



Detailed Quantitative Risk Assessment

Battle Hospital, Portman Way, Reading, RG30 1AN

For:

Bellway Homes Limited (Thames Valley)

Contact Details:

Enzygo Geoenvironmental Ltd.
The Byre
Woodend Lane
Cromhall
Gloucestershire
GL12 8AA

tel: 01454 269237
email: steve.rhodes@enzygo.com
www: enzygo.com

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Author:	Philip Miles Associates
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1.0 INTRODUCTION

Background

- 1.1 Enzygo Geoenvironmental Limited has been commissioned by Bellway Homes Limited to prepare a Site-Specific Detailed Quantitative Risk Assessment (DQRA) for land that was formally occupied by the Battle Hospital, Portman Way, Reading.
- 1.2 The proposed end use is as residential housing and the development layout is shown on Drawing 031610-BEL-TV-01 prepared by DHA Architect Ltd.
- 1.3 The site was part of a larger former hospital originally constructed in the 1860s (initially operated as a work infirmary). A number of potential sources of contamination were recorded during the initial desk based assessment, principally relating to on site operations and ancillary activities. These include, fuel storage tanks, electricity sub-station, laundry, sterilisation unit, motor vehicle work shop, waste oil drums. Anecdotal evidence suggests the possible presence of infilling in the northern portion of the study area.
- 1.4 A Phase I Desk Study and subsequent Phase II Intrusive Ground Investigation were undertaken at the site by RSK. This included a desk study and targeted ground investigation together with a Conceptual Model. The finds are presented in the following report: Land at Battle Hospital, Portman Way, Reading; Project 28916-R01 (100) dated March 2017.
- 1.5 The site investigation identified hydrocarbon (TPH) contamination locally within the Made Ground (PH1, PH2, PH6, and visually in PH3 and BH2), considered to be associated with an oil loss from the area of bulk fuel storage and filling. Subsequent groundwater quality monitoring identified the presence of dissolved phase TPH concentrations and benzo(a)pyrene (BaP) that were above the adopted GAC.

Objectives

- 1.6 Main project objectives include:
 - Deriving suitable risk-based remedial concentrations for hydrocarbons and BaP in soils which meet current Environmental Quality Standard (EQS) Directive 2008/105/EC and Priority Substances Directive 2013/39/EU;
 - Identifying existing concentrations of selected hydrocarbons and BaP at a modelled Compliance Point (CP); which can be compared to the risk-based remedial targets, with any exceedances to be remediated as part of the site development works; and

- The risk-based target values can be used with a remedial methodology to address the areas of contamination identified during the investigations and also any areas of unforeseen contamination encountered during site development.
- 1.7 This DQRA provides controlled water risk-based remedial targets which will be incorporated into a separate remedial methodology.

2.0 APPROACH

Introduction

2.1 The site-specific risk assessment has been completed with the principal objectives being to determine which of the following are required:

- No remedial action, that is, the level of contamination does not or is not likely to cause pollution of groundwater.
- Remedial action to protect an identified groundwater receptor, based on the risk based targets generated.
- Further analysis and data collection to quantify the degree of risk to the receptor.

Baseline Conditions

2.2 A desk study and subsequent site investigation were undertaken by RSK which confirmed the ground conditions as comprising variable thicknesses of made ground over alluvium, Taplow Gravel Formation and the White Chalk Sub-group. Within the northern portion of the site where the dissolved phase hydrocarbons were identified the made ground varies between 2.0m and 5.0m thick. The made ground is heterogeneous in nature and consists of variable proportions of anthropogenic materials within a clayey sand matrix.

2.3 Alluvium was encountered beneath the made ground along the northern, eastern and western margins of the site. The alluvium comprises of soft organic silty clay and clayey silt within areas of fine to coarse gravels and locally occurring peat horizons.

2.4 The Taplow Gravel Formation was found to be lateral and horizontally variable in nature and typically comprises of gravelly fine to coarse clayey sand, sandy gravels and clayey gravels.

2.5 The Taplow Gravel Formation is underlain by the White Chalk Subgroup with comprised of structureless white chalk.

2.6 The findings of the site investigation identified variable groundwater conditions beneath the site. Perched groundwater conditions were encountered within the made ground and the alluvium. It is anticipated that perched water within the alluvium may flow radially from the centre of the site. Within the White Chalk Sub-group and the Taplow Gravels groundwater

strikes were recorded at variable depths indicating the possible presence of perched groundwater level.

- 2.7 Within the groundwater samples exceedance of the GAC for BaP and TPH (aromatic and aliphatic hydrocarbons between C8 and C35) were recorded in samples obtained from monitoring wells installed within the vicinity of fuel storage tanks located in the northern part of the site. Concentrations of BaP and TPH (aromatic and aliphatic hydrocarbons between C8 and C35) were also recorded within the soils.

Conceptual Site Model (CSM)

- 2.8 In order to evaluate risk a site-specific Conceptual Site Model (CSM) is used to define significant risks requiring further assessment and where appropriate, remediation. The CSM is a simplified qualitative representation of ground conditions, pollutant source(s), pathways, pollutant linkages with associated uncertainties.
- 2.9 The CSM in the context of Hydrogeological Risk Assessment “must identify the crucial factors influencing groundwater flow and contaminant transport; whether the observed behaviour appears to be predictable; and whether mathematical approximations can be used to describe its behaviour” (Environment Agency, 2001, *Guide to good practice for the development of conceptual models and the selection and application of mathematical models of contaminant transport in the subsurface. National Groundwater and Contaminated Land Centre Report NC/99/38/2*).
- 2.10 Risks to controlled water resources from TPH and BaP will be addressed through the use of source removal to suitable risk-based remediation thresholds. GAC values exist for human health impact from TPH and PAH concentrations. But no values exist for risk to groundwater resources.
- 2.11 Therefore, the CSM identifies that the residual un-quantified risk at the site is from TPH and BaP to groundwater resources. This DQRA therefore specifically targets the risk from TPH and PAH (source) through lateral migration (pathway) to a suitable groundwater compliance point (receptor). These are discussed below:
- Source is considered to be the areas of hydrocarbon impacted soils identified from the ground investigation works within the vicinity of the fuel storage area.

- The receptors for this site have been identified as groundwater resources that are located off site and off-site surface water features. Groundwater receptors being the Secondary (undifferentiated) Aquifer of the Alluvium, the Secondary A Aquifer of the Taplow Gravel Formation and the Principal Aquifer of the Chalk. It is likely that the groundwater within the superficial deposits are in hydraulic continuity with the River Thames located to the north. The perched groundwater within the made ground is not considered to be a resource, but will represent a migration pathway to the underlying aquifers.
- For the assessment of the risk from the leaching of CoC from the made ground, the depth to groundwater of 2.0m has been adopted for the compliance point. For the aquifers within the superficial deposits and the Chalk, a compliance point of the site boundary which is located 20m to the north has been adopted as a reasonable receptor point.

2.12 In terms of the CSM the source pathway receptor mechanism is for groundwater infiltrating through the Made Ground within the vicinity of the fuel storage area to entrain hydrocarbon and PAH. The water then percolates downward through the Made Ground to the top of the aquifer contained within the alluvium. The alluvium beneath this portion of the site consist of clay, which is acting as barrier to further downward migration into the Taplow Gravels. The resulting effect is groundwater is perched within the made ground. The presence of the weathered zone at the top of the chalk will act as an aquitard that will restrict downward migration into the chalk aquifer. The hydrocarbons present are generally lighter than water, restricting further downward migration

2.13 In general, 'heavy' hydrocarbons (i.e. those with a high molecular weight) are significantly less mobile in the environment and less (eco) toxic than lighter fractions. However, they are more persistent in the environment¹. For the purposes of this assessment, petroleum hydrocarbon fractions C₈ to C₃₅ (aliphatic and aromatic species), and selected PAH species will be considered as the main contaminants of concern (CoC).

Parameters

2.14 The key parameters considered within this risk assessment are summarised in the table below:

Input Parameter	Value	Source of parameter value
Length of contaminant source in direction of groundwater flow	20m	The distance from PH6 and PH3.
Saturated aquifer thickness	80m	Estimated value for the base of the Chalk aquifer
Hydraulic conductivity in which dilution occurs	0.3024 m/d	Site specific data from rising head test completed in PH3.
Hydraulic gradient of water table	0.0017	Gradient based on regional conditions. Assumes water within a drainage ditch located 350m to the north is in hydraulic continuity with groundwater beneath the site.
Distance to compliance point from source area	2.0m 20m	Depth of groundwater. Distance from site boundary hydraulically down gradient of the tanks.
Width of contaminant source perpendicular to groundwater flow	60m	Width of tank farm between PH6 and PH2.
Fraction of organic carbon (f_{oc})	0.045	Site specific data for soils.

2.15 Values of effective porosity (n), air filled porosity and water filled porosity have been calculated using the Porosity calculator. These values are based on bulk densities obtained as part of the geotechnical site investigation.

2.16 Values for organic carbon co-efficient (K_{oc}) and for Henry's Law constant (H) are taken from the *Canada Wide Standards for Petroleum Hydrocarbons in Soils: Scientific Rationale*; R&D Technical report P2-228 (2008)¹⁰ and data defined by TPH Criteria Working Group. All CoC are treated as non-polar molecules.

2.17 Values for infiltration were calculated from an average annual rainfall for Reading Gauging Station on the River Thames contained in CEH Hydrological Data UK, Hydrometric Register

and Statistics 1996 - 2000. Value is based on annual rainfall, less average run-off for the area and 20% evapotranspiration.

- 2.18 The half-lives adopted for hydrocarbons within the model are taken from data defined by TPH Criteria Working Group and R&D Technical report P2-228 (2008)¹⁰.
- 2.19 For the target concentrations for the CoC, UK or WHO Drinking Water Standards have been adopted. Where these are not available Environmental Quality Standards for freshwater have been adopted.

Modelling

- 2.20 The site-specific risk assessment has been completed using the Environment Agency P20 Hydrogeological Risk Assessment Model for Contaminated Land (Version 3.2). The model has been used to back calculate suitable risk based remedial targets for soils on site which do not pose a significant risk to controlled waters.
- 2.21 The print-outs from the P20 risk assessments for the Tier 3 (Soil) and Tier 3 (Groundwater) are presented in Appendix 2. The Tier 1 (soil) and Tier 2 (soil) results are generally simplified models of the site and are not as representative of 'true' ground conditions. The Tier 3 results are considered representative and therefore used as the risk based remedial target values.

Results

- 2.22 Remedial target concentrations for each model tier are included in Appendix 1.

3.0 SENSITIVITY ANALYSIS

1.1 Sensitivity analysis was performed on the TPH C8-C10 Aromatic species, as it is one of the most mobile CoC. Sensitivity analysis included amending the following input parameters:

- Decreasing and increasing each parameter by 20%. The exceptions being:
- Increasing the hydraulic conductivity (k) value to 0.864 m/d (10 x the previous k value).
- Decreasing the compliance point distance from 20m to 10m.

1.2 Undertaking changes to the input parameters makes no significant difference to the Tier 3 remedial target values.

4.0 CONCLUSIONS

- 5 The print-outs from the P20 risk assessments are presented in Appendix 1 and summarised in Table 1 below. Tier 1 and 2 results are 'remedial targets' for the source concentration of CoC and the Level 3 (soil and groundwater) results are the concentrations of CoC at the compliance point (for comparison with measured soil concentrations).

Table 1) P20 risk assessment results

Determinant	Risk Assessment Tier	Remedial Target Level (Compliance Point being site Boundary located 20m from source)	Maximum concentration identified
C ₈ -C ₁₀ Aliphatic	Tier 3 Soil	1650.00 mg/kg	9 mg/kg
	Tier 3 Groundwater	770 mg/l	0.008 mg/l
C ₈ -C ₁₀ Aromatic	Tier 3 Soil	3320. mg/kg	9.0 mg/kg
	Tier 3 Groundwater	1.76 E+7 mg/l	0.002 mg/l
C ₁₀ -C ₁₂ Aliphatic	Tier 3 Soil	8800 mg/kg	522 mg/kg
	Tier 3 Groundwater	17.3 mg/l	0.117 mg/l
C ₁₀ -C ₁₂ Aromatic	Tier 3 Soil	84.6 mg/kg	63.7 mg/kg
	Tier 3 Groundwater	9.9 E+4 mg/l	0.015 mg/l
C ₁₂ -C ₁₆ Aliphatic	Tier 3 Soil	1.76 E+6 mg/kg	689 mg/kg
	Tier 3 Groundwater	17.3 mg/l	0.689 mg/l
C ₁₂ -C ₁₆ Aromatic	Tier 3 Soil	300 mg/kg	1080 mg/kg

	Tier 3 Groundwater	4.27 E+6 mg/l	0.338 mg/l
C ₁₆ -C ₂₁ Aliphatic	Tier 3 Soil	2.21 E+7 mg/kg	3900 mg/kg
	Tier 3 Groundwater	17.3 mg/l	1.4 mg/l
C ₁₆ -C ₂₁ Aromatic	Tier 3 Soil	3880 mg/kg	2030 mg/kg
	Tier 3 Groundwater	355 mg/l	0.545 mg/l
C ₂₁ -C ₃₅ Aliphatic	Tier 3 Soil	2.22 E+7 mg/kg	827 mg/kg
	Tier 3 Groundwater	17.3 mg/l	0.0488 mg/l
C ₂₁ -C ₃₅ Aromatic	Tier 3 Soil	2460 mg/kg	779 mg/kg
	Tier 3 Groundwater	231 mg/l	0.008 mg/l
Benzo(a)pyrene	Tier 3 Soil	1.75 E+147 mg/kg	28.8 mg/kg
	Tier 3 Groundwater	NO IMPACT	0.00004 mg/l

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Description	Qty
One Bedroom Apartment	45
Two Bedroom Apartment	105
Three Bedroom Apartment	14
Two Bedroom Coach House	1
Three Bedroom House	31
Three Bedroom Townhouse	15

TOTAL	211
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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:	Portman Way		
Site Address:	Reading		
Completed by:	PDM		
Date:	21-Jun-18	Version:	1.1
Contaminant	Benzo(a)pyrene		
Target Concentration (C _T)	5.00E-05	mg/l	Origin of C _T : 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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

Benzo(a)pyrene
0.00005 mg/l

Input Parameters Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

2.40E-01

fraction

calculated

Air filled soil porosity

θ_a

1.84E-01

fraction

calculated

Bulk density of soil zone material

ρ

1.60E+00

g/cm³

R & D Technical report sand fill

Henry's Law constant

H

1.86E-05

dimensionless

Total Petroleum Hydrocarbon Criteria Working Group

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 soil)

f_{oc}

4.50E-02

fraction

Site data

Organic carbon partition coefficient

K_{oc}

1.31E+05

l/kg

Total Petroleum Hydrocarbon Criteria Working Group

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

5.90E+03

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

2.95E-01

mg/kg

(for comparison with soil analyses)

or

0.00005

mg/l

(for comparison with leachate test results)

Site being assessed: Portman Way
Completed by: PDM
Date: 21-Jun-18
Version: 1.1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

Benzo(a)pyrene
0.00005

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
Area of contaminant source

Inf
A

4.40E-04
1.50E+02

m/d
m²

96-2000 30% pf values River Thames at Reading 70% c
Area of boiler house and tank farm

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow
Saturated aquifer thickness
Hydraulic Conductivity of aquifer in which dilution occurs
Hydraulic gradient of water table
Width of contaminant source perpendicular to groundwater flow
Background concentration of contaminant in groundwater beneath site

L
da
K
i
w
Cu

3.00E+01
8.00E+01
3.02E-01
1.70E-03
6.00E+01
0.00E+00

m
m
m/d
fraction
m
mg/l

Width of source area between PH2 and PH6
assumed vale to base of chalk
Site data
Estimate
Length of source area between PH2 and PH6
Estimated

Not used in calculation

Define mixing zone depth by specifying or calculating depth (using pull down list)

Enter mixing zone thickness
Calculated mixing zone thickness

Mz
Mz

Calculate
2.51E+01

m
m

Calculated Parameters

Dilution Factor

DF

1.98E+00

Level 2 Remedial Target

9.90E-05

mg/l

For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration

or

5.83E-01

mg/kg

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)

C_c

0.00E+00

mg/l

Calculated concentration within receptor (dilution only)

0.00E+00

mg/l

0

Site being assessed: Portman Way
Completed by: PDM
Date: 21-Jun-18
Version: 1.1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzo(a)pyrene		from Level 1
Target Concentration	C _T	0.00005	mg/l	from Level 1
Dilution Factor	DF	1.98E+00		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, RBCA)

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration			
Enter soil concentration	28.8	mg/kg	
Half life for degradation of contaminant in water	t _{1/2}	days	RBCA
Calculated decay rate	λ	days ⁻¹	calculated
Width of plume in aquifer at source	Sz	m	from Level 2
Plume thickness in aquifer at source	Sy	m	from Level 2
Bulk density of aquifer materials	ρ	g/cm ³	R & D Technical Report P13
Effective porosity of aquifer	n	fraction	Consim
Hydraulic gradient	i	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	m/d	from Level 2
Distance to compliance point	x	m	Estimated Depth to water table
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	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	l/kg	see options
Longitudinal dispersivity	ax	m	see options
Transverse dispersivity	az	m	see options
Vertical dispersivity	ay	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

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

Remedial Targets

Level 3 Remedial Target	2.97E+143	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	1.75E+147	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	2	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C _{CP} /C ₀	3.34E-148	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 non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 4.50E-02 fractionOrganic carbon partition coefficient K_{oc} 1.31E+05 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,i} l/kgSorption 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 5.90E+03 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-01 4.58E-02 m

Transverse dispersivity az 0.00E+00 2.00E-02 4.58E-03 m

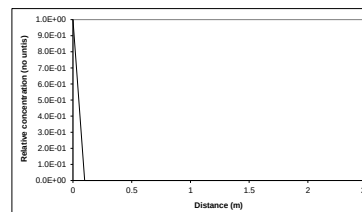
Vertical dispersivity ay 0.00E+00 2.00E-03 4.58E-04 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀ t)^{0.414}, 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 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

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	2.47E-03
0.1	4.23E-08	1.04E-10
0.2	1.79E-15	4.41E-18
0.3	7.56E-23	1.87E-25
0.4	3.20E-30	7.89E-33
0.5	1.35E-37	3.34E-40
0.6	5.71E-45	1.41E-47
0.7	2.42E-52	5.96E-55
0.8	1.02E-59	2.52E-62
0.9	4.32E-67	1.07E-69
1.0	1.83E-74	4.51E-77
1.1	7.72E-82	1.91E-84
1.2	3.27E-89	8.06E-92
1.3	1.38E-96	3.41E-99
1.4	5.84E-104	1.44E-106
1.5	2.47E-111	6.09E-114
1.6	1.04E-118	2.58E-121
1.7	4.41E-126	1.09E-128
1.8	1.87E-133	4.61E-136
1.9	7.89E-141	1.95E-143
2.0	3.34E-148	8.24E-151

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:	Portman Way
Completed by:	PDM
Date:	#####
Version:	1.1

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters
Soil contaminant concentration C_0 2.00E-01 mg/kg

Level 1 Parameters

Water filled soil porosity	θ_w	2.40E-01	fraction
Air filled soil porosity	θ_a	1.84E-01	fraction
Bulk density	ρ	1.60E+00	g/cm ³
Henry's Law constant	H	1.86E-05	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	5.90E+03	l/kg
Factor (partitioning between soil and water)		5.90E+03	dimensionless

Level 2 Parameters

Dilution Factor DF 1.98E+00

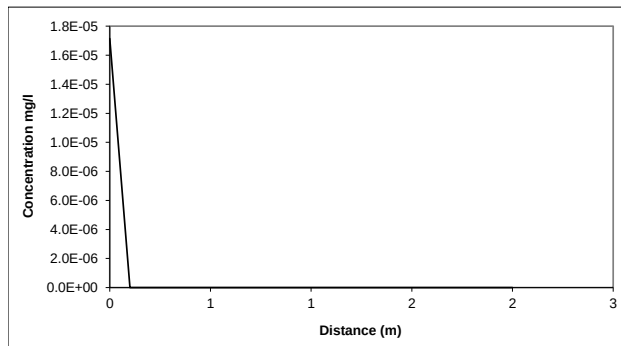
Level 3 Parameters

Attenuation factor (C_0/C_{ED}) AF 3.00E+147

Predicted concentrations at compliance point

Level 1	C	3.39E-05 mg/l	No dilution or attenuation
Level 2	C	1.71E-05 mg/l	Dilution taken into account
Level 3	C	5.72E-153 mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	1.71E-05
0.10	7.25E-13
0.20	3.06E-20
0.30	1.30E-27
0.40	5.48E-35
0.50	2.32E-42
0.60	9.80E-50
0.70	4.14E-57
0.80	1.75E-64
0.90	7.41E-72
1.00	3.13E-79
1.10	1.32E-86
1.20	5.60E-94
1.30	2.37E-101
1.40	1.00E-108
1.50	4.23E-116
1.60	1.79E-123
1.70	7.57E-131
1.80	3.20E-138
1.90	1.35E-145
2.00	5.72E-153

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	Benzo(a)pyrene 5.00E-05	mg/l	from Level 1 from Level 1

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

Ogata Banks 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 pollutants in all phases (e.g. field derived value)

Source of parameter value				
Initial contaminant concentration in groundwater at plume core	C ₀	4.00E-05	mg/l	Site data
Half life for degradation of contaminant in water	t _{1/2}	1.06E+03	days	Canada Wide Standards for PHC in Soils
Calculated decay rate	λ	6.54E-04	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.00E+01	m	Estimated from site data
Plume thickness at source	Sy	4.00E+00	m	to top of chalk
Saturated aquifer thickness	da	8.00E+01	m	Estimated from site data
Bulk density of aquifer materials	ρ	1.60E+00	g/cm ³	Consim
Effective porosity of aquifer	n	3.70E-01	fraction	Consim
Hydraulic gradient	i	1.70E-03	fraction	Estimated from site data
Hydraulic conductivity of aquifer	K	3.02E-01	m/d	Site data
Distance to compliance point	x	2.00E+01	m	Distance to site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	time variant options only
Parameters values determined from options				
Partition coefficient	Kd	5.90E+03	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	1.39E-03	m/d
Retardation factor	Rf	2.55E+04	fraction
Decay rate used	λ	6.54E-04	d ⁻¹
Rate of contaminant flow due to retardation	u	5.45E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	0.00E+00	mg/l
Attenuation factor (one way vertical dispersion, COICED)	AF	breakthrough at compliance point	

Remedial Targets

Remedial Target	No impact	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	0.00E+00 9.9E+99	mg/l days
			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.

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

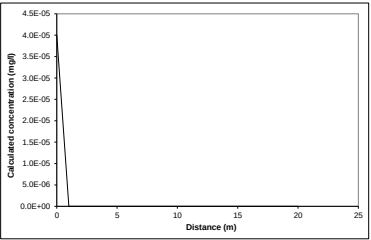
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)	Kd		l/kg
Soil water partition coefficient			
Entry for non-polar organic chemicals (option)	foc	4.50E-02	fraction
Fraction of organic carbon in aquifer			
Organic carbon partition coefficient	Koc	1.31E+05	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	5.90E+03	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	3.57E+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 α _x = 0.1 * x, α _z = 0.01 * x, α _y = 0.001 * x				
Xu & Eckstein (1995) report α _x = 0.83(log ₁₀ x) ^{-0.414} , α _z = α _x /10, α _y = α _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:	Portman Way
Completed by:	PDM
Date:	#####
Version:	1.1

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	1.000	fraction	#DIV/0!
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

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	Value	Units	Calculations (Refer to Table 4.3, R&D Publication 20)		
(carried over from input sheet)			Selected option	Calculate for non-polar organic chemicals	
			calc	calc	Calc Kd l/kg
C _T	5.00E-05	mg/l	Calculation of partition coefficient		
Kd	5.90E+03	l/kg	for ionic organic chemical		
foc	4.50E-02	fraction			
koc	1.31E+05	l/kg	Partition coefficient used in Level 1 Assessment		
θ _w	2.40E-01	fraction	5.90E+03 l/kg		
θ _a	1.84E-01	fraction			
ρ	1.60E+00	g/cm ³			
H	1.86E-05	dimensionless			
Koc,n		l/kg			
Koc,i		l/kg			
pH		pH units			
pKa					
foc (ionic)		fraction			
			Calculated Remedial Target 2.95E-01 mg/kg for Benzo(a)pyrene		
			Factor (partitioning between soil and water) 5.90E+03		
			Site being assessed: Portman Way Completed by: PDM Date: 21/06/2018 Version: 1.1		

Level 2 Calculation Sheet

Contaminant Benzo(a)pyrene

Site assessed:	Portman Way
Date:	21/06/2018
Version:	1.1

Parameter Value Units
(carried over from input sheet)

Mz	2.51E+01	m
L	3.00E+01	m
da	8.00E+01	m
Inf	4.40E-04	m/d
K	3.02E-01	m/d
i	1.70E-03	m3/d
A	1.50E+02	m2
Cc	0.00E+00	mg/l
C _T	5.00E-05	mg/l
Cu	0.00E+00	mg/l
w	6.00E+01	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Calculated
Dilution Factor

1.98E+00

#DIV/0!



Contaminant		Benzo(a)pyrene		OGATA BANKS SOLUTION																		
				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	Relative Concentration
C _T DF	5.000E-05	mg/l	1	0.1	0.13	-1.70E+01	4.23E-08	-8.09E+47	2	1.75E+01	3.90E+07	8.09E+47	0	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	4.23E-08
	1.979E+00		2	0.2	0.13	-3.40E+01	1.79E-15	-8.09E+47	2	3.50E+01	1.52E+15	8.09E+47	0	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	1.79E-15
			3	0.3	0.13	-5.09E+01	7.56E-23	-8.09E+47	2	5.24E+01	5.93E+22	8.09E+47	0	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	7.56E-23
			4	0.4	0.13	-6.79E+01	3.20E-30	-8.09E+47	2	6.99E+01	2.31E+30	8.09E+47	0	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	3.20E-30
λ	6.539E-04	days ⁻¹	5	0.5	0.13	-8.49E+01	1.35E-37	-8.09E+47	2	8.74E+01	9.01E+37	8.09E+47	0	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	1.35E-37
Sz	6.000E+01		6	0.6	0.13	-1.02E+02	5.71E-45	-8.09E+47	2	1.05E+02	3.51E+45	8.09E+47	0	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	5.71E-45
Sy	2.514E+01	m	7	0.7	0.13	-1.19E+02	2.42E-52	-8.09E+47	2	1.22E+02	1.37E+53	8.09E+47	0	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	2.42E-52
Kd	5.895E+03		8	0.8	0.13	-1.36E+02	1.02E-59	-8.09E+47	2	1.40E+02	5.34E+60	8.09E+47	0	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	1.02E-59
ρ	1.600E+00	g/cm3	9	0.9	0.13	-1.53E+02	4.32E-67	-8.09E+47	2	1.57E+02	2.08E+68	8.09E+47	0	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	4.32E-67
n	3.000E-01		10	1	0.13	-1.70E+02	1.83E-74	-8.09E+47	2	1.75E+02	8.13E+75	8.09E+47	0	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	1.83E-74
i	3.436E-03	m/d	11	1.1	0.13	-1.87E+02	7.72E-82	-8.09E+47	2	1.92E+02	3.17E+83	8.09E+47	0	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	7.72E-82
K	3.024E-01		12	1.2	0.13	-2.04E+02	3.27E-89	-8.09E+47	2	2.10E+02	1.24E+91	8.09E+47	0	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	3.27E-89
x	2.000E+00	m	13	1.3	0.13	-2.21E+02	1.38E-96	-8.09E+47	2	2.27E+02	4.82E+98	8.09E+47	0	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	1.38E-96
z	0.000E+00		14	1.4	0.13	-2.38E+02	5.84E-104	-8.09E+47	2	2.45E+02	1.88E+106	8.09E+47	0	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	5.84E-104
y	0.000E+00	m	15	1.5	0.13	-2.55E+02	2.47E-111	-8.09E+47	2	2.62E+02	7.32E+113	8.09E+47	0	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	2.47E-111
t	1.000E+99		16	1.6	0.13	-2.72E+02	1.04E-118	-8.09E+47	2	2.80E+02	2.86E+121	8.09E+47	0	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	1.04E-118
ax	2.000E-01	days	17	1.7	0.13	-2.89E+02	4.41E-126	-8.09E+47	2	2.97E+02	1.11E+129	8.09E+47	0	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	4.41E-126
az	2.000E-02		18	1.8	0.13	-3.06E+02	1.87E-133	-8.09E+47	2	3.15E+02	4.34E+136	8.09E+47	0	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	1.87E-133
ay	2.000E-03	m	19	1.9	0.13	-3.23E+02	7.89E-141	-8.09E+47	2	3.32E+02	1.69E+144	8.09E+47	0	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	7.89E-141
			20	2	0.13	-3.40E+02	3.34E-148	-8.09E+47	2	3.50E+02	6.60E+151	8.09E+47	0	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	3.34E-148
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	Relative Concentration	
v	0.0035	m/d	1	0.1	0.13	-1.70E+01	4.23E-08	-8.09E+47	2	1.75E+01	3.90E+07	8.09E+47	0	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	4.23E-08
Rc	31441.0000		2	0.2	0.13	-3.40E+01	1.79E-15	-8.09E+47	2	3.50E+01	1.52E+15	8.09E+47	0	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	1.79E-15
u	0.0000	m/d	3	0.3	0.13	-5.09E+01	7.56E-23	-8.09E+47	2	5.24E+01	5.93E+22	8.09E+47	0	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	7.56E-23
			4	0.4	0.13	-6.79E+01	3.20E-30	-8.09E+47	2	6.99E+01	2.31E+30	8.09E+47	0	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	3.20E-30
			5	0.5	0.13	-8.49E+01	1.35E-37	-8.09E+47	2	8.74E+01	9.01E+37	8.09E+47	0	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	1.35E-37
			6	0.6	0.13	-1.02E+02	5.71E-45	-8.09E+47	2	1.05E+02	3.51E+45	8.09E+47	0	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	5.71E-45
			7	0.7	0.13	-1.19E+02	2.42E-52	-8.09E+47	2	1.22E+02	1.37E+53	8.09E+47	0	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	2.42E-52
			8	0.8	0.13	-1.36E+02	1.02E-59	-8.09E+47	2	1.40E+02	5.34E+60	8.09E+47	0	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	1.02E-59
			9	0.9	0.13	-1.53E+02	4.32E-67	-8.09E+47	2	1.57E+02	2.08E+68	8.09E+47	0	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	4.32E-67
			10	1	0.13	-1.70E+02	1.83E-74	-8.09E+47	2	1.75E+02	8.13E+75	8.09E+47	0	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	1.83E-74
			11	1.1	0.13	-1.87E+02	7.72E-82	-8.09E+47	2	1.92E+02	3.17E+83	8.09E+47	0	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	7.72E-82
			12	1.2	0.13	-2.04E+02	3.27E-89	-8.09E+47	2	2.10E+02	1.24E+91	8.09E+47	0	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	3.27E-89
			13	1.3	0.13	-2.21E+02	1.38E-96	-8.09E+47	2	2.27E+02	4.82E+98	8.09E+47	0	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	1.38E-96
			14	1.4	0.13	-2.38E+02	5.84E-104	-8.09E+47	2	2.45E+02	1.88E+106	8.09E+47	0	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	5.84E-104
			15	1.5	0.13	-2.55E+02	2.47E-111	-8.09E+47	2	2.62E+02	7.32E+113	8.09E+47	0	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	2.47E-111
			16	1.6	0.13	-2.72E+02	1.04E-118	-8.09E+47	2	2.80E+02	2.86E+121	8.09E+47	0	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	1.04E-118
			17	1.7	0.13	-2.89E+02	4.41E-126	-8.09E+47	2	2.97E+02	1.11E+129	8.09E+47	0	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	4.41E-126
			18	1.8	0.13	-3.06E+02	1.87E-133	-8.09E+47	2	3.15E+02	4.34E+136	8.09E+47	0	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	1.87E-133
			19	1.9	0.13	-3.23E+02	7.89E-141	-8.09E+47	2	3.32E+02	1.69E+144	8.09E+47	0	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	7.89E-141
			20	2	0.13	-3.40E+02	3.34E-148	-8.09E+47	2	3.50E+02	6.60E+151	8.09E+47	0	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	3.34E-148

Qgata Banks - Time Variant

Relative Concentration

Distance m

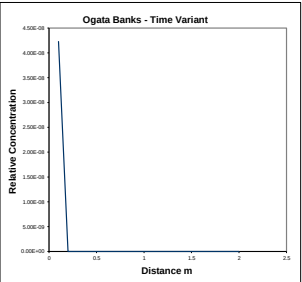
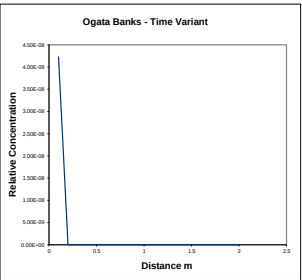
Qgata Banks - Time Variant

Relative Concentration

Distance m

Date: 21/06/2018

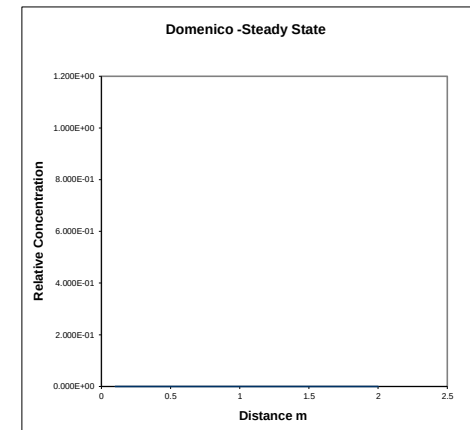
Version: 1.1



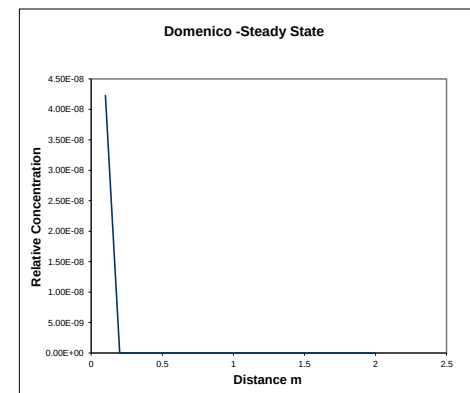
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Version: 1.1

Contaminant		DOMENICO (STEADY STATE)															Relative Concentration
lenzo(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			
C _T	5.000E-05	mg/l	1	0.1	0.25	-1.70E+01	4.23E-08	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	4.228E-08	
DF	1.979E+00		2	0.2	0.25	-3.40E+01	1.79E-15	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	1.788E-15	
			3	0.3	0.25	-5.09E+01	7.56E-23	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	7.559E-23	
			4	0.4	0.25	-6.79E+01	3.20E-30	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	3.196E-30	
λ	6.539E-04	days ⁻¹	5	0.5	0.25	-8.49E+01	1.35E-37	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	1.352E-37	
Sz	6.000E+01	m	6	0.6	0.25	-1.02E+02	5.71E-45	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	5.715E-45	
Sy	2.514E+01	m	7	0.7	0.25	-1.19E+02	2.42E-52	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	2.416E-52	
Kd	5.895E+03	l/kg	8	0.8	0.25	-1.36E+02	1.02E-59	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	1.022E-59	
ρ	1.600E+00	g/cm3	9	0.9	0.25	-1.53E+02	4.32E-67	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	4.320E-67	
n	3.000E-01		10	1	0.25	-1.70E+02	1.83E-74	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	1.827E-74	
i	3.436E-03		11	1.1	0.25	-1.87E+02	7.72E-82	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	7.723E-82	
K	3.024E-01	m/d	12	1.2	0.25	-2.04E+02	3.27E-89	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	3.266E-89	
x	2.000E+00	m	13	1.3	0.25	-2.21E+02	1.38E-96	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	1.381E-96	
z	0.000E+00	m	14	1.4	0.25	-2.38E+02	5.84E-104	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	5.838E-104	
y	0.000E+00	m	15	1.5	0.25	-2.55E+02	2.47E-111	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	2.469E-111	
ax	2.000E-01	m	16	1.6	0.25	-2.72E+02	1.04E-118	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	1.044E-118	
az	2.000E-02	m	17	1.7	0.25	-2.89E+02	4.41E-126	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	4.414E-126	
ay	2.000E-03	m	18	1.8	0.25	-3.06E+02	1.87E-133	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	1.866E-133	
			19	1.9	0.25	-3.23E+02	7.89E-141	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	7.891E-141	
			20	2	0.25	-3.40E+02	3.34E-148	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	3.336E-148	



Calc	Value	DOMENICO (STEADY STATE)														
Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT																
v	3.46E-03	m/d <th>X</th> <th>Term 1</th> <th>Term 2</th> <th>EXP</th> <th>Term 3A</th> <th>ERF</th> <th>Term 3B</th> <th>ERF</th> <th>Term 4A</th> <th>ERF</th> <th>Term 4B</th> <th>ERF</th> <th>Relative Concentration</th>	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration	
Rc	3.14E+04															
u	1.10E-07	m/d <td>1</td> <td>0.1</td> <td>0.25</td> <td>-1.70E+01</td> <td>4.23E-08</td> <td>3.35E+02</td> <td>1</td> <td>-3.35E+02</td> <td>-1</td> <td>8.89E+02</td> <td>1</td> <td>-8.89E+02</td> <td>-1</td> <td>4.23E-08</td>	1	0.1	0.25	-1.70E+01	4.23E-08	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	4.23E-08
			2	0.2	0.25	-3.40E+01	1.79E-15	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	1.79E-15
			3	0.3	0.25	-5.09E+01	7.56E-23	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	7.56E-23
			4	0.4	0.25	-6.79E+01	3.20E-30	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	3.20E-30
			5	0.5	0.25	-8.49E+01	1.35E-37	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	1.35E-37
			6	0.6	0.25	-1.02E+02	5.71E-45	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	5.71E-45
			7	0.7	0.25	-1.19E+02	2.42E-52	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	2.42E-52
			8	0.8	0.25	-1.36E+02	1.02E-59	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	1.02E-59
			9	0.9	0.25	-1.53E+02	4.32E-67	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	4.32E-67
			10	1	0.25	-1.70E+02	1.83E-74	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	1.83E-74
			11	1.1	0.25	-1.87E+02	7.72E-82	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	7.72E-82
			12	1.2	0.25	-2.04E+02	3.27E-89	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	3.27E-89
			13	1.3	0.25	-2.21E+02	1.38E-96	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	1.38E-96
			14	1.4	0.25	-2.38E+02	5.84E-104	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	5.84E-104
			15	1.5	0.25	-2.55E+02	2.47E-111	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	2.47E-111
			16	1.6	0.25	-2.72E+02	1.04E-118	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	1.04E-118
			17	1.7	0.25	-2.89E+02	4.41E-126	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	4.41E-126
			18	1.8	0.25	-3.06E+02	1.87E-133	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	1.87E-133
			19	1.9	0.25	-3.23E+02	7.89E-141	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	7.89E-141
			20	2	0.25	-3.40E+02	3.34E-148	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	3.34E-148
21/06/2018																
n:	1.1		20	2	0.25	-3.40E+02	3.34E-148	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	3.34E-148



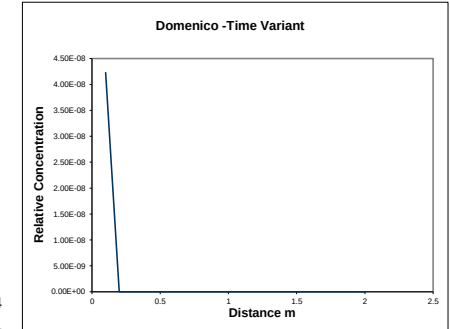
Date: 21/06/2018
Version: 1.1

DOMENICO (TIME VARIANT)

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 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
Input	Value	Units		m														
C _T	0.00005		1	0.1	0.125	-1.70E+01	4.23E-08	-8.09E+47	2	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	4.23E-08
DF	1.9790	mg/l	2	0.2	0.125	-3.40E+01	1.79E-15	-8.09E+47	2	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	1.79E-15
			3	0.3	0.125	-5.09E+01	7.56E-23	-8.09E+47	2	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	7.56E-23
			4	0.4	0.125	-6.79E+01	3.20E-30	-8.09E+47	2	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	3.20E-30
λ	6.539E-04	days ⁻¹	5	0.5	0.125	-8.49E+01	1.35E-37	-8.09E+47	2	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	1.35E-37
Sz	6.000E+01	m	6	0.6	0.125	-1.02E+02	5.71E-45	-8.09E+47	2	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	5.71E-45
Sy	2.514E+01	m	7	0.7	0.125	-1.19E+02	2.42E-52	-8.09E+47	2	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	2.42E-52
Kd	5.895E+03	l/kg	8	0.8	0.125	-1.36E+02	1.02E-59	-8.09E+47	2	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	1.02E-59
ρ	1.600E+00	g/cm3	9	0.9	0.125	-1.53E+02	4.32E-67	-8.09E+47	2	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	4.32E-67
n	3.000E-01		10	1	0.125	-1.70E+02	1.83E-74	-8.09E+47	2	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	1.83E-74
i	3.436E-03		11	1.1	0.125	-1.87E+02	7.72E-82	-8.09E+47	2	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	7.72E-82
K	3.024E-01	m/d	12	1.2	0.125	-2.04E+02	3.27E-89	-8.09E+47	2	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	3.27E-89
x	2.000E+00	m	13	1.3	0.125	-2.21E+02	1.38E-96	-8.09E+47	2	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	1.38E-96
z	0.000E+00	m	14	1.4	0.125	-2.38E+02	5.84E-104	-8.09E+47	2	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	5.84E-104
y	0.000E+00	m	15	1.5	0.125	-2.55E+02	2.47E-111	-8.09E+47	2	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	2.47E-111
t	1.000E+99	days	16	1.6	0.125	-2.72E+02	1.04E-118	-8.09E+47	2	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	1.04E-118
ax	2.000E-01	m	17	1.7	0.125	-2.89E+02	4.41E-126	-8.09E+47	2	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	4.41E-126
az	2.000E-02	m	18	1.8	0.125	-3.06E+02	1.87E-133	-8.09E+47	2	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	1.87E-133
ay	2.000E-03	m	19	1.9	0.125	-3.23E+02	7.89E-141	-8.09E+47	2	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	7.89E-141
			20	2	0.125	-3.40E+02	3.34E-148	-8.09E+47	2	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	3.34E-148

