for 40% Infiltration of Incident Rainfall into Engineered Made Ground. Either the reuse levels are made more conservative given the level of proposed cover ; or the level of cover is increased to a minimum of 600mm. 600mm is likely to be acceptable. 600mm will be accepted as suggested subject to its engineered nature. Incorporation of the features in 3 above would be relevant in landscaped areas also for any thickness of cover. The reengineered ground is likely to be provide a sufficient no dig barrier. This aspect is noted however it is the contamination status of the final formations surface that will dictate the degree to which additional separation from domestic digging activity contact is required through engineered features.

5. It is not clear whether the one metre turn over specification will prevent any lateral movement of contaminants into regions that have had the full turnover applied of full turn over ? The 1m turnover applies to the central business park where the interception of rainfall is >90% when the site is developed and the proposed levels are to be raised providing at least 2m of low permeability reengineered material above the base of excavation. The remediation strategy proposed by RLE recommends full turnover in the residential areas. Where this meets the remediation strategy proposed by Vertase FLI, the full depth of reengineered made ground would retard migration from the 1m turnover strategy. or what the significance of this would be? Graphical illustration of how this will work between areas of the two specifications is sought. If there is any risk of migration from one meter turnover regions into full turnover regions then an approach where all regions undergo full turnover may be worth considering ? This has been assessed as part of the CWRA, appended to the remediation strategy, the hydraulic gradient would suggest that the direction of migration would be from the engineered material to the non engineered material. Thus protecting the fully engineered profile. However the likely volume of perched water will be reduced due to

the reduced permeability of the engineered profile. This aspect is noted and may require further consideration by NRW – copied in for comment.

6. Onward developer action documentation needs to be provided in advance of any developers being in the frame; and the format of this is sought at this stage. *A general developer actions list can be provided. The actions typically comprise the provision of clean cover and gas protection measures.* Accepted that a draft format may be all that is possible at this stage in view of finalising developer engineered cover design further to validation of this first remedial phase.

It is important that the LPA obtain comments from NRW in respect of this site as controlled waters are clearly a sensitive receptor and Reuse Criteria for 40% Infiltration of Incident Rainfall into Engineered Made Ground are concerningly high. *The strategy is intended to deliver an acceptable water quality into the surface waters by turning over the made ground and creating a consistent low permeability, 2m thick, engineered material. This is intended inhibit the percolation of rainwater into the made ground. The compaction also reduces the ability to disturb the made ground without the use of heavy mechanical means.* This aspect is noted however it is the contamination status of the final formations surface that will dictate the degree to which additional separation from end user digging activity contact is required.

I am not at present reassured that the human health pathway will be sufficiently mitigated at both made ground remedial and developer remedial stages and as such the above matters need to be addressed before any consideration can be given to support for discharge. We would like to invite the local authority to attend site for a walkover as the benefit and scale of the remediation works are better understood during a site visit. A site meeting is welcomed and I would suggest NRW are invited to such a meeting also.

1.

Technical Note

Project:	P18-669 Glan Llyn, Newport
Subject:	CWDQRA Validation Plan
Date:	June 2022
Document Reference:	18669-RLL-22-XX-RP-O-0260
Prepared by	Chris Wilson BSc (Hons) MCIWEM
Reviewed by	Howel Morris BSc (Hons) MSc CGeol FGS

A site wide Remediation Strategy was submitted by Rodgers Leask Limited (RLL) in November 2021 for the Glan Llyn development in Newport pursuant to the sitewide discharge of part of condition 27 of the outline planning approval 06/0471. Natural Resources Wales (NRW) reviewed the strategy and the appended updated controlled water detailed quantitative risk assessment (CWDQRA). A meeting was held with NRW on 20th April 2022 and following the meeting RLL has prepared this CWDQRA validation plan to verify that material with contaminants of concern exceeding the criteria are placed at the appropriate distance from a surface water, to assess whether the hydraulic conductivity and the pore water chemical concentrations within the reengineered material are as assumed in the CWDQRA. This note provides the method to collect and assess the CWDQRA validation information as an addendum to the remediation strategy and also presents a number of points as a contingency plan.

Contaminants of Concern Validation

The updated CWDQRA identified some exceedances for concentrations of contaminants of concern (CoC) in relation to a 20m compliance distance. A further assessment has shown material recording concentrations exceeding the 20m compliance criteria for the CoC is suitable when placed at a distance of greater than 30m from the compliance point. The phase specific validation report will show that material with CoC exceeding the 20m compliance criteria has been placed at a suitable distance i.e. greater than 30m.