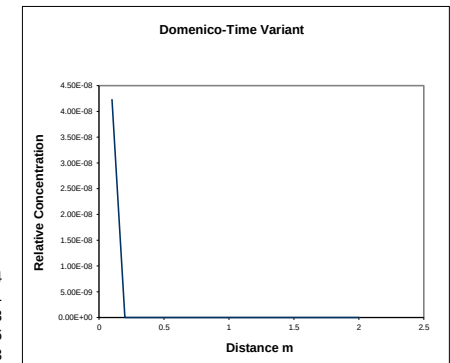


Calc

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	3.46E-03	m/d		m														
Rc	3.14E+04		1	0.1	0.125	-1.70E+01	4.23E-08	-8.09E+47	2	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	4.23E-08
u	1.10E-07	m/d	2	0.2	0.125	-3.40E+01	1.79E-15	-8.09E+47	2	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	1.79E-15
			3	0.3	0.125	-5.09E+01	7.56E-23	-8.09E+47	2	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	7.56E-23
			4	0.4	0.125	-6.79E+01	3.20E-30	-8.09E+47	2	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	3.20E-30
			5	0.5	0.125	-8.49E+01	1.35E-37	-8.09E+47	2	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	1.35E-37
			6	0.6	0.125	-1.02E+02	5.71E-45	-8.09E+47	2	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	5.71E-45
			7	0.7	0.125	-1.19E+02	2.42E-52	-8.09E+47	2	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	2.42E-52
			8	0.8	0.125	-1.36E+02	1.02E-59	-8.09E+47	2	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	1.02E-59
			9	0.9	0.125	-1.53E+02	4.32E-67	-8.09E+47	2	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	4.32E-67
			10	1	0.125	-1.70E+02	1.83E-74	-8.09E+47	2	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	1.83E-74
			11	1.1	0.125	-1.87E+02	7.72E-82	-8.09E+47	2	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	7.72E-82
			12	1.2	0.125	-2.04E+02	3.27E-89	-8.09E+47	2	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	3.27E-89
			13	1.3	0.125	-2.21E+02	1.38E-96	-8.09E+47	2	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	1.38E-96
			14	1.4	0.125	-2.38E+02	5.84E-104	-8.09E+47	2	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	5.84E-104
			15	1.5	0.125	-2.55E+02	2.47E-111	-8.09E+47	2	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	2.47E-111
			16	1.6	0.125	-2.72E+02	1.04E-118	-8.09E+47	2	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	1.04E-118
			17	1.7	0.125	-2.89E+02	4.41E-126	-8.09E+47	2	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	4.41E-126
			18	1.8	0.125	-3.06E+02	1.87E-133	-8.09E+47	2	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	1.87E-133
e:	21/06/2018		19	1.9	0.125	-3.23E+02	7.89E-141	-8.09E+47	2	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	7.89E-141
sion:	1.1		20	2	0.125	-3.40E+02	3.34E-148	-8.09E+47	2	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	3.34E-148



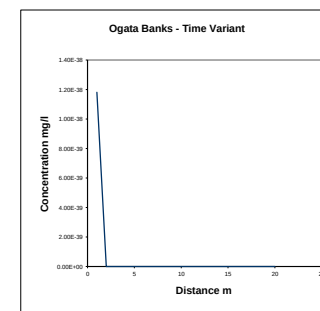
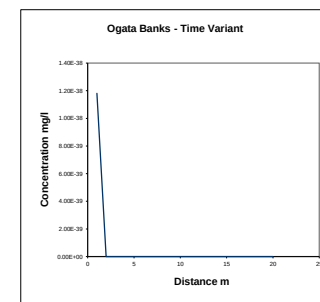
Date: 21/06/2018
Version: 1.1

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	0.00005	mg/l	1	1	5E-06	-7.7E+01	3.0E-34	-2.5E+48	2.000	7.8E+01	5.6E+33	2.5E+48	0.000	3.4E+01	1	-3.4E+01	-1	7.1E+00	1	-7.1E+00	-1	1.18E-38
			2	2	5E-06	-1.5E+02	8.7E-68	-2.5E+48	2.000	1.6E+02	3.1E+67	2.5E+48	0.000	2.4E+01	1	-2.4E+01	-1	5.0E+00	1	-5.0E+00	-1	3.49E-72
			3	3	5E-06	-2.3E+02	2.6E-101	-2.5E+48	2.000	2.3E+02	1.7E+101	2.5E+48	0.000	1.9E+01	1	-1.9E+01	-1	4.1E+00	1	-4.1E+00	-1	1.03E-105
Co	4.00E-05	mg/l	4	4	5E-06	-3.1E+02	7.6E-135	-2.5E+48	2.000	3.1E+02	9.7E+134	2.5E+48	0.000	1.7E+01	1	-1.7E+01	-1	3.5E+00	1	-3.5E+00	-1	3.04E-139
λ	6.54E-04	days ⁻¹	5	5	5E-06	-3.9E+02	2.2E-168	-2.5E+48	2.000	3.9E+02	5.4E+168	2.5E+48	0.000	1.5E+01	1	-1.5E+01	-1	3.2E+00	1	-3.2E+00	-0.99999	8.98E-173
Sz	6.00E+01	m	6	6	5E-06	-4.6E+02	6.6E-202	-2.5E+48	2.000	4.7E+02	3.0E+202	2.5E+48	0.000	1.4E+01	1	-1.4E+01	-1	2.9E+00	1	-2.9E+00	-0.99996	2.65E-206
Sy	4.00E+00	m	7	7	5E-06	-5.4E+02	2.0E-235	-2.5E+48	2.000	5.4E+02	1.7E+236	2.5E+48	0.000	1.3E+01	1	-1.3E+01	-1	2.7E+00	0.9998	-2.7E+00	-0.99984	7.82E-240
Kd	5.90E+03	l/kg	8	8	5E-06	-6.2E+02	5.8E-269	-2.5E+48	2.000	6.2E+02	9.5E+269	2.5E+48	0.000	1.2E+01	1	-1.2E+01	-1	2.5E+00	0.9996	-2.5E+00	-0.99959	2.31E-273
ρ	1.60E+00	g/cm3	9	9	5E-06	-6.9E+02	1.7E-302	-2.5E+48	2.000	7.0E+02	5.3E+303	2.5E+48	0.000	1.1E+01	1	-1.1E+01	-1	2.4E+00	0.9991	-2.4E+00	-0.99914	6.82E-307
n	3.70E-01		10	10	5E-06	-7.7E+02	0.0E+00	-2.5E+48	2.000	7.8E+02	1.0E+304	2.5E+48	0.000	1.1E+01	1	-1.1E+01	-1	2.2E+00	0.9984	-2.2E+00	-0.99843	0.00E+00
i	1.70E-03		11	11	5E-06	-8.5E+02	0.0E+00	-2.5E+48	2.000	8.5E+02	1.0E+304	2.5E+48	0.000	1.0E+01	1	-1.0E+01	-1	2.1E+00	0.9974	-2.1E+00	-0.99743	0.00E+00
K	3.02E-01	m/d	12	12	5E-06	-9.3E+02	0.0E+00	-2.5E+48	2.000	9.3E+02	1.0E+304	2.5E+48	0.000	9.7E+00	1	-9.7E+00	-1	2.0E+00	0.9961	-2.0E+00	-0.99611	0.00E+00
x	2.00E+01	m	13	13	5E-06	-1.0E+03	0.0E+00	-2.5E+48	2.000	1.0E+03	1.0E+304	2.5E+48	0.000	9.3E+00	1	-9.3E+00	-1	2.0E+00	0.9945	-2.0E+00	-0.99445	0.00E+00
z	0.00E+00	m	14	14	5E-06	-1.1E+03	0.0E+00	-2.5E+48	2.000	1.1E+03	1.0E+304	2.5E+48	0.000	9.0E+00	1	-9.0E+00	-1	1.9E+00	0.9925	-1.9E+00	-0.99247	0.00E+00
y	0.00E+00	m	15	15	5E-06	-1.2E+03	0.0E+00	-2.5E+48	2.000	1.2E+03	1.0E+304	2.5E+48	0.000	8.7E+00	1	-8.7E+00	-1	1.8E+00	0.9902	-1.8E+00	-0.99018	0.00E+00
t	9.90E+99	days	16	16	5E-06	-1.2E+03	0.0E+00	-2.5E+48	2.000	1.2E+03	1.0E+304	2.5E+48	0.000	8.4E+00	1	-8.4E+00	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	0.00E+00
ax	2.00E+00	m	17	17	5E-06	-1.3E+03	0.0E+00	-2.5E+48	2.000	1.3E+03	1.0E+304	2.5E+48	0.000	8.1E+00	1	-8.1E+00	-1	1.7E+00	0.9847	-1.7E+00	-0.98471	0.00E+00
az	2.00E-01	m	18	18	5E-06	-1.4E+03	0.0E+00	-2.5E+48	2.000	1.4E+03	1.0E+304	2.5E+48	0.000	7.9E+00	1	-7.9E+00	-1	1.7E+00	0.9816	-1.7E+00	-0.98158	0.00E+00
ay	2.00E-02	m	19	19	5E-06	-1.5E+03	0.0E+00	-2.5E+48	2.000	1.5E+03	1.0E+304	2.5E+48	0.000	7.7E+00	1	-7.7E+00	-1	1.6E+00	0.9782	-1.6E+00	-0.97822	0.00E+00
			20	20	5E-06	-1.5E+03	0.0E+00	-2.5E+48	2.000	1.6E+03	1.0E+304	2.5E+48	0.000	7.5E+00	1	-7.5E+00	-1	1.6E+00	0.9747	-1.6E+00	-0.97465	0.00E+00

Vertical dispersion option Simulate vertical dispersion in 1 direction

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	1.39E-03	m/d																				
Rc	2.55E+04		1	1	5E-06	-7.7E+01	3.0E-34	-2.5E+48	2.000	7.8E+01	5.6E+33	2.5E+48	0.000	3.4E+01	1	-3.4E+01	-1	1.4E+01	1	-1.4E+01	-1	1.18E-38
u	5.45E-08	m/d	2	2	5E-06	-1.5E+02	8.7E-68	-2.5E+48	2.000	1.6E+02	3.1E+67	2.5E+48	0.000	2.4E+01	1	-2.4E+01	-1	1.0E+01	1	-1.0E+01	-1	3.49E-72
			3	3	5E-06	-2.3E+02	2.6E-101	-2.5E+48	2.000	2.3E+02	1.7E+101	2.5E+48	0.000	1.9E+01	1	-1.9E+01	-1	8.2E+00	1	-8.2E+00	-1	1.03E-105
			4	4	5E-06	-3.1E+02	7.6E-135	-2.5E+48	2.000	3.1E+02	9.7E+134	2.5E+48	0.000	1.7E+01	1	-1.7E+01	-1	7.1E+00	1	-7.1E+00	-1	3.04E-139
			5	5	5E-06	-3.9E+02	2.2E-168	-2.5E+48	2.000	3.9E+02	5.4E+168	2.5E+48	0.000	1.5E+01	1	-1.5E+01	-1	6.3E+00	1	-6.3E+00	-1	8.98E-173
			6	6	5E-06	-4.6E+02	6.6E-202	-2.5E+48	2.000	4.7E+02	3.0E+202	2.5E+48	0.000	1.4E+01	1	-1.4E+01	-1	5.8E+00	1	-5.8E+00	-1	2.65E-206
			7	7	5E-06	-5.4E+02	2.0E-235	-2.5E+48	2.000	5.4E+02	1.7E+236	2.5E+48	0.000	1.3E+01	1	-1.3E+01	-1	5.3E+00	1	-5.3E+00	-1	7.83E-240
			8	8	5E-06	-6.2E+02	5.8E-269	-2.5E+48	2.000	6.2E+02	9.5E+269	2.5E+48	0.000	1.2E+01	1	-1.2E+01	-1	5.0E+00	1	-5.0E+00	-1	2.31E-273
			9	9	5E-06	-6.9E+02	1.7E-302	-2.5E+48	2.000	7.0E+02	5.3E+303	2.5E+48	0.000	1.1E+01	1	-1.1E+01	-1	4.7E+00	1	-4.7E+00	-1	6.82E-307
			10	10	5E-06	-7.7E+02	0.0E+00	-2.5E+48	2.000	7.8E+02	1.0E+304	2.5E+48	0.000	1.1E+01	1	-1.1E+01	-1	4.5E+00	1	-4.5E+00	-1	0.00E+00
			11	11	5E-06	-8.5E+02	0.0E+00	-2.5E+48	2.000	8.5E+02	1.0E+304	2.5E+48	0.000	1.0E+01	1	-1.0E+01	-1	4.3E+00	1	-4.3E+00	-1	0.00E+00
			12	12	5E-06	-9.3E+02	0.0E+00	-2.5E+48	2.000	9.3E+02	1.0E+304	2.5E+48	0.000	9.7E+00	1	-9.7E+00	-1	4.1E+00	1	-4.1E+00	-1	0.00E+00
			13	13	5E-06	-1.0E+03	0.0E+00	-2.5E+48	2.000	1.0E+03	1.0E+304	2.5E+48	0.000	9.3E+00	1	-9.3E+00	-1	3.9E+00	1	-3.9E+00	-1	0.00E+00
			14	14	5E-06	-1.1E+03	0.0E+00	-2.5E+48	2.000	1.1E+03	1.0E+304	2.5E+48	0.000	9.0E+00	1	-9.0E+00	-1	3.8E+00	1	-3.8E+00	-1	0.00E+00
			15	15	5E-06	-1.2E+03	0.0E+00	-2.5E+48	2.000	1.2E+03	1.0E+304	2.5E+48	0.000	8.7E+00	1	-8.7E+00	-1	3.7E+00	1	-3.7E+00	-1	0.00E+00
			16	16	5E-06	-1.2E+03	0.0E+00	-2.5E+48	2.000	1.2E+03	1.0E+304	2.5E+48	0.000	8.4E+00	1	-8.4E+00	-1	3.5E+00	1	-3.5E+00	-1	0.00E+00
			17	17	5E-06	-1.3E+03	0.0E+00	-2.5E+48	2.000	1.3E+03	1.0E+304	2.5E+48	0.000	8.1E+00	1	-8.1E+00	-1	3.4E+00	1	-3.4E+00	-1	0.00E+00
			18	18	5E-06	-1.4E+03	0.0E+00	-2.5E+48	2.000	1.4E+03	1.0E+304	2.5E+48	0.000	7.9E+00	1	-7.9E+00	-1	3.3E+00	1	-3.3E+00	-1	0.00E+00
			19	19	5E-06	-1.5E+03	0.0E+00	-2.5E+48	2.000	1.5E+03	1.0E+304	2.5E+48	0.000	7.7E+00	1	-7.7E+00	-1	3.2E+00	1	-3.2E+00	-1	0.00E+00
			20	20	5E-06	-1.5E+03	0.0E+00	-2.5E+48	2.000	1.6E+03	1.0E+304	2.5E+48	0.000	7.5E+00	1	-7.5E+00	-1	3.2E+00	1	-3.2E+00	-0.99999	0.00E+00
Date:	21/06/2018																					
Version:	1.1																					

Date: 21/06/2018
Version: 1.1



Contaminant Benzo(a)pyrene

DOMENICO (STEADY STATE)

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	Concentration	
Input	Value	Units														
C _T	0.00005	mg/l	1	1	0.00001	-7.72E+01	2.95E-34	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	1.18E-38
			2	2	0.00001	-1.54E+02	8.72E-68	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	3.49E-72
			3	3	0.00001	-2.32E+02	2.57E-101	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	1.03E-105
Co	4.00E-05	mg/l	4	4	0.00001	-3.09E+02	7.60E-135	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	3.04E-139
λ	6.54E-04	days ⁻¹	5	5	0.00001	-3.86E+02	2.24E-168	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	8.98E-173
Sz	6.00E+01	m	6	6	0.00001	-4.63E+02	6.63E-202	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	2.65E-206
Sy	4.00E+00	m	7	7	0.00001	-5.40E+02	1.96E-235	1.27E+01	1	-1.27E+01	-1	2.67E+00	1	-2.67E+00	-0.9998	7.82E-240
Kd	5.90E+03	l/kg	8	8	0.00001	-6.18E+02	5.78E-269	1.19E+01	1	-1.19E+01	-1	2.50E+00	1	-2.50E+00	-0.9996	2.31E-273
ρ	1.60E+00	g/cm3	9	9	0.00001	-6.95E+02	1.71E-302	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.999	-2.36E+00	-0.9991	6.82E-307
n	3.70E-01		10	10	0.00001	-7.72E+02	0.00E+00	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.998	-2.24E+00	-0.9984	0.00E+00
i	1.70E-03		11	11	0.00001	-8.49E+02	0.00E+00	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.997	-2.13E+00	-0.9974	0.00E+00
K	3.02E-01	m/d	12	12	0.00001	-9.26E+02	0.00E+00	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.996	-2.04E+00	-0.9961	0.00E+00
x	2.00E+01	m	13	13	0.00001	-1.00E+03	0.00E+00	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.994	-1.96E+00	-0.9945	0.00E+00
z	0.00E+00	m	14	14	0.00001	-1.08E+03	0.00E+00	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.992	-1.89E+00	-0.9925	0.00E+00
y	0.00E+00	m	15	15	0.00001	-1.16E+03	0.00E+00	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.99	-1.83E+00	-0.9902	0.00E+00
			16	16	0.00001	-1.24E+03	0.00E+00	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.988	-1.77E+00	-0.9876	0.00E+00
ax	2.00E+00	m	17	17	0.00001	-1.31E+03	0.00E+00	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.985	-1.71E+00	-0.9847	0.00E+00
az	2.00E-01	m	18	18	0.00001	-1.39E+03	0.00E+00	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.982	-1.67E+00	-0.9816	0.00E+00
ay	2.00E-02	m	19	19	0.00001	-1.47E+03	0.00E+00	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.978	-1.62E+00	-0.9782	0.00E+00
			20	20	0.00001	-1.54E+03	0.00E+00	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.975	-1.58E+00	-0.9747	0.00E+00

Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc

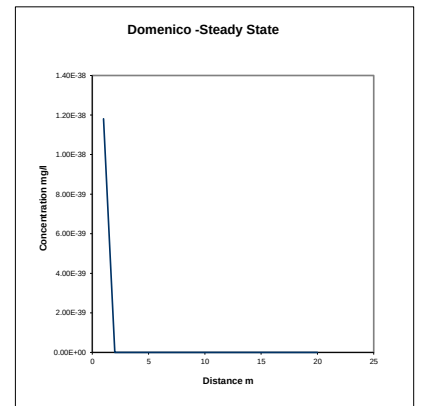
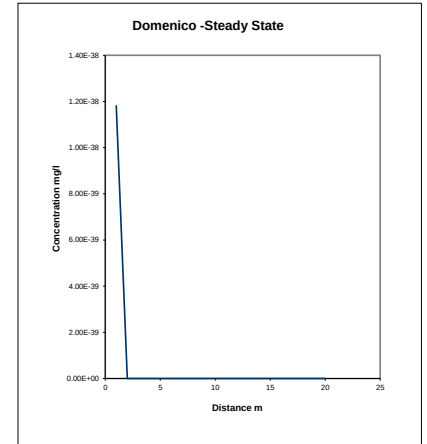
Value

DOMENICO (STEADY STATE)

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

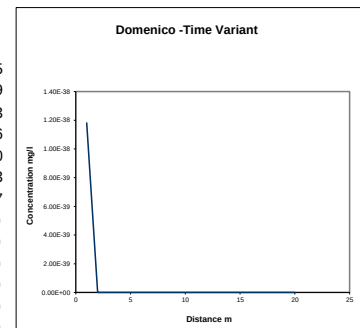
				X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
v Rc u	1.39E-03	m/d														
	2.55E+04															
	5.45E-08	m/d	1	1	0.00001	-7.72E+01	2.95E-34	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	1.18E-38
			2	2	0.00001	-1.54E+02	8.72E-68	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	3.49E-72
			3	3	0.00001	-2.32E+02	2.57E-101	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	1.03E-105
			4	4	0.00001	-3.09E+02	7.60E-135	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	3.04E-139
			5	5	0.00001	-3.86E+02	2.24E-168	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	8.98E-173
			6	6	0.00001	-4.63E+02	6.63E-202	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	2.65E-206
			7	7	0.00001	-5.40E+02	1.96E-235	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	7.83E-240
			8	8	0.00001	-6.18E+02	5.78E-269	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	2.31E-273
			9	9	0.00001	-6.95E+02	1.71E-302	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	6.82E-307
			10	10	0.00001	-7.72E+02	0.00E+00	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	0.00E+00
			11	11	0.00001	-8.49E+02	0.00E+00	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	0.00E+00
			12	12	0.00001	-9.26E+02	0.00E+00	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	0.00E+00
			13	13	0.00001	-1.00E+03	0.00E+00	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	0.00E+00
			14	14	0.00001	-1.08E+03	0.00E+00	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	0.00E+00
			15	15	0.00001	-1.16E+03	0.00E+00	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	0.00E+00
			16	16	0.00001	-1.24E+03	0.00E+00	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	0.00E+00
			17	17	0.00001	-1.31E+03	0.00E+00	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	0.00E+00
			18	18	0.00001	-1.39E+03	0.00E+00	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	0.00E+00
		19	19	0.00001	-1.47E+03	0.00E+00	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	0.00E+00	
		20	20	0.00001	-1.54E+03	0.00E+00	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	0.00E+00	
21/06/2018																
n:	1.1															

Date: 21/06/2018
Version: 1.1



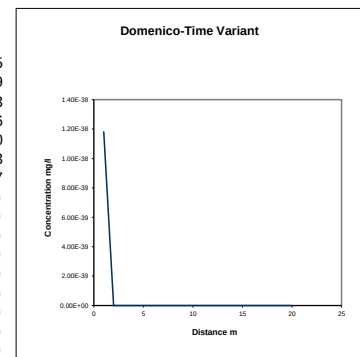
DOMENICO (TIME VARIANT)

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	0.00005	mg/l	m															
			1	1	5E-06	-7.72E+01	2.95E-34	-2.54E+48	2	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	1.18E-38
			2	2	5E-06	-1.54E+02	8.72E-68	-2.54E+48	2	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	3.49E-72
			3	3	5E-06	-2.32E+02	#####	-2.54E+48	2	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	1.03E-105
Co	4.00E-05	mg/l	4	4	5E-06	-3.09E+02	#####	-2.54E+48	2	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	3.04E-139
λ	6.54E-04	days ⁻¹	5	5	5E-06	-3.86E+02	#####	-2.54E+48	2	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	8.98E-173
Sz	6.00E+01	m	6	6	5E-06	-4.63E+02	#####	-2.54E+48	2	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	2.65E-206
Sy	4.00E+00	m	7	7	5E-06	-5.40E+02	#####	-2.54E+48	2	1.27E+01	1	-1.27E+01	-1	2.67E+00	0.9998	-2.67E+00	-1	7.82E-240
Kd	5.90E+03	l/kg	8	8	5E-06	-6.18E+02	#####	-2.54E+48	2	1.19E+01	1	-1.19E+01	-1	2.50E+00	0.9996	-2.50E+00	-1	2.31E-273
ρ	1.60E+00	g/cm3	9	9	5E-06	-6.95E+02	#####	-2.54E+48	2	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.9991	-2.36E+00	-0.999	6.82E-307
n	3.70E-01		10	10	5E-06	-7.72E+02	0.00E+00	-2.54E+48	2	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.9984	-2.24E+00	-0.998	0.00E+00
i	1.70E-03		11	11	5E-06	-8.49E+02	0.00E+00	-2.54E+48	2	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.9974	-2.13E+00	-0.997	0.00E+00
K	3.02E-01	m/d	12	12	5E-06	-9.26E+02	0.00E+00	-2.54E+48	2	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.9961	-2.04E+00	-0.996	0.00E+00
x	2.00E+01	m	13	13	5E-06	-1.00E+03	0.00E+00	-2.54E+48	2	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.9945	-1.96E+00	-0.994	0.00E+00
z	0.00E+00	m	14	14	5E-06	-1.08E+03	0.00E+00	-2.54E+48	2	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.9925	-1.89E+00	-0.992	0.00E+00
y	0.00E+00	m	15	15	5E-06	-1.16E+03	0.00E+00	-2.54E+48	2	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.9902	-1.83E+00	-0.99	0.00E+00
t	9.90E+99	days	16	16	5E-06	-1.24E+03	0.00E+00	-2.54E+48	2	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.9876	-1.77E+00	-0.988	0.00E+00
ax	2.00E+00	m	17	17	5E-06	-1.31E+03	0.00E+00	-2.54E+48	2	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.9847	-1.71E+00	-0.985	0.00E+00
az	2.00E-01	m	18	18	5E-06	-1.39E+03	0.00E+00	-2.54E+48	2	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.9816	-1.67E+00	-0.982	0.00E+00
ay	2.00E-02	m	19	19	5E-06	-1.47E+03	0.00E+00	-2.54E+48	2	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.9782	-1.62E+00	-0.978	0.00E+00
			20	20	5E-06	-1.54E+03	0.00E+00	-2.54E+48	2	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.9747	-1.58E+00	-0.975	0.00E+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	1.39E-03	m/d																
Rc	2.55E+04		1	1	5E-06	-7.72E+01	2.95E-34	-2.54E+48	2	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	1.18E-38
u	5.45E-08	m/d	2	2	5E-06	-1.54E+02	8.72E-68	-2.54E+48	2	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	3.49E-72
			3	3	5E-06	-2.32E+02	#####	-2.54E+48	2	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	1.03E-105
			4	4	5E-06	-3.09E+02	#####	-2.54E+48	2	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	3.04E-139
			5	5	5E-06	-3.86E+02	#####	-2.54E+48	2	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	8.98E-173
			6	6	5E-06	-4.63E+02	#####	-2.54E+48	2	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	2.65E-206
			7	7	5E-06	-5.40E+02	#####	-2.54E+48	2	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	7.83E-240
			8	8	5E-06	-6.18E+02	#####	-2.54E+48	2	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	2.31E-273
			9	9	5E-06	-6.95E+02	#####	-2.54E+48	2	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	6.82E-307
			10	10	5E-06	-7.72E+02	0.00E+00	-2.54E+48	2	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	0.00E+00
			11	11	5E-06	-8.49E+02	0.00E+00	-2.54E+48	2	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	0.00E+00
			12	12	5E-06	-9.26E+02	0.00E+00	-2.54E+48	2	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	0.00E+00
			13	13	5E-06	-1.00E+03	0.00E+00	-2.54E+48	2	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	0.00E+00
			14	14	5E-06	-1.08E+03	0.00E+00	-2.54E+48	2	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	0.00E+00
			15	15	5E-06	-1.16E+03	0.00E+00	-2.54E+48	2	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	0.00E+00
			16	16	5E-06	-1.24E+03	0.00E+00	-2.54E+48	2	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	0.00E+00
			17	17	5E-06	-1.31E+03	0.00E+00	-2.54E+48	2	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	0.00E+00
			18	18	5E-06	-1.39E+03	0.00E+00	-2.54E+48	2	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	0.00E+00
	21/06/2018		19	19	5E-06	-1.47E+03	0.00E+00	-2.54E+48	2	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	0.00E+00
	1.1		20	20	5E-06	-1.54E+03	0.00E+00	-2.54E+48	2	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	0.00E+00



Date: 21/06/2018
Version: 1.1



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:	Portman Way		
Site Address:	Reading		
Completed by:	PDM		
Date:	21-Jun-18	Version:	1.1
Contaminant	C10-C12 aromatic		
Target Concentration (C _T)	9.00E-02	mg/l	Origin of C _T : WHO

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

C10-C12 aromatic
0.09 mg/l

Input Parameters

Standard entry

Water filled soil porosity

θ_w

2.40E-01 fraction

calculated

Air filled soil porosity

θ_a

1.84E-01 fraction

calculated

Bulk density of soil zone material

ρ

1.60E+00 g/cm³

R & D Technical report sand fill

Henry's Law constant

H

1.40E-01 dimensionless

Total Petroleum Hydrocarbon Criteria Working Group

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d

l/kg

calculated

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc}

4.50E-02 fraction

site data

Organic carbon partition coefficient

K_{oc}

2.50E+03 l/kg

CLAIRE 2017 Hydrocarbons in Groundwater

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n}

l/kg

calculated

Sorption coefficient for ionised species

K_{oc,i}

l/kg

calculated

pH value

pH

pH units

calculated

Acid dissociation constant

pK_a

calculated

Fraction of organic carbon (in soil)

f_{oc}

fraction

calculated

Soil water partition coefficient used in Level Assessment

K_d

1.13E+02 l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

1.01E+01 mg/kg

(for comparison with soil analyses)

or

0.09 mg/l

(for comparison with leachate test results)

Site being assessed: Portman Way

Completed by: PDM

Date: 21-Jun-18

Version: 1.1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T C10-C12 aromatic
0.09 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
Area of contaminant source

Inf
A

4.40E-04
1.50E+02

m/d
m²

96-2000 30% pf values River Thames at Reading 70%
Area of boiler house and tank farm

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow
Saturated aquifer thickness
Hydraulic Conductivity of aquifer in which dilution occurs
Hydraulic gradient of water table
Width of contaminant source perpendicular to groundwater flow
Background concentration of contaminant in groundwater beneath site

L
da
K
i
w
Cu

3.00E+01
8.00E+01
3.02E-01
1.70E-03
6.00E+01
0.00E+00

m
m
m/d
fraction
m
mg/l

Width of source area between PH2 and PH6
assumed vale to base of chalk
site data
Estimate
Length of source area between PH2 and PH6
Estimated

Not used in calculation

Define mixing zone depth by specifying or calculating depth (using pull down list)

Enter mixing zone thickness
Calculated mixing zone thickness

Mz
Mz

Calculate
2.51E+01

m
m

Calculated Parameters

Dilution Factor

DF

1.98E+00

Level 2 Remedial Target

1.78E-01

mg/l

or

2.01E+01

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)

C_c

0.00E+00

mg/l

Calculated concentration within receptor (dilution only)

0.00E+00

mg/l

0

Site being assessed: Portman Way
Completed by: PDM
Date: 21-Jun-18
Version: 1.1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

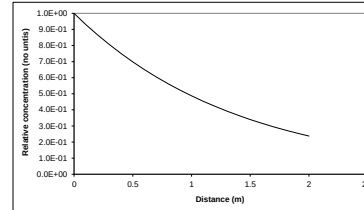
See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		C10-C12 aromatic		from Level 1
Target Concentration	C _t	0.09	mg/l	from Level 1
Dilution Factor	DF	1.98E+00		from Level 2

Enter method of defining partition co-efficient (using pull down list)
Calculate for non-polar organic chemicals

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	4.50E-02 fraction
Organic carbon partition coefficient	Koc	2.50E+03 l/kg
Entry for ionic organic chemicals (option)		
Sorption coefficient for related species	K _{oc,ri}	
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	1.13E+02 l/kg



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	Relative concentration	Concentration
Distance	(No units)	mg/l
0	1.0E+00	2.86E-01
0.1	9.31E-01	2.66E-01
0.2	8.66E-01	2.47E-01
0.3	8.06E-01	2.30E-01
0.4	7.50E-01	2.14E-01
0.5	6.98E-01	1.99E-01
0.6	6.50E-01	1.86E-01
0.7	6.04E-01	1.73E-01
0.8	5.62E-01	1.61E-01
0.9	5.23E-01	1.50E-01
1.0	4.87E-01	1.39E-01
1.1	4.53E-01	1.30E-01
1.2	4.22E-01	1.21E-01
1.3	3.93E-01	1.12E-01
1.4	3.65E-01	1.04E-01
1.5	3.40E-01	9.71E-02
1.6	3.16E-01	9.04E-02
1.7	2.94E-01	8.41E-02
1.8	2.74E-01	7.83E-02
1.9	2.55E-01	7.28E-02
2.0	2.37E-01	6.78E-02

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 dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Enter source concentration			
Enter soil concentration			
Half life for degradation of contaminant in water	t _{1/2}	63.7 days	Handbook of Environmental Degradation Rates
Calculated decay rate	λ	2.31E-03 days ⁻¹	calculated
Width of plume in aquifer at source	Sz	6.00E+01 m	from Level 2
Plume thickness in aquifer at source	Sy	2.51E+01 m	from Level 2
Bulk density of aquifer materials	ρ	1.60E+00 g/cm ³	R & D Technical Report P13
Effective porosity of aquifer	n	3.70E-01 fraction	Consim
Hydraulic gradient	i	3.44E-03 fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	3.02E-01 m/d	from Level 2
Distance to compliance point	x	2.00E+00 m	Estimated Depth to water table
Distance (lateral) to compliance point perpendicular to flow direction	z		
Distance (depth) to compliance point perpendicular to flow direction	y		
Time since pollutant entered groundwater	t	1.00E+99 days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	1.13E+02 l/kg	see options
Longitudinal dispersivity	ax	0.200 m	see options
Transverse dispersivity	az	0.020 m	see options
Vertical dispersivity	av	0.002 m	see options

Parameter values should be checked against Level 1 and 2

Define dispersivity (click brown cell and use pull down list)
Dispersivities 10%, 1%, 0.1% of pathway length

Longitudinal dispersivity	ax	0.00E+00	2.00E-01	4.58E-02	m
Transverse dispersivity	az	0.00E+00	2.00E-02	4.58E-03	m
Vertical dispersivity	ay	0.00E+00	2.00E-03	4.58E-04	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀ t)^{0.414}; 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 O₂, NO₃, SO₄ etc than an alternative solution should be used

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.

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	V	2.81E-03 m/d
Retardation factor	Rf	4.87E+02 fraction
Decay rate used	λ	4.74E-06 d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.44E-03 fraction
Rate of contaminant flow due to retardation	u	5.76E-06 m/d
Ratio of Compliance Point to Source Concentration	C ₁₀ /C ₀	2.37E-01 fraction
Attenuation factor (C ₁₀ /C ₁₀₀)	AF	4.21E+00 fraction
Calculated soil leachate concentration	Co	5.65E-01 mg/l

Remedial Targets

Level 3 Remedial Target	7.51E-01	mg/l	For comparison with measured pore water concentration.
Ogata Banks	8.46E+01	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2	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 ₁₀ /C ₀	2.37E-01	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

Site being assessed:	Portman Way
Completed by:	PDM
Date:	#####
Version:	1.1

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters
Soil contaminant concentration C_0 2.00E-01 mg/kg

Level 1 Parameters

Water filled soil porosity	θ_w	2.40E-01	fraction
Air filled soil porosity	θ_a	1.84E-01	fraction
Bulk density	ρ	1.60E+00	g/cm ³
Henry's Law constant	H	1.40E-01	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	1.13E+02	l/kg
Factor (partitioning between soil and water)		1.13E+02	dimensionless

Level 2 Parameters

Dilution Factor DF 1.98E+00

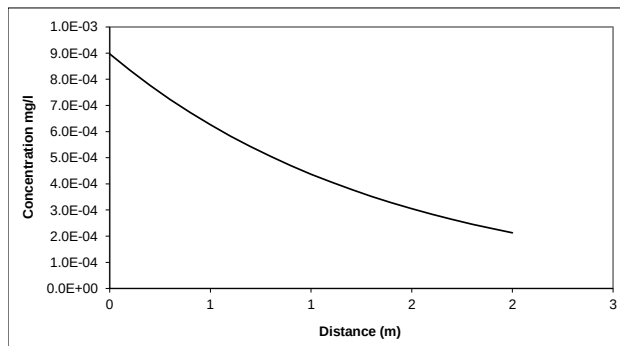
Level 3 Parameters

Attenuation factor (C_0/C_{ED}) AF 4.21E+00

Predicted concentrations at compliance point

Level 1	C	1.78E-03 mg/l	No dilution or attenuation
Level 2	C	8.97E-04 mg/l	Dilution taken into account
Level 3	C	2.13E-04 mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	8.97E-04
0.10	8.35E-04
0.20	7.77E-04
0.30	7.23E-04
0.40	6.73E-04
0.50	6.26E-04
0.60	5.83E-04
0.70	5.42E-04
0.80	5.05E-04
0.90	4.70E-04
1.00	4.37E-04
1.10	4.07E-04
1.20	3.78E-04
1.30	3.52E-04
1.40	3.28E-04
1.50	3.05E-04
1.60	2.84E-04
1.70	2.64E-04
1.80	2.46E-04
1.90	2.29E-04
2.00	2.13E-04

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	C10-C12 aromatic	from Level 1
Target Concentration	9.00E-02	mg/l from Level 1

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

Ogata Banks	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	1.50E-02	mg/l	Site data
Half life for degradation of contaminant in water	t _{1/2}	3.00E+02	days	Handbook of Environmental Degradation R
Calculated decay rate	λ	2.31E-03	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.00E+01	m	Estimated from site data
Plume thickness at source	Sy	4.00E+00	m	to top of chalk
Saturated aquifer thickness	da	8.00E+01	m	Estimated from site data
Bulk density of aquifer materials	p	1.80E+00	g/cm ³	Consim
Effective porosity of aquifer	n	3.70E-01	fraction	Consim
Hydraulic gradient	i	1.70E-03	fraction	Estimate from site data
Hydraulic conductivity of aquifer	K	3.02E-01	m/d	Site data
Distance to compliance point	x	2.00E+01	m	Distance to site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	1.13E+02	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	1.39E-03	m/d
Retardation factor	Rf	4.87E+02	fraction
Decay rate used	λ	4.74E-06	d ⁻¹
Rate of contaminant flow due to retardation	u	2.85E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	1.36E-08	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	1.10E+06	

Remedial Targets

Remedial Target	9.90E+04	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	1.36E-08	mg/l
		9.9E+99	days

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)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient

Kd

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer

foc

4.50E-02

fraction

Organic carbon partition coefficient

Koc

2.50E+03

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species

K_{oc,ri}

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

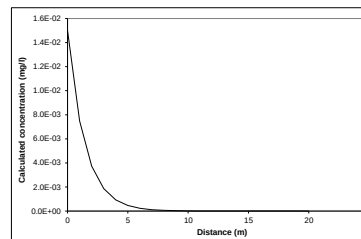
1.13E+02

l/kg

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

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

Longitudinal dispersivity	ax	2.00E+00	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(log ₁₀ K _d) ^{-0.14} , 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:	Portman Way
Completed by:	PDM
Date:	20/07/2018
Version:	1.1



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	15.00	% wt	(Change this number only if you have specific information)
Particle Density	2.78	tonnes/m ³	
Dry Bulk Density	1.60	tonnes/m ³	
Calculated Parameters			
Voids Ratio	0.74	fraction	
Initial Saturation	56.54	%	
Total porosity	0.424	fraction	
Air Filled Porosity	0.184	fraction	
Water Filled Porosity	0.240	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	1.000	fraction	#DIV/0!
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

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 C10-C12 aromatic

Parameter	Value	Units	Calculations (Refer toTable 4.3, R&D Publication 20)																			
(carried over from input sheet)			Selected option		Calculate for non-polar organic chemicals																	
			calc	calc	Calc Kd	l/kg																
C _T	9.00E-02	mg/l	Calculation of partition coefficient																			
Kd	1.13E+02	l/kg	for ionic organic chemical																			
foc	4.50E-02	fraction																				
koc	2.50E+03	l/kg	Partition coefficient used in Level 1 Assessment																			
θ _w	2.40E-01	fraction	1.13E+02 l/kg																			
θ _a	1.84E-01	fraction																				
ρ	1.60E+00	g/cm3																				
H	1.40E-01	dimensionless	Factor (partitioning between soil and water)																			
Koc,n		l/kg																				
Koc,i		l/kg																				
pH		pH units																				
pKa																						
foc (ionic)		fraction																				
			<table><tr><td>Calculated Remedial Target</td><td>1.01E+01 mg/kg</td><td>for C10-C12 aromatic</td></tr></table>				Calculated Remedial Target	1.01E+01 mg/kg	for C10-C12 aromatic													
Calculated Remedial Target	1.01E+01 mg/kg	for C10-C12 aromatic																				
			<table><tr><td>Site being assessed:</td><td colspan="3">Portman Way</td></tr><tr><td>Completed by:</td><td colspan="3">PDM</td></tr><tr><td>Date:</td><td colspan="3">21/06/2018</td></tr><tr><td>Version:</td><td colspan="3">1.1</td></tr></table>				Site being assessed:	Portman Way			Completed by:	PDM			Date:	21/06/2018			Version:	1.1		
Site being assessed:	Portman Way																					
Completed by:	PDM																					
Date:	21/06/2018																					
Version:	1.1																					

Level 2 Calculation Sheet

Contaminant C10-C12 aromatic

Site assessed:	Portman Way
Date:	21/06/2018
Version:	1.1

Parameter **Value** **Units**
(carried over from input sheet)

Mz	2.51E+01	m
L	3.00E+01	m
da	8.00E+01	m
Inf	4.40E-04	m/d
K	3.02E-01	m/d
i	1.70E-03	m3/d
A	1.50E+02	m2
		m3/d
Cc	0.00E+00	mg/l
C _T	9.00E-02	mg/l
Cu	0.00E+00	mg/l
w	6.00E+01	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Calculated
Dilution Factor

1.98E+00

#DIV/0!

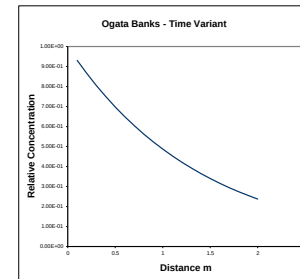


Contaminant :10-C12 aromatic

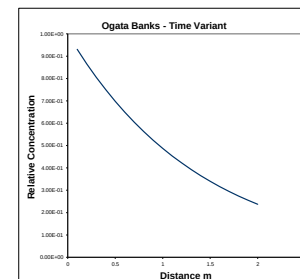
OGATA BANKS SOLUTION

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	Relative Concentration
C _T	9.000E-02	mg/l	1	0.1	0.13	-7.19E-02	9.31E-01	-1.09E+47	2	5.72E-01	1.77E+00	1.09E+47	0	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.31E-01
DF	1.979E+00		2	0.2	0.13	-1.44E-01	8.66E-01	-1.09E+47	2	1.14E+00	3.14E+00	1.09E+47	0	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	8.66E-01
			3	0.3	0.13	-2.16E-01	8.06E-01	-1.09E+47	2	1.72E+00	5.56E+00	1.09E+47	0	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	8.06E-01
			4	0.4	0.13	-2.88E-01	7.50E-01	-1.09E+47	2	2.29E+00	9.85E+00	1.09E+47	0	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	7.50E-01
λ	4.740E-06	days ⁻¹	5	0.5	0.13	-3.60E-01	6.98E-01	-1.09E+47	2	2.86E+00	1.75E+01	1.09E+47	0	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	6.98E-01
Sz	6.000E+01	m	6	0.6	0.13	-4.32E-01	6.50E-01	-1.09E+47	2	3.43E+00	3.09E+01	1.09E+47	0	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	6.50E-01
Sy	2.514E+01	m	7	0.7	0.13	-5.03E-01	6.04E-01	-1.09E+47	2	4.00E+00	5.48E+01	1.09E+47	0	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	6.04E-01
Kd	1.125E+02	l/kg	8	0.8	0.13	-5.75E-01	5.62E-01	-1.09E+47	2	4.58E+00	9.71E+01	1.09E+47	0	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	5.62E-01
ρ	1.600E+00	g/cm ³	9	0.9	0.13	-6.47E-01	5.23E-01	-1.09E+47	2	5.15E+00	1.72E+02	1.09E+47	0	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	5.23E-01
n	3.700E-01		10	1	0.13	-7.19E-01	4.87E-01	-1.09E+47	2	5.72E+00	3.05E+02	1.09E+47	0	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	4.87E-01
i	3.436E-03		11	1.1	0.13	-7.91E-01	4.53E-01	-1.09E+47	2	6.29E+00	5.40E+02	1.09E+47	0	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	4.53E-01
K	3.024E-01	m/d	12	1.2	0.13	-8.63E-01	4.22E-01	-1.09E+47	2	6.86E+00	9.56E+02	1.09E+47	0	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	4.22E-01
x	2.000E+00	m	13	1.3	0.13	-9.35E-01	3.93E-01	-1.09E+47	2	7.43E+00	1.69E+03	1.09E+47	0	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	3.93E-01
z	0.000E+00	m	14	1.4	0.13	-1.01E+00	3.65E-01	-1.09E+47	2	8.01E+00	3.00E+03	1.09E+47	0	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	3.65E-01
y	0.000E+00	m	15	1.5	0.13	-1.08E+00	3.40E-01	-1.09E+47	2	8.58E+00	5.32E+03	1.09E+47	0	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	3.40E-01
t	1.000E+99	days	16	1.6	0.13	-1.15E+00	3.16E-01	-1.09E+47	2	9.15E+00	9.42E+03	1.09E+47	0	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	3.16E-01
ax	2.000E-01	m	17	1.7	0.13	-1.22E+00	2.94E-01	-1.09E+47	2	9.72E+00	1.67E+04	1.09E+47	0	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	2.94E-01
az	2.000E-02	m	18	1.8	0.13	-1.29E+00	2.74E-01	-1.09E+47	2	1.03E+01	2.96E+04	1.09E+47	0	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	2.74E-01
ay	2.000E-03	m	19	1.9	0.13	-1.37E+00	2.55E-01	-1.09E+47	2	1.09E+01	5.24E+04	1.09E+47	0	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	2.55E-01
			20	2	0.13	-1.44E+00	2.37E-01	-1.09E+47	2	1.14E+01	9.28E+04	1.09E+47	0	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	2.37E-01



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	Relative Concentration
v	0.0028	m/d	1	0.1	0.13	-7.19E-02	9.31E-01	-1.09E+47	2	5.72E-01	1.77E+00	1.09E+47	0	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.31E-01
Rc	487.4865		2	0.2	0.13	-1.44E-01	8.66E-01	-1.09E+47	2	1.14E+00	3.14E+00	1.09E+47	0	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	8.66E-01
u	0.0000	m/d	3	0.3	0.13	-2.16E-01	8.06E-01	-1.09E+47	2	1.72E+00	5.56E+00	1.09E+47	0	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	8.06E-01
			4	0.4	0.13	-2.88E-01	7.50E-01	-1.09E+47	2	2.29E+00	9.85E+00	1.09E+47	0	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	7.50E-01
			5	0.5	0.13	-3.60E-01	6.98E-01	-1.09E+47	2	2.86E+00	1.75E+01	1.09E+47	0	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	6.98E-01
			6	0.6	0.13	-4.32E-01	6.50E-01	-1.09E+47	2	3.43E+00	3.09E+01	1.09E+47	0	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	6.50E-01
			7	0.7	0.13	-5.03E-01	6.04E-01	-1.09E+47	2	4.00E+00	5.48E+01	1.09E+47	0	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	6.04E-01
			8	0.8	0.13	-5.75E-01	5.62E-01	-1.09E+47	2	4.58E+00	9.71E+01	1.09E+47	0	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	5.62E-01
			9	0.9	0.13	-6.47E-01	5.23E-01	-1.09E+47	2	5.15E+00	1.72E+02	1.09E+47	0	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	5.23E-01
			10	1	0.13	-7.19E-01	4.87E-01	-1.09E+47	2	5.72E+00	3.05E+02	1.09E+47	0	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	4.87E-01
			11	1.1	0.13	-7.91E-01	4.53E-01	-1.09E+47	2	6.29E+00	5.40E+02	1.09E+47	0	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	4.53E-01
			12	1.2	0.13	-8.63E-01	4.22E-01	-1.09E+47	2	6.86E+00	9.56E+02	1.09E+47	0	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	4.22E-01
			13	1.3	0.13	-9.35E-01	3.93E-01	-1.09E+47	2	7.43E+00	1.69E+03	1.09E+47	0	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	3.93E-01
			14	1.4	0.13	-1.01E+00	3.65E-01	-1.09E+47	2	8.01E+00	3.00E+03	1.09E+47	0	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	3.65E-01
			15	1.5	0.13	-1.08E+00	3.40E-01	-1.09E+47	2	8.58E+00	5.32E+03	1.09E+47	0	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	3.40E-01
			16	1.6	0.13	-1.15E+00	3.16E-01	-1.09E+47	2	9.15E+00	9.42E+03	1.09E+47	0	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	3.16E-01
			17	1.7	0.13	-1.22E+00	2.94E-01	-1.09E+47	2	9.72E+00	1.67E+04	1.09E+47	0	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	2.94E-01
			18	1.8	0.13	-1.29E+00	2.74E-01	-1.09E+47	2	1.03E+01	2.96E+04	1.09E+47	0	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	2.74E-01
			19	1.9	0.13	-1.37E+00	2.55E-01	-1.09E+47	2	1.09E+01	5.24E+04	1.09E+47	0	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	2.55E-01
			20	2	0.13	-1.44E+00	2.37E-01	-1.09E+47	2	1.14E+01	9.28E+04	1.09E+47	0	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	2.37E-01



Date: 21/06/2018
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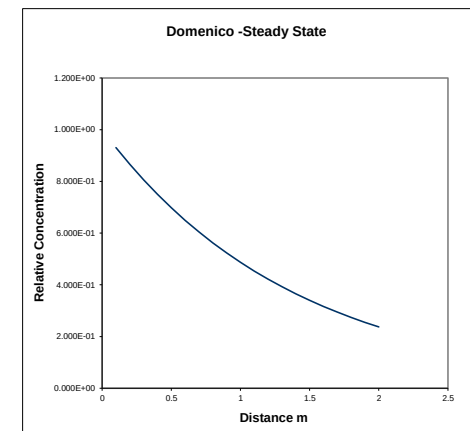
Contaminant I0-C12 aromatic

DOMENICO (STEADY STATE)

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	9.000E-02	mg/l	1	0.1	0.25	-7.19E-02	9.31E-01	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.306E-01
DF	1.979E+00		2	0.2	0.25	-1.44E-01	8.66E-01	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	8.660E-01
			3	0.3	0.25	-2.16E-01	8.06E-01	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	8.059E-01
			4	0.4	0.25	-2.88E-01	7.50E-01	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	7.500E-01
λ	4.740E-06	days ⁻¹	5	0.5	0.25	-3.60E-01	6.98E-01	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	6.980E-01
Sz	6.000E+01	m	6	0.6	0.25	-4.32E-01	6.50E-01	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	6.495E-01
Sy	2.514E+01	m	7	0.7	0.25	-5.03E-01	6.04E-01	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	6.044E-01
Kd	1.125E+02	l/kg	8	0.8	0.25	-5.75E-01	5.62E-01	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	5.625E-01
ρ	1.600E+00	g/cm3	9	0.9	0.25	-6.47E-01	5.23E-01	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	5.235E-01
n	3.700E-01		10	1	0.25	-7.19E-01	4.87E-01	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	4.871E-01
i	3.436E-03		11	1.1	0.25	-7.91E-01	4.53E-01	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	4.533E-01
K	3.024E-01	m/d	12	1.2	0.25	-8.63E-01	4.22E-01	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	4.219E-01
x	2.000E+00	m	13	1.3	0.25	-9.35E-01	3.93E-01	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	3.926E-01
z	0.000E+00	m	14	1.4	0.25	-1.01E+00	3.65E-01	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	3.654E-01
y	0.000E+00	m	15	1.5	0.25	-1.08E+00	3.40E-01	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	3.400E-01
ax	2.000E-01	m	16	1.6	0.25	-1.15E+00	3.16E-01	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	3.164E-01
az	2.000E-02	m	17	1.7	0.25	-1.22E+00	2.94E-01	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	2.944E-01
ay	2.000E-03	m	18	1.8	0.25	-1.29E+00	2.74E-01	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	2.740E-01
			19	1.9	0.25	-1.37E+00	2.55E-01	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	2.550E-01
			20	2	0.25	-1.44E+00	2.37E-01	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	2.373E-01

Relative Concentration



Calc

Value

DOMENICO (STEADY STATE)

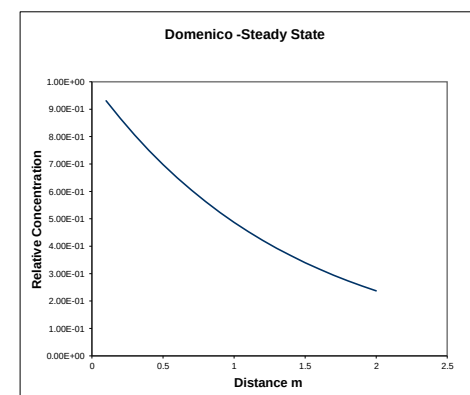
Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	2.81E-03	m/d	X		Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
Rc	4.87E+02															
u	5.76E-06	m/d	1	0.1	0.25	-7.19E-02	9.31E-01	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.31E-01
			2	0.2	0.25	-1.44E-01	8.66E-01	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	8.66E-01
			3	0.3	0.25	-2.16E-01	8.06E-01	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	8.06E-01
			4	0.4	0.25	-2.88E-01	7.50E-01	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	7.50E-01
			5	0.5	0.25	-3.60E-01	6.98E-01	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	6.98E-01
			6	0.6	0.25	-4.32E-01	6.50E-01	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	6.50E-01
			7	0.7	0.25	-5.03E-01	6.04E-01	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	6.04E-01
			8	0.8	0.25	-5.75E-01	5.62E-01	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	5.62E-01
			9	0.9	0.25	-6.47E-01	5.23E-01	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	5.23E-01
			10	1	0.25	-7.19E-01	4.87E-01	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	4.87E-01
			11	1.1	0.25	-7.91E-01	4.53E-01	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	4.53E-01
			12	1.2	0.25	-8.63E-01	4.22E-01	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	4.22E-01
			13	1.3	0.25	-9.35E-01	3.93E-01	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	3.93E-01
			14	1.4	0.25	-1.01E+00	3.65E-01	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	3.65E-01
			15	1.5	0.25	-1.08E+00	3.40E-01	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	3.40E-01
			16	1.6	0.25	-1.15E+00	3.16E-01	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	3.16E-01
			17	1.7	0.25	-1.22E+00	2.94E-01	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	2.94E-01
			18	1.8	0.25	-1.29E+00	2.74E-01	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	2.74E-01
			19	1.9	0.25	-1.37E+00	2.55E-01	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	2.55E-01
			20	2	0.25	-1.44E+00	2.37E-01	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	2.37E-01

21/06/2018

1.1

Relative Concentration



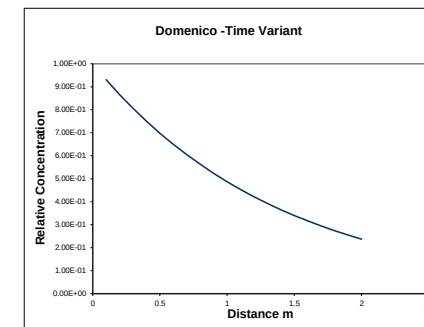
Date: 21/06/2018
Version: 1.1

DOMENICO (TIME VARIANT)

Contaminant 10-C12 aromatic

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	0.09	mg/l	1	0.1	0.125	-7.19E-02	9.31E-01	-1.09E+47	2	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.31E-01
DF	1.9790		2	0.2	0.125	-1.44E-01	8.66E-01	-1.09E+47	2	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	8.66E-01
			3	0.3	0.125	-2.16E-01	8.06E-01	-1.09E+47	2	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	8.06E-01
			4	0.4	0.125	-2.88E-01	7.50E-01	-1.09E+47	2	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	7.50E-01
λ	4.740E-06	days ⁻¹	5	0.5	0.125	-3.60E-01	6.98E-01	-1.09E+47	2	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	6.98E-01
Sz	6.000E+01	m	6	0.6	0.125	-4.32E-01	6.50E-01	-1.09E+47	2	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	6.50E-01
Sy	2.514E+01	m	7	0.7	0.125	-5.03E-01	6.04E-01	-1.09E+47	2	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	6.04E-01
Kd	1.125E+02	l/kg	8	0.8	0.125	-5.75E-01	5.62E-01	-1.09E+47	2	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	5.62E-01
ρ	1.600E+00	g/cm3	9	0.9	0.125	-6.47E-01	5.23E-01	-1.09E+47	2	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	5.23E-01
n	3.700E-01		10	1	0.125	-7.19E-01	4.87E-01	-1.09E+47	2	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	4.87E-01
i	3.436E-03		11	1.1	0.125	-7.91E-01	4.53E-01	-1.09E+47	2	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	4.53E-01
K	3.024E-01	m/d	12	1.2	0.125	-8.63E-01	4.22E-01	-1.09E+47	2	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	4.22E-01
x	2.000E+00	m	13	1.3	0.125	-9.35E-01	3.93E-01	-1.09E+47	2	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	3.93E-01
z	0.000E+00	m	14	1.4	0.125	-1.01E+00	3.65E-01	-1.09E+47	2	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	3.65E-01
y	0.000E+00	m	15	1.5	0.125	-1.08E+00	3.40E-01	-1.09E+47	2	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	3.40E-01
t	1.000E+99	days	16	1.6	0.125	-1.15E+00	3.16E-01	-1.09E+47	2	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	3.16E-01
ax	2.000E-01	m	17	1.7	0.125	-1.22E+00	2.94E-01	-1.09E+47	2	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	2.94E-01
az	2.000E-02	m	18	1.8	0.125	-1.29E+00	2.74E-01	-1.09E+47	2	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	2.74E-01
ay	2.000E-03	m	19	1.9	0.125	-1.37E+00	2.55E-01	-1.09E+47	2	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	2.55E-01
			20	2	0.125	-1.44E+00	2.37E-01	-1.09E+47	2	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	2.37E-01

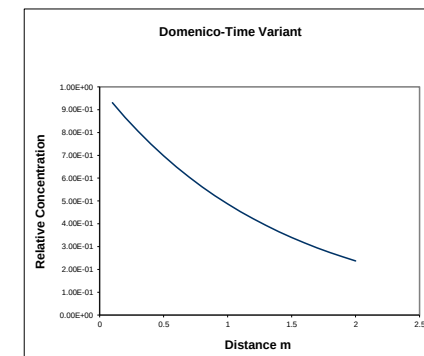


Calc

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	2.81E-03	m/d	m															
Rc	4.87E+02		1	0.1	0.125	-7.19E-02	9.31E-01	-1.09E+47	2	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.31E-01
u	5.76E-06	m/d	2	0.2	0.125	-1.44E-01	8.66E-01	-1.09E+47	2	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	8.66E-01
			3	0.3	0.125	-2.16E-01	8.06E-01	-1.09E+47	2	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	8.06E-01
			4	0.4	0.125	-2.88E-01	7.50E-01	-1.09E+47	2	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	7.50E-01
			5	0.5	0.125	-3.60E-01	6.98E-01	-1.09E+47	2	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	6.98E-01
			6	0.6	0.125	-4.32E-01	6.50E-01	-1.09E+47	2	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	6.50E-01
			7	0.7	0.125	-5.03E-01	6.04E-01	-1.09E+47	2	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	6.04E-01
			8	0.8	0.125	-5.75E-01	5.62E-01	-1.09E+47	2	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	5.62E-01
			9	0.9	0.125	-6.47E-01	5.23E-01	-1.09E+47	2	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	5.23E-01
			10	1	0.125	-7.19E-01	4.87E-01	-1.09E+47	2	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	4.87E-01
			11	1.1	0.125	-7.91E-01	4.53E-01	-1.09E+47	2	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	4.53E-01
			12	1.2	0.125	-8.63E-01	4.22E-01	-1.09E+47	2	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	4.22E-01
			13	1.3	0.125	-9.35E-01	3.93E-01	-1.09E+47	2	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	3.93E-01
			14	1.4	0.125	-1.01E+00	3.65E-01	-1.09E+47	2	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	3.65E-01
			15	1.5	0.125	-1.08E+00	3.40E-01	-1.09E+47	2	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	3.40E-01
			16	1.6	0.125	-1.15E+00	3.16E-01	-1.09E+47	2	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	3.16E-01
			17	1.7	0.125	-1.22E+00	2.94E-01	-1.09E+47	2	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	2.94E-01
			18	1.8	0.125	-1.29E+00	2.74E-01	-1.09E+47	2	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	2.74E-01
			19	1.9	0.125	-1.37E+00	2.55E-01	-1.09E+47	2	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	2.55E-01
			20	2	0.125	-1.44E+00	2.37E-01	-1.09E+47	2	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	2.37E-01



Date: 21/06/2018
Version: 1.1

OGATA BANKS SOLUTION																						
Contaminant	:10-C12 aromatic		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	0.09	mg/l	1	1	0.00188	-7.0E-01	5.0E-01	-2.2E+47	2.000	1.2E+00	3.3E+00	2.2E+47	0.000	3.4E+01	1	-3.4E+01	-1	7.1E+00	1	-7.1E+00	-1	7.48E-03
			2	2	0.00188	-1.4E+00	2.5E-01	-2.2E+47	2.000	2.4E+00	1.1E+01	2.2E+47	0.000	2.4E+01	1	-2.4E+01	-1	5.0E+00	1	-5.0E+00	-1	3.73E-03
			3	3	0.00188	-2.1E+00	1.2E-01	-2.2E+47	2.000	3.6E+00	3.6E+01	2.2E+47	0.000	1.9E+01	1	-1.9E+01	-1	4.1E+00	1	-4.1E+00	-1	1.86E-03
Co	1.50E-02	mg/l	4	4	0.00188	-2.8E+00	6.2E-02	-2.2E+47	2.000	4.8E+00	1.2E+02	2.2E+47	0.000	1.7E+01	1	-1.7E+01	-1	3.5E+00	1	-3.5E+00	-1	9.29E-04
λ	4.74E-06	days ⁻¹	5	5	0.00188	-3.5E+00	3.1E-02	-2.2E+47	2.000	6.0E+00	3.9E+02	2.2E+47	0.000	1.5E+01	1	-1.5E+01	-1	3.2E+00	1	-3.2E+00	-0.99999	4.63E-04
Sz	6.00E+01	m	6	6	0.00188	-4.2E+00	1.5E-02	-2.2E+47	2.000	7.2E+00	1.3E+03	2.2E+47	0.000	1.4E+01	1	-1.4E+01	-1	2.9E+00	1	-2.9E+00	-0.99996	2.31E-04
Sy	4.00E+00	m	7	7	0.00188	-4.9E+00	7.7E-03	-2.2E+47	2.000	8.4E+00	4.3E+03	2.2E+47	0.000	1.3E+01	1	-1.3E+01	-1	2.7E+00	0.9998	-2.7E+00	-0.99984	1.15E-04
Kd	1.13E+02	l/kg	8	8	0.00188	-5.6E+00	3.8E-03	-2.2E+47	2.000	9.6E+00	1.4E+04	2.2E+47	0.000	1.2E+01	1	-1.2E+01	-1	2.5E+00	0.9996	-2.5E+00	-0.99959	5.75E-05
ρ	1.60E+00	g/cm3	9	9	0.00188	-6.3E+00	1.9E-03	-2.2E+47	2.000	1.1E+01	4.7E+04	2.2E+47	0.000	1.1E+01	1	-1.1E+01	-1	2.4E+00	0.9991	-2.4E+00	-0.99914	2.87E-05
n	3.70E-01		10	10	0.00188	-7.0E+00	9.5E-04	-2.2E+47	2.000	1.2E+01	1.6E+05	2.2E+47	0.000	1.1E+01	1	-1.1E+01	-1	2.2E+00	0.9984	-2.2E+00	-0.99843	1.43E-05
i	1.70E-03		11	11	0.00188	-7.7E+00	4.8E-04	-2.2E+47	2.000	1.3E+01	5.1E+05	2.2E+47	0.000	1.0E+01	1	-1.0E+01	-1	2.1E+00	0.9974	-2.1E+00	-0.99743	7.12E-06
K	3.02E-01	m/d	12	12	0.00188	-8.3E+00	2.4E-04	-2.2E+47	2.000	1.4E+01	1.7E+06	2.2E+47	0.000	9.7E+00	1	-9.7E+00	-1	2.0E+00	0.9961	-2.0E+00	-0.99611	3.55E-06
x	2.00E+01	m	13	13	0.00188	-9.0E+00	1.2E-04	-2.2E+47	2.000	1.6E+01	5.6E+06	2.2E+47	0.000	9.3E+00	1	-9.3E+00	-1	2.0E+00	0.9945	-2.0E+00	-0.99445	1.77E-06
z	0.00E+00	m	14	14	0.00188	-9.7E+00	5.9E-05	-2.2E+47	2.000	1.7E+01	1.9E+07	2.2E+47	0.000	9.0E+00	1	-9.0E+00	-1	1.9E+00	0.9925	-1.9E+00	-0.99247	8.79E-07
y	0.00E+00	m	15	15	0.00188	-1.0E+01	2.9E-05	-2.2E+47	2.000	1.8E+01	6.1E+07	2.2E+47	0.000	8.7E+00	1	-8.7E+00	-1	1.8E+00	0.9902	-1.8E+00	-0.99018	4.37E-07
t	9.90E+99	days	16	16	0.00188	-1.1E+01	1.5E-05	-2.2E+47	2.000	1.9E+01	2.0E+08	2.2E+47	0.000	8.4E+00	1	-8.4E+00	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	2.18E-07
ax	2.00E+00	m	17	17	0.00188	-1.2E+01	7.3E-06	-2.2E+47	2.000	2.0E+01	6.7E+08	2.2E+47	0.000	8.1E+00	1	-8.1E+00	-1	1.7E+00	0.9847	-1.7E+00	-0.98471	1.08E-07
az	2.00E-01	m	18	18	0.00188	-1.3E+01	3.7E-06	-2.2E+47	2.000	2.2E+01	2.2E+09	2.2E+47	0.000	7.9E+00	1	-7.9E+00	-1	1.7E+00	0.9816	-1.7E+00	-0.98158	5.38E-08
ay	2.00E-02	m	19	19	0.00188	-1.3E+01	1.8E-06	-2.2E+47	2.000	2.3E+01	7.3E+09	2.2E+47	0.000	7.7E+00	1	-7.7E+00	-1	1.6E+00	0.9782	-1.6E+00	-0.97822	2.68E-08
			20	20	0.00188	-1.4E+01	9.1E-07	-2.2E+47	2.000	2.4E+01	2.4E+10	2.2E+47	0.000	7.5E+00	1	-7.5E+00	-1	1.6E+00	0.9747	-1.6E+00	-0.97465	1.33E-08

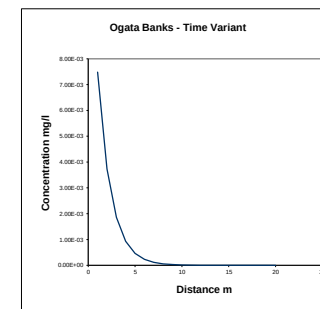
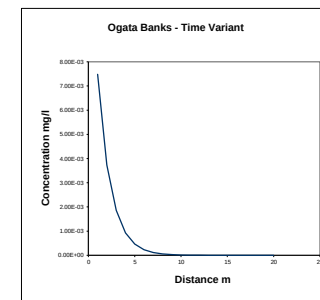
Vertical dispersion option Simulate vertical dispersion in 1 direction

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	1.39E-03	m/d																					
Rc	4.87E+02		1	1	0.00188	-7.0E-01	5.0E-01	-2.2E+47	2.000	1.2E+00	3.3E+00	2.2E+47	0.000	3.4E+01	1	-3.4E+01	-1	1.4E+01	1	-1.4E+01	-1	7.48E-03	
u	2.85E-06	m/d	2	2	0.00188	-1.4E+00	2.5E-01	-2.2E+47	2.000	2.4E+00	1.1E+01	2.2E+47	0.000	2.4E+01	1	-2.4E+01	-1	1.0E+01	1	-1.0E+01	-1	3.73E-03	
			3	3	0.00188	-2.1E+00	1.2E-01	-2.2E+47	2.000	3.6E+00	3.6E+01	2.2E+47	0.000	1.9E+01	1	-1.9E+01	-1	8.2E+00	1	-8.2E+00	-1	1.86E-03	
			4	4	0.00188	-2.8E+00	6.2E-02	-2.2E+47	2.000	4.8E+00	1.2E+02	2.2E+47	0.000	1.7E+01	1	-1.7E+01	-1	7.1E+00	1	-7.1E+00	-1	9.29E-04	
			5	5	0.00188	-3.5E+00	3.1E-02	-2.2E+47	2.000	6.0E+00	3.9E+02	2.2E+47	0.000	1.5E+01	1	-1.5E+01	-1	6.3E+00	1	-6.3E+00	-1	4.63E-04	
			6	6	0.00188	-4.2E+00	1.5E-02	-2.2E+47	2.000	7.2E+00	1.3E+03	2.2E+47	0.000	1.4E+01	1	-1.4E+01	-1	5.8E+00	1	-5.8E+00	-1	2.31E-04	
			7	7	0.00188	-4.9E+00	7.7E-03	-2.2E+47	2.000	8.4E+00	4.3E+03	2.2E+47	0.000	1.3E+01	1	-1.3E+01	-1	5.3E+00	1	-5.3E+00	-1	1.15E-04	
			8	8	0.00188	-5.6E+00	3.8E-03	-2.2E+47	2.000	9.6E+00	1.4E+04	2.2E+47	0.000	1.2E+01	1	-1.2E+01	-1	5.0E+00	1	-5.0E+00	-1	5.75E-05	
			9	9	0.00188	-6.3E+00	1.9E-03	-2.2E+47	2.000	1.1E+01	4.7E+04	2.2E+47	0.000	1.1E+01	1	-1.1E+01	-1	4.7E+00	1	-4.7E+00	-1	2.87E-05	
			10	10	0.00188	-7.0E+00	9.5E-04	-2.2E+47	2.000	1.2E+01	1.6E+05	2.2E+47	0.000	1.1E+01	1	-1.1E+01	-1	4.5E+00	1	-4.5E+00	-1	1.43E-05	
			11	11	0.00188	-7.7E+00	4.8E-04	-2.2E+47	2.000	1.3E+01	5.1E+05	2.2E+47	0.000	1.0E+01	1	-1.0E+01	-1	4.3E+00	1	-4.3E+00	-1	7.14E-06	
			12	12	0.00188	-8.3E+00	2.4E-04	-2.2E+47	2.000	1.4E+01	1.7E+06	2.2E+47	0.000	9.7E+00	1	-9.7E+00	-1	4.1E+00	1	-4.1E+00	-1	3.56E-06	
			13	13	0.00188	-9.0E+00	1.2E-04	-2.2E+47	2.000	1.6E+01	5.6E+06	2.2E+47	0.000	9.3E+00	1	-9.3E+00	-1	3.9E+00	1	-3.9E+00	-1	1.78E-06	
			14	14	0.00188	-9.7E+00	5.9E-05	-2.2E+47	2.000	1.7E+01	1.9E+07	2.2E+47	0.000	9.0E+00	1	-9.0E+00	-1	3.8E+00	1	-3.8E+00	-1	8.86E-07	
			15	15	0.00188	-1.0E+01	2.9E-05	-2.2E+47	2.000	1.8E+01	6.1E+07	2.2E+47	0.000	8.7E+00	1	-8.7E+00	-1	3.7E+00	1	-3.7E+00	-1	4.42E-07	
			16	16	0.00188	-1.1E+01	1.5E-05	-2.2E+47	2.000	1.9E+01	2.0E+08	2.2E+47	0.000	8.4E+00	1	-8.4E+00	-1	3.5E+00	1	-3.5E+00	-1	2.20E-07	
			17	17	0.00188	-1.2E+01	7.3E-06	-2.2E+47	2.000	2.0E+01	6.7E+08	2.2E+47	0.000	8.1E+00	1	-8.1E+00	-1	3.4E+00	1	-3.4E+00	-1	1.10E-07	
			18	18	0.00188	-1.3E+01	3.7E-06	-2.2E+47	2.000	2.2E+01	2.2E+09	2.2E+47	0.000	7.9E+00	1	-7.9E+00	-1	3.3E+00	1	-3.3E+00	-1	5.48E-08	
			19	19	0.00188	-1.3E+01	1.8E-06	-2.2E+47	2.000	2.3E+01	7.3E+09	2.2E+47	0.000	7.7E+00	1	-7.7E+00	-1	3.2E+00	1	-3.2E+00	-1	2.74E-08	
			20	20	0.00188	-1.4E+01	9.1E-07	-2.2E+47	2.000	2.4E+01	2.4E+10	2.2E+47	0.000	7.5E+00	1	-7.5E+00	-1	3.2E+00	1	-3.2E+00	-0.99999	1.36E-08	

Date: 21/06/2018

Version: 1.1

Date: 21/06/2018
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Contaminant I0-C12 aromatic

DOMENICO (STEADY STATE)

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	0.09	mg/l	1	1	0.00375	-6.96E-01	4.99E-01	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	7.48E-03
			2	2	0.00375	-1.39E+00	2.49E-01	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	3.73E-03
			3	3	0.00375	-2.09E+00	1.24E-01	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	1.86E-03
Co	1.50E-02	mg/l	4	4	0.00375	-2.78E+00	6.19E-02	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	9.29E-04
λ	4.74E-06	days ⁻¹	5	5	0.00375	-3.48E+00	3.09E-02	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	4.63E-04
Sz	6.00E+01	m	6	6	0.00375	-4.17E+00	1.54E-02	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	2.31E-04
Sy	4.00E+00	m	7	7	0.00375	-4.87E+00	7.68E-03	1.27E+01	1	-1.27E+01	-1	2.67E+00	1	-2.67E+00	-0.9998	1.15E-04
Kd	1.13E+02	l/kg	8	8	0.00375	-5.56E+00	3.83E-03	1.19E+01	1	-1.19E+01	-1	2.50E+00	1	-2.50E+00	-0.9996	5.75E-05
ρ	1.60E+00	g/cm3	9	9	0.00375	-6.26E+00	1.91E-03	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.999	-2.36E+00	-0.9991	2.87E-05
n	3.70E-01		10	10	0.00375	-6.96E+00	9.54E-04	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.998	-2.24E+00	-0.9984	1.43E-05
i	1.70E-03		11	11	0.00375	-7.65E+00	4.76E-04	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.997	-2.13E+00	-0.9974	7.12E-06
K	3.02E-01	m/d	12	12	0.00375	-8.35E+00	2.37E-04	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.996	-2.04E+00	-0.9961	3.55E-06
x	2.00E+01	m	13	13	0.00375	-9.04E+00	1.18E-04	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.994	-1.96E+00	-0.9945	1.77E-06
z	0.00E+00	m	14	14	0.00375	-9.74E+00	5.90E-05	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.992	-1.89E+00	-0.9925	8.79E-07
y	0.00E+00	m	15	15	0.00375	-1.04E+01	2.95E-05	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.99	-1.83E+00	-0.9902	4.37E-07
			16	16	0.00375	-1.11E+01	1.47E-05	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.988	-1.77E+00	-0.9876	2.18E-07
ax	2.00E+00	m	17	17	0.00375	-1.18E+01	7.33E-06	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.985	-1.71E+00	-0.9847	1.08E-07
az	2.00E-01	m	18	18	0.00375	-1.25E+01	3.66E-06	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.982	-1.67E+00	-0.9816	5.38E-08
ay	2.00E-02	m	19	19	0.00375	-1.32E+01	1.82E-06	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.978	-1.62E+00	-0.9782	2.68E-08
			20	20	0.00375	-1.39E+01	9.10E-07	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.975	-1.58E+00	-0.9747	1.33E-08

Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc

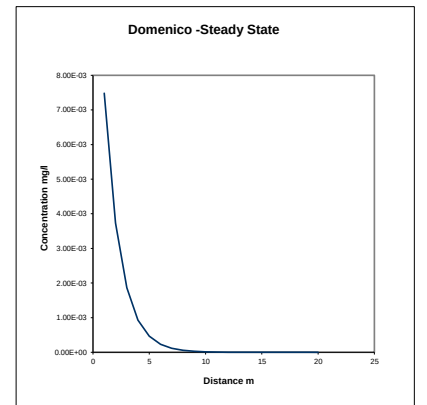
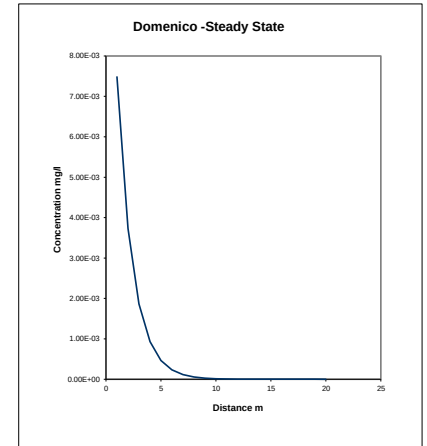
Value

DOMENICO (STEADY STATE)

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

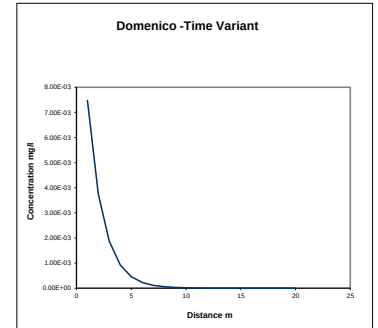
				X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
v Rc u	1.39E-03	m/d														
	4.87E+02															
	2.85E-06	m/d	1	1	0.00375	-6.96E-01	4.99E-01	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	7.48E-03
			2	2	0.00375	-1.39E+00	2.49E-01	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	3.73E-03
			3	3	0.00375	-2.09E+00	1.24E-01	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	1.86E-03
			4	4	0.00375	-2.78E+00	6.19E-02	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	9.29E-04
			5	5	0.00375	-3.48E+00	3.09E-02	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	4.63E-04
			6	6	0.00375	-4.17E+00	1.54E-02	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	2.31E-04
			7	7	0.00375	-4.87E+00	7.68E-03	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	1.15E-04
			8	8	0.00375	-5.56E+00	3.83E-03	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	5.75E-05
			9	9	0.00375	-6.26E+00	1.91E-03	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	2.87E-05
			10	10	0.00375	-6.96E+00	9.54E-04	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	1.43E-05
			11	11	0.00375	-7.65E+00	4.76E-04	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	7.14E-06
			12	12	0.00375	-8.35E+00	2.37E-04	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	3.56E-06
			13	13	0.00375	-9.04E+00	1.18E-04	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	1.78E-06
			14	14	0.00375	-9.74E+00	5.90E-05	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	8.86E-07
			15	15	0.00375	-1.04E+01	2.95E-05	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	4.42E-07
			16	16	0.00375	-1.11E+01	1.47E-05	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	2.20E-07
			17	17	0.00375	-1.18E+01	7.33E-06	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	1.10E-07
			18	18	0.00375	-1.25E+01	3.66E-06	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	5.48E-08
		19	19	0.00375	-1.32E+01	1.82E-06	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	2.74E-08	
		20	20	0.00375	-1.39E+01	9.10E-07	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	1.36E-08	
21/06/2018																
n:	1.1															

Date: 21/06/2018
Version: 1.1



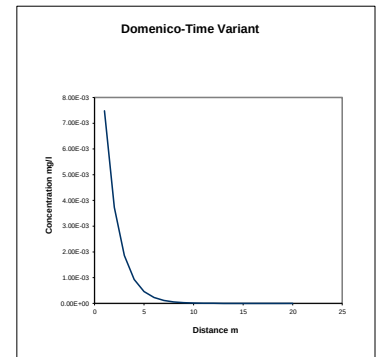
DOMENICO (TIME VARIANT)

Contaminant	10-C12 aromatic		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	0.09	mg/l	1	1	0.00188	-6.96E-01	4.99E-01	-2.25E+47	2	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	7.48E-03
			2	2	0.00188	-1.39E+00	2.49E-01	-2.25E+47	2	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	3.73E-03
			3	3	0.00188	-2.09E+00	1.24E-01	-2.25E+47	2	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	1.86E-03
Co	1.50E-02	mg/l	4	4	0.00188	-2.78E+00	6.19E-02	-2.25E+47	2	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	9.29E-04
λ	4.74E-06	days ⁻¹	5	5	0.00188	-3.48E+00	3.09E-02	-2.25E+47	2	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	4.63E-04
Sz	6.00E+01	m	6	6	0.00188	-4.17E+00	1.54E-02	-2.25E+47	2	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	2.31E-04
Sy	4.00E+00	m	7	7	0.00188	-4.87E+00	7.68E-03	-2.25E+47	2	1.27E+01	1	-1.27E+01	-1	2.67E+00	0.9998	-2.67E+00	-1	1.15E-04
Kd	1.13E+02	l/kg	8	8	0.00188	-5.56E+00	3.83E-03	-2.25E+47	2	1.19E+01	1	-1.19E+01	-1	2.50E+00	0.9996	-2.50E+00	-1	5.75E-05
ρ	1.60E+00	g/cm3	9	9	0.00188	-6.26E+00	1.91E-03	-2.25E+47	2	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.9991	-2.36E+00	-0.999	2.87E-05
n	3.70E-01		10	10	0.00188	-6.96E+00	9.54E-04	-2.25E+47	2	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.9984	-2.24E+00	-0.998	1.43E-05
i	1.70E-03		11	11	0.00188	-7.65E+00	4.76E-04	-2.25E+47	2	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.9974	-2.13E+00	-0.997	7.12E-06
K	3.02E-01	m/d	12	12	0.00188	-8.35E+00	2.37E-04	-2.25E+47	2	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.9961	-2.04E+00	-0.996	3.55E-06
x	2.00E+01	m	13	13	0.00188	-9.04E+00	1.18E-04	-2.25E+47	2	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.9945	-1.96E+00	-0.994	1.77E-06
z	0.00E+00	m	14	14	0.00188	-9.74E+00	5.90E-05	-2.25E+47	2	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.9925	-1.89E+00	-0.992	8.79E-07
y	0.00E+00	m	15	15	0.00188	-1.04E+01	2.95E-05	-2.25E+47	2	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.9902	-1.83E+00	-0.99	4.37E-07
t	9.90E+99	days	16	16	0.00188	-1.11E+01	1.47E-05	-2.25E+47	2	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.9876	-1.77E+00	-0.988	2.18E-07
ax	2.00E+00	m	17	17	0.00188	-1.18E+01	7.33E-06	-2.25E+47	2	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.9847	-1.71E+00	-0.985	1.08E-07
az	2.00E-01	m	18	18	0.00188	-1.25E+01	3.66E-06	-2.25E+47	2	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.9816	-1.67E+00	-0.982	5.38E-08
ay	2.00E-02	m	19	19	0.00188	-1.32E+01	1.82E-06	-2.25E+47	2	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.9782	-1.62E+00	-0.978	2.68E-08
			20	20	0.00188	-1.39E+01	9.10E-07	-2.25E+47	2	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.9747	-1.58E+00	-0.975	1.33E-08



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	1.39E-03	m/d																
Rc	4.87E+02		1	1	0.00188	-6.96E-01	4.99E-01	-2.25E+47	2	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	7.48E-03
u	2.85E-06	m/d	2	2	0.00188	-1.39E+00	2.49E-01	-2.25E+47	2	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	3.73E-03
			3	3	0.00188	-2.09E+00	1.24E-01	-2.25E+47	2	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	1.86E-03
			4	4	0.00188	-2.78E+00	6.19E-02	-2.25E+47	2	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	9.29E-04
			5	5	0.00188	-3.48E+00	3.09E-02	-2.25E+47	2	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	4.63E-04
			6	6	0.00188	-4.17E+00	1.54E-02	-2.25E+47	2	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	2.31E-04
			7	7	0.00188	-4.87E+00	7.68E-03	-2.25E+47	2	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	1.15E-04
			8	8	0.00188	-5.56E+00	3.83E-03	-2.25E+47	2	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	5.75E-05
			9	9	0.00188	-6.26E+00	1.91E-03	-2.25E+47	2	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	2.87E-05
			10	10	0.00188	-6.96E+00	9.54E-04	-2.25E+47	2	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	1.43E-05
			11	11	0.00188	-7.65E+00	4.76E-04	-2.25E+47	2	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	7.14E-06
			12	12	0.00188	-8.35E+00	2.37E-04	-2.25E+47	2	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	3.56E-06
			13	13	0.00188	-9.04E+00	1.18E-04	-2.25E+47	2	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	1.78E-06
			14	14	0.00188	-9.74E+00	5.90E-05	-2.25E+47	2	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	8.86E-07
			15	15	0.00188	-1.04E+01	2.95E-05	-2.25E+47	2	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	4.42E-07
			16	16	0.00188	-1.11E+01	1.47E-05	-2.25E+47	2	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	2.20E-07
			17	17	0.00188	-1.18E+01	7.33E-06	-2.25E+47	2	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	1.10E-07
			18	18	0.00188	-1.25E+01	3.66E-06	-2.25E+47	2	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	5.48E-08
	21/06/2018		19	19	0.00188	-1.32E+01	1.82E-06	-2.25E+47	2	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	2.74E-08
	1.1		20	20	0.00188	-1.39E+01	9.10E-07	-2.25E+47	2	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	1.36E-08