Hydraulic Conductivity Validation

The updated CWDQRA recognises the benefits of excavating and reengineering the made ground on the permeability of the material. The earthworks validation report presents test results characterising the made ground and standard results for compaction and air voids validating that the compaction requirements have been achieved. It is considered helpful, as a line of evidence to support the poor drainage characterisation of the reengineered material, to undertake falling head tests, and where possible rising head tests, upon and within the reengineered material.

The formation falling head tests are to be undertaken using a cylinder to hold a head of water against the formation surface. Approximately 10 falling head tests will be undertaken per phase or a minimum of 1 test per 100m². Whilst the dimensions of the falling head test are not



complaint with BRE Soakaway test, the monitoring and assessment will be undertaken in accordance with the BRE. The standard dimensions of the BRE Soakaway test would damage the formation and potentially be influenced by the underlying clay.

The falling and rising head tests will be undertaken on the shallow monitoring wells installed, following the earthworks, in the reengineered made ground. Up to 8 shallow monitoring locations will be installed in each phase.

The CWDQRA describes the permeability of piling mat post construction. The validation report shall include, as part of the developer obligations, confirmation or verification of construction material/ piling mat with the suitable permeability characteristics in accordance with the CWDQRA & Remediation Strategy.

Pore Water Concentration Assessment

The updated DQCWRA assumed pore water concentrations as shown in Table 1.

Table 1. Calculated Pore-water Concentrations for Contaminants of Concern (CoC) Modelled in P20 Remedial Target Worksheets

Determinands	Calculated Porewater Concentrations (mg/l) based upon laboratory derived totals soil concentrations (mg/kg) and 1806 (No.) Soil Samples		
	Average	Upper 95 % Percentile	Maximum
Iron	113.57	314.67	2949.27
Manganese	12.00	44.70	566.00
Vanadium	0.97	3.01	13.498
Benzo(a)pyrene	2.85E-4	0.00113	0.07
Benzo(b)fluoranthene	0.0767	0.28	20.77
Naphthalene	0.231	0.165	128.68

It is intended, as part of the validation, to then compare the field chemical concentrations with the pore water concentrations adopted within the CWDQRA. This will only be possible where perched water is encountered. Where water is present within the shallow monitoring wells the sample will be collected using a peristaltic (low flow) pump.

The monitoring locations, the positions of the formation surface tests falling head tests, the results and the assessment of the results will be presented in the validation report for each phase.

Following validation of the earthworks to achieve the formation surface, it is proposed that a limited number of monitoring wells are retained (approximately 30% or 3 per phase) or



installed in landscaping areas. The validation report for each phase will contain specific information on how this will be achieved. This will allow long-term monitoring of the perched water post construction and build on a sitewide dataset of perched water quality.