Date: 21/06/2018
Version: 1.1



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:	Portsman Way		
Site Address:	Reading		
Completed by:	PDM	Version:	1.1
Date:	21-Jun-18		
Contaminant	C8-C10 aliphatic		
Target Concentration (C_T)	3.00E-01	mg/l	Origin of C_T: WHO

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

C8-C10 aliphatic
0.3 mg/l

Input Parameters

Standard entry

Water filled soil porosity

θ_w

2.40E-01

fraction

calculated

Air filled soil porosity

θ_a

1.84E-01

fraction

calculated

Bulk density of soil zone material

ρ

1.60E+00

g/cm³

R & D Technical report sand fill

Henry's Law constant

H

8.00E+01

dimensionless

Total Petroleum Hydrocarbon Criteria Working Group

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 soil)

f_{oc}

4.50E-02

fraction

Site data

Organic carbon partition coefficient

K_{oc}

3.20E+04

l/kg

CLAIRE 2017 Hydrocarbons in Groundwater

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

1.44E+03

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

4.35E+02

mg/kg

(for comparison with soil analyses)

or

0.3

mg/l

(for comparison with leachate test results)

Site being assessed: Portsman Way

Completed by: PDM

Date: 21-Jun-18

Version: 1.1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

C8-C10 aliphatic
0.3

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
Area of contaminant source

Inf
A

4.40E-04
1.50E+02

m/d
m²

96-2000 30% pf values River Thames at Reading 70%
Area of boiler house and tank farm

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow
Saturated aquifer thickness
Hydraulic Conductivity of aquifer in which dilution occurs
Hydraulic gradient of water table
Width of contaminant source perpendicular to groundwater flow
Background concentration of contaminant in groundwater beneath site

L
da
K
i
w
Cu

3.00E+01
8.00E+01
3.02E-01
1.70E-03
6.00E+01
0.00E+00

m
m
m/d
fraction
m
mg/l

Width of source area between PH3 and PH6
assumed vale to base of chalk
Consim average HC for gravel
site data
Length of source area between PH2 and PH6
Estimated

Not used in calculation

Define mixing zone depth by specifying or calculating depth (using pull down list)

Enter mixing zone thickness
Calculated mixing zone thickness

Mz
Mz

Calculate
2.51E+01

m
m

Calculated Parameters

Dilution Factor DF

1.98E+00

Level 2 Remedial Target

5.94E-01
or
8.60E+02
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)

C_c

0.00E+00

mg/l

Calculated concentration within receptor (dilution only)

0.00E+00

mg/l

0

Site being assessed: Portsman Way
Completed by: PDM
Date: 21-Jun-18
Version: 1.1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

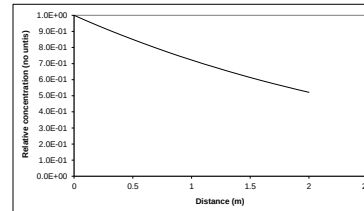
See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		C8-C10 aliphatic		from Level 1
Target Concentration	C _t	0.3	mg/l	from Level 1
Dilution Factor	DF	1.98E+00		from Level 2

Enter method of defining partition co-efficient (using pull down list)
Calculate for non-polar organic chemicals

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	4.50E-02 fraction
Organic carbon partition coefficient	Koc	3.20E+04 l/kg
Entry for ionic organic chemicals (option)		
Sorption coefficient for related species	K _{oc,li}	
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	1.44E+03 l/kg



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	Relative concentration	Concentration
Distance	(No units)	mg/l
0	1.0E+00	3.14E-03
0.1	9.68E-01	3.04E-03
0.2	9.37E-01	2.94E-03
0.3	9.07E-01	2.85E-03
0.4	8.78E-01	2.75E-03
0.5	8.50E-01	2.67E-03
0.6	8.23E-01	2.58E-03
0.7	7.96E-01	2.50E-03
0.8	7.71E-01	2.42E-03
0.9	7.46E-01	2.34E-03
1.0	7.22E-01	2.27E-03
1.1	6.99E-01	2.19E-03
1.2	6.77E-01	2.12E-03
1.3	6.55E-01	2.06E-03
1.4	6.34E-01	1.99E-03
1.5	6.14E-01	1.93E-03
1.6	5.94E-01	1.86E-03
1.7	5.75E-01	1.80E-03
1.8	5.57E-01	1.75E-03
1.9	5.39E-01	1.69E-03
2.0	5.22E-01	1.64E-03

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 dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Enter source concentration			
Enter soil concentration	9	mg/kg	Soil concentration as mg/kg
Half life for degradation of contaminant in water	7.12E+02	days	Canada Wide Standards for PHC in Soils
Calculated decay rate	9.74E-04	days ⁻¹	calculated
Width of plume in aquifer at source	6.00E+01	m	from Level 2
Plume thickness in aquifer at source	2.51E+01	m	from Level 2
Bulk density of aquifer materials	1.60E+00	g/cm ³	R & D Technical Report P13
Effective porosity of aquifer	3.70E-01	fraction	Consim
Hydraulic gradient	3.44E-03	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	3.02E-01	m/d	from Level 2
Distance to compliance point	2.00E+00	m	Estimated Depth to water table
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	1.44E+03	l/kg see options
Longitudinal dispersivity	ax	0.200	m see options
Transverse dispersivity	az	0.020	m see options
Vertical dispersivity	av	0.002	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	2.81E-03	m/d
Retardation factor	6.23E+03	fraction
Decay rate used	1.56E-07	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	3.44E-03	fraction
Rate of contaminant flow due to retardation	4.51E-07	m/d
Ratio of Compliance Point to Source Concentration	C ₁₀ /C ₀	fraction
Attenuation factor (C ₀ /C ₁₀)	AF	1.92E+00
Calculated soil leachate concentration	Co	6.21E-03

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

Xu & Eckstein (1995) report ax = 0.83(log₁₀)^{0.414}; az = ax/10, ay = ax/100 are assumed

Enter value

Calc value

Xu & Eckstein

ax

az

ay

0.00E+00

2.00E-01

4.58E-02

0.00E+00

2.00E-02

4.58E-03

0.00E+00

2.00E-03

4.58E-04

Remedial Targets

Level 3 Remedial Target	1.14E+00	mg/l	For comparison with measured pore water concentration.
Ogata Banks	1.65E+03	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2	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 ₁₀ /C ₀	5.22E-01	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

Site being assessed:	Portman Way
Completed by:	PDM
Date:	#####
Version:	1.1

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters
Soil contaminant concentration C_0 2.00E-01 mg/kg

Level 1 Parameters

Water filled soil porosity	θ_w	2.40E-01	fraction
Air filled soil porosity	θ_a	1.84E-01	fraction
Bulk density	ρ	1.60E+00	g/cm ³
Henry's Law constant	H	8.00E+01	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	1.44E+03	l/kg
Factor (partitioning between soil and water)		1.45E+03	dimensionless

Level 2 Parameters

Dilution Factor DF 1.98E+00

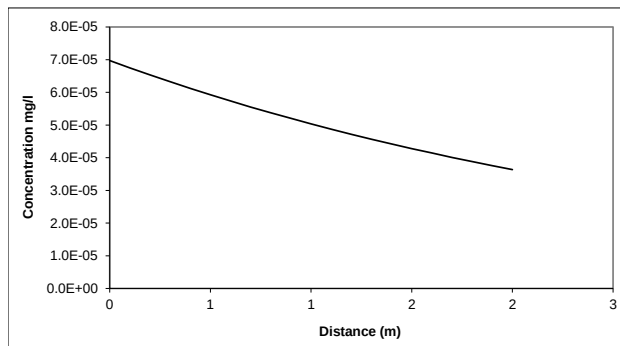
Level 3 Parameters

Attenuation factor (C_0/C_{ED}) AF 1.92E+00

Predicted concentrations at compliance point

Level 1	C	1.38E-04 mg/l	No dilution or attenuation
Level 2	C	6.97E-05 mg/l	Dilution taken into account
Level 3	C	3.64E-05 mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	6.97E-05
0.10	6.75E-05
0.20	6.53E-05
0.30	6.32E-05
0.40	6.12E-05
0.50	5.93E-05
0.60	5.74E-05
0.70	5.55E-05
0.80	5.37E-05
0.90	5.20E-05
1.00	5.04E-05
1.10	4.87E-05
1.20	4.72E-05
1.30	4.57E-05
1.40	4.42E-05
1.50	4.28E-05
1.60	4.14E-05
1.70	4.01E-05
1.80	3.88E-05
1.90	3.76E-05
2.00	3.64E-05

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	C8-C10 aliphatic		from Level 1
Target Concentration	C _T	3.00E-01	mg/l from Level 1

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

Ogata Banks	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	8.00E-03	mg/l Site data
Half life for degradation of contaminant in water	t _{1/2}	7.12E+02	days Canada Wide Standards for PHC in Soils
Calculated decay rate	λ	9.74E-04	days ⁻¹ Estimated from site data
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.00E+01	m to top of chalk
Plume thickness at source	Sy	4.00E+00	m Estimated from site data
Saturated aquifer thickness	da	8.00E+01	m Estimated from site data
Bulk density of aquifer materials	p	1.80E+00	g/cm ³ Consum
Effective porosity of aquifer	n	3.70E-01	fraction Consum
Hydraulic gradient	i	1.70E-03	fraction Estimate from site data
Hydraulic conductivity of aquifer	K	3.02E-01	m/d Site data
Distance to compliance point	x	2.00E+01	m Distance to site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m
Time since pollutant entered groundwater	t	9.90E+99	days time variant options only

Parameters values determined from options

Partition coefficient	Kd	1.44E+03	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	1.39E-03 m/d
Retardation factor	Rf	6.23E+03
Decay rate used	λ	1.56E-07 d ⁻¹
Rate of contaminant flow due to retardation	u	2.23E-07 m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	3.12E-06 mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	2.57E+03

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

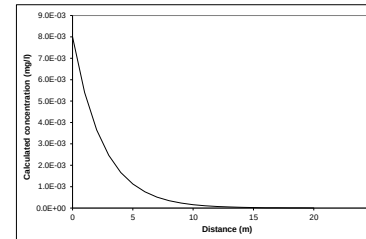
Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)	Kd		l/kg
Soil water partition coefficient	K _d		l/kg
Entry for non-polar organic chemicals (option)	f _{oc}	4.50E-02	fraction
Fraction of organic carbon in aquifer	K _{oc}	3.20E+04	l/kg
Organic carbon partition coefficient	K _{oc,n}		l/kg
Entry for ionic organic chemicals (option)	K _{oc,i}		l/kg
Sorption coefficient for related species	pH		l/kg
Sorption coefficient for ionised species	pKa		l/kg
pH value	f _{oc}		fraction
acid dissociation constant	K _d	1.44E+03	l/kg
Fraction of organic carbon in aquifer			
Soil water partition coefficient			

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	ax	0.00E+00	2.00E+00	1.57E+01
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 ax = 0.1 * x, az = 0.01 * x, ay = 0.001 * x				
Xu & Eckstein (1995) report ax = 0.83(log ₁₀ x) ^{-0.14} , 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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet
Distance Concentration

Distance	Concentration
0	8.0E-03
1.0	5.40E-03
2.0	3.65E-03
3.0	2.46E-03
4.0	1.66E-03
5.0	1.12E-03
6.0	7.59E-04
7.0	5.13E-04
8.0	3.46E-04
9.0	2.34E-04
10.0	1.58E-04
11.0	1.07E-04
12.0	7.20E-05
13.0	4.86E-05
14.0	3.28E-05
15.0	2.22E-05
16.0	1.50E-05
17.0	1.01E-05
18.0	6.83E-06
19.0	4.61E-06
20.0	3.12E-06

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:	Portsmouth Way
Completed by:	PDM
Date:	20/07/2018
Version:	1.1

Remedial Targets

Remedial Target	7.70E+02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	3.12E-06	mg/l Ogata Banks
		9.9E+99	days

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	15.00	% wt	(Change this number only if you have specific information)
Particle Density	2.78	tonnes/m ³	
Dry Bulk Density	1.60	tonnes/m ³	
Calculated Parameters			
Voids Ratio	0.74	fraction	
Initial Saturation	56.54	%	
Total porosity	0.424	fraction	
Air Filled Porosity	0.184	fraction	
Water Filled Porosity	0.240	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	1.000	fraction	#DIV/0!
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

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 C8-C10 aliphatic

Parameter	Value	Units	Calculations (Refer to Table 4.3, R&D Publication 20)		
(carried over from input sheet)			Selected option	Calculate for non-polar organic chemicals	
			calc	calc	Calc Kd l/kg
C _T	3.00E-01	mg/l	Calculation of partition coefficient		
Kd	1.44E+03	l/kg	for ionic organic chemical		
foc	4.50E-02	fraction			
koc	3.20E+04	l/kg	Partition coefficient used in Level 1 Assessment		
θ _w	2.40E-01	fraction	1.44E+03 l/kg		
θ _a	1.84E-01	fraction			
ρ	1.60E+00	g/cm ³			
H	8.00E+01	dimensionless	Factor (partitioning between soil and water)		
Koc,n		l/kg			
Koc,i		l/kg			
pH		pH units			
pKa					
foc (ionic)		fraction			
			Calculated Remedial Target 4.35E+02 mg/kg for C8-C10 aliphatic		
			Site being assessed: Portsman Way Completed by: PDM Date: 21/06/2018 Version: 1.1		

Level 2 Calculation Sheet

Contaminant C8-C10 aliphatic

Site assessed:	Portsman Wa
Date:	21/06/2018
Version:	1.1

Parameter Value Units
(carried over from input sheet)

Mz	2.51E+01	m
L	3.00E+01	m
da	8.00E+01	m
Inf	4.40E-04	m/d
K	3.02E-01	m/d
i	1.70E-03	m3/d
A	1.50E+02	m2
Cc	0.00E+00	mg/l
C _T	3.00E-01	mg/l
Cu	0.00E+00	mg/l
w	6.00E+01	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Calculated
Dilution Factor

1.98E+00

#DIV/0!



Ogata Banks - Time Variant

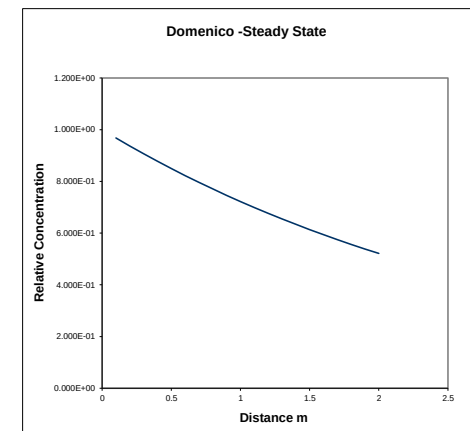
Distance m	Relative Concentration
0.1	0.95
0.5	0.75
1.0	0.65
1.5	0.55
2.0	0.50

Contaminant 8-C10 aliphatic

DOMENICO (STEADY STATE)

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	3.000E-01	mg/l	1	0.1	0.25	-3.25E-02	9.68E-01	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.680E-01
DF	1.979E+00		2	0.2	0.25	-6.51E-02	9.37E-01	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	9.370E-01
			3	0.3	0.25	-9.76E-02	9.07E-01	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	9.070E-01
			4	0.4	0.25	-1.30E-01	8.78E-01	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	8.779E-01
λ	1.563E-07	days ⁻¹	5	0.5	0.25	-1.63E-01	8.50E-01	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	8.498E-01
Sz	6.000E+01	m	6	0.6	0.25	-1.95E-01	8.23E-01	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	8.226E-01
Sy	2.514E+01	m	7	0.7	0.25	-2.28E-01	7.96E-01	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	7.963E-01
Kd	1.440E+03	l/kg	8	0.8	0.25	-2.60E-01	7.71E-01	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	7.708E-01
ρ	1.600E+00	g/cm3	9	0.9	0.25	-2.93E-01	7.46E-01	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	7.461E-01
n	3.700E-01		10	1	0.25	-3.25E-01	7.22E-01	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	7.222E-01
i	3.436E-03		11	1.1	0.25	-3.58E-01	6.99E-01	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	6.991E-01
K	3.024E-01	m/d	12	1.2	0.25	-3.91E-01	6.77E-01	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	6.767E-01
x	2.000E+00	m	13	1.3	0.25	-4.23E-01	6.55E-01	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	6.550E-01
z	0.000E+00	m	14	1.4	0.25	-4.56E-01	6.34E-01	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	6.341E-01
y	0.000E+00	m	15	1.5	0.25	-4.88E-01	6.14E-01	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	6.138E-01
ax	2.000E-01	m	16	1.6	0.25	-5.21E-01	5.94E-01	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	5.941E-01
az	2.000E-02	m	17	1.7	0.25	-5.53E-01	5.75E-01	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	5.751E-01
ay	2.000E-03	m	18	1.8	0.25	-5.86E-01	5.57E-01	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	5.567E-01
			19	1.9	0.25	-6.18E-01	5.39E-01	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	5.388E-01
			20	2	0.25	-6.51E-01	5.22E-01	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	5.216E-01



Calc

Value

DOMENICO (STEADY STATE)

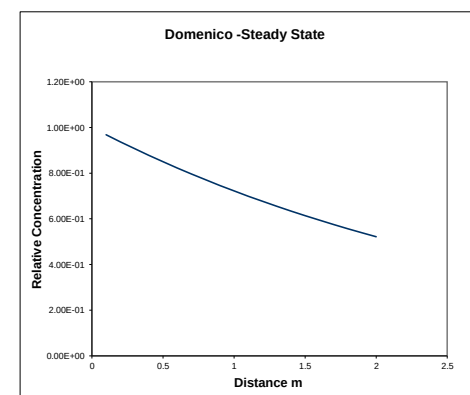
Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	2.81E-03	m/d	X		Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
Rc	6.23E+03															
u	4.51E-07	m/d	1	0.1	0.25	-3.25E-02	9.68E-01	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.68E-01
			2	0.2	0.25	-6.51E-02	9.37E-01	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	9.37E-01
			3	0.3	0.25	-9.76E-02	9.07E-01	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	9.07E-01
			4	0.4	0.25	-1.30E-01	8.78E-01	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	8.78E-01
			5	0.5	0.25	-1.63E-01	8.50E-01	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	8.50E-01
			6	0.6	0.25	-1.95E-01	8.23E-01	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	8.23E-01
			7	0.7	0.25	-2.28E-01	7.96E-01	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	7.96E-01
			8	0.8	0.25	-2.60E-01	7.71E-01	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	7.71E-01
			9	0.9	0.25	-2.93E-01	7.46E-01	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	7.46E-01
			10	1	0.25	-3.25E-01	7.22E-01	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	7.22E-01
			11	1.1	0.25	-3.58E-01	6.99E-01	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	6.99E-01
			12	1.2	0.25	-3.91E-01	6.77E-01	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	6.77E-01
			13	1.3	0.25	-4.23E-01	6.55E-01	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	6.55E-01
			14	1.4	0.25	-4.56E-01	6.34E-01	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	6.34E-01
			15	1.5	0.25	-4.88E-01	6.14E-01	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	6.14E-01
			16	1.6	0.25	-5.21E-01	5.94E-01	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	5.94E-01
			17	1.7	0.25	-5.53E-01	5.75E-01	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	5.75E-01
			18	1.8	0.25	-5.86E-01	5.57E-01	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	5.57E-01
			19	1.9	0.25	-6.18E-01	5.39E-01	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	5.39E-01
			20	2	0.25	-6.51E-01	5.22E-01	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	5.22E-01

21/06/2018

1.1

Relative Concentration



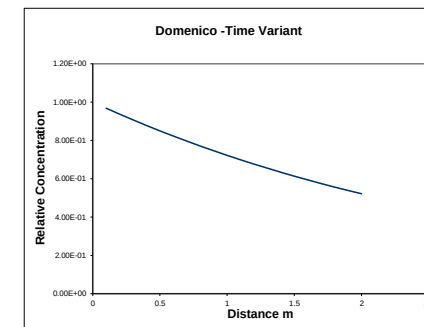
Date: 21/06/2018
Version: 1.1

DOMENICO (TIME VARIANT)

Contaminant :8-C10 aliphatic

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	0.3	mg/l	1	0.1	0.125	-3.25E-02	9.68E-01	-2.68E+46	2	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.68E-01
DF	1.9790		2	0.2	0.125	-6.51E-02	9.37E-01	-2.68E+46	2	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	9.37E-01
			3	0.3	0.125	-9.76E-02	9.07E-01	-2.68E+46	2	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	9.07E-01
			4	0.4	0.125	-1.30E-01	8.78E-01	-2.68E+46	2	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	8.78E-01
λ	1.563E-07	days ⁻¹	5	0.5	0.125	-1.63E-01	8.50E-01	-2.68E+46	2	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	8.50E-01
Sz	6.000E+01	m	6	0.6	0.125	-1.95E-01	8.23E-01	-2.68E+46	2	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	8.23E-01
Sy	2.514E+01	m	7	0.7	0.125	-2.28E-01	7.96E-01	-2.68E+46	2	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	7.96E-01
Kd	1.440E+03	l/kg	8	0.8	0.125	-2.60E-01	7.71E-01	-2.68E+46	2	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	7.71E-01
ρ	1.600E+00	g/cm3	9	0.9	0.125	-2.93E-01	7.46E-01	-2.68E+46	2	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	7.46E-01
n	3.700E-01		10	1	0.125	-3.25E-01	7.22E-01	-2.68E+46	2	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	7.22E-01
i	3.436E-03		11	1.1	0.125	-3.58E-01	6.99E-01	-2.68E+46	2	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	6.99E-01
K	3.024E-01	m/d	12	1.2	0.125	-3.91E-01	6.77E-01	-2.68E+46	2	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	6.77E-01
x	2.000E+00	m	13	1.3	0.125	-4.23E-01	6.55E-01	-2.68E+46	2	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	6.55E-01
z	0.000E+00	m	14	1.4	0.125	-4.56E-01	6.34E-01	-2.68E+46	2	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	6.34E-01
y	0.000E+00	m	15	1.5	0.125	-4.88E-01	6.14E-01	-2.68E+46	2	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	6.14E-01
t	1.000E+99	days	16	1.6	0.125	-5.21E-01	5.94E-01	-2.68E+46	2	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	5.94E-01
ax	2.000E-01	m	17	1.7	0.125	-5.53E-01	5.75E-01	-2.68E+46	2	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	5.75E-01
az	2.000E-02	m	18	1.8	0.125	-5.86E-01	5.57E-01	-2.68E+46	2	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	5.57E-01
ay	2.000E-03	m	19	1.9	0.125	-6.18E-01	5.39E-01	-2.68E+46	2	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	5.39E-01
			20	2	0.125	-6.51E-01	5.22E-01	-2.68E+46	2	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	5.22E-01

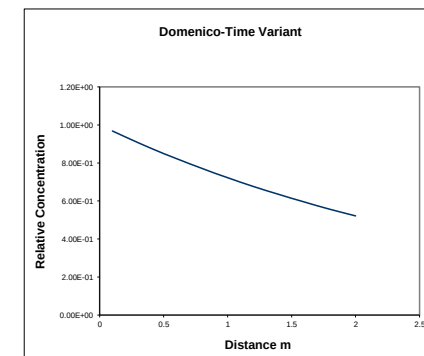


Calc

Value

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

			Calculations for sources located at top of aquifer (for vertical dispersion in the direction of flow)															Relative Concentration
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF		
v	2.81E-03	m/d	m															
Rc	6.23E+03		1	0.1	0.125	-3.25E-02	9.68E-01	-2.68E+46	2	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.68E-01
u	4.51E-07	m/d	2	0.2	0.125	-6.51E-02	9.37E-01	-2.68E+46	2	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	9.37E-01
			3	0.3	0.125	-9.76E-02	9.07E-01	-2.68E+46	2	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	9.07E-01
			4	0.4	0.125	-1.30E-01	8.78E-01	-2.68E+46	2	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	8.78E-01
			5	0.5	0.125	-1.63E-01	8.50E-01	-2.68E+46	2	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	8.50E-01
			6	0.6	0.125	-1.95E-01	8.23E-01	-2.68E+46	2	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	8.23E-01
			7	0.7	0.125	-2.28E-01	7.96E-01	-2.68E+46	2	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	7.96E-01
			8	0.8	0.125	-2.60E-01	7.71E-01	-2.68E+46	2	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	7.71E-01
			9	0.9	0.125	-2.93E-01	7.46E-01	-2.68E+46	2	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	7.46E-01
			10	1	0.125	-3.25E-01	7.22E-01	-2.68E+46	2	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	7.22E-01
			11	1.1	0.125	-3.58E-01	6.99E-01	-2.68E+46	2	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	6.99E-01
			12	1.2	0.125	-3.91E-01	6.77E-01	-2.68E+46	2	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	6.77E-01
			13	1.3	0.125	-4.23E-01	6.55E-01	-2.68E+46	2	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	6.55E-01
			14	1.4	0.125	-4.56E-01	6.34E-01	-2.68E+46	2	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	6.34E-01
			15	1.5	0.125	-4.88E-01	6.14E-01	-2.68E+46	2	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	6.14E-01
			16	1.6	0.125	-5.21E-01	5.94E-01	-2.68E+46	2	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	5.94E-01
			17	1.7	0.125	-5.53E-01	5.75E-01	-2.68E+46	2	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	5.75E-01
			18	1.8	0.125	-5.86E-01	5.57E-01	-2.68E+46	2	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	5.57E-01
			19	1.9	0.125	-6.18E-01	5.39E-01	-2.68E+46	2	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	5.39E-01
			20	2	0.125	-6.51E-01	5.22E-01	-2.68E+46	2	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	5.22E-01
Date: 21/06/2018																		
Version: 1.1																		



Date: 21/06/2018
Version: 1.1

OGATA BANKS SOLUTION																						
Contaminant	C8-C10 aliphatic		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	0.3	mg/l	1	1	0.001	-3.9E-01	6.8E-01	-4.3E+46	2.000	8.9E-01	2.4E+00	4.3E+46	0.000	3.4E+01	1	-3.4E+01	-1	7.1E+00	1	-7.1E+00	-1	5.40E-03
			2	2	0.001	-7.9E-01	4.6E-01	-4.3E+46	2.000	1.8E+00	6.0E+00	4.3E+46	0.000	2.4E+01	1	-2.4E+01	-1	5.0E+00	1	-5.0E+00	-1	3.65E-03
			3	3	0.001	-1.2E+00	3.1E-01	-4.3E+46	2.000	2.7E+00	1.5E+01	4.3E+46	0.000	1.9E+01	1	-1.9E+01	-1	4.1E+00	1	-4.1E+00	-1	2.46E-03
Co	8.00E-03	mg/l	4	4	0.001	-1.6E+00	2.1E-01	-4.3E+46	2.000	3.6E+00	3.6E+01	4.3E+46	0.000	1.7E+01	1	-1.7E+01	-1	3.5E+00	1	-3.5E+00	-1	1.66E-03
λ	1.56E-07	days ⁻¹	5	5	0.001	-2.0E+00	1.4E-01	-4.3E+46	2.000	4.5E+00	8.7E+01	4.3E+46	0.000	1.5E+01	1	-1.5E+01	-1	3.2E+00	1	-3.2E+00	-0.99999	1.12E-03
Sz	6.00E+01	m	6	6	0.001	-2.4E+00	9.5E-02	-4.3E+46	2.000	5.4E+00	2.1E+02	4.3E+46	0.000	1.4E+01	1	-1.4E+01	-1	2.9E+00	1	-2.9E+00	-0.99996	7.59E-04
Sy	4.00E+00	m	7	7	0.001	-2.7E+00	6.4E-02	-4.3E+46	2.000	6.2E+00	5.2E+02	4.3E+46	0.000	1.3E+01	1	-1.3E+01	-1	2.7E+00	0.9998	-2.7E+00	-0.99984	5.12E-04
Kd	1.44E+03	l/kg	8	8	0.001	-3.1E+00	4.3E-02	-4.3E+46	2.000	7.1E+00	1.3E+03	4.3E+46	0.000	1.2E+01	1	-1.2E+01	-1	2.5E+00	0.9996	-2.5E+00	-0.99959	3.46E-04
ρ	1.60E+00	g/cm3	9	9	0.001	-3.5E+00	2.9E-02	-4.3E+46	2.000	8.0E+00	3.1E+03	4.3E+46	0.000	1.1E+01	1	-1.1E+01	-1	2.4E+00	0.9991	-2.4E+00	-0.99914	2.34E-04
n	3.70E-01		10	10	0.001	-3.9E+00	2.0E-02	-4.3E+46	2.000	8.9E+00	7.5E+03	4.3E+46	0.000	1.1E+01	1	-1.1E+01	-1	2.2E+00	0.9984	-2.2E+00	-0.99843	1.58E-04
i	1.70E-03		11	11	0.001	-4.3E+00	1.3E-02	-4.3E+46	2.000	9.8E+00	1.8E+04	4.3E+46	0.000	1.0E+01	1	-1.0E+01	-1	2.1E+00	0.9974	-2.1E+00	-0.99743	1.06E-04
K	3.02E-01	m/d	12	12	0.001	-4.7E+00	9.0E-03	-4.3E+46	2.000	1.1E+01	4.5E+04	4.3E+46	0.000	9.7E+00	1	-9.7E+00	-1	2.0E+00	0.9961	-2.0E+00	-0.99611	7.17E-05
x	2.00E+01	m	13	13	0.001	-5.1E+00	6.1E-03	-4.3E+46	2.000	1.2E+01	1.1E+05	4.3E+46	0.000	9.3E+00	1	-9.3E+00	-1	2.0E+00	0.9945	-2.0E+00	-0.99445	4.84E-05
z	0.00E+00	m	14	14	0.001	-5.5E+00	4.1E-03	-4.3E+46	2.000	1.2E+01	2.7E+05	4.3E+46	0.000	9.0E+00	1	-9.0E+00	-1	1.9E+00	0.9925	-1.9E+00	-0.99247	3.26E-05
y	0.00E+00	m	15	15	0.001	-5.9E+00	2.8E-03	-4.3E+46	2.000	1.3E+01	6.5E+05	4.3E+46	0.000	8.7E+00	1	-8.7E+00	-1	1.8E+00	0.9902	-1.8E+00	-0.99018	2.20E-05
t	9.90E+99	days	16	16	0.001	-6.3E+00	1.9E-03	-4.3E+46	2.000	1.4E+01	1.6E+06	4.3E+46	0.000	8.4E+00	1	-8.4E+00	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	1.48E-05
ax	2.00E+00	m	17	17	0.001	-6.7E+00	1.3E-03	-4.3E+46	2.000	1.5E+01	3.9E+06	4.3E+46	0.000	8.1E+00	1	-8.1E+00	-1	1.7E+00	0.9847	-1.7E+00	-0.98471	9.96E-06
az	2.00E-01	m	18	18	0.001	-7.1E+00	8.5E-04	-4.3E+46	2.000	1.6E+01	9.5E+06	4.3E+46	0.000	7.9E+00	1	-7.9E+00	-1	1.7E+00	0.9816	-1.7E+00	-0.98158	6.71E-06
ay	2.00E-02	m	19	19	0.001	-7.5E+00	5.8E-04	-4.3E+46	2.000	1.7E+01	2.3E+07	4.3E+46	0.000	7.7E+00	1	-7.7E+00	-1	1.6E+00	0.9782	-1.6E+00	-0.97822	4.51E-06
			20	20	0.001	-7.9E+00	3.9E-04	-4.3E+46	2.000	1.8E+01	5.7E+07	4.3E+46	0.000	7.5E+00	1	-7.5E+00	-1	1.6E+00	0.9747	-1.6E+00	-0.97465	3.04E-06

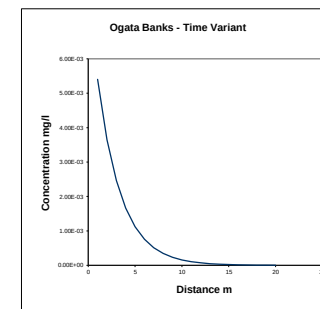
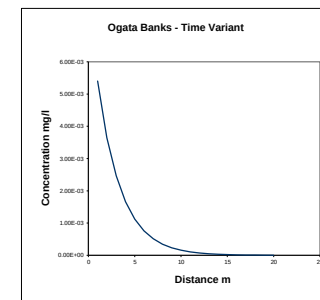
Vertical dispersion option Simulate vertical dispersion in 1 direction

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	1.39E-03	m/d	1	1	0.001	-3.9E-01	6.8E-01	-4.3E+46	2.000	8.9E-01	2.4E+00	4.3E+46	0.000	3.4E+01	1	-3.4E+01	-1	1.4E+01	1	-1.4E+01	-1	5.40E-03
Rc	6.23E+03	m/d	2	2	0.001	-7.9E-01	4.6E-01	-4.3E+46	2.000	1.8E+00	6.0E+00	4.3E+46	0.000	2.4E+01	1	-2.4E+01	-1	1.0E+01	1	-1.0E+01	-1	3.65E-03
u	2.23E-07		3	3	0.001	-1.2E+00	3.1E-01	-4.3E+46	2.000	2.7E+00	1.5E+01	4.3E+46	0.000	1.9E+01	1	-1.9E+01	-1	8.2E+00	1	-8.2E+00	-1	2.46E-03
			4	4	0.001	-1.6E+00	2.1E-01	-4.3E+46	2.000	3.6E+00	3.6E+01	4.3E+46	0.000	1.7E+01	1	-1.7E+01	-1	7.1E+00	1	-7.1E+00	-1	1.66E-03
			5	5	0.001	-2.0E+00	1.4E-01	-4.3E+46	2.000	4.5E+00	8.7E+01	4.3E+46	0.000	1.5E+01	1	-1.5E+01	-1	6.3E+00	1	-6.3E+00	-1	1.12E-03
			6	6	0.001	-2.4E+00	9.5E-02	-4.3E+46	2.000	5.4E+00	2.1E+02	4.3E+46	0.000	1.4E+01	1	-1.4E+01	-1	5.8E+00	1	-5.8E+00	-1	7.59E-04
			7	7	0.001	-2.7E+00	6.4E-02	-4.3E+46	2.000	6.2E+00	5.2E+02	4.3E+46	0.000	1.3E+01	1	-1.3E+01	-1	5.3E+00	1	-5.3E+00	-1	5.13E-04
			8	8	0.001	-3.1E+00	4.3E-02	-4.3E+46	2.000	7.1E+00	1.3E+03	4.3E+46	0.000	1.2E+01	1	-1.2E+01	-1	5.0E+00	1	-5.0E+00	-1	3.46E-04
			9	9	0.001	-3.5E+00	2.9E-02	-4.3E+46	2.000	8.0E+00	3.1E+03	4.3E+46	0.000	1.1E+01	1	-1.1E+01	-1	4.7E+00	1	-4.7E+00	-1	2.34E-04
			10	10	0.001	-3.9E+00	2.0E-02	-4.3E+46	2.000	8.9E+00	7.5E+03	4.3E+46	0.000	1.1E+01	1	-1.1E+01	-1	4.5E+00	1	-4.5E+00	-1	1.58E-04
			11	11	0.001	-4.3E+00	1.3E-02	-4.3E+46	2.000	9.8E+00	1.8E+04	4.3E+46	0.000	1.0E+01	1	-1.0E+01	-1	4.3E+00	1	-4.3E+00	-1	1.07E-04
			12	12	0.001	-4.7E+00	9.0E-03	-4.3E+46	2.000	1.1E+01	4.5E+04	4.3E+46	0.000	9.7E+00	1	-9.7E+00	-1	4.1E+00	1	-4.1E+00	-1	7.20E-05
			13	13	0.001	-5.1E+00	6.1E-03	-4.3E+46	2.000	1.2E+01	1.1E+05	4.3E+46	0.000	9.3E+00	1	-9.3E+00	-1	3.9E+00	1	-3.9E+00	-1	4.86E-05
			14	14	0.001	-5.5E+00	4.1E-03	-4.3E+46	2.000	1.2E+01	2.7E+05	4.3E+46	0.000	9.0E+00	1	-9.0E+00	-1	3.8E+00	1	-3.8E+00	-1	3.28E-05
			15	15	0.001	-5.9E+00	2.8E-03	-4.3E+46	2.000	1.3E+01	6.5E+05	4.3E+46	0.000	8.7E+00	1	-8.7E+00	-1	3.7E+00	1	-3.7E+00	-1	2.22E-05
			16	16	0.001	-6.3E+00	1.9E-03	-4.3E+46	2.000	1.4E+01	1.6E+06	4.3E+46	0.000	8.4E+00	1	-8.4E+00	-1	3.5E+00	1	-3.5E+00	-1	1.50E-05
			17	17	0.001	-6.7E+00	1.3E-03	-4.3E+46	2.000	1.5E+01	3.9E+06	4.3E+46	0.000	8.1E+00	1	-8.1E+00	-1	3.4E+00	1	-3.4E+00	-1	1.01E-05
			18	18	0.001	-7.1E+00	8.5E-04	-4.3E+46	2.000	1.6E+01	9.5E+06	4.3E+46	0.000	7.9E+00	1	-7.9E+00	-1	3.3E+00	1	-3.3E+00	-1	6.83E-06
			19	19	0.001	-7.5E+00	5.8E-04	-4.3E+46	2.000	1.7E+01	2.3E+07	4.3E+46	0.000	7.7E+00	1	-7.7E+00	-1	3.2E+00	1	-3.2E+00	-1	4.61E-06
			20	20	0.001	-7.9E+00	3.9E-04	-4.3E+46	2.000	1.8E+01	5.7E+07	4.3E+46	0.000	7.5E+00	1	-7.5E+00	-1	3.2E+00	1	-3.2E+00	-0.99999	3.12E-06

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Contaminant 8-C10 aliphatic

DOMENICO (STEADY STATE)

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	0.3	mg/l	1	1	0.002	-3.93E-01	6.75E-01	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	5.40E-03
			2	2	0.002	-7.85E-01	4.56E-01	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	3.65E-03
			3	3	0.002	-1.18E+00	3.08E-01	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	2.46E-03
Co	8.00E-03	mg/l	4	4	0.002	-1.57E+00	2.08E-01	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	1.66E-03
λ	1.56E-07	days ⁻¹	5	5	0.002	-1.96E+00	1.40E-01	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	1.12E-03
Sz	6.00E+01	m	6	6	0.002	-2.36E+00	9.49E-02	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	7.59E-04
Sy	4.00E+00	m	7	7	0.002	-2.75E+00	6.41E-02	1.27E+01	1	-1.27E+01	-1	2.67E+00	1	-2.67E+00	-0.9998	5.12E-04
Kd	1.44E+03	l/kg	8	8	0.002	-3.14E+00	4.33E-02	1.19E+01	1	-1.19E+01	-1	2.50E+00	1	-2.50E+00	-0.9996	3.46E-04
ρ	1.60E+00	g/cm3	9	9	0.002	-3.53E+00	2.92E-02	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.999	-2.36E+00	-0.9991	2.34E-04
n	3.70E-01		10	10	0.002	-3.93E+00	1.97E-02	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.998	-2.24E+00	-0.9984	1.58E-04
i	1.70E-03		11	11	0.002	-4.32E+00	1.33E-02	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.997	-2.13E+00	-0.9974	1.06E-04
K	3.02E-01	m/d	12	12	0.002	-4.71E+00	9.00E-03	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.996	-2.04E+00	-0.9961	7.17E-05
x	2.00E+01	m	13	13	0.002	-5.10E+00	6.08E-03	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.994	-1.96E+00	-0.9945	4.84E-05
z	0.00E+00	m	14	14	0.002	-5.50E+00	4.11E-03	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.992	-1.89E+00	-0.9925	3.26E-05
y	0.00E+00	m	15	15	0.002	-5.89E+00	2.77E-03	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.99	-1.83E+00	-0.9902	2.20E-05
			16	16	0.002	-6.28E+00	1.87E-03	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.988	-1.77E+00	-0.9876	1.48E-05
ax	2.00E+00	m	17	17	0.002	-6.67E+00	1.26E-03	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.985	-1.71E+00	-0.9847	9.96E-06
az	2.00E-01	m	18	18	0.002	-7.07E+00	8.54E-04	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.982	-1.67E+00	-0.9816	6.71E-06
ay	2.00E-02	m	19	19	0.002	-7.46E+00	5.77E-04	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.978	-1.62E+00	-0.9782	4.51E-06
			20	20	0.002	-7.85E+00	3.89E-04	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.975	-1.58E+00	-0.9747	3.04E-06

Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc

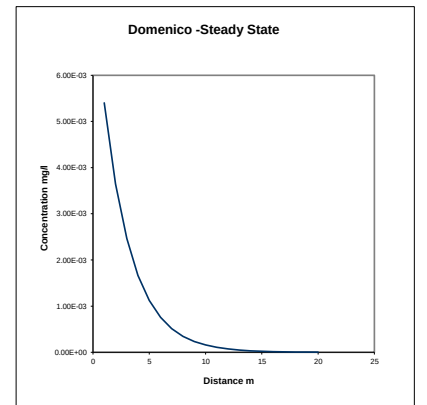
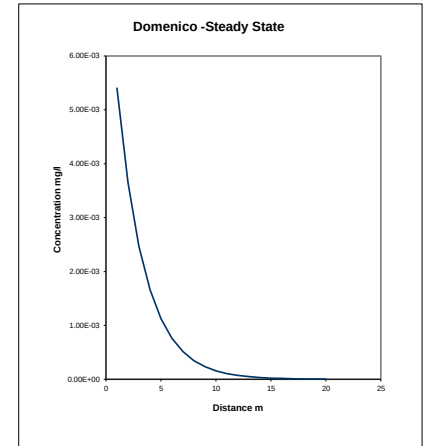
Value

DOMENICO (STEADY STATE)

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

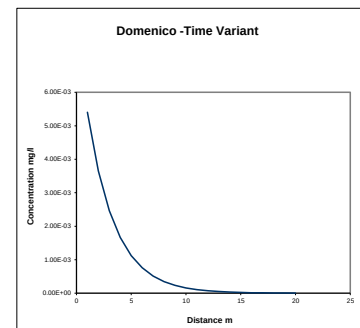
	1.39E-03	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration	
Rc	6.23E+03															
u	2.23E-07	m/d	1	1	0.002	-3.93E-01	6.75E-01	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	5.40E-03
			2	2	0.002	-7.85E-01	4.56E-01	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	3.65E-03
			3	3	0.002	-1.18E+00	3.08E-01	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	2.46E-03
			4	4	0.002	-1.57E+00	2.08E-01	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	1.66E-03
			5	5	0.002	-1.96E+00	1.40E-01	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	1.12E-03
			6	6	0.002	-2.36E+00	9.49E-02	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	7.59E-04
			7	7	0.002	-2.75E+00	6.41E-02	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	5.13E-04
			8	8	0.002	-3.14E+00	4.33E-02	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	3.46E-04
			9	9	0.002	-3.53E+00	2.92E-02	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	2.34E-04
			10	10	0.002	-3.93E+00	1.97E-02	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	1.58E-04
			11	11	0.002	-4.32E+00	1.33E-02	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	1.07E-04
			12	12	0.002	-4.71E+00	9.00E-03	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	7.20E-05
			13	13	0.002	-5.10E+00	6.08E-03	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	4.86E-05
			14	14	0.002	-5.50E+00	4.11E-03	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	3.28E-05
			15	15	0.002	-5.89E+00	2.77E-03	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	2.22E-05
			16	16	0.002	-6.28E+00	1.87E-03	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	1.50E-05
			17	17	0.002	-6.67E+00	1.26E-03	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	1.01E-05
			18	18	0.002	-7.07E+00	8.54E-04	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	6.83E-06
	21/06/2018		19	19	0.002	-7.46E+00	5.77E-04	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	4.61E-06
	1.1		20	20	0.002	-7.85E+00	3.89E-04	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	3.12E-06

Date: 21/06/2018
Version: 1.1



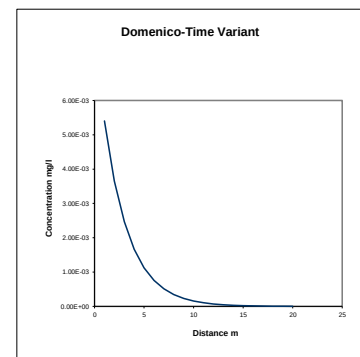
DOMENICO (TIME VARIANT)

Contaminant	:8-C10 aliphatic		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	0.3	mg/l	m															
Co	8.00E-03	mg/l	1	1	0.001	-3.93E-01	6.75E-01	-4.27E+46	2	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	5.40E-03
			2	2	0.001	-7.85E-01	4.56E-01	-4.27E+46	2	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	3.65E-03
			3	3	0.001	-1.18E+00	3.08E-01	-4.27E+46	2	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	2.46E-03
λ	1.56E-07	days ⁻¹	4	4	0.001	-1.57E+00	2.08E-01	-4.27E+46	2	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	1.66E-03
Sz	6.00E+01	m	5	5	0.001	-1.96E+00	1.40E-01	-4.27E+46	2	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	1.12E-03
Sy	4.00E+00	m	6	6	0.001	-2.36E+00	9.49E-02	-4.27E+46	2	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	7.59E-04
Kd	1.44E+03	l/kg	7	7	0.001	-2.75E+00	6.41E-02	-4.27E+46	2	1.27E+01	1	-1.27E+01	-1	2.67E+00	0.9998	-2.67E+00	-1	5.12E-04
ρ	1.60E+00	g/cm3	8	8	0.001	-3.14E+00	4.33E-02	-4.27E+46	2	1.19E+01	1	-1.19E+01	-1	2.50E+00	0.9996	-2.50E+00	-1	3.46E-04
n	3.70E-01		9	9	0.001	-3.53E+00	2.92E-02	-4.27E+46	2	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.9991	-2.36E+00	-0.999	2.34E-04
i	1.70E-03		10	10	0.001	-3.93E+00	1.97E-02	-4.27E+46	2	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.9984	-2.24E+00	-0.998	1.58E-04
K	3.02E-01	m/d	11	11	0.001	-4.32E+00	1.33E-02	-4.27E+46	2	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.9974	-2.13E+00	-0.997	1.06E-04
x	2.00E+01	m	12	12	0.001	-4.71E+00	9.00E-03	-4.27E+46	2	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.9961	-2.04E+00	-0.996	7.17E-05
z	0.00E+00	m	13	13	0.001	-5.10E+00	6.08E-03	-4.27E+46	2	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.9945	-1.96E+00	-0.994	4.84E-05
y	0.00E+00	m	14	14	0.001	-5.50E+00	4.11E-03	-4.27E+46	2	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.9925	-1.89E+00	-0.992	3.26E-05
t	9.90E+99	days	15	15	0.001	-5.89E+00	2.77E-03	-4.27E+46	2	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.9902	-1.83E+00	-0.99	2.20E-05
ax	2.00E+00	m	16	16	0.001	-6.28E+00	1.87E-03	-4.27E+46	2	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.9876	-1.77E+00	-0.988	1.48E-05
az	2.00E-01	m	17	17	0.001	-6.67E+00	1.26E-03	-4.27E+46	2	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.9847	-1.71E+00	-0.985	9.96E-06
ay	2.00E-02	m	18	18	0.001	-7.07E+00	8.54E-04	-4.27E+46	2	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.9816	-1.67E+00	-0.982	6.71E-06
			19	19	0.001	-7.46E+00	5.77E-04	-4.27E+46	2	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.9782	-1.62E+00	-0.978	4.51E-06
			20	20	0.001	-7.85E+00	3.89E-04	-4.27E+46	2	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.9747	-1.58E+00	-0.975	3.04E-06



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	1.39E-03	m/d																
Rc	6.23E+03		1	1	0.001	-3.93E-01	6.75E-01	-4.27E+46	2	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	5.40E-03
u	2.23E-07	m/d	2	2	0.001	-7.85E-01	4.56E-01	-4.27E+46	2	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	3.65E-03
			3	3	0.001	-1.18E+00	3.08E-01	-4.27E+46	2	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	2.46E-03
			4	4	0.001	-1.57E+00	2.08E-01	-4.27E+46	2	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	1.66E-03
			5	5	0.001	-1.96E+00	1.40E-01	-4.27E+46	2	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	1.12E-03
			6	6	0.001	-2.36E+00	9.49E-02	-4.27E+46	2	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	7.59E-04
			7	7	0.001	-2.75E+00	6.41E-02	-4.27E+46	2	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	5.13E-04
			8	8	0.001	-3.14E+00	4.33E-02	-4.27E+46	2	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	3.46E-04
			9	9	0.001	-3.53E+00	2.92E-02	-4.27E+46	2	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	2.34E-04
			10	10	0.001	-3.93E+00	1.97E-02	-4.27E+46	2	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	1.58E-04
			11	11	0.001	-4.32E+00	1.33E-02	-4.27E+46	2	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	1.07E-04
			12	12	0.001	-4.71E+00	9.00E-03	-4.27E+46	2	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	7.20E-05
			13	13	0.001	-5.10E+00	6.08E-03	-4.27E+46	2	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	4.86E-05
			14	14	0.001	-5.50E+00	4.11E-03	-4.27E+46	2	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	3.28E-05
			15	15	0.001	-5.89E+00	2.77E-03	-4.27E+46	2	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	2.22E-05
			16	16	0.001	-6.28E+00	1.87E-03	-4.27E+46	2	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	1.50E-05
			17	17	0.001	-6.67E+00	1.26E-03	-4.27E+46	2	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	1.01E-05
			18	18	0.001	-7.07E+00	8.54E-04	-4.27E+46	2	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	6.83E-06
			19	19	0.001	-7.46E+00	5.77E-04	-4.27E+46	2	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	4.61E-06
			20	20	0.001	-7.85E+00	3.89E-04	-4.27E+46	2	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	3.12E-06



Date: 21/06/2018
Version: 1.1



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:	Portsmen Way		
Site Address:	Reading		
Completed by:	PDM	Version:	1.1
Date:	21-Jun-18		
Contaminant	C16-C21 aromatic		
Target Concentration (C _T)	9.00E-02	mg/l	Origin of C _T : WHO

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

C16-C21 aromatic
0.09 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

2.40E-01

fraction

calculated

Air filled soil porosity

θ_a

1.84E-01

fraction

calculated

Bulk density of soil zone material

ρ

1.60E+00

g/cm³

R & D Technical report sand fill

Henry's Law constant

H

1.30E-02

dimensionless

Total Petroleum Hydrocarbon Criteria Working Group

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 soil)

f_{oc}

4.50E-02

fraction

Site data

Organic carbon partition coefficient

K_{oc}

1.60E+04

l/kg

CLAIRE 2017 Hydrocarbons in Groundwater

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

7.20E+02

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

6.48E+01

mg/kg

(for comparison with soil analyses)

or

0.09

mg/l

(for comparison with leachate test results)

Site being assessed: Portsman Way

Completed by: PDM

Date: 21-Jun-18

Version: 1.1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

C16-C21 aromatic
0.09

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
Area of contaminant source

Inf
A

4.40E-04
1.50E+02

m/d
m²

96-2000 30% pf values River Thames at Reading 70%
Area of boiler house and tank farm

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow
Saturated aquifer thickness
Hydraulic Conductivity of aquifer in which dilution occurs
Hydraulic gradient of water table
Width of contaminant source perpendicular to groundwater flow
Background concentration of contaminant in groundwater beneath site

L
da
K
i
w
Cu

3.00E+01
8.00E+01
3.02E-01
1.70E-03
6.00E+01
0.00E+00

m
m
m/d
fraction
m
mg/l

Width of source area between PH2 and PH6
assumed vale to base of chalk
site data
Estimate
Length of source area between PH2 and PH6
Estimated

Not used in calculation

Define mixing zone depth by specifying or calculating depth (using pull down list)

Enter mixing zone thickness
Calculated mixing zone thickness

Mz
Mz

Calculate
2.51E+01

m
m

Calculated Parameters

Dilution Factor DF

1.98E+00

Level 2 Remedial Target

1.78E-01
or
1.28E+02
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)

C_c

0.00E+00

mg/l

Calculated concentration within receptor (dilution only)

0.00E+00

mg/l

0

Site being assessed: Portsman Way
Completed by: PDM
Date: 21-Jun-18
Version: 1.1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		C16-C21 aromatic		from Level 1
Target Concentration	C _t	0.09	mg/l	from Level 1
Dilution Factor	DF	1.98E+00		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 dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration			
Enter soil concentration	2030	mg/kg	
Half life for degradation of contaminant in water	t _{1/2}	days	Handbook of Environmental Degradation Rates
Calculated decay rate	λ	days ⁻¹	calculated
Width of plume in aquifer at source	Sz	m	from Level 2
Plume thickness in aquifer at source	Sy	m	from Level 2
Bulk density of aquifer materials	ρ	g/cm ³	R & D Technical Report P13
Effective porosity of aquifer	n	fraction	Consim
Hydraulic gradient	i	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	m/d	from Level 2
Distance to compliance point	x	m	Estimated Depth to water table
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	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	7.20E+02	l/kg see options
Longitudinal dispersivity	ax	0.200	m see options
Transverse dispersivity	az	0.020	m see options
Vertical dispersivity	av	0.002	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	V	2.81E-03 m/d
Retardation factor	Rf	3.11E+03
Decay rate used	λ	5.06E-07 d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.44E-03
Rate of contaminant flow due to retardation	u	9.02E-07 m/d
Ratio of Compliance Point to Source Concentration	C ₁₀ /C ₀	3.61E-01
Attenuation factor (C ₀ /C ₁₀)	AF	2.77E+00
Calculated soil leachate concentration	Co	2.82E+00 mg/l

Remedial Targets

Level 3 Remedial Target	4.93E-01	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	3.55E+02	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	2	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₁₀ /C ₀	3.61E-01	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 non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 4.50E-02 fractionOrganic carbon partition coefficient K_{oc} 1.60E+04 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,ri} l/kgSorption 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)

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

Longitudinal dispersivity

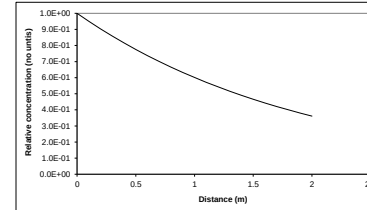
Transverse dispersivity

Vertical dispersivity

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀)^{0.4+14}; 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

Distance	Relative concentration (No units)	Concentration mg/l
0	1.0E+00	1.42E+00
0.1	9.50E-01	1.35E+00
0.2	9.03E-01	1.29E+00
0.3	8.58E-01	1.22E+00
0.4	8.16E-01	1.16E+00
0.5	7.75E-01	1.10E+00
0.6	7.37E-01	1.05E+00
0.7	7.00E-01	9.97E-01
0.8	6.65E-01	9.48E-01
0.9	6.32E-01	9.01E-01
1.0	6.01E-01	8.56E-01
1.1	5.71E-01	8.14E-01
1.2	5.43E-01	7.73E-01
1.3	5.16E-01	7.35E-01
1.4	4.90E-01	6.98E-01
1.5	4.66E-01	6.64E-01
1.6	4.43E-01	6.31E-01
1.7	4.21E-01	5.99E-01
1.8	4.00E-01	5.70E-01
1.9	3.80E-01	5.41E-01
2.0	3.61E-01	5.15E-01

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:	Portemans Way
Completed by:	PDM
Date:	#####
Version:	1.1

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters
Soil contaminant concentration C_0 2.00E-01 mg/kg

Level 1 Parameters

Water filled soil porosity	θ_w	2.40E-01	fraction
Air filled soil porosity	θ_a	1.84E-01	fraction
Bulk density	ρ	1.60E+00	g/cm ³
Henry's Law constant	H	1.30E-02	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	7.20E+02	l/kg
Factor (partitioning between soil and water)		7.20E+02	dimensionless

Level 2 Parameters

Dilution Factor DF 1.98E+00

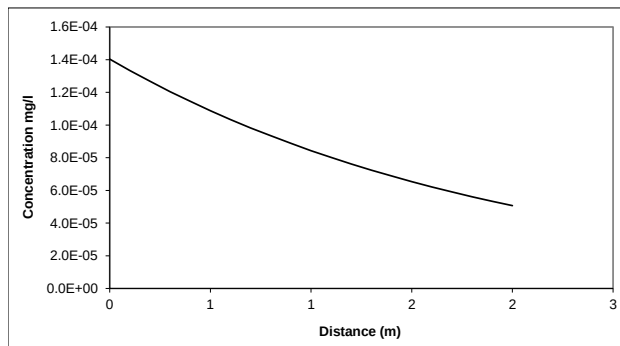
Level 3 Parameters

Attenuation factor (C_0/C_{ED}) AF 2.77E+00

Predicted concentrations at compliance point

Level 1	C	2.78E-04 mg/l	No dilution or attenuation
Level 2	C	1.40E-04 mg/l	Dilution taken into account
Level 3	C	5.07E-05 mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	1.40E-04
0.10	1.33E-04
0.20	1.27E-04
0.30	1.20E-04
0.40	1.14E-04
0.50	1.09E-04
0.60	1.03E-04
0.70	9.83E-05
0.80	9.34E-05
0.90	8.88E-05
1.00	8.43E-05
1.10	8.02E-05
1.20	7.62E-05
1.30	7.24E-05
1.40	6.88E-05
1.50	6.54E-05
1.60	6.21E-05
1.70	5.91E-05
1.80	5.61E-05
1.90	5.33E-05
2.00	5.07E-05

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	C16-C21 aromatic	from Level 1
Target Concentration	9.00E-02	mg/l from Level 1

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

Ogata Banks	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	5.45E-01	mg/l	Site data
Half life for degradation of contaminant in water	t _{1/2}	4.40E+02	days	Handbook of Environmental Degradation R
Calculated decay rate	λ	1.58E-03	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.00E+01	m	Estimated from site data
Plume thickness at source	Sy	4.00E+00	m	to top of chalk
Saturated aquifer thickness	da	8.00E+01	m	Estimated from site data
Bulk density of aquifer materials	p	1.80E+00	g/cm ³	Consim
Effective porosity of aquifer	n	3.70E-01	fraction	Consim
Hydraulic gradient	i	1.70E-03	fraction	Estimate from site data
Hydraulic conductivity of aquifer	K	3.02E-01	m/d	Site data
Distance to compliance point	x	2.00E+01	m	Distance to site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	7.20E+02	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	1.39E-03	m/d
Retardation factor	Rf	3.11E+03	fraction
Decay rate used	λ	5.06E-07	d ⁻¹
Rate of contaminant flow due to retardation	u	4.46E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	1.04E-05	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	5.24E+04	

Remedial Targets

Remedial Target	4.72E+03	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	1.04E-05	mg/l
		9.9E+99	days

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)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient

Kd

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer

foc

4.50E-02

fraction

Organic carbon partition coefficient

Koc

1.60E+04

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species

K_{oc,ri}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

l/kg

acid dissociation constant

pKa

l/kg

Fraction of organic carbon in aquifer

foc

fraction

Soil water partition coefficient

Kd

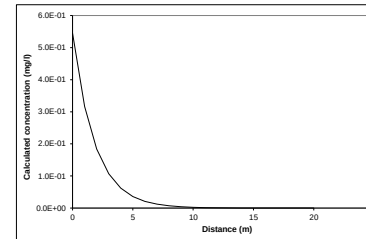
7.20E+02

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-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(log ₁₀ x) ^{-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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	5.5E-01
1.0	3.17E-01
2.0	1.84E-01
3.0	1.07E-01
4.0	6.20E-02
5.0	3.60E-02
6.0	2.09E-02
7.0	1.21E-02
8.0	7.06E-03
9.0	4.10E-03
10.0	2.38E-03
11.0	1.38E-03
12.0	8.03E-04
13.0	4.66E-04
14.0	2.71E-04
15.0	1.57E-04
16.0	9.13E-05
17.0	5.31E-05
18.0	3.08E-05
19.0	1.79E-05
20.0	1.04E-05

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:	Portsmouth Way
Completed by:	PDM
Date:	20/07/2018
Version:	1.1

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	15.00	% wt	(Change this number only if you have specific information)
Particle Density	2.78	tonnes/m ³	
Dry Bulk Density	1.60	tonnes/m ³	
Calculated Parameters			
Voids Ratio	0.74	fraction	
Initial Saturation	56.54	%	
Total porosity	0.424	fraction	
Air Filled Porosity	0.184	fraction	
Water Filled Porosity	0.240	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	1.000	fraction	#DIV/0!
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

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 C16-C21 aromatic

Parameter	Value	Units	Calculations (Refer toTable 4.3, R&D Publication 20)															
(carried over from input sheet)			Selected option		Calculate for non-polar organic chemicals													
			calc	calc	Calc Kd l/kg													
C _T	9.00E-02	mg/l	Calculation of partition coefficient															
Kd	7.20E+02	l/kg	for ionic organic chemical															
foc	4.50E-02	fraction																
koc	1.60E+04	l/kg	Partition coefficient used in Level 1 Assessment															
θ _w	2.40E-01	fraction	7.20E+02 l/kg															
θ _a	1.84E-01	fraction																
ρ	1.60E+00	g/cm3																
H	1.30E-02	dimensionless	Factor (partitioning between soil and water)															
Koc,n		l/kg																
Koc,i		l/kg																
pH		pH units																
pKa																		
foc (ionic)		fraction																
			<table><tr><td>Calculated Remedial Target</td><td>6.48E+01 mg/kg</td><td>for C16-C21 arom</td></tr></table>				Calculated Remedial Target	6.48E+01 mg/kg	for C16-C21 arom									
Calculated Remedial Target	6.48E+01 mg/kg	for C16-C21 arom																
			<table><tr><td>Site being assessed:</td><td colspan="2">Portsman Way</td></tr><tr><td>Completed by:</td><td colspan="2">PDM</td></tr><tr><td>Date:</td><td colspan="2">21/06/2018</td></tr><tr><td>Version:</td><td colspan="2">1.1</td></tr></table>				Site being assessed:	Portsman Way		Completed by:	PDM		Date:	21/06/2018		Version:	1.1	
Site being assessed:	Portsman Way																	
Completed by:	PDM																	
Date:	21/06/2018																	
Version:	1.1																	

Level 2 Calculation Sheet

Contaminant C16-C21 aromatic

Site assessed:	Portsman Wa
Date:	21/06/2018
Version:	1.1

Parameter **Value** **Units**
(carried over from input sheet)

Mz	2.51E+01	m
L	3.00E+01	m
da	8.00E+01	m
Inf	4.40E-04	m/d
K	3.02E-01	m/d
i	1.70E-03	m3/d
A	1.50E+02	m2
		m3/d
Cc	0.00E+00	mg/l
C _T	9.00E-02	mg/l
Cu	0.00E+00	mg/l
w	6.00E+01	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Calculated
Dilution Factor

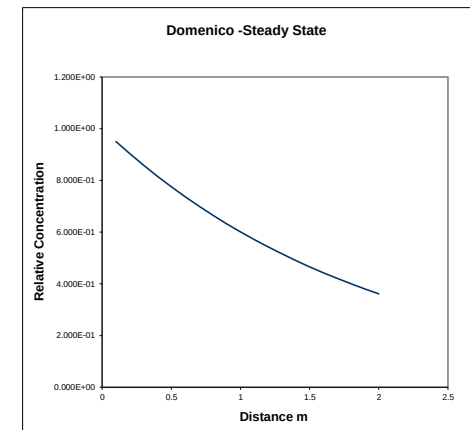
1.98E+00

#DIV/0!

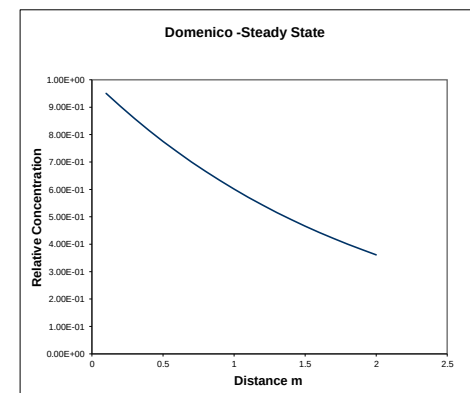


Figure 1 is a line graph titled "Ogata Banks - Time Variant". The Y-axis is labeled "Relative Concentration" and has a logarithmic scale ranging from 0.00E+00 to 1.00E+00. The X-axis is labeled "Distance m" and has a linear scale ranging from 0 to 2.5. The graph shows a single blue line representing the relationship between distance and relative concentration. The concentration starts at approximately 0.85 at 0m and decreases as distance increases, reaching about 0.35 at 2m.

Contaminant		DOMENICO (STEADY STATE)														
I6-C21 aromatic		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	9.000E-02	mg/l	1	0.1	0.25	-5.09E-02	9.50E-01	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.504E-01
DF	1.979E+00		2	0.2	0.25	-1.02E-01	9.03E-01	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	9.032E-01
			3	0.3	0.25	-1.53E-01	8.58E-01	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	8.584E-01
			4	0.4	0.25	-2.04E-01	8.16E-01	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	8.158E-01
λ	5.058E-07	days ⁻¹	5	0.5	0.25	-2.55E-01	7.75E-01	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	7.753E-01
Sz	6.000E+01	m	6	0.6	0.25	-3.05E-01	7.37E-01	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	7.368E-01
Sy	2.514E+01	m	7	0.7	0.25	-3.56E-01	7.00E-01	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	7.002E-01
Kd	7.200E+02	l/kg	8	0.8	0.25	-4.07E-01	6.65E-01	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	6.655E-01
ρ	1.600E+00	g/cm3	9	0.9	0.25	-4.58E-01	6.32E-01	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	6.324E-01
n	3.700E-01		10	1	0.25	-5.09E-01	6.01E-01	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	6.011E-01
i	3.436E-03		11	1.1	0.25	-5.60E-01	5.71E-01	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	5.712E-01
K	3.024E-01	m/d	12	1.2	0.25	-6.11E-01	5.43E-01	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	5.429E-01
x	2.000E+00	m	13	1.3	0.25	-6.62E-01	5.16E-01	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	5.159E-01
z	0.000E+00	m	14	1.4	0.25	-7.13E-01	4.90E-01	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	4.903E-01
y	0.000E+00	m	15	1.5	0.25	-7.64E-01	4.66E-01	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	4.660E-01
ax	2.000E-01	m	16	1.6	0.25	-8.15E-01	4.43E-01	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	4.429E-01
az	2.000E-02	m	17	1.7	0.25	-8.65E-01	4.21E-01	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	4.209E-01
ay	2.000E-03	m	18	1.8	0.25	-9.16E-01	4.00E-01	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	4.000E-01
			19	1.9	0.25	-9.67E-01	3.80E-01	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	3.801E-01
			20	2	0.25	-1.02E+00	3.61E-01	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	3.613E-01



Calc	Value	DOMENICO (STEADY STATE)														
Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT																
v	2.81E-03	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration	
Rc	3.11E+03															
u	9.02E-07	m/d	1	0.1	0.25	-5.09E-02	9.50E-01	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.50E-01
			2	0.2	0.25	-1.02E-01	9.03E-01	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	9.03E-01
			3	0.3	0.25	-1.53E-01	8.58E-01	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	8.58E-01
			4	0.4	0.25	-2.04E-01	8.16E-01	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	8.16E-01
			5	0.5	0.25	-2.55E-01	7.75E-01	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	7.75E-01
			6	0.6	0.25	-3.05E-01	7.37E-01	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	7.37E-01
			7	0.7	0.25	-3.56E-01	7.00E-01	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	7.00E-01
			8	0.8	0.25	-4.07E-01	6.65E-01	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	6.65E-01
			9	0.9	0.25	-4.58E-01	6.32E-01	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	6.32E-01
			10	1	0.25	-5.09E-01	6.01E-01	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	6.01E-01
			11	1.1	0.25	-5.60E-01	5.71E-01	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	5.71E-01
			12	1.2	0.25	-6.11E-01	5.43E-01	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	5.43E-01
			13	1.3	0.25	-6.62E-01	5.16E-01	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	5.16E-01
			14	1.4	0.25	-7.13E-01	4.90E-01	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	4.90E-01
			15	1.5	0.25	-7.64E-01	4.66E-01	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	4.66E-01
			16	1.6	0.25	-8.15E-01	4.43E-01	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	4.43E-01
			17	1.7	0.25	-8.65E-01	4.21E-01	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	4.21E-01
			18	1.8	0.25	-9.16E-01	4.00E-01	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	4.00E-01
			19	1.9	0.25	-9.67E-01	3.80E-01	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	3.80E-01
			20	2	0.25	-1.02E+00	3.61E-01	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	3.61E-01
	21/06/2018															
n:	1.1															



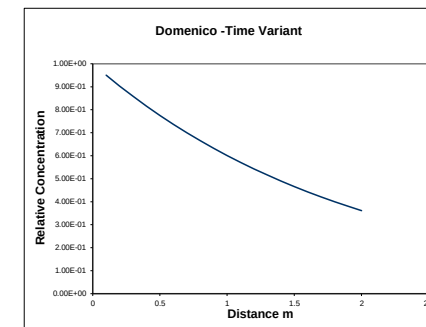
Date: 21/06/2018
Version: 1.1

DOMENICO (TIME VARIANT)

Contaminant 16-C21 aromatic

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	0.09	mg/l	1	0.1	0.125	-5.09E-02	9.50E-01	-4.04E+6	2	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.50E-01
DF	1.9790		2	0.2	0.125	-1.02E-01	9.03E-01	-4.04E+6	2	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	9.03E-01
			3	0.3	0.125	-1.53E-01	8.58E-01	-4.04E+6	2	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	8.58E-01
			4	0.4	0.125	-2.04E-01	8.16E-01	-4.04E+6	2	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	8.16E-01
λ	5.058E-07	days ⁻¹	5	0.5	0.125	-2.55E-01	7.75E-01	-4.04E+6	2	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	7.75E-01
Sz	6.000E+01	m	6	0.6	0.125	-3.05E-01	7.37E-01	-4.04E+6	2	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	7.37E-01
Sy	2.514E+01	m	7	0.7	0.125	-3.56E-01	7.00E-01	-4.04E+6	2	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	7.00E-01
Kd	7.200E+02	l/kg	8	0.8	0.125	-4.07E-01	6.65E-01	-4.04E+6	2	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	6.65E-01
ρ	1.600E+00	g/cm3	9	0.9	0.125	-4.58E-01	6.32E-01	-4.04E+6	2	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	6.32E-01
n	3.700E-01		10	1	0.125	-5.09E-01	6.01E-01	-4.04E+6	2	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	6.01E-01
i	3.436E-03		11	1.1	0.125	-5.60E-01	5.71E-01	-4.04E+6	2	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	5.71E-01
K	3.024E-01	m/d	12	1.2	0.125	-6.11E-01	5.43E-01	-4.04E+6	2	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	5.43E-01
x	2.000E+00	m	13	1.3	0.125	-6.62E-01	5.16E-01	-4.04E+6	2	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	5.16E-01
z	0.000E+00	m	14	1.4	0.125	-7.13E-01	4.90E-01	-4.04E+6	2	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	4.90E-01
y	0.000E+00	m	15	1.5	0.125	-7.64E-01	4.66E-01	-4.04E+6	2	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	4.66E-01
t	1.000E+99	days	16	1.6	0.125	-8.15E-01	4.43E-01	-4.04E+6	2	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	4.43E-01
ax	2.000E-01	m	17	1.7	0.125	-8.65E-01	4.21E-01	-4.04E+6	2	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	4.21E-01
az	2.000E-02	m	18	1.8	0.125	-9.16E-01	4.00E-01	-4.04E+6	2	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	4.00E-01
ay	2.000E-03	m	19	1.9	0.125	-9.67E-01	3.80E-01	-4.04E+6	2	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	3.80E-01
			20	2	0.125	-1.02E+00	3.61E-01	-4.04E+6	2	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	3.61E-01

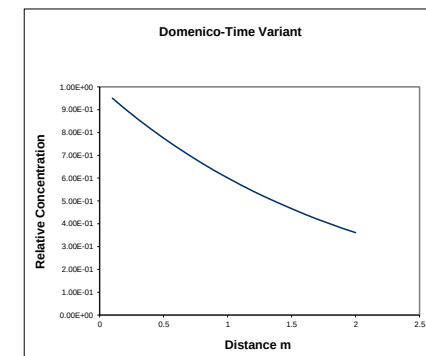


Calc

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	2.81E-03	m/d	m															
Rc	3.11E+03		1	0.1	0.125	-5.09E-02	9.50E-01	-4.04E+6	2	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.50E-01
u	9.02E-07	m/d	2	0.2	0.125	-1.02E-01	9.03E-01	-4.04E+6	2	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	9.03E-01
			3	0.3	0.125	-1.53E-01	8.58E-01	-4.04E+6	2	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	8.58E-01
			4	0.4	0.125	-2.04E-01	8.16E-01	-4.04E+6	2	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	8.16E-01
			5	0.5	0.125	-2.55E-01	7.75E-01	-4.04E+6	2	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	7.75E-01
			6	0.6	0.125	-3.05E-01	7.37E-01	-4.04E+6	2	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	7.37E-01
			7	0.7	0.125	-3.56E-01	7.00E-01	-4.04E+6	2	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	7.00E-01
			8	0.8	0.125	-4.07E-01	6.65E-01	-4.04E+6	2	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	6.65E-01
			9	0.9	0.125	-4.58E-01	6.32E-01	-4.04E+6	2	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	6.32E-01
			10	1	0.125	-5.09E-01	6.01E-01	-4.04E+6	2	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	6.01E-01
			11	1.1	0.125	-5.60E-01	5.71E-01	-4.04E+6	2	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	5.71E-01
			12	1.2	0.125	-6.11E-01	5.43E-01	-4.04E+6	2	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	5.43E-01
			13	1.3	0.125	-6.62E-01	5.16E-01	-4.04E+6	2	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	5.16E-01
			14	1.4	0.125	-7.13E-01	4.90E-01	-4.04E+6	2	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	4.90E-01
			15	1.5	0.125	-7.64E-01	4.66E-01	-4.04E+6	2	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	4.66E-01
			16	1.6	0.125	-8.15E-01	4.43E-01	-4.04E+6	2	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	4.43E-01
			17	1.7	0.125	-8.65E-01	4.21E-01	-4.04E+6	2	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	4.21E-01
			18	1.8	0.125	-9.16E-01	4.00E-01	-4.04E+6	2	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	4.00E-01
			19	1.9	0.125	-9.67E-01	3.80E-01	-4.04E+6	2	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	3.80E-01
			20	2	0.125	-1.02E+00	3.61E-01	-4.04E+6	2	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	3.61E-01



Date: 21/06/2018
Version: 1.1

OGATA BANKS SOLUTION																						
Contaminant	:16-C21 aromatic		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	0.09	mg/l	1	1	0.06813	-5.4E-01	5.8E-01	-7.5E+6	2.000	1.0E+00	2.8E+00	7.5E+6	0.000	3.4E+01	1	-3.4E+01	-1	7.1E+00	1	-7.1E+00	-1	3.17E-01
			2	2	0.06813	-1.1E+00	3.4E-01	-7.5E+6	2.000	2.1E+00	8.1E+00	7.5E+6	0.000	2.4E+01	1	-2.4E+01	-1	5.0E+00	1	-5.0E+00	-1	1.84E-01
			3	3	0.06813	-1.6E+00	2.0E-01	-7.5E+6	2.000	3.1E+00	2.3E+01	7.5E+6	0.000	1.9E+01	1	-1.9E+01	-1	4.1E+00	1	-4.1E+00	-1	1.07E-01
Co	5.45E-01	mg/l	4	4	0.06813	-2.2E+00	1.1E-01	-7.5E+6	2.000	4.2E+00	6.5E+01	7.5E+6	0.000	1.7E+01	1	-1.7E+01	-1	3.5E+00	1	-3.5E+00	-1	6.20E-02
λ	5.06E-07	days ⁻¹	5	5	0.06813	-2.7E+00	6.6E-02	-7.5E+6	2.000	5.2E+00	1.8E+02	7.5E+6	0.000	1.5E+01	1	-1.5E+01	-1	3.2E+00	1	-3.2E+00	-0.99999	3.60E-02
Sz	6.00E+01	m	6	6	0.06813	-3.3E+00	3.8E-02	-7.5E+6	2.000	6.3E+00	5.2E+02	7.5E+6	0.000	1.4E+01	1	-1.4E+01	-1	2.9E+00	1	-2.9E+00	-0.99996	2.09E-02
Sy	4.00E+00	m	7	7	0.06813	-3.8E+00	2.2E-02	-7.5E+6	2.000	7.3E+00	1.5E+03	7.5E+6	0.000	1.3E+01	1	-1.3E+01	-1	2.7E+00	0.9998	-2.7E+00	-0.99984	1.21E-02
Kd	7.20E+02	l/kg	8	8	0.06813	-4.3E+00	1.3E-02	-7.5E+6	2.000	8.3E+00	4.2E+03	7.5E+6	0.000	1.2E+01	1	-1.2E+01	-1	2.5E+00	0.9996	-2.5E+00	-0.99959	7.05E-03
ρ	1.60E+00	g/cm3	9	9	0.06813	-4.9E+00	7.5E-03	-7.5E+6	2.000	9.4E+00	1.2E+04	7.5E+6	0.000	1.1E+01	1	-1.1E+01	-1	2.4E+00	0.9991	-2.4E+00	-0.99914	4.09E-03
n	3.70E-01		10	10	0.06813	-5.4E+00	4.4E-03	-7.5E+6	2.000	1.0E+01	3.4E+04	7.5E+6	0.000	1.1E+01	1	-1.1E+01	-1	2.2E+00	0.9984	-2.2E+00	-0.99843	2.38E-03
i	1.70E-03		11	11	0.06813	-6.0E+00	2.5E-03	-7.5E+6	2.000	1.1E+01	9.6E+04	7.5E+6	0.000	1.0E+01	1	-1.0E+01	-1	2.1E+00	0.9974	-2.1E+00	-0.99743	1.38E-03
K	3.02E-01	m/d	12	12	0.06813	-6.5E+00	1.5E-03	-7.5E+6	2.000	1.3E+01	2.7E+05	7.5E+6	0.000	9.7E+00	1	-9.7E+00	-1	2.0E+00	0.9961	-2.0E+00	-0.99611	8.00E-04
x	2.00E+01	m	13	13	0.06813	-7.1E+00	8.6E-04	-7.5E+6	2.000	1.4E+01	7.8E+05	7.5E+6	0.000	9.3E+00	1	-9.3E+00	-1	2.0E+00	0.9945	-2.0E+00	-0.99445	4.64E-04
z	0.00E+00	m	14	14	0.06813	-7.6E+00	5.0E-04	-7.5E+6	2.000	1.5E+01	2.2E+06	7.5E+6	0.000	9.0E+00	1	-9.0E+00	-1	1.9E+00	0.9925	-1.9E+00	-0.99247	2.69E-04
y	0.00E+00	m	15	15	0.06813	-8.2E+00	2.9E-04	-7.5E+6	2.000	1.6E+01	6.3E+06	7.5E+6	0.000	8.7E+00	1	-8.7E+00	-1	1.8E+00	0.9902	-1.8E+00	-0.99018	1.56E-04
t	9.90E+99	days	16	16	0.06813	-8.7E+00	1.7E-04	-7.5E+6	2.000	1.7E+01	1.8E+07	7.5E+6	0.000	8.4E+00	1	-8.4E+00	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	9.02E-05
ax	2.00E+00	m	17	17	0.06813	-9.2E+00	9.7E-05	-7.5E+6	2.000	1.8E+01	5.0E+07	7.5E+6	0.000	8.1E+00	1	-8.1E+00	-1	1.7E+00	0.9847	-1.7E+00	-0.98471	5.22E-05
az	2.00E-01	m	18	18	0.06813	-9.8E+00	5.7E-05	-7.5E+6	2.000	1.9E+01	1.4E+08	7.5E+6	0.000	7.9E+00	1	-7.9E+00	-1	1.7E+00	0.9816	-1.7E+00	-0.98158	3.02E-05
ay	2.00E-02	m	19	19	0.06813	-1.0E+01	3.3E-05	-7.5E+6	2.000	2.0E+01	4.1E+08	7.5E+6	0.000	7.7E+00	1	-7.7E+00	-1	1.6E+00	0.9782	-1.6E+00	-0.97822	1.75E-05
			20	20	0.06813	-1.1E+01	1.9E-05	-7.5E+6	2.000	2.1E+01	1.2E+09	7.5E+6	0.000	7.5E+00	1	-7.5E+00	-1	1.6E+00	0.9747	-1.6E+00	-0.97465	1.01E-05

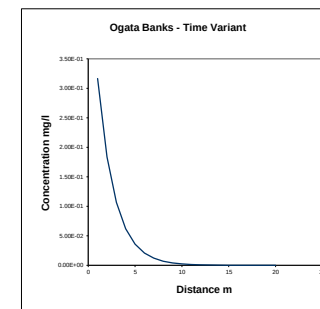
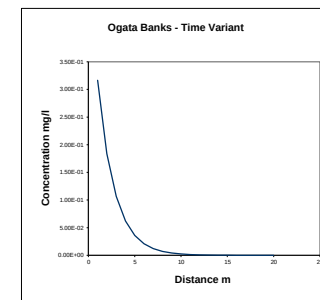
Vertical dispersion option Simulate vertical dispersion in 1 direction

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	1.39E-03	m/d																					
Rc	3.11E+03		1	1	0.06813	-5.4E-01	5.8E-01	-7.5E+6	2.000	1.0E+00	2.8E+00	7.5E+6	0.000	3.4E+01	1	-3.4E+01	-1	1.4E+01	1	-1.4E+01	-1	3.17E-01	
u	4.46E-07	m/d	2	2	0.06813	-1.1E+00	3.4E-01	-7.5E+6	2.000	2.1E+00	8.1E+00	7.5E+6	0.000	2.4E+01	1	-2.4E+01	-1	1.0E+01	1	-1.0E+01	-1	1.84E-01	
			3	3	0.06813	-1.6E+00	2.0E-01	-7.5E+6	2.000	3.1E+00	2.3E+01	7.5E+6	0.000	1.9E+01	1	-1.9E+01	-1	8.2E+00	1	-8.2E+00	-1	1.07E-01	
			4	4	0.06813	-2.2E+00	1.1E-01	-7.5E+6	2.000	4.2E+00	6.5E+01	7.5E+6	0.000	1.7E+01	1	-1.7E+01	-1	7.1E+00	1	-7.1E+00	-1	6.20E-02	
			5	5	0.06813	-2.7E+00	6.6E-02	-7.5E+6	2.000	5.2E+00	1.8E+02	7.5E+6	0.000	1.5E+01	1	-1.5E+01	-1	6.3E+00	1	-6.3E+00	-1	3.60E-02	
			6	6	0.06813	-3.3E+00	3.8E-02	-7.5E+6	2.000	6.3E+00	5.2E+02	7.5E+6	0.000	1.4E+01	1	-1.4E+01	-1	5.8E+00	1	-5.8E+00	-1	2.09E-02	
			7	7	0.06813	-3.8E+00	2.2E-02	-7.5E+6	2.000	7.3E+00	1.5E+03	7.5E+6	0.000	1.3E+01	1	-1.3E+01	-1	5.3E+00	1	-5.3E+00	-1	1.21E-02	
			8	8	0.06813	-4.3E+00	1.3E-02	-7.5E+6	2.000	8.3E+00	4.2E+03	7.5E+6	0.000	1.2E+01	1	-1.2E+01	-1	5.0E+00	1	-5.0E+00	-1	7.06E-03	
			9	9	0.06813	-4.9E+00	7.5E-03	-7.5E+6	2.000	9.4E+00	1.2E+04	7.5E+6	0.000	1.1E+01	1	-1.1E+01	-1	4.7E+00	1	-4.7E+00	-1	4.10E-03	
			10	10	0.06813	-5.4E+00	4.4E-03	-7.5E+6	2.000	1.0E+01	3.4E+04	7.5E+6	0.000	1.1E+01	1	-1.1E+01	-1	4.5E+00	1	-4.5E+00	-1	2.38E-03	
			11	11	0.06813	-6.0E+00	2.5E-03	-7.5E+6	2.000	1.1E+01	9.6E+04	7.5E+6	0.000	1.0E+01	1	-1.0E+01	-1	4.3E+00	1	-4.3E+00	-1	1.38E-03	
			12	12	0.06813	-6.5E+00	1.5E-03	-7.5E+6	2.000	1.3E+01	2.7E+05	7.5E+6	0.000	9.7E+00	1	-9.7E+00	-1	4.1E+00	1	-4.1E+00	-1	8.03E-04	
			13	13	0.06813	-7.1E+00	8.6E-04	-7.5E+6	2.000	1.4E+01	7.8E+05	7.5E+6	0.000	9.3E+00	1	-9.3E+00	-1	3.9E+00	1	-3.9E+00	-1	4.66E-04	
			14	14	0.06813	-7.6E+00	5.0E-04	-7.5E+6	2.000	1.5E+01	2.2E+06	7.5E+6	0.000	9.0E+00	1	-9.0E+00	-1	3.8E+00	1	-3.8E+00	-1	2.71E-04	
			15	15	0.06813	-8.2E+00	2.9E-04	-7.5E+6	2.000	1.6E+01	6.3E+06	7.5E+6	0.000	8.7E+00	1	-8.7E+00	-1	3.7E+00	1	-3.7E+00	-1	1.57E-04	
			16	16	0.06813	-8.7E+00	1.7E-04	-7.5E+6	2.000	1.7E+01	1.8E+07	7.5E+6	0.000	8.4E+00	1	-8.4E+00	-1	3.5E+00	1	-3.5E+00	-1	9.13E-05	
			17	17	0.06813	-9.2E+00	9.7E-05	-7.5E+6	2.000	1.8E+01	5.0E+07	7.5E+6	0.000	8.1E+00	1	-8.1E+00	-1	3.4E+00	1	-3.4E+00	-1	5.31E-05	
			18	18	0.06813	-9.8E+00	5.7E-05	-7.5E+6	2.000	1.9E+01	1.4E+08	7.5E+6	0.000	7.9E+00	1	-7.9E+00	-1	3.3E+00	1	-3.3E+00	-1	3.08E-05	
			19	19	0.06813	-1.0E+01	3.3E-05	-7.5E+6	2.000	2.0E+01	4.1E+08	7.5E+6	0.000	7.7E+00	1	-7.7E+00	-1	3.2E+00	1	-3.2E+00	-1	1.79E-05	
			20	20	0.06813	-1.1E+01	1.9E-05	-7.5E+6	2.000	2.1E+01	1.2E+09	7.5E+6	0.000	7.5E+00	1	-7.5E+00	-1	3.2E+00	1	-3.2E+00	-0.99999	1.04E-05	