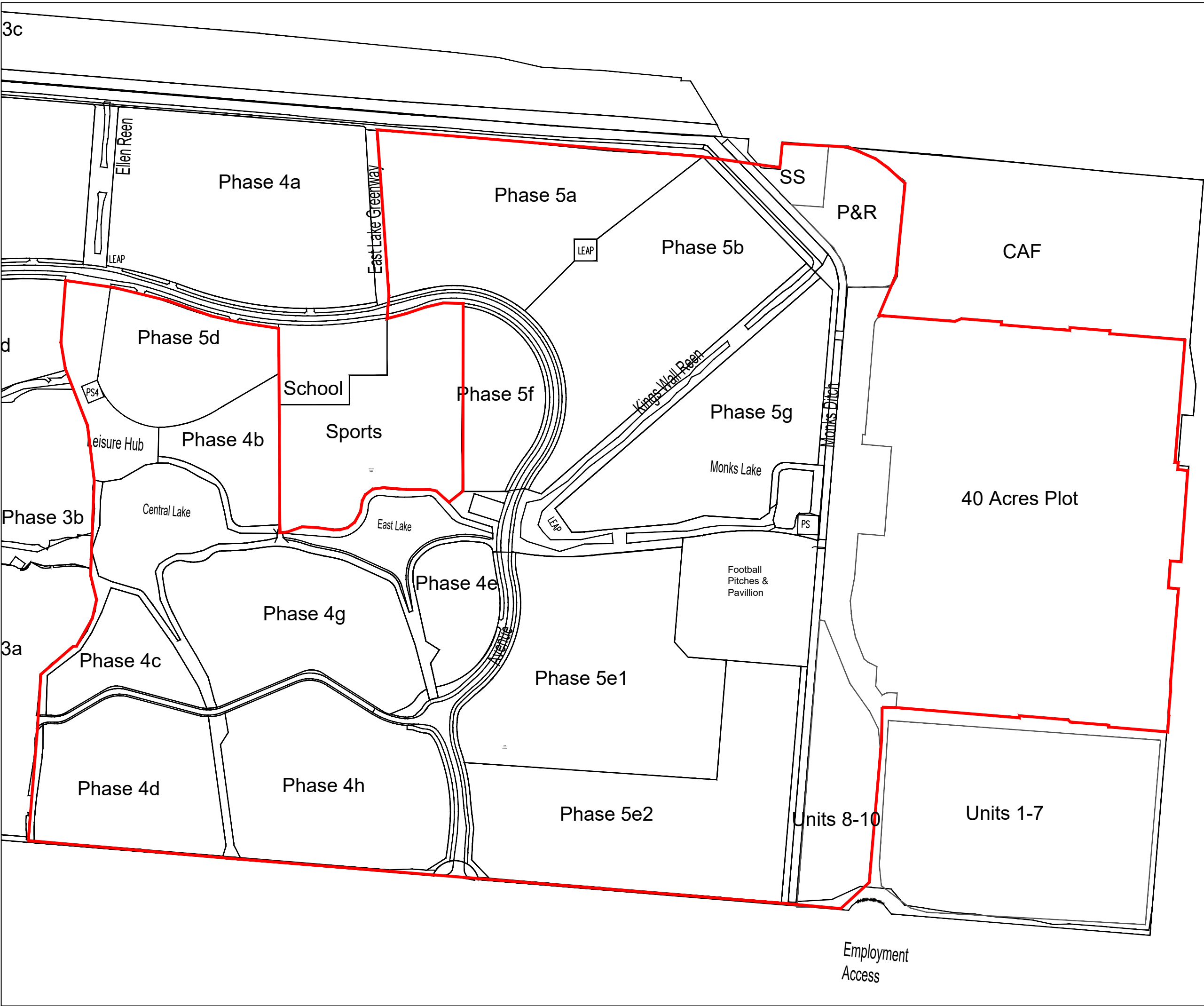
Contingency Plan

The validation assessment will also, where appropriate, compare results from adjacent phases and site wide monitoring results as part of the validation assessment. The creation of baseline set of data for the site, through the accumulation of results from individual phases, to support the maintenance of suitable site wide surface water quality. The comparison of phase specific information and sitewide information may also be used as contingency where soil concentrations exceed criteria or pore water concentrations exceed modelled parameters but monitoring indicates suitable sitewide conditions.

The CWDQRA also considers that there is a potential for natural attenuation benefits from further improving the existing surface water features on the site, which mainly comprise reens and ponds/small lakes. This is anticipated particularly through:

1. Further establishing the vegetation within the reens which will help reduce the concentrations of organic contaminants and particularly nutrients such as ammoniacal nitrogen. The reens are known to vegetate rapidly and require regular maintenance to remove surplus growth;
2. Undertaking organic matter enrichment of soils along margins of the reens and ponds/lakes into which water penetrating the Made Ground are likely to discharge. This could be undertaken by placement of locally excavated peat (obtained from Alluvial and underlying Tidal Flat Deposits) and other soils containing high concentrations of organic matter. This should enable a further stripping out of low concentrations of PAHs and TPH within these discharge waters. Amendment of these soils with other materials will also be considered, taking into consideration further knowledge of the residual contaminant profile, in order to provide a passive sustainable solution to the long-term remediation of this site.

The preliminary validation plan for Phase 4h is attached to this note as an example of the typical layout of post earthworks validation sampling and monitoring locations for a residential phase.



GENERAL NOTES

NO DIMENSIONS TO BE SCALED OFF THIS DRAWING.
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ALL LEVELS ARE IN METRES UNLESS NOTED OTHERWISE.
ANY DISCREPANCIES NOTED ON SITE ARE TO BE REPORTED TO THE ENGINEER IMMEDIATELY.