Date: 21/06/2018

Version: 1.1

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Version: 1.1



Contaminant l6-C21 aromatic

DOMENICO (STEADY STATE)

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	Concentration	
Input	Value	Units														
C _T	0.09	mg/l	1	1	0.13625	-5.43E-01	5.81E-01	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	3.17E-01
			2	2	0.13625	-1.09E+00	3.37E-01	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	1.84E-01
			3	3	0.13625	-1.63E+00	1.96E-01	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	1.07E-01
Co	5.45E-01	mg/l	4	4	0.13625	-2.17E+00	1.14E-01	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	6.20E-02
λ	5.06E-07	days ⁻¹	5	5	0.13625	-2.72E+00	6.61E-02	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	3.60E-02
Sz	6.00E+01	m	6	6	0.13625	-3.26E+00	3.84E-02	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	2.09E-02
Sy	4.00E+00	m	7	7	0.13625	-3.80E+00	2.23E-02	1.27E+01	1	-1.27E+01	-1	2.67E+00	1	-2.67E+00	-0.9998	1.21E-02
Kd	7.20E+02	l/kg	8	8	0.13625	-4.35E+00	1.29E-02	1.19E+01	1	-1.19E+01	-1	2.50E+00	1	-2.50E+00	-0.9996	7.05E-03
ρ	1.60E+00	g/cm3	9	9	0.13625	-4.89E+00	7.52E-03	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.999	-2.36E+00	-0.9991	4.09E-03
n	3.70E-01		10	10	0.13625	-5.43E+00	4.37E-03	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.998	-2.24E+00	-0.9984	2.38E-03
i	1.70E-03		11	11	0.13625	-5.98E+00	2.54E-03	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.997	-2.13E+00	-0.9974	1.38E-03
K	3.02E-01	m/d	12	12	0.13625	-6.52E+00	1.47E-03	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.996	-2.04E+00	-0.9961	8.00E-04
x	2.00E+01	m	13	13	0.13625	-7.06E+00	8.56E-04	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.994	-1.96E+00	-0.9945	4.64E-04
z	0.00E+00	m	14	14	0.13625	-7.61E+00	4.97E-04	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.992	-1.89E+00	-0.9925	2.69E-04
y	0.00E+00	m	15	15	0.13625	-8.15E+00	2.89E-04	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.99	-1.83E+00	-0.9902	1.56E-04
			16	16	0.13625	-8.69E+00	1.68E-04	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.988	-1.77E+00	-0.9876	9.02E-05
ax	2.00E+00	m	17	17	0.13625	-9.24E+00	9.73E-05	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.985	-1.71E+00	-0.9847	5.22E-05
az	2.00E-01	m	18	18	0.13625	-9.78E+00	5.65E-05	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.982	-1.67E+00	-0.9816	3.02E-05
ay	2.00E-02	m	19	19	0.13625	-1.03E+01	3.28E-05	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.978	-1.62E+00	-0.9782	1.75E-05
			20	20	0.13625	-1.09E+01	1.91E-05	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.975	-1.58E+00	-0.9747	1.01E-05

Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc

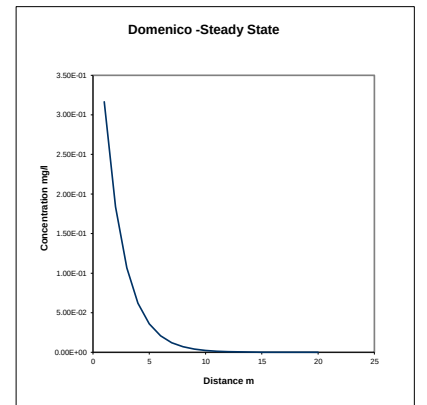
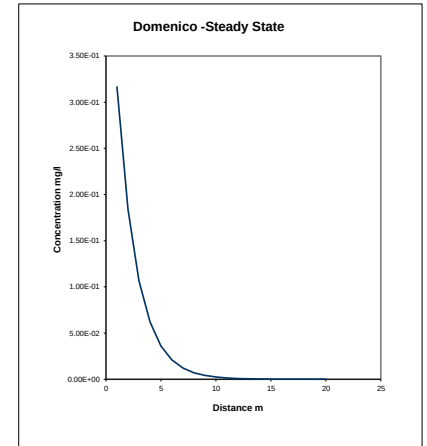
Value

DOMENICO (STEADY STATE)

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

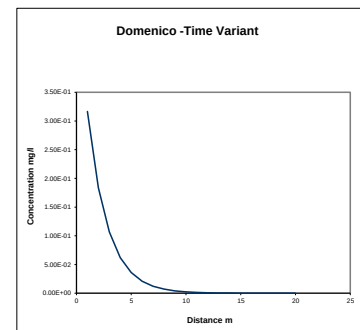
				X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
v Rc u	1.39E-03	m/d														
	3.11E+03															
	4.46E-07	m/d	1	1	0.13625	-5.43E-01	5.81E-01	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	3.17E-01
			2	2	0.13625	-1.09E+00	3.37E-01	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	1.84E-01
			3	3	0.13625	-1.63E+00	1.96E-01	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	1.07E-01
			4	4	0.13625	-2.17E+00	1.14E-01	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	6.20E-02
			5	5	0.13625	-2.72E+00	6.61E-02	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	3.60E-02
			6	6	0.13625	-3.26E+00	3.84E-02	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	2.09E-02
			7	7	0.13625	-3.80E+00	2.23E-02	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	1.21E-02
			8	8	0.13625	-4.35E+00	1.29E-02	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	7.06E-03
			9	9	0.13625	-4.89E+00	7.52E-03	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	4.10E-03
			10	10	0.13625	-5.43E+00	4.37E-03	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	2.38E-03
			11	11	0.13625	-5.98E+00	2.54E-03	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	1.38E-03
			12	12	0.13625	-6.52E+00	1.47E-03	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	8.03E-04
			13	13	0.13625	-7.06E+00	8.56E-04	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	4.66E-04
			14	14	0.13625	-7.61E+00	4.97E-04	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	2.71E-04
			15	15	0.13625	-8.15E+00	2.89E-04	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	1.57E-04
			16	16	0.13625	-8.69E+00	1.68E-04	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	9.13E-05
			17	17	0.13625	-9.24E+00	9.73E-05	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	5.31E-05
			18	18	0.13625	-9.78E+00	5.65E-05	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	3.08E-05
		19	19	0.13625	-1.03E+01	3.28E-05	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	1.79E-05	
		20	20	0.13625	-1.09E+01	1.91E-05	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	1.04E-05	
	21/06/2018															
n:	1.1															

Date: 21/06/2018
Version: 1.1



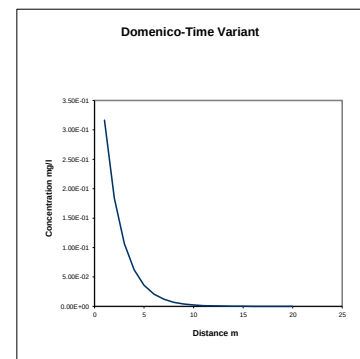
DOMENICO (TIME VARIANT)

Contaminant	16-C21 aromatic		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	Concentration	
C _T	0.09	mg/l	m															
Co	5.45E-01	mg/l	1	1	0.06813	-5.43E-01	5.81E-01	-7.46E+46	2	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	3.17E-01
			2	2	0.06813	-1.09E+00	3.37E-01	-7.46E+46	2	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	1.84E-01
			3	3	0.06813	-1.63E+00	1.96E-01	-7.46E+46	2	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	1.07E-01
λ	5.06E-07	days ⁻¹	4	4	0.06813	-2.17E+00	1.14E-01	-7.46E+46	2	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	6.20E-02
Sz	6.00E+01	m	5	5	0.06813	-2.72E+00	6.61E-02	-7.46E+46	2	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	3.60E-02
Sy	4.00E+00	m	6	6	0.06813	-3.26E+00	3.84E-02	-7.46E+46	2	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	2.09E-02
Kd	7.20E+02	l/kg	7	7	0.06813	-3.80E+00	2.23E-02	-7.46E+46	2	1.27E+01	1	-1.27E+01	-1	2.67E+00	0.9998	-2.67E+00	-1	1.21E-02
ρ	1.60E+00	g/cm3	8	8	0.06813	-4.35E+00	1.29E-02	-7.46E+46	2	1.19E+01	1	-1.19E+01	-1	2.50E+00	0.9996	-2.50E+00	-1	7.05E-03
n	3.70E-01		9	9	0.06813	-4.89E+00	7.52E-03	-7.46E+46	2	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.9991	-2.36E+00	-0.999	4.09E-03
i	1.70E-03		10	10	0.06813	-5.43E+00	4.37E-03	-7.46E+46	2	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.9984	-2.24E+00	-0.998	2.38E-03
K	3.02E-01	m/d	11	11	0.06813	-5.98E+00	2.54E-03	-7.46E+46	2	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.9974	-2.13E+00	-0.997	1.38E-03
x	2.00E+01	m	12	12	0.06813	-6.52E+00	1.47E-03	-7.46E+46	2	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.9961	-2.04E+00	-0.996	8.00E-04
z	0.00E+00	m	13	13	0.06813	-7.06E+00	8.56E-04	-7.46E+46	2	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.9945	-1.96E+00	-0.994	4.64E-04
y	0.00E+00	m	14	14	0.06813	-7.61E+00	4.97E-04	-7.46E+46	2	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.9925	-1.89E+00	-0.992	2.69E-04
t	9.90E+99	days	15	15	0.06813	-8.15E+00	2.89E-04	-7.46E+46	2	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.9902	-1.83E+00	-0.99	1.56E-04
ax	2.00E+00	m	16	16	0.06813	-8.69E+00	1.68E-04	-7.46E+46	2	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.9876	-1.77E+00	-0.988	9.02E-05
az	2.00E-01	m	17	17	0.06813	-9.24E+00	9.73E-05	-7.46E+46	2	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.9847	-1.71E+00	-0.985	5.22E-05
ay	2.00E-02	m	18	18	0.06813	-9.78E+00	5.65E-05	-7.46E+46	2	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.9816	-1.67E+00	-0.982	3.02E-05
			19	19	0.06813	-1.03E+01	3.28E-05	-7.46E+46	2	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.9782	-1.62E+00	-0.978	1.75E-05
			20	20	0.06813	-1.09E+01	1.91E-05	-7.46E+46	2	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.9747	-1.58E+00	-0.975	1.01E-05



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															Concentration
				X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	
v	1.39E-03	m/d		m														
Rc	3.11E+03		1	1	0.06813	-5.43E-01	5.81E-01	-7.46E+46	2	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	3.17E-01
u	4.46E-07	m/d	2	2	0.06813	-1.09E+00	3.37E-01	-7.46E+46	2	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	1.84E-01
			3	3	0.06813	-1.63E+00	1.96E-01	-7.46E+46	2	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	1.07E-01
			4	4	0.06813	-2.17E+00	1.14E-01	-7.46E+46	2	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	6.20E-02
			5	5	0.06813	-2.72E+00	6.61E-02	-7.46E+46	2	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	3.60E-02
			6	6	0.06813	-3.26E+00	3.84E-02	-7.46E+46	2	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	2.09E-02
			7	7	0.06813	-3.80E+00	2.23E-02	-7.46E+46	2	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	1.21E-02
			8	8	0.06813	-4.35E+00	1.29E-02	-7.46E+46	2	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	7.06E-03
			9	9	0.06813	-4.89E+00	7.52E-03	-7.46E+46	2	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	4.10E-03
			10	10	0.06813	-5.43E+00	4.37E-03	-7.46E+46	2	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	2.38E-03
			11	11	0.06813	-5.98E+00	2.54E-03	-7.46E+46	2	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	1.38E-03
			12	12	0.06813	-6.52E+00	1.47E-03	-7.46E+46	2	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	8.03E-04
			13	13	0.06813	-7.06E+00	8.56E-04	-7.46E+46	2	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	4.66E-04
			14	14	0.06813	-7.61E+00	4.97E-04	-7.46E+46	2	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	2.71E-04
			15	15	0.06813	-8.15E+00	2.89E-04	-7.46E+46	2	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	1.57E-04
			16	16	0.06813	-8.69E+00	1.68E-04	-7.46E+46	2	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	9.13E-05
			17	17	0.06813	-9.24E+00	9.73E-05	-7.46E+46	2	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	5.31E-05
			18	18	0.06813	-9.78E+00	5.65E-05	-7.46E+46	2	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	3.08E-05
	21/06/2018		19	19	0.06813	-1.03E+01	3.28E-05	-7.46E+46	2	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	1.79E-05
	1.1		20	20	0.06813	-1.09E+01	1.91E-05	-7.46E+46	2	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	1.04E-05



Date: 21/06/2018
Version: 1.1



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:	Portman Way		
Site Address:	Reading		
Completed by:	PDM	Version:	1.1
Date:	21-Jun-18		
Contaminant	C21-C35 aromatic		
Target Concentration (C _T)	9.00E-02	mg/l	Origin of C _T : WHO

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

C21-C35 aromatic
0.09 mg/l

Input Parameters
Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

2.40E-01

fraction

calculated

Air filled soil porosity

θ_a

1.84E-01

fraction

calculated

Bulk density of soil zone material

ρ

1.60E+00

g/cm³

R & D Technical report sand fill

Henry's Law constant

H

1.30E-02

dimensionless

Total Petroleum Hydrocarbon Criteria Working Group

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 soil)

f_{oc}

4.50E-02

fraction

Site data

Organic carbon partition coefficient

K_{oc}

1.30E+05

l/kg

CLAIRE 2017 Hydrocarbons in Groundwater

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

5.85E+03

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

5.27E+02

mg/kg

(for comparison with soil analyses)

or

0.09

mg/l

(for comparison with leachate test results)

Site being assessed: Portman Way

Completed by: PDM

Date: 21-Jun-18

Version: 1.1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T C21-C35 aromatic
0.09 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
Area of contaminant source

Inf
A

4.40E-04
1.50E+02

m/d
m²

96-2000 30% pf values River Thames at Reading 70%
Area of boiler house and tank farm

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow
Saturated aquifer thickness
Hydraulic Conductivity of aquifer in which dilution occurs
Hydraulic gradient of water table
Width of contaminant source perpendicular to groundwater flow
Background concentration of contaminant in groundwater beneath site

L
da
K
i
w
Cu

3.00E+01
8.00E+01
3.02E-01
1.70E-03
6.00E+01
0.00E+00

m
m
m/d
fraction
m
mg/l

Width of source area between PH2 and PH6
assumed vale to base of chalk
Site data
Estimate
Length of source area between PH2 and PH6
Estimated

Not used in calculation

Define mixing zone depth by specifying or calculating depth (using pull down list)

Enter mixing zone thickness
Calculated mixing zone thickness

Mz
Mz

Calculate
2.51E+01

m
m

Calculated Parameters

Dilution Factor

DF

1.98E+00

Level 2 Remedial Target

1.78E-01

mg/l

or

1.04E+03

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)

C_c

0.00E+00

mg/l

Calculated concentration within receptor (dilution only)

0.00E+00

mg/l

0

Site being assessed: Portman Way
Completed by: PDM
Date: 21-Jun-18
Version: 1.1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

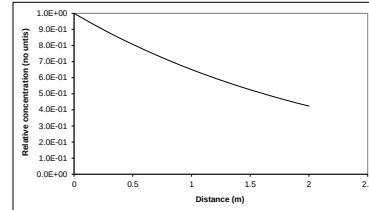
See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		C21-C35 aromatic		from Level 1
Target Concentration	C _t	0.09	mg/l	from Level 1
Dilution Factor	DF	1.98E+00		from Level 2

Enter method of defining partition co-efficient (using pull down list)
Calculate for non-polar organic chemicals

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	4.50E-02 fraction
Organic carbon partition coefficient	Koc	1.30E+05 l/kg
Entry for ionic organic chemicals (option)		
Sorption coefficient for related species	K _{oc,li}	
Sorption coefficient for ionised species	K _{oc,li}	
pH value	pH	
Acid dissociation constant	pKa	
Fraction of organic carbon in aquifer	foc	
Soil water partition coefficient	Kd	5.85E+03 l/kg



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	Relative concentration	Concentration
Distance	(No units)	mg/l
0	1.0E+00	6.73E-02
0.1	9.58E-01	6.45E-02
0.2	9.18E-01	6.17E-02
0.3	8.79E-01	5.91E-02
0.4	8.42E-01	5.67E-02
0.5	8.07E-01	5.43E-02
0.6	7.73E-01	5.20E-02
0.7	7.40E-01	4.98E-02
0.8	7.09E-01	4.77E-02
0.9	6.79E-01	4.57E-02
1.0	6.51E-01	4.38E-02
1.1	6.23E-01	4.19E-02
1.2	5.97E-01	4.02E-02
1.3	5.72E-01	3.85E-02
1.4	5.48E-01	3.69E-02
1.5	5.25E-01	3.53E-02
1.6	5.03E-01	3.38E-02
1.7	4.82E-01	3.24E-02
1.8	4.61E-01	3.11E-02
1.9	4.42E-01	2.97E-02
2.0	4.23E-01	2.85E-02

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 dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Enter source concentration			
Enter soil concentration	779	mg/kg	Soil concentration as mg/kg
Half life for degradation of contaminant in water	t _{1/2}	days	Handbook of Environmental Degradation Rates
Calculated decay rate	λ	days ⁻¹	calculated
Width of plume in aquifer at source	Sz	m	from Level 2
Plume thickness in aquifer at source	Sy	m	from Level 2
Bulk density of aquifer materials	ρ	g/cm ³	R & D Technical Report P13
Effective porosity of aquifer	n	fraction	Consim
Hydraulic gradient	i	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	m/d	from Level 2
Distance to compliance point	x	m	Estimated Depth to water table
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	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	5.85E+03	l/kg see options
Longitudinal dispersivity	ax	0.200	m see options
Transverse dispersivity	az	0.020	m see options
Vertical dispersivity	av	0.002	m see options

Parameter values should be checked against Level 1 and 2

Define dispersivity (click brown cell and use pull down list)
Dispersivities 10%, 1%, 0.1% of pathway length

Longitudinal dispersivity	ax	0.00E+00	2.00E-01	4.58E-02	m
Transverse dispersivity	az	0.00E+00	2.00E-02	4.58E-03	m
Vertical dispersivity	ay	0.00E+00	2.00E-03	4.58E-04	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀)^{0.414}; 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 O₂, NO₃, SO₄ etc than an alternative solution should be used

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.

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	v	2.81E-03 m/d
Retardation factor	Rf	2.53E+04 fraction
Decay rate used	λ	5.18E-08 d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.44E-03 fraction
Rate of contaminant flow due to retardation	u	1.11E-07 m/d
Ratio of Compliance Point to Source Concentration	C ₁₀ /C ₀	4.23E-01 fraction
Attenuation factor (C ₁₀ /C ₁₀₀)	AF	2.36E+00 fraction
Calculated soil leachate concentration	Co	1.33E-01 mg/l

Remedial Targets

Level 3 Remedial Target	4.21E-01	mg/l	For comparison with measured pore water concentration.
Ogata Banks	2.46E+03	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2	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 ₁₀ /C ₀	4.23E-01	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

Site being assessed:	Portman Way
Completed by:	PDM
Date:	#####
Version:	1.1

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters
Soil contaminant concentration C_0 2.00E-01 mg/kg

Level 1 Parameters

Water filled soil porosity	θ_w	2.40E-01	fraction
Air filled soil porosity	θ_a	1.84E-01	fraction
Bulk density	ρ	1.60E+00	g/cm ³
Henry's Law constant	H	1.30E-02	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	5.85E+03	l/kg
Factor (partitioning between soil and water)		5.85E+03	dimensionless

Level 2 Parameters

Dilution Factor DF 1.98E+00

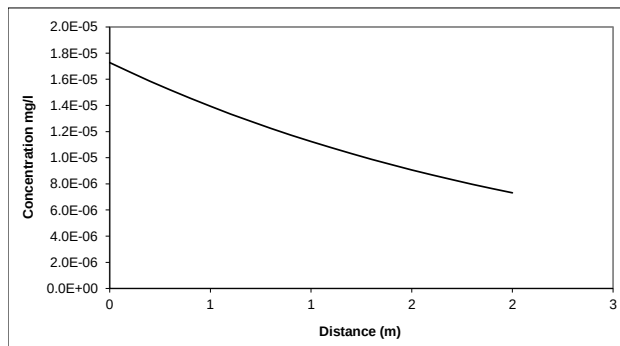
Level 3 Parameters

Attenuation factor (C_0/C_{ED}) AF 2.36E+00

Predicted concentrations at compliance point

Level 1	C	3.42E-05 mg/l	No dilution or attenuation
Level 2	C	1.73E-05 mg/l	Dilution taken into account
Level 3	C	7.32E-06 mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	1.73E-05
0.10	1.65E-05
0.20	1.59E-05
0.30	1.52E-05
0.40	1.45E-05
0.50	1.39E-05
0.60	1.33E-05
0.70	1.28E-05
0.80	1.23E-05
0.90	1.17E-05
1.00	1.12E-05
1.10	1.08E-05
1.20	1.03E-05
1.30	9.88E-06
1.40	9.47E-06
1.50	9.07E-06
1.60	8.69E-06
1.70	8.32E-06
1.80	7.97E-06
1.90	7.64E-06
2.00	7.32E-06

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	C ₁	C21-C35 aromatic	mg/l	from Level 1
Target Concentration	C _T	9.00E-02	mg/l	from Level 1

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

Ogata Banks	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	8.00E-03	mg/l	Site data
Half life for degradation of contaminant in water	t _{1/2}	7.12E+02	days	Canada Wide Standards for PHC in Soils
Calculated decay rate	λ	9.74E-04	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.00E+01	m	Estimated from site data
Plume thickness at source	Sy	4.00E+00	m	to top of chalk
Saturated aquifer thickness	da	8.00E+01	m	Estimated from site data
Bulk density of aquifer materials	ρ	1.60E+00	g/cm ³	Consim
Effective porosity of aquifer	n	3.70E-01	fraction	Consim
Hydraulic gradient	i	1.70E-03	fraction	Estimate from site data
Hydraulic conductivity of aquifer	K	3.02E-01	m/d	Site data
Distance to compliance point	x	2.00E+01	m	Distance to site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	5.85E+03	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	1.39E-03	m/d
Retardation factor	Rf	2.53E+04	fraction
Decay rate used	λ	3.85E-08	d ⁻¹
Rate of contaminant flow due to retardation	u	5.49E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	3.12E-06	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	2.57E+03	

Remedial Targets

Remedial Target	2.31E+02	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	3.12E-06	mg/l
		9.9E+99	days

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)

Calculate for non-polar organic chemicals

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		l/kg
foc	4.50E-02	fraction
Koc	1.30E+05	l/kg
K _{oc,m}		l/kg
K _{oc,i}		l/kg
pH		
pKa		
foc		fraction
Kd	5.85E+03	l/kg

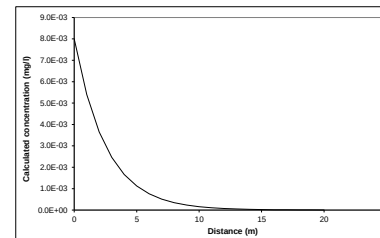
Define dispersivity (click brown cell and use pull down list)

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-01	m
Vertical dispersivity	ay	0.00E+00	2.00E-01	1.57E-02	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(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

Site being assessed: Portman Way
Completed by: PDM
Date: 21/06/2018
Version: 1.1

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	15.00	% wt	(Change this number only if you have specific information)
Particle Density	2.78	tonnes/m ³	
Dry Bulk Density	1.60	tonnes/m ³	
Calculated Parameters			
Voids Ratio	0.74	fraction	
Initial Saturation	56.54	%	
Total porosity	0.424	fraction	
Air Filled Porosity	0.184	fraction	
Water Filled Porosity	0.240	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	1.000	fraction	#DIV/0!
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

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 C21-C35 aromatic

Parameter (carried over from input sheet)	Value	Units	Calculations (Refer toTable 4.3, R&D Publication 20)															
			Selected option		Calculate for non-polar organic chemicals													
				calc	calc	Calc Kd l/kg												
C _T	9.00E-02	mg/l	Calculation of partition coefficient															
Kd	5.85E+03	l/kg	for ionic organic chemical															
foc	4.50E-02	fraction																
koc	1.30E+05	l/kg	Partition coefficient used in Level 1 Assessment															
θ _w	2.40E-01	fraction																
θ _a	1.84E-01	fraction																
ρ	1.60E+00	g/cm3																
H	1.30E-02	dimensionless	Factor (partitioning between soil and water)															
Koc,n		l/kg																
Koc,i		l/kg																
pH		pH units																
pKa																		
foc (ionic)		fraction																
			<table><tr><td>Calculated Remedial Target</td><td>5.27E+02 mg/kg</td><td>for C21-C35 aromatic</td></tr></table>				Calculated Remedial Target	5.27E+02 mg/kg	for C21-C35 aromatic									
Calculated Remedial Target	5.27E+02 mg/kg	for C21-C35 aromatic																
			<table><tr><td>Site being assessed:</td><td colspan="2">Portman Way</td></tr><tr><td>Completed by:</td><td colspan="2">PDM</td></tr><tr><td>Date:</td><td colspan="2">21/06/2018</td></tr><tr><td>Version:</td><td colspan="2">1.1</td></tr></table>				Site being assessed:	Portman Way		Completed by:	PDM		Date:	21/06/2018		Version:	1.1	
Site being assessed:	Portman Way																	
Completed by:	PDM																	
Date:	21/06/2018																	
Version:	1.1																	

Level 2 Calculation Sheet

Contaminant C21-C35 aromatic

Site assessed:	Portman Way
Date:	21/06/2018
Version:	1.1

Parameter **Value** **Units**
(carried over from input sheet)

Mz	2.51E+01	m
L	3.00E+01	m
da	8.00E+01	m
Inf	4.40E-04	m/d
K	3.02E-01	m/d
i	1.70E-03	m3/d
A	1.50E+02	m2
Cc	0.00E+00	mg/l
C _T	9.00E-02	mg/l
Cu	0.00E+00	mg/l
w	6.00E+01	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Calculated
Dilution Factor

1.98E+00

#DIV/0!



Ogata Banks - Time Variant

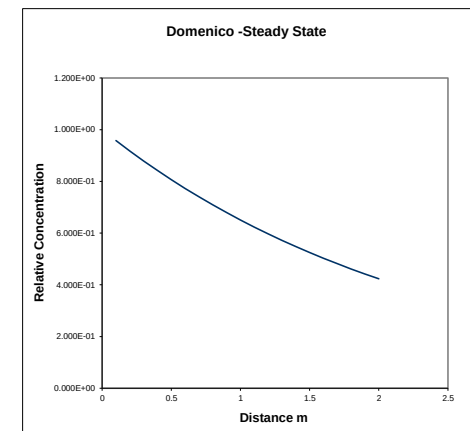
Distance m	Relative Concentration
0.1	0.95
0.5	0.78
1.0	0.65
1.5	0.52
2.0	0.42

Contaminant **1-C35 aromatic**

DOMENICO (STEADY STATE)

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	9.000E-02	mg/l	1	0.1	0.25	-4.30E-02	9.58E-01	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.579E-01
DF	1.979E+00		2	0.2	0.25	-8.59E-02	9.18E-01	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	9.177E-01
			3	0.3	0.25	-1.29E-01	8.79E-01	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	8.791E-01
			4	0.4	0.25	-1.72E-01	8.42E-01	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	8.421E-01
λ	5.179E-08	days ⁻¹	5	0.5	0.25	-2.15E-01	8.07E-01	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	8.067E-01
Sz	6.000E+01	m	6	0.6	0.25	-2.58E-01	7.73E-01	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	7.728E-01
Sy	2.514E+01	m	7	0.7	0.25	-3.01E-01	7.40E-01	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	7.403E-01
Kd	5.850E+03	l/kg	8	0.8	0.25	-3.44E-01	7.09E-01	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	7.091E-01
ρ	1.600E+00	g/cm3	9	0.9	0.25	-3.87E-01	6.79E-01	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	6.793E-01
n	3.700E-01		10	1	0.25	-4.30E-01	6.51E-01	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	6.508E-01
i	3.436E-03		11	1.1	0.25	-4.73E-01	6.23E-01	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	6.234E-01
K	3.024E-01	m/d	12	1.2	0.25	-5.16E-01	5.97E-01	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	5.972E-01
x	2.000E+00	m	13	1.3	0.25	-5.59E-01	5.72E-01	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	5.721E-01
z	0.000E+00	m	14	1.4	0.25	-6.01E-01	5.48E-01	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	5.480E-01
y	0.000E+00	m	15	1.5	0.25	-6.44E-01	5.25E-01	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	5.250E-01
ax	2.000E-01	m	16	1.6	0.25	-6.87E-01	5.03E-01	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	5.029E-01
az	2.000E-02	m	17	1.7	0.25	-7.30E-01	4.82E-01	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	4.817E-01
ay	2.000E-03	m	18	1.8	0.25	-7.73E-01	4.61E-01	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	4.615E-01
			19	1.9	0.25	-8.16E-01	4.42E-01	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	4.421E-01
			20	2	0.25	-8.59E-01	4.23E-01	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	4.235E-01



Calc

Value

DOMENICO (STEADY STATE)

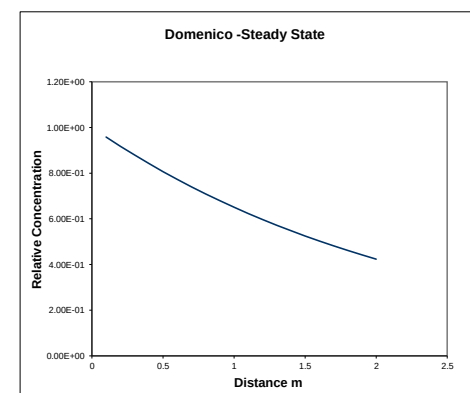
Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	2.81E-03	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration	
Rc	2.53E+04															
u	1.11E-07	m/d	1	0.1	0.25	-4.30E-02	9.58E-01	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.58E-01
			2	0.2	0.25	-8.59E-02	9.18E-01	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	9.18E-01
			3	0.3	0.25	-1.29E-01	8.79E-01	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	8.79E-01
			4	0.4	0.25	-1.72E-01	8.42E-01	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	8.42E-01
			5	0.5	0.25	-2.15E-01	8.07E-01	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	8.07E-01
			6	0.6	0.25	-2.58E-01	7.73E-01	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	7.73E-01
			7	0.7	0.25	-3.01E-01	7.40E-01	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	7.40E-01
			8	0.8	0.25	-3.44E-01	7.09E-01	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	7.09E-01
			9	0.9	0.25	-3.87E-01	6.79E-01	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	6.79E-01
			10	1	0.25	-4.30E-01	6.51E-01	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	6.51E-01
			11	1.1	0.25	-4.73E-01	6.23E-01	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	6.23E-01
			12	1.2	0.25	-5.16E-01	5.97E-01	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	5.97E-01
			13	1.3	0.25	-5.59E-01	5.72E-01	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	5.72E-01
			14	1.4	0.25	-6.01E-01	5.48E-01	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	5.48E-01
			15	1.5	0.25	-6.44E-01	5.25E-01	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	5.25E-01
			16	1.6	0.25	-6.87E-01	5.03E-01	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	5.03E-01
			17	1.7	0.25	-7.30E-01	4.82E-01	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	4.82E-01
			18	1.8	0.25	-7.73E-01	4.61E-01	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	4.61E-01
			19	1.9	0.25	-8.16E-01	4.42E-01	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	4.42E-01
			20	2	0.25	-8.59E-01	4.23E-01	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	4.23E-01

21/06/2018

1.1

Relative Concentration



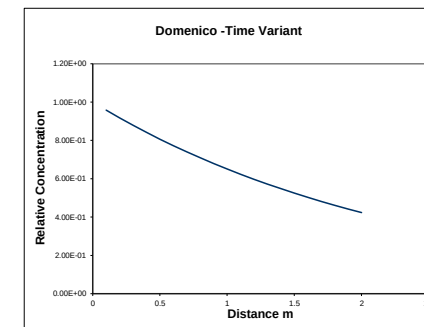
Date: 21/06/2018
Version: 1.1

DOMENICO (TIME VARIANT)

Contaminant 21-C35 aromatic

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	0.09	mg/l	1	0.1	0.125	-4.30E-02	9.58E-01	-1.38E+46	2	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.58E-01
DF	1.9790		2	0.2	0.125	-8.59E-02	9.18E-01	-1.38E+46	2	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	9.18E-01
			3	0.3	0.125	-1.29E-01	8.79E-01	-1.38E+46	2	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	8.79E-01
			4	0.4	0.125	-1.72E-01	8.42E-01	-1.38E+46	2	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	8.42E-01
λ	5.179E-08	days ⁻¹	5	0.5	0.125	-2.15E-01	8.07E-01	-1.38E+46	2	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	8.07E-01
Sz	6.000E+01	m	6	0.6	0.125	-2.58E-01	7.73E-01	-1.38E+46	2	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	7.73E-01
Sy	2.514E+01	m	7	0.7	0.125	-3.01E-01	7.40E-01	-1.38E+46	2	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	7.40E-01
Kd	5.850E+03	l/kg	8	0.8	0.125	-3.44E-01	7.09E-01	-1.38E+46	2	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	7.09E-01
ρ	1.600E+00	g/cm3	9	0.9	0.125	-3.87E-01	6.79E-01	-1.38E+46	2	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	6.79E-01
n	3.700E-01		10	1	0.125	-4.30E-01	6.51E-01	-1.38E+46	2	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	6.51E-01
i	3.436E-03		11	1.1	0.125	-4.73E-01	6.23E-01	-1.38E+46	2	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	6.23E-01
K	3.024E-01	m/d	12	1.2	0.125	-5.16E-01	5.97E-01	-1.38E+46	2	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	5.97E-01
x	2.000E+00	m	13	1.3	0.125	-5.59E-01	5.72E-01	-1.38E+46	2	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	5.72E-01
z	0.000E+00	m	14	1.4	0.125	-6.01E-01	5.48E-01	-1.38E+46	2	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	5.48E-01
y	0.000E+00	m	15	1.5	0.125	-6.44E-01	5.25E-01	-1.38E+46	2	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	5.25E-01
t	1.000E+99	days	16	1.6	0.125	-6.87E-01	5.03E-01	-1.38E+46	2	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	5.03E-01
ax	2.000E-01	m	17	1.7	0.125	-7.30E-01	4.82E-01	-1.38E+46	2	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	4.82E-01
az	2.000E-02	m	18	1.8	0.125	-7.73E-01	4.61E-01	-1.38E+46	2	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	4.61E-01
ay	2.000E-03	m	19	1.9	0.125	-8.16E-01	4.42E-01	-1.38E+46	2	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	4.42E-01
			20	2	0.125	-8.59E-01	4.23E-01	-1.38E+46	2	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	4.23E-01

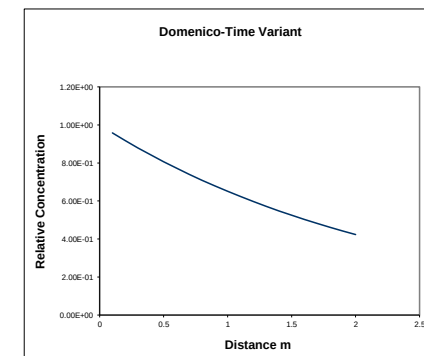


Calc

Value

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

		Calculated Relative Concentration of Top 40 Compounds (Relative to 1,1,1-Trichloroethane = 1.0000000000000000)																
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration	
v	2.81E-03	m/d	m															
Rc	2.53E+04		1	0.1	0.125	-4.30E-02	9.58E-01	-1.38E+46	2	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.58E-01
u	1.11E-07	m/d	2	0.2	0.125	-8.59E-02	9.18E-01	-1.38E+46	2	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	9.18E-01
			3	0.3	0.125	-1.29E-01	8.79E-01	-1.38E+46	2	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	8.79E-01
			4	0.4	0.125	-1.72E-01	8.42E-01	-1.38E+46	2	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	8.42E-01
			5	0.5	0.125	-2.15E-01	8.07E-01	-1.38E+46	2	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	8.07E-01
			6	0.6	0.125	-2.58E-01	7.73E-01	-1.38E+46	2	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	7.73E-01
			7	0.7	0.125	-3.01E-01	7.40E-01	-1.38E+46	2	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	7.40E-01
			8	0.8	0.125	-3.44E-01	7.09E-01	-1.38E+46	2	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	7.09E-01
			9	0.9	0.125	-3.87E-01	6.79E-01	-1.38E+46	2	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	6.79E-01
			10	1	0.125	-4.30E-01	6.51E-01	-1.38E+46	2	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	6.51E-01
			11	1.1	0.125	-4.73E-01	6.23E-01	-1.38E+46	2	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	6.23E-01
			12	1.2	0.125	-5.16E-01	5.97E-01	-1.38E+46	2	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	5.97E-01
			13	1.3	0.125	-5.59E-01	5.72E-01	-1.38E+46	2	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	5.72E-01
			14	1.4	0.125	-6.01E-01	5.48E-01	-1.38E+46	2	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	5.48E-01
			15	1.5	0.125	-6.44E-01	5.25E-01	-1.38E+46	2	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	5.25E-01
			16	1.6	0.125	-6.87E-01	5.03E-01	-1.38E+46	2	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	5.03E-01
			17	1.7	0.125	-7.30E-01	4.82E-01	-1.38E+46	2	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	4.82E-01
			18	1.8	0.125	-7.73E-01	4.61E-01	-1.38E+46	2	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	4.61E-01
			19	1.9	0.125	-8.16E-01	4.42E-01	-1.38E+46	2	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	4.42E-01
			20	2	0.125	-8.59E-01	4.23E-01	-1.38E+46	2	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	4.23E-01



Date: 21/06/2018
Version: 1.1

Contaminant		:21-C35 aromatic		OGATA BANKS SOLUTION																			
				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	0.09	mg/l	1	1	0.001	-3.9E-01	6.8E-01	-2.1E+06	2.000	8.9E-01	2.4E+00	2.1E+06	0.000	3.4E+01	1	-3.4E+01	-1	7.1E+00	1	-7.1E+00	-1	5.40E-03	
			2	2	0.001	-7.9E-01	4.6E-01	-2.1E+06	2.000	1.8E+00	6.0E+00	2.1E+06	0.000	2.4E+01	1	-2.4E+01	-1	5.0E+00	1	-5.0E+00	-1	3.65E-03	
			3	3	0.001	-1.2E+00	3.1E-01	-2.1E+06	2.000	2.7E+00	1.5E+01	2.1E+06	0.000	1.9E+01	1	-1.9E+01	-1	4.1E+00	1	-4.1E+00	-1	2.46E-03	
Co	8.00E-03	mg/l	4	4	0.001	-1.6E+00	2.1E-01	-2.1E+06	2.000	3.6E+00	3.6E+01	2.1E+06	0.000	1.7E+01	1	-1.7E+01	-1	3.5E+00	1	-3.5E+00	-1	1.66E-03	
λ	3.85E-08	days ⁻¹	5	5	0.001	-2.0E+00	1.4E-01	-2.1E+06	2.000	4.5E+00	8.7E+01	2.1E+06	0.000	1.5E+01	1	-1.5E+01	-1	3.2E+00	1	-3.2E+00	-0.99999	1.12E-03	
Sz	6.00E+01	m	6	6	0.001	-2.4E+00	9.5E-02	-2.1E+06	2.000	5.4E+00	2.1E+02	2.1E+06	0.000	1.4E+01	1	-1.4E+01	-1	2.9E+00	1	-2.9E+00	-0.99996	7.59E-04	
Sy	4.00E+00	m	7	7	0.001	-2.7E+00	6.4E-02	-2.1E+06	2.000	6.2E+00	5.2E+02	2.1E+06	0.000	1.3E+01	1	-1.3E+01	-1	2.7E+00	0.9998	-2.7E+00	-0.99984	5.12E-04	
Kd	5.85E+03	l/kg	8	8	0.001	-3.1E+00	4.3E-02	-2.1E+06	2.000	7.1E+00	1.3E+03	2.1E+06	0.000	1.2E+01	1	-1.2E+01	-1	2.5E+00	0.9996	-2.5E+00	-0.99959	3.46E-04	
ρ	1.60E+00	g/cm3	9	9	0.001	-3.5E+00	2.9E-02	-2.1E+06	2.000	8.0E+00	3.1E+03	2.1E+06	0.000	1.1E+01	1	-1.1E+01	-1	2.4E+00	0.9991	-2.4E+00	-0.99914	2.34E-04	
n	3.70E-01	m	10	10	0.001	-3.9E+00	2.0E-02	-2.1E+06	2.000	8.9E+00	7.5E+03	2.1E+06	0.000	1.1E+01	1	-1.1E+01	-1	2.2E+00	0.9984	-2.2E+00	-0.99843	1.58E-04	
i	1.70E-03	m	11	11	0.001	-4.3E+00	1.3E-02	-2.1E+06	2.000	9.8E+00	1.8E+04	2.1E+06	0.000	1.0E+01	1	-1.0E+01	-1	2.1E+00	0.9974	-2.1E+00	-0.99743	1.06E-04	
K	3.02E-01	m/d	12	12	0.001	-4.7E+00	9.0E-03	-2.1E+06	2.000	1.1E+01	4.5E+04	2.1E+06	0.000	9.7E+00	1	-9.7E+00	-1	2.0E+00	0.9961	-2.0E+00	-0.99611	7.17E-05	
x	2.00E+01	m	13	13	0.001	-5.1E+00	6.1E-03	-2.1E+06	2.000	1.2E+01	1.1E+05	2.1E+06	0.000	9.3E+00	1	-9.3E+00	-1	2.0E+00	0.9945	-2.0E+00	-0.99445	4.84E-05	
z	0.00E+00	m	14	14	0.001	-5.5E+00	4.1E-03	-2.1E+06	2.000	1.2E+01	2.7E+05	2.1E+06	0.000	9.0E+00	1	-9.0E+00	-1	1.9E+00	0.9925	-1.9E+00	-0.99247	3.26E-05	
y	0.00E+00	m	15	15	0.001	-5.9E+00	2.8E-03	-2.1E+06	2.000	1.3E+01	6.5E+05	2.1E+06	0.000	8.7E+00	1	-8.7E+00	-1	1.8E+00	0.9902	-1.8E+00	-0.99018	2.20E-05	
t	9.90E+99	days	16	16	0.001	-6.3E+00	1.9E-03	-2.1E+06	2.000	1.4E+01	1.6E+06	2.1E+06	0.000	8.4E+00	1	-8.4E+00	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	1.48E-05	
ax	2.00E+00	m	17	17	0.001	-6.7E+00	1.3E-03	-2.1E+06	2.000	1.5E+01	3.9E+06	2.1E+06	0.000	8.1E+00	1	-8.1E+00	-1	1.7E+00	0.9847	-1.7E+00	-0.98471	9.96E-06	
az	2.00E-01	m	18	18	0.001	-7.1E+00	8.5E-04	-2.1E+06	2.000	1.6E+01	9.5E+06	2.1E+06	0.000	7.9E+00	1	-7.9E+00	-1	1.7E+00	0.9816	-1.7E+00	-0.98158	6.71E-06	
ay	2.00E-02	m	19	19	0.001	-7.5E+00	5.8E-04	-2.1E+06	2.000	1.7E+01	2.3E+07	2.1E+06	0.000	7.7E+00	1	-7.7E+00	-1	1.6E+00	0.9782	-1.6E+00	-0.97822	4.51E-06	
			20	20	0.001	-7.9E+00	3.9E-04	-2.1E+06	2.000	1.8E+01	5.7E+07	2.1E+06	0.000	7.5E+00	1	-7.5E+00	-1	1.6E+00	0.9747	-1.6E+00	-0.97465	3.04E-06	

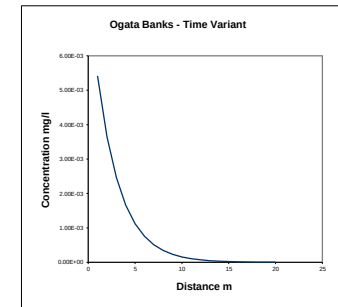
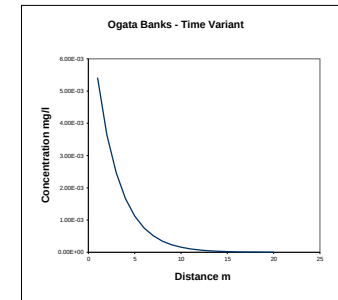
Vertical dispersion option Simulate vertical dispersion in 1 direction

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	1.39E-03	m/d		1	1	0.001	-3.9E-01	6.8E-01	-2.1E+06	2.000	8.9E-01	2.4E+00	2.1E+06	0.000	3.4E+01	1	-3.4E+01	-1	1.4E+01	1	-1.4E+01	-1	5.40E-03
Rc	2.53E+04			2	2	0.001	-7.9E-01	4.6E-01	-2.1E+06	2.000	1.8E+00	6.0E+00	2.1E+06	0.000	2.4E+01	1	-2.4E+01	-1	1.0E+01	1	-1.0E+01	-1	3.65E-03
u	5.49E-08	m/d		3	3	0.001	-1.2E+00	3.1E-01	-2.1E+06	2.000	2.7E+00	1.5E+01	2.1E+06	0.000	1.9E+01	1	-1.9E+01	-1	8.2E+00	1	-8.2E+00	-1	2.46E-03
				4	4	0.001	-1.6E+00	2.1E-01	-2.1E+06	2.000	3.6E+00	3.6E+01	2.1E+06	0.000	1.7E+01	1	-1.7E+01	-1	7.1E+00	1	-7.1E+00	-1	1.66E-03
				5	5	0.001	-2.0E+00	1.4E-01	-2.1E+06	2.000	4.5E+00	8.7E+01	2.1E+06	0.000	1.5E+01	1	-1.5E+01	-1	6.3E+00	1	-6.3E+00	-1	1.12E-03
				6	6	0.001	-2.4E+00	9.5E-02	-2.1E+06	2.000	5.4E+00	2.1E+02	2.1E+06	0.000	1.4E+01	1	-1.4E+01	-1	5.8E+00	1	-5.8E+00	-1	7.59E-04
				7	7	0.001	-2.7E+00	6.4E-02	-2.1E+06	2.000	6.2E+00	5.2E+02	2.1E+06	0.000	1.3E+01	1	-1.3E+01	-1	5.3E+00	1	-5.3E+00	-1	5.13E-04
				8	8	0.001	-3.1E+00	4.3E-02	-2.1E+06	2.000	7.1E+00	1.3E+03	2.1E+06	0.000	1.2E+01	1	-1.2E+01	-1	5.0E+00	1	-5.0E+00	-1	3.46E-04
				9	9	0.001	-3.5E+00	2.9E-02	-2.1E+06	2.000	8.0E+00	3.1E+03	2.1E+06	0.000	1.1E+01	1	-1.1E+01	-1	4.7E+00	1	-4.7E+00	-1	2.34E-04
				10	10	0.001	-3.9E+00	2.0E-02	-2.1E+06	2.000	8.9E+00	7.5E+03	2.1E+06	0.000	1.1E+01	1	-1.1E+01	-1	4.5E+00	1	-4.5E+00	-1	1.58E-04
				11	11	0.001	-4.3E+00	1.3E-02	-2.1E+06	2.000	9.8E+00	1.8E+04	2.1E+06	0.000	1.0E+01	1	-1.0E+01	-1	4.3E+00	1	-4.3E+00	-1	1.07E-04
				12	12	0.001	-4.7E+00	9.0E-03	-2.1E+06	2.000	1.1E+01	4.5E+04	2.1E+06	0.000	9.7E+00	1	-9.7E+00	-1	4.1E+00	1	-4.1E+00	-1	7.20E-05
				13	13	0.001	-5.1E+00	6.1E-03	-2.1E+06	2.000	1.2E+01	1.1E+05	2.1E+06	0.000	9.3E+00	1	-9.3E+00	-1	3.9E+00	1	-3.9E+00	-1	4.86E-05
				14	14	0.001	-5.5E+00	4.1E-03	-2.1E+06	2.000	1.2E+01	2.7E+05	2.1E+06	0.000	9.0E+00	1	-9.0E+00	-1	3.8E+00	1	-3.8E+00	-1	3.28E-05
				15	15	0.001	-5.9E+00	2.8E-03	-2.1E+06	2.000	1.3E+01	6.5E+05	2.1E+06	0.000	8.7E+00	1	-8.7E+00	-1	3.7E+00	1	-3.7E+00	-1	2.22E-05
				16	16	0.001	-6.3E+00	1.9E-03	-2.1E+06	2.000	1.4E+01	1.6E+06	2.1E+06	0.000	8.4E+00	1	-8.4E+00	-1	3.5E+00	1	-3.5E+00	-1	1.50E-05
				17	17	0.001	-6.7E+00	1.3E-03	-2.1E+06	2.000	1.5E+01	3.9E+06	2.1E+06	0.000	8.1E+00	1	-8.1E+00	-1	3.4E+00	1	-3.4E+00	-1	1.01E-05
				18	18	0.001	-7.1E+00	8.5E-04	-2.1E+06	2.000	1.6E+01	9.5E+06	2.1E+06	0.000	7.9E+00	1	-7.9E+00	-1	3.3E+00	1	-3.3E+00	-1	6.83E-06
				19	19	0.001	-7.5E+00	5.8E-04	-2.1E+06	2.000	1.7E+01	2.3E+07	2.1E+06	0.000	7.7E+00	1	-7.7E+00	-1	3.2E+00	1	-3.2E+00	-1	4.61E-06
				20	20	0.001	-7.9E+00	3.9E-04	-2.1E+06	2.000	1.8E+01	5.7E+07	2.1E+06	0.000	7.5E+00	1	-7.5E+00	-1	3.2E+00	1	-3.2E+00	-0.99999	3.12E-06

Date: 21/06/2018

Version: 1.1

Date: 21/06/2018
Version: 1.1



Contaminant **1-C35 aromatic**

DOMENICO (STEADY STATE)

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	0.09	mg/l	1	1	0.002	-3.93E-01	6.75E-01	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	5.40E-03
			2	2	0.002	-7.85E-01	4.56E-01	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	3.65E-03
			3	3	0.002	-1.18E+00	3.08E-01	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	2.46E-03
Co	8.00E-03	mg/l	4	4	0.002	-1.57E+00	2.08E-01	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	1.66E-03
λ	3.85E-08	days ⁻¹	5	5	0.002	-1.96E+00	1.40E-01	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	1.12E-03
Sz	6.00E+01	m	6	6	0.002	-2.36E+00	9.49E-02	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	7.59E-04
Sy	4.00E+00	m	7	7	0.002	-2.75E+00	6.41E-02	1.27E+01	1	-1.27E+01	-1	2.67E+00	1	-2.67E+00	-0.9998	5.12E-04
Kd	5.85E+03	l/kg	8	8	0.002	-3.14E+00	4.33E-02	1.19E+01	1	-1.19E+01	-1	2.50E+00	1	-2.50E+00	-0.9996	3.46E-04
ρ	1.60E+00	g/cm3	9	9	0.002	-3.53E+00	2.92E-02	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.999	-2.36E+00	-0.9991	2.34E-04
n	3.70E-01		10	10	0.002	-3.93E+00	1.97E-02	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.998	-2.24E+00	-0.9984	1.58E-04
i	1.70E-03		11	11	0.002	-4.32E+00	1.33E-02	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.997	-2.13E+00	-0.9974	1.06E-04
K	3.02E-01	m/d	12	12	0.002	-4.71E+00	9.00E-03	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.996	-2.04E+00	-0.9961	7.17E-05
x	2.00E+01	m	13	13	0.002	-5.10E+00	6.08E-03	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.994	-1.96E+00	-0.9945	4.84E-05
z	0.00E+00	m	14	14	0.002	-5.50E+00	4.11E-03	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.992	-1.89E+00	-0.9925	3.26E-05
y	0.00E+00	m	15	15	0.002	-5.89E+00	2.77E-03	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.99	-1.83E+00	-0.9902	2.20E-05
			16	16	0.002	-6.28E+00	1.87E-03	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.988	-1.77E+00	-0.9876	1.48E-05
ax	2.00E+00	m	17	17	0.002	-6.67E+00	1.26E-03	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.985	-1.71E+00	-0.9847	9.96E-06
az	2.00E-01	m	18	18	0.002	-7.07E+00	8.54E-04	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.982	-1.67E+00	-0.9816	6.71E-06
ay	2.00E-02	m	19	19	0.002	-7.46E+00	5.77E-04	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.978	-1.62E+00	-0.9782	4.51E-06
			20	20	0.002	-7.85E+00	3.89E-04	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.975	-1.58E+00	-0.9747	3.04E-06

Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc

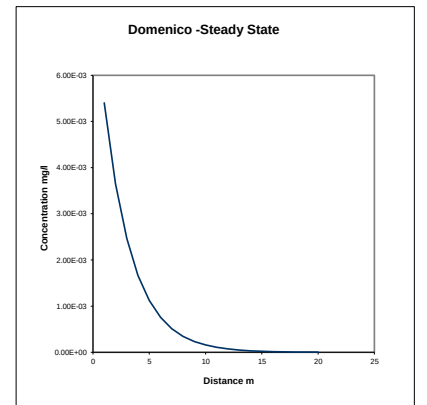
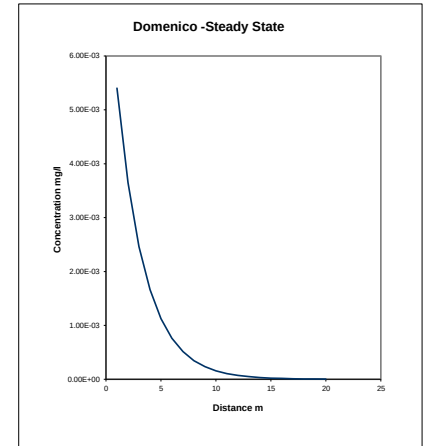
Value

DOMENICO (STEADY STATE)

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

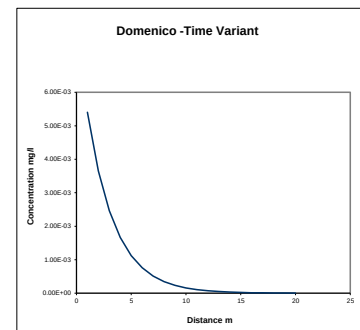
	1.39E-03	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration	
Rc	2.53E+04															
u	5.49E-08	m/d	1	1	0.002	-3.93E-01	6.75E-01	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	5.40E-03
			2	2	0.002	-7.85E-01	4.56E-01	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	3.65E-03
			3	3	0.002	-1.18E+00	3.08E-01	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	2.46E-03
			4	4	0.002	-1.57E+00	2.08E-01	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	1.66E-03
			5	5	0.002	-1.96E+00	1.40E-01	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	1.12E-03
			6	6	0.002	-2.36E+00	9.49E-02	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	7.59E-04
			7	7	0.002	-2.75E+00	6.41E-02	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	5.13E-04
			8	8	0.002	-3.14E+00	4.33E-02	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	3.46E-04
			9	9	0.002	-3.53E+00	2.92E-02	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	2.34E-04
			10	10	0.002	-3.93E+00	1.97E-02	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	1.58E-04
			11	11	0.002	-4.32E+00	1.33E-02	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	1.07E-04
			12	12	0.002	-4.71E+00	9.00E-03	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	7.20E-05
			13	13	0.002	-5.10E+00	6.08E-03	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	4.86E-05
			14	14	0.002	-5.50E+00	4.11E-03	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	3.28E-05
			15	15	0.002	-5.89E+00	2.77E-03	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	2.22E-05
			16	16	0.002	-6.28E+00	1.87E-03	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	1.50E-05
			17	17	0.002	-6.67E+00	1.26E-03	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	1.01E-05
			18	18	0.002	-7.07E+00	8.54E-04	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	6.83E-06
	21/06/2018		19	19	0.002	-7.46E+00	5.77E-04	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	4.61E-06
	1.1		20	20	0.002	-7.85E+00	3.89E-04	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	3.12E-06

Date: 21/06/2018
Version: 1.1



DOMENICO (TIME VARIANT)

Contaminant	21-C35 aromatic		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	0.09	mg/l	m																		
Co	8.00E-03	mg/l	1	1	0.001	-3.93E-01	6.75E-01	-2.12E+46	2	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	5.40E-03			
			2	2	0.001	-7.85E-01	4.56E-01	-2.12E+46	2	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	3.65E-03			
			3	3	0.001	-1.18E+00	3.08E-01	-2.12E+46	2	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	2.46E-03			
			4	4	0.001	-1.57E+00	2.08E-01	-2.12E+46	2	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	1.66E-03			
			λ	3.85E-08	days ⁻¹	5	5	0.001	-1.96E+00	1.40E-01	-2.12E+46	2	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	1.12E-03
			Sz	6.00E+01	m	6	6	0.001	-2.36E+00	9.49E-02	-2.12E+46	2	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	7.59E-04
			Sy	4.00E+00	m	7	7	0.001	-2.75E+00	6.41E-02	-2.12E+46	2	1.27E+01	1	-1.27E+01	-1	2.67E+00	0.9998	-2.67E+00	-1	5.12E-04
			Kd	5.85E+03	l/kg	8	8	0.001	-3.14E+00	4.33E-02	-2.12E+46	2	1.19E+01	1	-1.19E+01	-1	2.50E+00	0.9996	-2.50E+00	-1	3.46E-04
			ρ	1.60E+00	g/cm3	9	9	0.001	-3.53E+00	2.92E-02	-2.12E+46	2	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.9991	-2.36E+00	-0.999	2.34E-04
			n	3.70E-01		10	10	0.001	-3.93E+00	1.97E-02	-2.12E+46	2	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.9984	-2.24E+00	-0.998	1.58E-04
			i	1.70E-03		11	11	0.001	-4.32E+00	1.33E-02	-2.12E+46	2	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.9974	-2.13E+00	-0.997	1.06E-04
			K	3.02E-01	m/d	12	12	0.001	-4.71E+00	9.00E-03	-2.12E+46	2	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.9961	-2.04E+00	-0.996	7.17E-05
			x	2.00E+01	m	13	13	0.001	-5.10E+00	6.08E-03	-2.12E+46	2	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.9945	-1.96E+00	-0.994	4.84E-05
			z	0.00E+00	m	14	14	0.001	-5.50E+00	4.11E-03	-2.12E+46	2	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.9925	-1.89E+00	-0.992	3.26E-05
			y	0.00E+00	m	15	15	0.001	-5.89E+00	2.77E-03	-2.12E+46	2	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.9902	-1.83E+00	-0.99	2.20E-05
			t	9.90E+99	days	16	16	0.001	-6.28E+00	1.87E-03	-2.12E+46	2	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.9876	-1.77E+00	-0.988	1.48E-05
			ax	2.00E+00	m	17	17	0.001	-6.67E+00	1.26E-03	-2.12E+46	2	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.9847	-1.71E+00	-0.985	9.96E-06
			az	2.00E-01	m	18	18	0.001	-7.07E+00	8.54E-04	-2.12E+46	2	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.9816	-1.67E+00	-0.982	6.71E-06
			ay	2.00E-02	m	19	19	0.001	-7.46E+00	5.77E-04	-2.12E+46	2	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.9782	-1.62E+00	-0.978	4.51E-06
						20	20	0.001	-7.85E+00	3.89E-04	-2.12E+46	2	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.9747	-1.58E+00	-0.975	3.04E-06

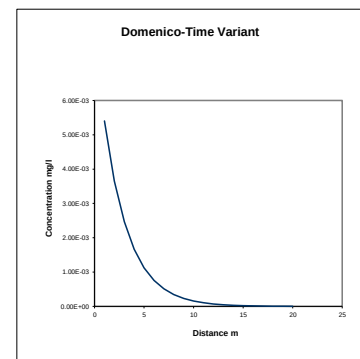


Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc	Value	Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT															Concentration	
		X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF			
v	1.39E-03	m/d																
Rc	2.53E+04		1	1	0.001	-3.93E-01	6.75E-01	-2.12E+46	2	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	5.40E-03
u	5.49E-08	m/d	2	2	0.001	-7.85E-01	4.56E-01	-2.12E+46	2	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	3.65E-03
			3	3	0.001	-1.18E+00	3.08E-01	-2.12E+46	2	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	2.46E-03
			4	4	0.001	-1.57E+00	2.08E-01	-2.12E+46	2	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	1.66E-03
			5	5	0.001	-1.96E+00	1.40E-01	-2.12E+46	2	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	1.12E-03
			6	6	0.001	-2.36E+00	9.49E-02	-2.12E+46	2	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	7.59E-04
			7	7	0.001	-2.75E+00	6.41E-02	-2.12E+46	2	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	5.13E-04
			8	8	0.001	-3.14E+00	4.33E-02	-2.12E+46	2	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	3.46E-04
			9	9	0.001	-3.53E+00	2.92E-02	-2.12E+46	2	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	2.34E-04
			10	10	0.001	-3.93E+00	1.97E-02	-2.12E+46	2	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	1.58E-04
			11	11	0.001	-4.32E+00	1.33E-02	-2.12E+46	2	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	1.07E-04
			12	12	0.001	-4.71E+00	9.00E-03	-2.12E+46	2	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	7.20E-05
			13	13	0.001	-5.10E+00	6.08E-03	-2.12E+46	2	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	4.86E-05
			14	14	0.001	-5.50E+00	4.11E-03	-2.12E+46	2	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	3.28E-05
			15	15	0.001	-5.89E+00	2.77E-03	-2.12E+46	2	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	2.22E-05
			16	16	0.001	-6.28E+00	1.87E-03	-2.12E+46	2	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	1.50E-05
			17	17	0.001	-6.67E+00	1.26E-03	-2.12E+46	2	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	1.01E-05
			18	18	0.001	-7.07E+00	8.54E-04	-2.12E+46	2	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	6.83E-06
			19	19	0.001	-7.46E+00	5.77E-04	-2.12E+46	2	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	4.61E-06
			20	20	0.001	-7.85E+00	3.89E-04	-2.12E+46	2	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	3.12E-06

21/06/2018

1.1



Date: 21/06/2018
Version: 1.1



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:	Portman Way		
Site Address:	Reading		
Completed by:	PDM	Version:	1.1
Date:	21-Jun-18		
Contaminant	C8-C10 aromatic		
Target Concentration (C_T)	3.00E-01	mg/l	Origin of C_T: WHO ethylbenzene

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration
 C_T

C8-C10 aromatic
0.3 mg/l

Input Parameters

Standard entry

Water filled soil porosity θ_w 2.40E-01 fraction
Air filled soil porosity θ_a 1.84E-01 fraction
Bulk density of soil zone material ρ 1.60E+00 g/cm³
Henry's Law constant H 4.80E-01 dimensionless

Source of parameter value

calculated
calculated
R & D Technical report sand fill
Total Petroleum Hydrocarbon Criteria Working Group

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 Kd

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil) foc 4.50E-01 fraction
Organic carbon partition coefficient Koc 1.60E+03 l/kg

Site data
CLAIRE 2017 Hydrocarbons in Groundwater

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 pKa
Fraction of organic carbon (in soil) foc fraction

Soil water partition coefficient used in Level Assessment Kd 7.20E+02 l/kg Calculated value

Level 1 Remedial Target

Level 1 Remedial Target	2.16E+02	mg/kg	(for comparison with soil analyses)
	or		
	0.3	mg/l	(for comparison with leachate test results)

Site being assessed:	Portman Way
Completed by:	PDM
Date:	21-Jun-18
Version:	1.1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant Target concentration C_T **C8-C10 aromatic** from Level 1
0.3 mg/l 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	4.40E-04	m/d	96-2000 30% pf values River Thames at Reading 70% of
Area of contaminant source	A	1.50E+02	m ²	Area of boiler house and tank farm Not used in calculation
Entry for groundwater flow below site				
Length of contaminant source in direction of groundwater flow	L	3.00E+01	m	Width of source area between PH2 and PH6
Saturated aquifer thickness	da	8.00E+01	m	assumed vale to base of chalk
Hydraulic Conductivity of aquifer in which dilution occurs	K	3.02E-01	m/d	site data
Hydraulic gradient of water table	i	1.70E-03	fraction	Estimate
Width of contaminant source perpendicular to groundwater flow	w	6.00E+01	m	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l	Estimated
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate		
Enter mixing zone thickness	Mz		m	
Calculated mixing zone thickness	Mz	2.51E+01	m	

Calculated Parameters

Dilution Factor	DF	1.98E+00		
Level 2 Remedial Target		5.94E-01	mg/l	For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentration
		or		
		4.28E+02	mg/kg	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)		0.00E+00	mg/l	0

Site being assessed:	Portman Way
Completed by:	PDM
Date:	21-Jun-18
Version:	1.1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters

Contaminant	C8-C10 aromatic	from Level 1
Target Concentration	C _t 0.3	from Level 1
Dilution Factor	DF 1.98E+00	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 dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	9	mg/kg	
Enter soil concentration	2.00E+02	days	
Half life for degradation of contaminant in water	t _{1/2} 3.47E-03	days ⁻¹	EA Publication P2-228/TR shallow sand/grav
Calculated decay rate	λ 6.00E+01	m	from Level 2
Width of plume in aquifer at source	Sz 2.51E+01	m	from Level 2
Plume thickness in aquifer at source	Sy 1.60E+00	g/cm ³	R & D Technical Report P13
Bulk density of aquifer materials	ρ 3.70E-01	fraction	Consim
Effective porosity of aquifer	n 3.44E-03	fraction	from Level 2 (adjusted)
Hydraulic gradient	i 3.02E-01	m/d	from Level 2
Hydraulic conductivity of saturated aquifer	K 2.00E+00	m	Estimated Depth to water table
Distance to compliance point	z	m	
Distance (lateral) to compliance point perpendicular to flow direction	y	m	
Distance (depth) to compliance point perpendicular to flow direction	t	days	time variant options only
Time since pollutant entered groundwater	1.00E+99	days	
Parameters values determined from options			
Partition coefficient	Kd 7.20E+01	l/kg	see options
Longitudinal dispersivity	ax 0.200	m	see options
Transverse dispersivity	az 0.020	m	see options
Vertical dispersivity	av 0.002	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Groundwater flow velocity	V	2.81E-03	m/d
Retardation factor	Rf	3.12E+02	fraction
Decay rate used	λ	1.11E-05	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.44E-03	fraction
Rate of contaminant flow due to retardation	u	8.99E-06	m/d
Ratio of Compliance Point to Source Concentration	C ₁₀ /C ₀	1.29E-01	fraction
Attenuation factor (C ₀ /C ₁₀)	AF	7.76E+00	fraction
Calculated soil leachate concentration	Co	1.25E-02	mg/l

Remedial Targets

Level 3 Remedial Target	4.60E+00	mg/l	For comparison with measured pore water concentration.
Ogata Banks	3.32E+03	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2	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 ₁₀ /C ₀	1.29E-01	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 non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 4.50E-02 fractionOrganic carbon partition coefficient K_{oc} 1.60E+03 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,ri} l/kgSorption 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+01 l/kg

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

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

Longitudinal dispersivity

Transverse dispersivity

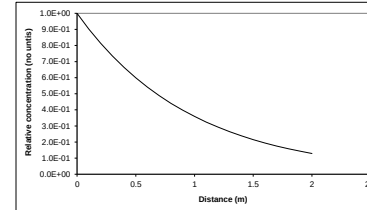
Vertical dispersivity

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀)^{0.414}; 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 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

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	6.31E-03
0.1	9.03E-01	5.70E-03
0.2	8.15E-01	5.14E-03
0.3	7.35E-01	4.64E-03
0.4	6.64E-01	4.19E-03
0.5	5.99E-01	3.78E-03
0.6	5.41E-01	3.42E-03
0.7	4.88E-01	3.08E-03
0.8	4.41E-01	2.78E-03
0.9	3.98E-01	2.51E-03
1.0	3.59E-01	2.27E-03
1.1	3.24E-01	2.05E-03
1.2	2.93E-01	1.85E-03
1.3	2.64E-01	1.67E-03
1.4	2.38E-01	1.51E-03
1.5	2.15E-01	1.36E-03
1.6	1.94E-01	1.23E-03
1.7	1.75E-01	1.11E-03
1.8	1.58E-01	9.99E-04
1.9	1.43E-01	9.02E-04
2.0	1.29E-01	8.14E-04

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:	Portman Way
Completed by:	PDM
Date:	#####
Version:	1.1

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters
Soil contaminant concentration C_0 2.00E-01 mg/kg

Level 1 Parameters

Water filled soil porosity	θ_w	2.40E-01	fraction
Air filled soil porosity	θ_a	1.84E-01	fraction
Bulk density	ρ	1.60E+00	g/cm ³
Henry's Law constant	H	4.80E-01	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	7.20E+02	l/kg
Factor (partitioning between soil and water)		7.20E+02	dimensionless

Level 2 Parameters

Dilution Factor DF 1.98E+00

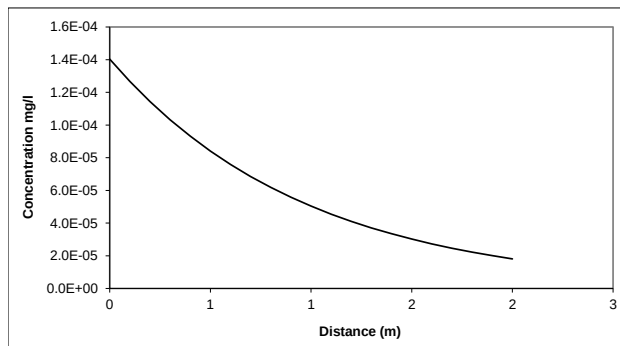
Level 3 Parameters

Attenuation factor (C_0/C_{ED}) AF 7.76E+00

Predicted concentrations at compliance point

Level 1	C	2.78E-04 mg/l	No dilution or attenuation
Level 2	C	1.40E-04 mg/l	Dilution taken into account
Level 3	C	1.81E-05 mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	1.40E-04
0.10	1.27E-04
0.20	1.14E-04
0.30	1.03E-04
0.40	9.32E-05
0.50	8.41E-05
0.60	7.59E-05
0.70	6.85E-05
0.80	6.18E-05
0.90	5.58E-05
1.00	5.04E-05
1.10	4.55E-05
1.20	4.11E-05
1.30	3.71E-05
1.40	3.34E-05
1.50	3.02E-05
1.60	2.73E-05
1.70	2.46E-05
1.80	2.22E-05
1.90	2.00E-05
2.00	1.81E-05

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	C8-C10 aromatic		from Level 1
Target Concentration	C _T	3.00E-01	mg/l from Level 1

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

Ogata Banks	Equations in HRA publication
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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	2.00E-03	mg/l	Site data
Half life for degradation of contaminant in water	t _{1/2}	2.00E+02	days	EA Publication P2-228/TR shallow sand/g
Calculated decay rate	λ	3.47E-03	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.00E+01	m	Estimated from site data
Plume thickness at source	Sy	4.00E+00	m	to top of chalk
Saturated aquifer thickness	da	8.00E+01	m	Estimated from site data
Bulk density of aquifer materials	p	1.80E+00	g/cm ³	Consim
Effective porosity of aquifer	n	3.70E-01	fraction	Consim
Hydraulic gradient	i	1.70E-03	fraction	Estimate from site data
Hydraulic conductivity of aquifer	K	3.02E-01	m/d	Site data
Distance to compliance point	x	2.00E+01	m	Distance to site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	7.20E+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	1.39E-03	m/d
Retardation factor	Rf	3.12E+02	fraction
Decay rate used	λ	1.11E-05	d ⁻¹
Rate of contaminant flow due to retardation	u	4.45E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	3.40E-11	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	5.88E+07	

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient

Kd

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer

foc

4.50E-02 fraction

Organic carbon partition coefficient

Koc

1.60E+03 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species

K_{oc,ri}

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

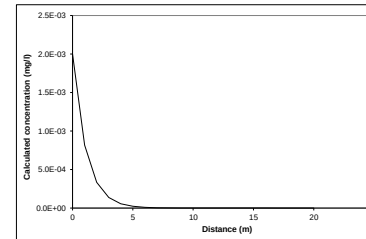
Kd

7.20E+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-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(log ₁₀ x) ^{-0.14} , 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:	Portman Way
Completed by:	PDM
Date:	20/07/2018
Version:	1.1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	2.0E-03
1.0	6.18E-04
2.0	3.34E-04
3.0	1.37E-04
4.0	5.59E-05
5.0	2.28E-05
6.0	9.34E-06
7.0	3.82E-06
8.0	1.56E-06
9.0	6.38E-07
10.0	2.61E-07
11.0	1.07E-07
12.0	4.36E-08
13.0	1.78E-08
14.0	7.29E-09
15.0	2.98E-09
16.0	1.22E-09
17.0	4.98E-10
18.0	2.04E-10
19.0	8.33E-11
20.0	3.40E-11

Remedial Targets

Remedial Target	1.76E+07	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	3.40E-11 9.9E+99	mg/l days
			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.

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	15.00	% wt	(Change this number only if you have specific information)
Particle Density	2.78	tonnes/m ³	
Dry Bulk Density	1.60	tonnes/m ³	
Calculated Parameters			
Voids Ratio	0.74	fraction	
Initial Saturation	56.54	%	
Total porosity	0.424	fraction	
Air Filled Porosity	0.184	fraction	
Water Filled Porosity	0.240	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	1.000	fraction	#DIV/0!
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

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 C8-C10 aromatic

Parameter	Value	Units	Calculations (Refer to Table 4.3, R&D Publication 20)		
(carried over from input sheet)			Selected option	Calculate for non-polar organic chemicals	
			calc	calc	Calc Kd l/kg
C _T	3.00E-01	mg/l	Calculation of partition coefficient		
Kd	7.20E+02	l/kg	for ionic organic chemical		
foc	4.50E-01	fraction			
koc	1.60E+03	l/kg	Partition coefficient used in Level 1 Assessment		
θ _w	2.40E-01	fraction	7.20E+02 l/kg		
θ _a	1.84E-01	fraction			
ρ	1.60E+00	g/cm ³			
H	4.80E-01	dimensionless			
Koc,n		l/kg			
Koc,i		l/kg			
pH		pH units			
pKa					
foc (ionic)		fraction			
			Calculated Remedial Target 2.16E+02 mg/kg for C8-C10 aromatic		
			Factor (partitioning between soil and water) 7.20E+02		
			Site being assessed: Portman Way Completed by: PDM Date: 21/06/2018 Version: 1.1		

Level 2 Calculation Sheet

Contaminant C8-C10 aromatic

Site assessed:	Portman Way
Date:	21/06/2018
Version:	1.1

Parameter Value Units
(carried over from input sheet)

Mz	2.51E+01	m
L	3.00E+01	m
da	8.00E+01	m
Inf	4.40E-04	m/d
K	3.02E-01	m/d
i	1.70E-03	m3/d
A	1.50E+02	m2
Cc	0.00E+00	mg/l
C _T	3.00E-01	mg/l
Cu	0.00E+00	mg/l
w	6.00E+01	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Calculated
Dilution Factor

1.98E+00

#DIV/0!



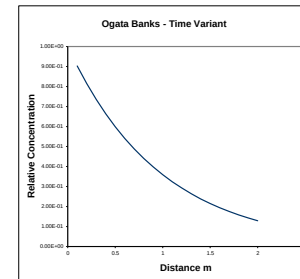
Contaminant ̢8-C10 aromatic

OGATA BANKS SOLUTION

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

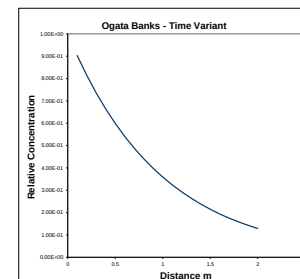
Input	Value	Units
C _T	3.000E-01	mg/l
DF	1.979E+00	
λ	1.110E-05	days ⁻¹
Sz	6.000E+01	m
Sy	2.514E+01	m
Kd	7.200E+01	l/kg
ρ	1.600E+00	g/cm ³
n	3.700E-01	
i	3.436E-03	
K	3.024E-01	m/d
x	2.000E+00	m
z	0.000E+00	m
y	0.000E+00	m
t	1.000E+99	days
ax	2.000E-01	m
az	2.000E-02	m
ay	2.000E-03	m

	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	Relative Concentration
1	0.1	0.13	-1.02E-01	9.03E-01	-1.49E+47	2	6.02E-01	1.83E+00	1.49E+47	0	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.03E-01
2	0.2	0.13	-2.05E-01	8.15E-01	-1.49E+47	2	1.20E+00	3.34E+00	1.49E+47	0	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	8.15E-01
3	0.3	0.13	-3.07E-01	7.35E-01	-1.49E+47	2	1.81E+00	6.09E+00	1.49E+47	0	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	7.35E-01
4	0.4	0.13	-4.10E-01	6.64E-01	-1.49E+47	2	2.41E+00	1.11E+01	1.49E+47	0	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	6.64E-01
5	0.5	0.13	-5.12E-01	5.99E-01	-1.49E+47	2	3.01E+00	2.03E+01	1.49E+47	0	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	5.99E-01
6	0.6	0.13	-6.15E-01	5.41E-01	-1.49E+47	2	3.61E+00	3.71E+01	1.49E+47	0	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	5.41E-01
7	0.7	0.13	-7.17E-01	4.88E-01	-1.49E+47	2	4.22E+00	6.78E+01	1.49E+47	0	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	4.88E-01
8	0.8	0.13	-8.19E-01	4.41E-01	-1.49E+47	2	4.82E+00	1.24E+02	1.49E+47	0	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	4.41E-01
9	0.9	0.13	-9.22E-01	3.98E-01	-1.49E+47	2	5.42E+00	2.26E+02	1.49E+47	0	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	3.98E-01
10	1	0.13	-1.02E+00	3.59E-01	-1.49E+47	2	6.02E+00	4.13E+02	1.49E+47	0	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	3.59E-01
11	1.1	0.13	-1.13E+00	3.24E-01	-1.49E+47	2	6.63E+00	7.55E+02	1.49E+47	0	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	3.24E-01
12	1.2	0.13	-1.23E+00	2.93E-01	-1.49E+47	2	7.23E+00	1.38E+03	1.49E+47	0	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	2.93E-01
13	1.3	0.13	-1.33E+00	2.64E-01	-1.49E+47	2	7.83E+00	2.52E+03	1.49E+47	0	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	2.64E-01
14	1.4	0.13	-1.43E+00	2.38E-01	-1.49E+47	2	8.43E+00	4.60E+03	1.49E+47	0	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	2.38E-01
15	1.5	0.13	-1.54E+00	2.15E-01	-1.49E+47	2	9.04E+00	8.40E+03	1.49E+47	0	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	2.15E-01
16	1.6	0.13	-1.64E+00	1.94E-01	-1.49E+47	2	9.64E+00	1.53E+04	1.49E+47	0	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	1.94E-01
17	1.7	0.13	-1.74E+00	1.75E-01	-1.49E+47	2	1.02E+01	2.80E+04	1.49E+47	0	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	1.75E-01
18	1.8	0.13	-1.84E+00	1.58E-01	-1.49E+47	2	1.08E+01	5.12E+04	1.49E+47	0	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	1.58E-01
19	1.9	0.13	-1.95E+00	1.43E-01	-1.49E+47	2	1.14E+01	9.35E+04	1.49E+47	0	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	1.43E-01
20	2	0.13	-2.05E+00	1.29E-01	-1.49E+47	2	1.20E+01	1.71E+05	1.49E+47	0	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	1.29E-01



Calc	Value	Units
v	0.0028	m/d
Rc	312.3514	
u	0.0000	m/d
Date:	21/06/2018	
Version:	1.1	

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	Relative Concentration
1	0.1	0.13	-1.02E-01	9.03E-01	-1.49E+47	2	6.02E-01	1.83E+00	1.49E+47	0	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.03E-01
2	0.2	0.13	-2.05E-01	8.15E-01	-1.49E+47	2	1.20E+00	3.34E+00	1.49E+47	0	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	8.15E-01
3	0.3	0.13	-3.07E-01	7.35E-01	-1.49E+47	2	1.81E+00	6.09E+00	1.49E+47	0	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	7.35E-01
4	0.4	0.13	-4.10E-01	6.64E-01	-1.49E+47	2	2.41E+00	1.11E+01	1.49E+47	0	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	6.64E-01
5	0.5	0.13	-5.12E-01	5.99E-01	-1.49E+47	2	3.01E+00	2.03E+01	1.49E+47	0	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	5.99E-01
6	0.6	0.13	-6.15E-01	5.41E-01	-1.49E+47	2	3.61E+00	3.71E+01	1.49E+47	0	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	5.41E-01
7	0.7	0.13	-7.17E-01	4.88E-01	-1.49E+47	2	4.22E+00	6.78E+01	1.49E+47	0	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	4.88E-01
8	0.8	0.13	-8.19E-01	4.41E-01	-1.49E+47	2	4.82E+00	1.24E+02	1.49E+47	0	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	4.41E-01
9	0.9	0.13	-9.22E-01	3.98E-01	-1.49E+47	2	5.42E+00	2.26E+02	1.49E+47	0	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	3.98E-01
10	1	0.13	-1.02E+00	3.59E-01	-1.49E+47	2	6.02E+00	4.13E+02	1.49E+47	0	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	3.59E-01
11	1.1	0.13	-1.13E+00	3.24E-01	-1.49E+47	2	6.63E+00	7.55E+02	1.49E+47	0	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	3.24E-01
12	1.2	0.13	-1.23E+00	2.93E-01	-1.49E+47	2	7.23E+00	1.38E+03	1.49E+47	0	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	2.93E-01
13	1.3	0.13	-1.33E+00	2.64E-01	-1.49E+47	2	7.83E+00	2.52E+03	1.49E+47	0	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	2.64E-01
14	1.4	0.13	-1.43E+00	2.38E-01	-1.49E+47	2	8.43E+00	4.60E+03	1.49E+47	0	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	2.38E-01
15	1.5	0.13	-1.54E+00	2.15E-01	-1.49E+47	2	9.04E+00	8.40E+03	1.49E+47	0	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	2.15E-01
16	1.6	0.13	-1.64E+00	1.94E-01	-1.49E+47	2	9.64E+00	1.53E+04	1.49E+47	0	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	1.94E-01
17	1.7	0.13	-1.74E+00	1.75E-01	-1.49E+47	2	1.02E+01	2.80E+04	1.49E+47	0	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	1.75E-01
18	1.8	0.13	-1.84E+00	1.58E-01	-1.49E+47	2	1.08E+01	5.12E+04	1.49E+47	0	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	1.58E-01
19	1.9	0.13	-1.95E+00	1.43E-01	-1.49E+47	2	1.14E+01	9.35E+04	1.49E+47	0	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	1.43E-01
20	2	0.13	-2.05E+00	1.29E-01	-1.49E+47	2	1.20E+01	1.71E+05	1.49E+47	0	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	1.29E-01