KEY:

- REMEDIAION STRATEGY BOUNDARY
- PHASE BOUNDARIES

A	03:05:22	Updated Boundary	SR	CW	
Rev	Date	Amendments	By	Chk	



Client
St Modwen Developments

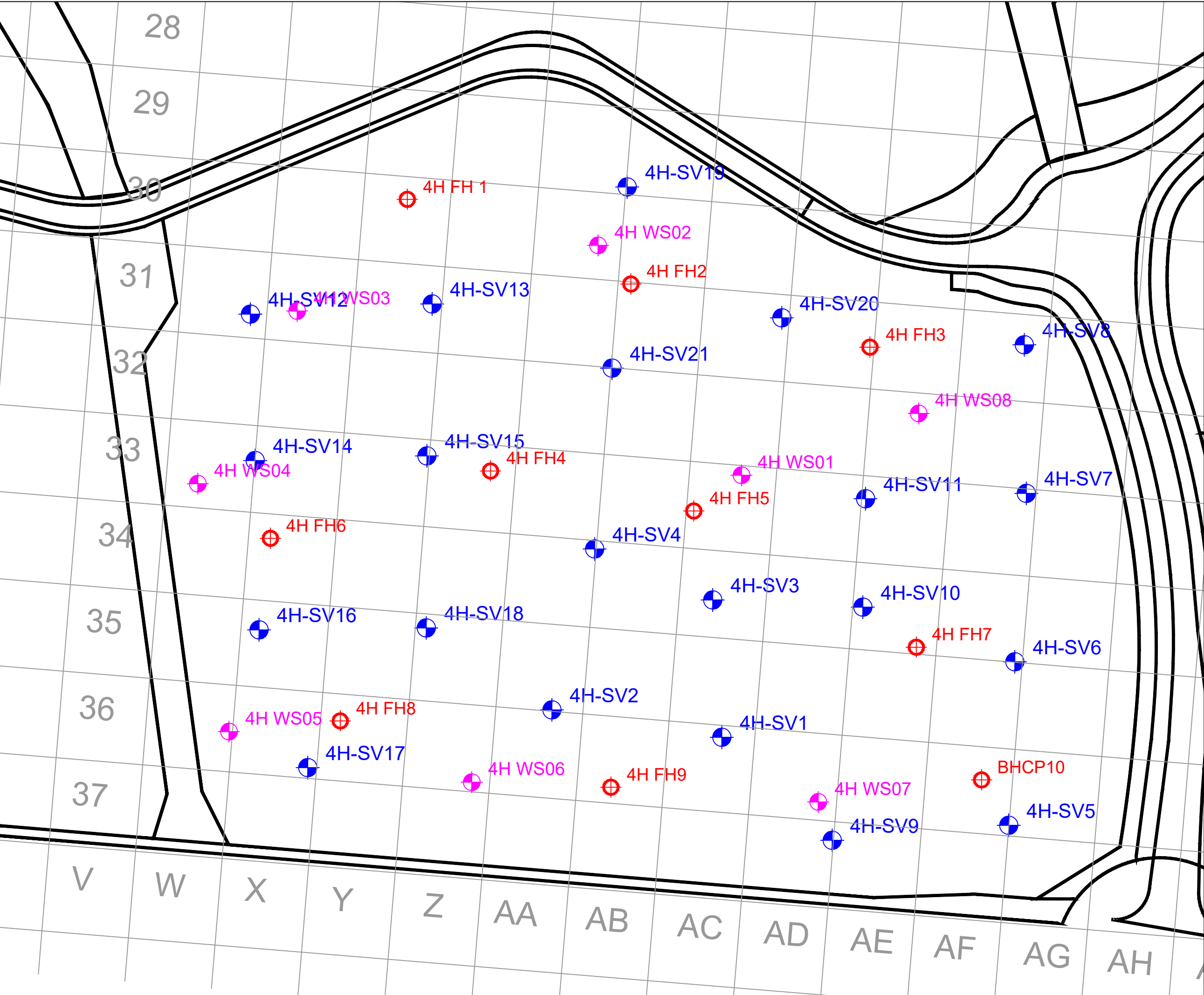
Project
P18-669 Llanwern Reclamation

Drawing Title
Remediation Strategy
Boundary Plan

INFORMATION

	Drawn	Checked	Date
NTS	SR	CW	27.04.22
Drawing No.	Rev.		
18669-RLL-22-XX-DR-O-0262	A		

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KEY:

- 4H-SV SURFACE VALIDATION CHEMICAL SAMPLE LOCATION
- 4H-WS WINDOW SAMPLE LOCATION FOR GAS AND PERCHED WATER MONITORING
- 4H-FH FALLING HEAD TEST LOCATION

Rev	Date	Amendments	By	Chk



Client
St Modwen Developments

Project
P18-669 Llanwern Reclamation

Drawing Title
Phase 4H Validation Plan

INFORMATION

Drawn	Checked	Date
NTS	SR	CW
27.04.22		

Drawing No.	Rev.
18669-RLL-22-XX-DR-O-0269	