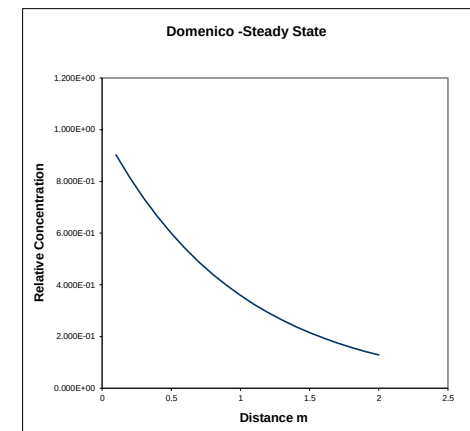


Contaminant 3-C10 aromatic

DOMENICO (STEADY STATE)

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	3.000E-01	mg/l	1	0.1	0.25	-1.02E-01	9.03E-01	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.027E-01
DF	1.979E+00		2	0.2	0.25	-2.05E-01	8.15E-01	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	8.148E-01
			3	0.3	0.25	-3.07E-01	7.35E-01	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	7.355E-01
			4	0.4	0.25	-4.10E-01	6.64E-01	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	6.639E-01
λ	1.110E-05	days ⁻¹	5	0.5	0.25	-5.12E-01	5.99E-01	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	5.992E-01
Sz	6.000E+01	m	6	0.6	0.25	-6.15E-01	5.41E-01	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	5.409E-01
Sy	2.514E+01	m	7	0.7	0.25	-7.17E-01	4.88E-01	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	4.882E-01
Kd	7.200E+01	l/kg	8	0.8	0.25	-8.19E-01	4.41E-01	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	4.407E-01
ρ	1.600E+00	g/cm3	9	0.9	0.25	-9.22E-01	3.98E-01	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	3.978E-01
n	3.700E-01		10	1	0.25	-1.02E+00	3.59E-01	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	3.591E-01
i	3.436E-03		11	1.1	0.25	-1.13E+00	3.24E-01	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	3.241E-01
K	3.024E-01	m/d	12	1.2	0.25	-1.23E+00	2.93E-01	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	2.926E-01
x	2.000E+00	m	13	1.3	0.25	-1.33E+00	2.64E-01	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	2.641E-01
z	0.000E+00	m	14	1.4	0.25	-1.43E+00	2.38E-01	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	2.384E-01
y	0.000E+00	m	15	1.5	0.25	-1.54E+00	2.15E-01	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	2.152E-01
ax	2.000E-01	m	16	1.6	0.25	-1.64E+00	1.94E-01	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	1.942E-01
az	2.000E-02	m	17	1.7	0.25	-1.74E+00	1.75E-01	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	1.753E-01
ay	2.000E-03	m	18	1.8	0.25	-1.84E+00	1.58E-01	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	1.583E-01
			19	1.9	0.25	-1.95E+00	1.43E-01	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	1.428E-01
			20	2	0.25	-2.05E+00	1.29E-01	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	1.289E-01



Calc

Value

DOMENICO (STEADY STATE)

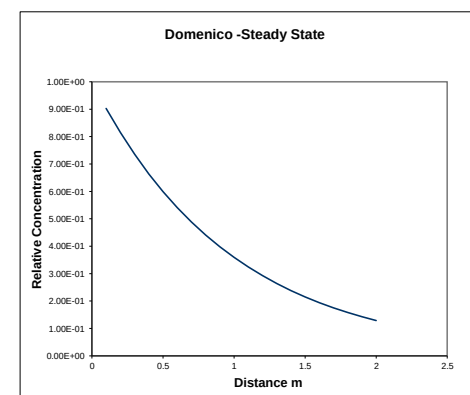
Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	2.81E-03	m/d	X		Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
Rc	3.12E+02															
u	8.99E-06	m/d	1	0.1	0.25	-1.02E-01	9.03E-01	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.03E-01
			2	0.2	0.25	-2.05E-01	8.15E-01	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	8.15E-01
			3	0.3	0.25	-3.07E-01	7.35E-01	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	7.35E-01
			4	0.4	0.25	-4.10E-01	6.64E-01	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	6.64E-01
			5	0.5	0.25	-5.12E-01	5.99E-01	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	5.99E-01
			6	0.6	0.25	-6.15E-01	5.41E-01	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	5.41E-01
			7	0.7	0.25	-7.17E-01	4.88E-01	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	4.88E-01
			8	0.8	0.25	-8.19E-01	4.41E-01	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	4.41E-01
			9	0.9	0.25	-9.22E-01	3.98E-01	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	3.98E-01
			10	1	0.25	-1.02E+00	3.59E-01	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	3.59E-01
			11	1.1	0.25	-1.13E+00	3.24E-01	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	3.24E-01
			12	1.2	0.25	-1.23E+00	2.93E-01	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	2.93E-01
			13	1.3	0.25	-1.33E+00	2.64E-01	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	2.64E-01
			14	1.4	0.25	-1.43E+00	2.38E-01	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	2.38E-01
			15	1.5	0.25	-1.54E+00	2.15E-01	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	2.15E-01
			16	1.6	0.25	-1.64E+00	1.94E-01	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	1.94E-01
			17	1.7	0.25	-1.74E+00	1.75E-01	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	1.75E-01
			18	1.8	0.25	-1.84E+00	1.58E-01	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	1.58E-01
			19	1.9	0.25	-1.95E+00	1.43E-01	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	1.43E-01
			20	2	0.25	-2.05E+00	1.29E-01	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	1.29E-01

21/06/2018

1.1

Relative Concentration



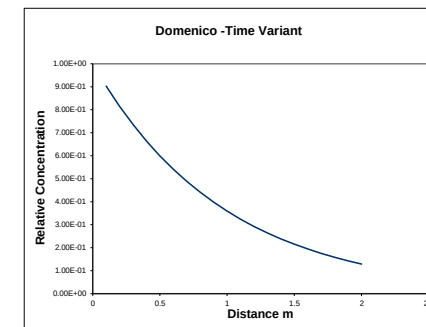
Date: 21/06/2018
Version: 1.1

DOMENICO (TIME VARIANT)

Contaminant 8-C10 aromatic

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	0.3	mg/l	1	0.1	0.125	-1.02E-01	9.03E-01	-1.49E+07	2	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.03E-01
DF	1.9790		2	0.2	0.125	-2.05E-01	8.15E-01	-1.49E+07	2	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	8.15E-01
			3	0.3	0.125	-3.07E-01	7.35E-01	-1.49E+07	2	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	7.35E-01
			4	0.4	0.125	-4.10E-01	6.64E-01	-1.49E+07	2	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	6.64E-01
λ	1.110E-05	days ⁻¹	5	0.5	0.125	-5.12E-01	5.99E-01	-1.49E+07	2	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	5.99E-01
Sz	6.000E+01	m	6	0.6	0.125	-6.15E-01	5.41E-01	-1.49E+07	2	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	5.41E-01
Sy	2.514E+01	m	7	0.7	0.125	-7.17E-01	4.88E-01	-1.49E+07	2	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	4.88E-01
Kd	7.200E+01	l/kg	8	0.8	0.125	-8.19E-01	4.41E-01	-1.49E+07	2	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	4.41E-01
ρ	1.600E+00	g/cm3	9	0.9	0.125	-9.22E-01	3.98E-01	-1.49E+07	2	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	3.98E-01
n	3.700E-01		10	1	0.125	-1.02E+00	3.59E-01	-1.49E+07	2	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	3.59E-01
i	3.436E-03		11	1.1	0.125	-1.13E+00	3.24E-01	-1.49E+07	2	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	3.24E-01
K	3.024E-01	m/d	12	1.2	0.125	-1.23E+00	2.93E-01	-1.49E+07	2	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	2.93E-01
x	2.000E+00	m	13	1.3	0.125	-1.33E+00	2.64E-01	-1.49E+07	2	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	2.64E-01
z	0.000E+00	m	14	1.4	0.125	-1.43E+00	2.38E-01	-1.49E+07	2	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	2.38E-01
y	0.000E+00	m	15	1.5	0.125	-1.54E+00	2.15E-01	-1.49E+07	2	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	2.15E-01
t	1.000E+99	days	16	1.6	0.125	-1.64E+00	1.94E-01	-1.49E+07	2	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	1.94E-01
ax	2.000E-01	m	17	1.7	0.125	-1.74E+00	1.75E-01	-1.49E+07	2	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	1.75E-01
az	2.000E-02	m	18	1.8	0.125	-1.84E+00	1.58E-01	-1.49E+07	2	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	1.58E-01
ay	2.000E-03	m	19	1.9	0.125	-1.95E+00	1.43E-01	-1.49E+07	2	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	1.43E-01
			20	2	0.125	-2.05E+00	1.29E-01	-1.49E+07	2	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	1.29E-01

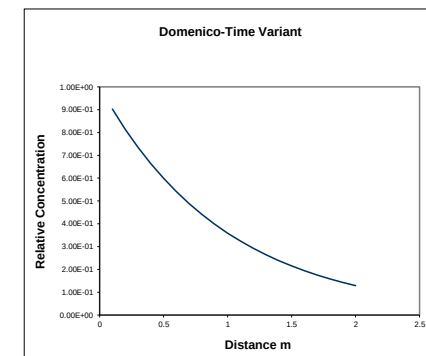


Calc

Value

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

		Calculation of the relative concentration of the top 20 principal components (PCs) of the data set, based on the first 20 principal components (PCs) of the data set, based on the first 20 principal components (PCs) of the data set, based on the first 20 principal components (PCs) of the data set, based on the first 20 principal components (PCs) of the data set, based on the first 20 principal components (PCs) of the data set, based on the first 20 principal components (PCs) of the data set, based on the first 20 principal components (PCs) of the data set, based on the first 20 principal components (PCs) of the data set, based on the first 20 principal components (PCs) of the data set, based on the first 20 principal components (PCs) of the data set, based on the first 20 principal components (PCs) of the data set, based on the first 20 principal components (PCs) of the data set, based on the first 20 principal components (PCs) of the data set, based on the first 20 principal 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Date: 21/06/2018
Version: 1.1

OGATA BANKS SOLUTION																						
Contaminant	C8-C10 aromatic	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	0.3	mg/l	1	1	0.00025	-8.9E-01	4.1E-01	-3.4E+47	2.000	1.4E+00	4.0E+00	3.4E+47	0.000	3.4E+01	1	-3.4E+01	-1	7.1E+00	1	-7.1E+00	-1	8.18E-04
			2	2	0.00025	-1.8E+00	1.7E-01	-3.4E+47	2.000	2.8E+00	1.6E+01	3.4E+47	0.000	2.4E+01	1	-2.4E+01	-1	5.0E+00	1	-5.0E+00	-1	3.34E-04
			3	3	0.00025	-2.7E+00	6.8E-02	-3.4E+47	2.000	4.2E+00	6.6E+01	3.4E+47	0.000	1.9E+01	1	-1.9E+01	-1	4.1E+00	1	-4.1E+00	-1	1.37E-04
Co	2.00E-03	mg/l	4	4	0.00025	-3.6E+00	2.8E-02	-3.4E+47	2.000	5.6E+00	2.6E+02	3.4E+47	0.000	1.7E+01	1	-1.7E+01	-1	3.5E+00	1	-3.5E+00	-1	5.59E-05
λ	1.11E-05	days ⁻¹	5	5	0.00025	-4.5E+00	1.1E-02	-3.4E+47	2.000	7.0E+00	1.1E+03	3.4E+47	0.000	1.5E+01	1	-1.5E+01	-1	3.2E+00	1	-3.2E+00	-0.99999	2.28E-05
Sz	6.00E+01	m	6	6	0.00025	-5.4E+00	4.7E-03	-3.4E+47	2.000	8.4E+00	4.3E+03	3.4E+47	0.000	1.4E+01	1	-1.4E+01	-1	2.9E+00	1	-2.9E+00	-0.99996	9.34E-06
Sy	4.00E+00	m	7	7	0.00025	-6.3E+00	1.9E-03	-3.4E+47	2.000	9.8E+00	1.7E+04	3.4E+47	0.000	1.3E+01	1	-1.3E+01	-1	2.7E+00	0.9998	-2.7E+00	-0.99984	3.82E-06
Kd	7.20E+01	l/kg	8	8	0.00025	-7.2E+00	7.8E-04	-3.4E+47	2.000	1.1E+01	7.0E+04	3.4E+47	0.000	1.2E+01	1	-1.2E+01	-1	2.5E+00	0.9996	-2.5E+00	-0.99959	1.56E-06
ρ	1.60E+00	g/cm3	9	9	0.00025	-8.0E+00	3.2E-04	-3.4E+47	2.000	1.3E+01	2.8E+05	3.4E+47	0.000	1.1E+01	1	-1.1E+01	-1	2.4E+00	0.9991	-2.4E+00	-0.99914	6.38E-07
n	3.70E-01		10	10	0.00025	-8.9E+00	1.3E-04	-3.4E+47	2.000	1.4E+01	1.1E+06	3.4E+47	0.000	1.1E+01	1	-1.1E+01	-1	2.2E+00	0.9984	-2.2E+00	-0.99843	2.61E-07
i	1.70E-03		11	11	0.00025	-9.8E+00	5.3E-05	-3.4E+47	2.000	1.5E+01	4.6E+06	3.4E+47	0.000	1.0E+01	1	-1.0E+01	-1	2.1E+00	0.9974	-2.1E+00	-0.99743	1.06E-07
K	3.02E-01	m/d	12	12	0.00025	-1.1E+01	2.2E-05	-3.4E+47	2.000	1.7E+01	1.9E+07	3.4E+47	0.000	9.7E+00	1	-9.7E+00	-1	2.0E+00	0.9961	-2.0E+00	-0.99611	4.34E-08
x	2.00E+01	m	13	13	0.00025	-1.2E+01	8.9E-06	-3.4E+47	2.000	1.8E+01	7.5E+07	3.4E+47	0.000	9.3E+00	1	-9.3E+00	-1	2.0E+00	0.9945	-2.0E+00	-0.99445	1.77E-08
z	0.00E+00	m	14	14	0.00025	-1.3E+01	3.6E-06	-3.4E+47	2.000	2.0E+01	3.0E+08	3.4E+47	0.000	9.0E+00	1	-9.0E+00	-1	1.9E+00	0.9925	-1.9E+00	-0.99247	7.23E-09
y	0.00E+00	m	15	15	0.00025	-1.3E+01	1.5E-06	-3.4E+47	2.000	2.1E+01	1.2E+09	3.4E+47	0.000	8.7E+00	1	-8.7E+00	-1	1.8E+00	0.9902	-1.8E+00	-0.99018	2.95E-09
t	9.90E+99	days	16	16	0.00025	-1.4E+01	6.1E-07	-3.4E+47	2.000	2.2E+01	4.9E+09	3.4E+47	0.000	8.4E+00	1	-8.4E+00	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	1.20E-09
ax	2.00E+00	m	17	17	0.00025	-1.5E+01	2.5E-07	-3.4E+47	2.000	2.4E+01	2.0E+10	3.4E+47	0.000	8.1E+00	1	-8.1E+00	-1	1.7E+00	0.9847	-1.7E+00	-0.98471	4.91E-10
az	2.00E-01	m	18	18	0.00025	-1.6E+01	1.0E-07	-3.4E+47	2.000	2.5E+01	8.0E+10	3.4E+47	0.000	7.9E+00	1	-7.9E+00	-1	1.7E+00	0.9816	-1.7E+00	-0.98158	2.00E-10
ay	2.00E-02	m	19	19	0.00025	-1.7E+01	4.2E-08	-3.4E+47	2.000	2.6E+01	3.2E+11	3.4E+47	0.000	7.7E+00	1	-7.7E+00	-1	1.6E+00	0.9782	-1.6E+00	-0.97822	8.14E-11
			20	20	0.00025	-1.8E+01	1.7E-08	-3.4E+47	2.000	2.8E+01	1.3E+12	3.4E+47	0.000	7.5E+00	1	-7.5E+00	-1	1.6E+00	0.9747	-1.6E+00	-0.97465	3.32E-11

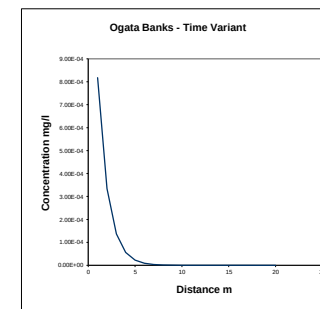
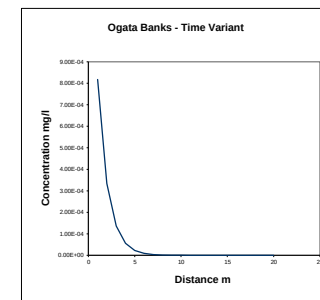
Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc		Value		Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT																		Concentration
				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	1.39E-03	m/d																				
Rc	3.12E+02		1	1	0.00025	-8.9E-01	4.1E-01	-3.4E+47	2.000	1.4E+00	4.0E+00	3.4E+47	0.000	3.4E+01	1	-3.4E+01	-1	1.4E+01	1	-1.4E+01	-1	8.18E-04
u	4.45E-06	m/d	2	2	0.00025	-1.8E+00	1.7E-01	-3.4E+47	2.000	2.8E+00	1.6E+01	3.4E+47	0.000	2.4E+01	1	-2.4E+01	-1	1.0E+01	1	-1.0E+01	-1	3.34E-04
			3	3	0.00025	-2.7E+00	6.8E-02	-3.4E+47	2.000	4.2E+00	6.6E+01	3.4E+47	0.000	1.9E+01	1	-1.9E+01	-1	8.2E+00	1	-8.2E+00	-1	1.37E-04
			4	4	0.00025	-3.6E+00	2.8E-02	-3.4E+47	2.000	5.6E+00	2.6E+02	3.4E+47	0.000	1.7E+01	1	-1.7E+01	-1	7.1E+00	1	-7.1E+00	-1	5.59E-05
			5	5	0.00025	-4.5E+00	1.1E-02	-3.4E+47	2.000	7.0E+00	1.1E+03	3.4E+47	0.000	1.5E+01	1	-1.5E+01	-1	6.3E+00	1	-6.3E+00	-1	2.28E-05
			6	6	0.00025	-5.4E+00	4.7E-03	-3.4E+47	2.000	8.4E+00	4.3E+03	3.4E+47	0.000	1.4E+01	1	-1.4E+01	-1	5.8E+00	1	-5.8E+00	-1	9.34E-06
			7	7	0.00025	-6.3E+00	1.9E-03	-3.4E+47	2.000	9.8E+00	1.7E+04	3.4E+47	0.000	1.3E+01	1	-1.3E+01	-1	5.3E+00	1	-5.3E+00	-1	3.82E-06
			8	8	0.00025	-7.2E+00	7.8E-04	-3.4E+47	2.000	1.1E+01	7.0E+04	3.4E+47	0.000	1.2E+01	1	-1.2E+01	-1	5.0E+00	1	-5.0E+00	-1	1.56E-06
			9	9	0.00025	-8.0E+00	3.2E-04	-3.4E+47	2.000	1.3E+01	2.8E+05	3.4E+47	0.000	1.1E+01	1	-1.1E+01	-1	4.7E+00	1	-4.7E+00	-1	6.38E-07
			10	10	0.00025	-8.9E+00	1.3E-04	-3.4E+47	2.000	1.4E+01	1.1E+06	3.4E+47	0.000	1.1E+01	1	-1.1E+01	-1	4.5E+00	1	-4.5E+00	-1	2.61E-07
			11	11	0.00025	-9.8E+00	5.3E-05	-3.4E+47	2.000	1.5E+01	4.6E+06	3.4E+47	0.000	1.0E+01	1	-1.0E+01	-1	4.3E+00	1	-4.3E+00	-1	1.07E-07
			12	12	0.00025	-1.1E+01	2.2E-05	-3.4E+47	2.000	1.7E+01	1.9E+07	3.4E+47	0.000	9.7E+00	1	-9.7E+00	-1	4.1E+00	1	-4.1E+00	-1	4.36E-08
			13	13	0.00025	-1.2E+01	8.9E-06	-3.4E+47	2.000	1.8E+01	7.5E+07	3.4E+47	0.000	9.3E+00	1	-9.3E+00	-1	3.9E+00	1	-3.9E+00	-1	1.78E-08
			14	14	0.00025	-1.3E+01	3.6E-06	-3.4E+47	2.000	2.0E+01	3.0E+08	3.4E+47	0.000	9.0E+00	1	-9.0E+00	-1	3.8E+00	1	-3.8E+00	-1	7.29E-09
			15	15	0.00025	-1.3E+01	1.5E-06	-3.4E+47	2.000	2.1E+01	1.2E+09	3.4E+47	0.000	8.7E+00	1	-8.7E+00	-1	3.7E+00	1	-3.7E+00	-1	2.98E-09
			16	16	0.00025	-1.4E+01	6.1E-07	-3.4E+47	2.000	2.2E+01	4.9E+09	3.4E+47	0.000	8.4E+00	1	-8.4E+00	-1	3.5E+00	1	-3.5E+00	-1	1.22E-09
			17	17	0.00025	-1.5E+01	2.5E-07	-3.4E+47	2.000	2.4E+01	2.0E+10	3.4E+47	0.000	8.1E+00	1	-8.1E+00	-1	3.4E+00	1	-3.4E+00	-1	4.98E-10
			18	18	0.00025	-1.6E+01	1.0E-07	-3.4E+47	2.000	2.5E+01	8.0E+10	3.4E+47	0.000	7.9E+00	1	-7.9E+00	-1	3.3E+00	1	-3.3E+00	-1	2.04E-10
			19	19	0.00025	-1.7E+01	4.2E-08	-3.4E+47	2.000	2.6E+01	3.2E+11	3.4E+47	0.000	7.7E+00	1	-7.7E+00	-1	3.2E+00	1	-3.2E+00	-1	8.33E-11
			20	20	0.00025	-1.8E+01	1.7E-08	-3.4E+47	2.000	2.8E+01	1.3E+12	3.4E+47	0.000	7.5E+00	1	-7.5E+00	-1	3.2E+00	1	-3.2E+00	-0.99999	3.40E-11

Date: 21/06/2018

Version: 1.1

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Contaminant 3-C10 aromatic

DOMENICO (STEADY STATE)

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	Concentration	
Input	Value	Units														
C _T	0.3	mg/l	1	1	0.0005	-8.94E-01	4.09E-01	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	8.18E-04
			2	2	0.0005	-1.79E+00	1.67E-01	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	3.34E-04
			3	3	0.0005	-2.68E+00	6.83E-02	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	1.37E-04
Co	2.00E-03	mg/l	4	4	0.0005	-3.58E+00	2.79E-02	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	5.59E-05
λ	1.11E-05	days ⁻¹	5	5	0.0005	-4.47E+00	1.14E-02	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	2.28E-05
Sz	6.00E+01	m	6	6	0.0005	-5.37E+00	4.67E-03	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	9.34E-06
Sy	4.00E+00	m	7	7	0.0005	-6.26E+00	1.91E-03	1.27E+01	1	-1.27E+01	-1	2.67E+00	1	-2.67E+00	-0.9998	3.82E-06
Kd	7.20E+01	l/kg	8	8	0.0005	-7.16E+00	7.81E-04	1.19E+01	1	-1.19E+01	-1	2.50E+00	1	-2.50E+00	-0.9996	1.56E-06
ρ	1.60E+00	g/cm3	9	9	0.0005	-8.05E+00	3.19E-04	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.999	-2.36E+00	-0.9991	6.38E-07
n	3.70E-01		10	10	0.0005	-8.94E+00	1.30E-04	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.998	-2.24E+00	-0.9984	2.61E-07
i	1.70E-03		11	11	0.0005	-9.84E+00	5.33E-05	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.997	-2.13E+00	-0.9974	1.06E-07
K	3.02E-01	m/d	12	12	0.0005	-1.07E+01	2.18E-05	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.996	-2.04E+00	-0.9961	4.34E-08
x	2.00E+01	m	13	13	0.0005	-1.16E+01	8.92E-06	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.994	-1.96E+00	-0.9945	1.77E-08
z	0.00E+00	m	14	14	0.0005	-1.25E+01	3.64E-06	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.992	-1.89E+00	-0.9925	7.23E-09
y	0.00E+00	m	15	15	0.0005	-1.34E+01	1.49E-06	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.99	-1.83E+00	-0.9902	2.95E-09
			16	16	0.0005	-1.43E+01	6.09E-07	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.988	-1.77E+00	-0.9876	1.20E-09
ax	2.00E+00	m	17	17	0.0005	-1.52E+01	2.49E-07	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.985	-1.71E+00	-0.9847	4.91E-10
az	2.00E-01	m	18	18	0.0005	-1.61E+01	1.02E-07	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.982	-1.67E+00	-0.9816	2.00E-10
ay	2.00E-02	m	19	19	0.0005	-1.70E+01	4.16E-08	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.978	-1.62E+00	-0.9782	8.14E-11
			20	20	0.0005	-1.79E+01	1.70E-08	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.975	-1.58E+00	-0.9747	3.32E-11

Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc

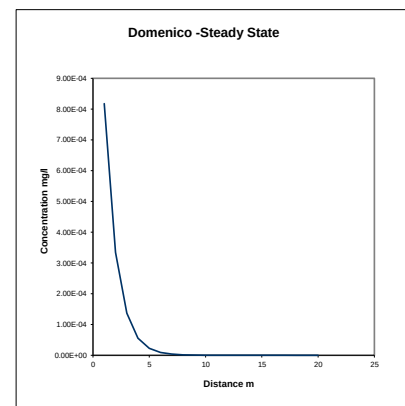
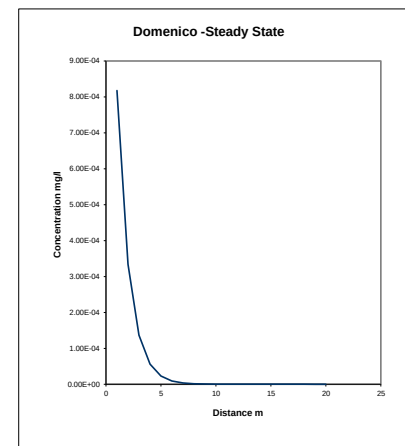
Value

DOMENICO (STEADY STATE)

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

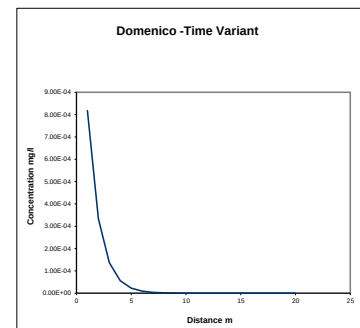
				X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
v	1.39E-03	m/d														
Rc	3.12E+02															
u	4.45E-06	m/d	1	1	0.0005	-8.94E-01	4.09E-01	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	8.18E-04
			2	2	0.0005	-1.79E+00	1.67E-01	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	3.34E-04
			3	3	0.0005	-2.68E+00	6.83E-02	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	1.37E-04
			4	4	0.0005	-3.58E+00	2.79E-02	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	5.59E-05
			5	5	0.0005	-4.47E+00	1.14E-02	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	2.28E-05
			6	6	0.0005	-5.37E+00	4.67E-03	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	9.34E-06
			7	7	0.0005	-6.26E+00	1.91E-03	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	3.82E-06
			8	8	0.0005	-7.16E+00	7.81E-04	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	1.56E-06
			9	9	0.0005	-8.05E+00	3.19E-04	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	6.38E-07
			10	10	0.0005	-8.94E+00	1.30E-04	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	2.61E-07
			11	11	0.0005	-9.84E+00	5.33E-05	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	1.07E-07
			12	12	0.0005	-1.07E+01	2.18E-05	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	4.36E-08
			13	13	0.0005	-1.16E+01	8.92E-06	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	1.78E-08
			14	14	0.0005	-1.25E+01	3.64E-06	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	7.29E-09
			15	15	0.0005	-1.34E+01	1.49E-06	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	2.98E-09
			16	16	0.0005	-1.43E+01	6.09E-07	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	1.22E-09
			17	17	0.0005	-1.52E+01	2.49E-07	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	4.98E-10
			18	18	0.0005	-1.61E+01	1.02E-07	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	2.04E-10
			19	19	0.0005	-1.70E+01	4.16E-08	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	8.33E-11
			20	20	0.0005	-1.79E+01	1.70E-08	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	3.40E-11

Date: 21/06/2018
Version: 1.1



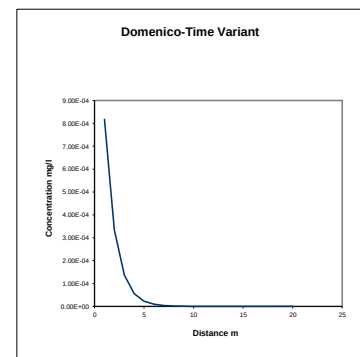
DOMENICO (TIME VARIANT)

Contaminant	8-C10 aromatic		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	0.3	mg/l	m															
Co	2.00E-03	mg/l	1	1	0.00025	-8.94E-01	4.09E-01	-3.40E+47	2	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	8.18E-04
			2	2	0.00025	-1.79E+00	1.67E-01	-3.40E+47	2	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	3.34E-04
			3	3	0.00025	-2.68E+00	6.83E-02	-3.40E+47	2	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	1.37E-04
λ	1.11E-05	days ⁻¹	4	4	0.00025	-3.58E+00	2.79E-02	-3.40E+47	2	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	5.59E-05
Sz	6.00E+01	m	5	5	0.00025	-4.47E+00	1.14E-02	-3.40E+47	2	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	2.28E-05
Sy	4.00E+00	m	6	6	0.00025	-5.37E+00	4.67E-03	-3.40E+47	2	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	9.34E-06
Kd	7.20E+01	l/kg	7	7	0.00025	-6.26E+00	1.91E-03	-3.40E+47	2	1.27E+01	1	-1.27E+01	-1	2.67E+00	0.9998	-2.67E+00	-1	3.82E-06
ρ	1.60E+00	g/cm3	8	8	0.00025	-7.16E+00	7.81E-04	-3.40E+47	2	1.19E+01	1	-1.19E+01	-1	2.50E+00	0.9996	-2.50E+00	-1	1.56E-06
n	3.70E-01		9	9	0.00025	-8.05E+00	3.19E-04	-3.40E+47	2	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.9991	-2.36E+00	-0.999	6.38E-07
i	1.70E-03		10	10	0.00025	-8.94E+00	1.30E-04	-3.40E+47	2	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.9984	-2.24E+00	-0.998	2.61E-07
K	3.02E-01	m/d	11	11	0.00025	-9.84E+00	5.33E-05	-3.40E+47	2	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.9974	-2.13E+00	-0.997	1.06E-07
x	2.00E+01	m	12	12	0.00025	-1.07E+01	2.18E-05	-3.40E+47	2	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.9961	-2.04E+00	-0.996	4.34E-08
z	0.00E+00	m	13	13	0.00025	-1.16E+01	8.92E-06	-3.40E+47	2	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.9945	-1.96E+00	-0.994	1.77E-08
y	0.00E+00	m	14	14	0.00025	-1.25E+01	3.64E-06	-3.40E+47	2	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.9925	-1.89E+00	-0.992	7.23E-09
t	9.90E+99	days	15	15	0.00025	-1.34E+01	1.49E-06	-3.40E+47	2	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.9902	-1.83E+00	-0.99	2.95E-09
ax	2.00E+00	m	16	16	0.00025	-1.43E+01	6.09E-07	-3.40E+47	2	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.9876	-1.77E+00	-0.988	1.20E-09
az	2.00E-01	m	17	17	0.00025	-1.52E+01	2.49E-07	-3.40E+47	2	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.9847	-1.71E+00	-0.985	4.91E-10
ay	2.00E-02	m	18	18	0.00025	-1.61E+01	1.02E-07	-3.40E+47	2	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.9816	-1.67E+00	-0.982	2.00E-10
			19	19	0.00025	-1.70E+01	4.16E-08	-3.40E+47	2	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.9782	-1.62E+00	-0.978	8.14E-11
			20	20	0.00025	-1.79E+01	1.70E-08	-3.40E+47	2	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.9747	-1.58E+00	-0.975	3.32E-11



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															Concentration	
		X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF			
v	1.39E-03	m/d																
Rc	3.12E+02		1	1	0.00025	-8.94E-01	4.09E-01	-3.40E+47	2	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	8.18E-04
u	4.45E-06	m/d	2	2	0.00025	-1.79E+00	1.67E-01	-3.40E+47	2	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	3.34E-04
			3	3	0.00025	-2.68E+00	6.83E-02	-3.40E+47	2	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	1.37E-04
			4	4	0.00025	-3.58E+00	2.79E-02	-3.40E+47	2	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	5.59E-05
			5	5	0.00025	-4.47E+00	1.14E-02	-3.40E+47	2	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	2.28E-05
			6	6	0.00025	-5.37E+00	4.67E-03	-3.40E+47	2	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	9.34E-06
			7	7	0.00025	-6.26E+00	1.91E-03	-3.40E+47	2	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	3.82E-06
			8	8	0.00025	-7.16E+00	7.81E-04	-3.40E+47	2	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	1.56E-06
			9	9	0.00025	-8.05E+00	3.19E-04	-3.40E+47	2	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	6.38E-07
			10	10	0.00025	-8.94E+00	1.30E-04	-3.40E+47	2	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	2.61E-07
			11	11	0.00025	-9.84E+00	5.33E-05	-3.40E+47	2	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	1.07E-07
			12	12	0.00025	-1.07E+01	2.18E-05	-3.40E+47	2	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	4.36E-08
			13	13	0.00025	-1.16E+01	8.92E-06	-3.40E+47	2	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	1.78E-08
			14	14	0.00025	-1.25E+01	3.64E-06	-3.40E+47	2	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	7.29E-09
			15	15	0.00025	-1.34E+01	1.49E-06	-3.40E+47	2	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	2.98E-09
			16	16	0.00025	-1.43E+01	6.09E-07	-3.40E+47	2	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	1.22E-09
			17	17	0.00025	-1.52E+01	2.49E-07	-3.40E+47	2	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	4.98E-10
			18	18	0.00025	-1.61E+01	1.02E-07	-3.40E+47	2	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	2.04E-10
	21/06/2018		19	19	0.00025	-1.70E+01	4.16E-08	-3.40E+47	2	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	8.33E-11
	1.1		20	20	0.00025	-1.79E+01	1.70E-08	-3.40E+47	2	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	3.40E-11



Date: 21/06/2018
Version: 1.1



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:	Portsmen Way		
Site Address:	Reading		
Completed by:	PDM	Version:	1.1
Date:	21-Jun-18		
Contaminant	C12-C16 aromatic		
Target Concentration (C _T)	9.00E-02	mg/l	Origin of C _T : WHO

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

Calculate for non-polar organic chemicals

Contaminant

Target concentration

C_T

C12-C16 aromatic

0.09

mg/l

Input Parameters

Standard entry

Water filled soil porosity

θ_w

2.40E-01

fraction

calculated

Air filled soil porosity

θ_a

1.84E-01

fraction

calculated

Bulk density of soil zone material

ρ

1.60E+00

g/cm³

R & D Technical report sand fill

Henry's Law constant

H

5.30E-02

dimensionless

Total Petroleum Hydrocarbon Criteria Working Group

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 soil)

f_{oc}

4.50E-02

fraction

Site data

Organic carbon partition coefficient

K_{oc}

5.00E+03

l/kg

CLAIRE 2017 Hydrocarbons in Groundwater

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

2.25E+02

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

2.03E+01

mg/kg

(for comparison with soil analyses)

or

0.09

mg/l

(for comparison with leachate test results)

Site being assessed: Portsman Way

Completed by: PDM

Date: 21-Jun-18

Version: 1.1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T C12-C16 aromatic
0.09 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
Area of contaminant source

Inf
A

4.40E-04
1.50E+02

m/d
m²

96-2000 30% pf values River Thames at Reading 70%
Area of boiler house and tank farm

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow
Saturated aquifer thickness
Hydraulic Conductivity of aquifer in which dilution occurs
Hydraulic gradient of water table
Width of contaminant source perpendicular to groundwater flow
Background concentration of contaminant in groundwater beneath site

L
da
K
i
w
Cu

3.00E+01
8.00E+01
3.02E-01
1.70E-03
6.00E+01
0.00E+00

m
m
m/d
fraction
m
mg/l

Width of source area between PH2 and PH6
assumed vale to base of chalk
Site data
Estimate
Length of source area between PH2 and PH6
Estimated

Not used in calculation

Define mixing zone depth by specifying or calculating depth (using pull down list)

Enter mixing zone thickness
Calculated mixing zone thickness

Mz
Mz

Calculate
2.51E+01

m
m

Calculated Parameters

Dilution Factor DF

1.98E+00

Level 2 Remedial Target

1.78E-01
or
4.01E+01
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)

0.00E+00

mg/l

0

Site being assessed: Portsman Way
Completed by: PDM
Date: 21-Jun-18
Version: 1.1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		C12-C16 aromatic		from Level 1
Target Concentration	C _t	0.09	mg/l	from Level 1
Dilution Factor	DF	1.98E+00		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 dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration			
Enter soil concentration	1080	mg/kg	
Half life for degradation of contaminant in water	t _{1/2}	days	Handbook of Environmental Degradation Rates
Calculated decay rate	λ	days ⁻¹	calculated
Width of plume in aquifer at source	Sz	m	from Level 2
Plume thickness in aquifer at source	Sy	m	from Level 2
Bulk density of aquifer materials	ρ	g/cm ³	R & D Technical Report P13
Effective porosity of aquifer	n	fraction	Consim
Hydraulic gradient	i	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	m/d	from Level 2
Distance to compliance point	x	m	Estimated Depth to water table
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	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	l/kg	see options
Longitudinal dispersivity	ax	m	see options
Transverse dispersivity	az	m	see options
Vertical dispersivity	av	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Groundwater flow velocity	V	2.81E-03	m/d
Retardation factor	Rf	9.74E+02	fraction
Decay rate used	λ	3.49E-06	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.44E-03	fraction
Rate of contaminant flow due to retardation	u	2.88E-06	m/d
Ratio of Compliance Point to Source Concentration	C ₁₀ /C ₀	1.33E-01	fraction
Attenuation factor (C ₀ /C ₁₀)	AF	7.49E+00	fraction
Calculated soil leachate concentration	Co	4.80E+00	mg/l

Remedial Targets

Level 3 Remedial Target	1.33E+00	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	3.00E+02	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	2	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₁₀ /C ₀	1.33E-01	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 non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 4.50E-02 fractionOrganic carbon partition coefficient K_{oc} 5.00E+03 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,ri} l/kgSorption 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 2.25E+02 l/kg

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

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

Longitudinal dispersivity

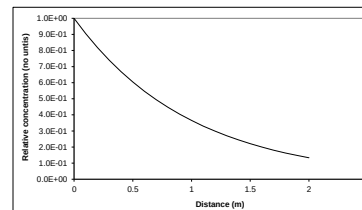
Transverse dispersivity

Vertical dispersivity

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀t)^{0.414}; 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 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

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	2.42E+00
0.1	9.04E-01	2.19E+00
0.2	8.18E-01	1.98E+00
0.3	7.39E-01	1.79E+00
0.4	6.68E-01	1.62E+00
0.5	6.04E-01	1.46E+00
0.6	5.47E-01	1.32E+00
0.7	4.94E-01	1.20E+00
0.8	4.47E-01	1.08E+00
0.9	4.04E-01	9.79E-01
1.0	3.65E-01	8.85E-01
1.1	3.30E-01	8.01E-01
1.2	2.99E-01	7.24E-01
1.3	2.70E-01	6.55E-01
1.4	2.44E-01	5.92E-01
1.5	2.21E-01	5.35E-01
1.6	2.00E-01	4.84E-01
1.7	1.81E-01	4.38E-01
1.8	1.63E-01	3.96E-01
1.9	1.48E-01	3.58E-01
2.0	1.33E-01	3.23E-01

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:	Portsmouth Way
Completed by:	PDM
Date:	#####
Version:	1.1

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters
Soil contaminant concentration C_0 2.00E-01 mg/kg

Level 1 Parameters

Water filled soil porosity	θ_w	2.40E-01	fraction
Air filled soil porosity	θ_a	1.84E-01	fraction
Bulk density	ρ	1.60E+00	g/cm ³
Henry's Law constant	H	5.30E-02	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	2.25E+02	l/kg
Factor (partitioning between soil and water)		2.25E+02	dimensionless

Level 2 Parameters

Dilution Factor DF 1.98E+00

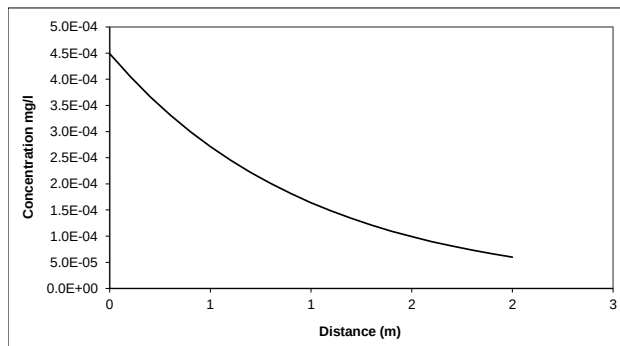
Level 3 Parameters

Attenuation factor (C_0/C_{ED}) AF 7.49E+00

Predicted concentrations at compliance point

Level 1	C	8.88E-04 mg/l	No dilution or attenuation
Level 2	C	4.49E-04 mg/l	Dilution taken into account
Level 3	C	5.99E-05 mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	4.49E-04
0.10	4.06E-04
0.20	3.67E-04
0.30	3.32E-04
0.40	3.00E-04
0.50	2.71E-04
0.60	2.45E-04
0.70	2.22E-04
0.80	2.01E-04
0.90	1.81E-04
1.00	1.64E-04
1.10	1.48E-04
1.20	1.34E-04
1.30	1.21E-04
1.40	1.10E-04
1.50	9.91E-05
1.60	8.96E-05
1.70	8.10E-05
1.80	7.33E-05
1.90	6.62E-05
2.00	5.99E-05

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	C12-C16 aromatic	from Level 1
Target Concentration	C _T 9.00E-02	mg/l from Level 1

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

Ogata Banks	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	3.38E-01	mg/l	Site data
Half life for degradation of contaminant in water	t _{1/2}	2.04E+02	days	Handbook of Environmental Degradation R
Calculated decay rate	λ	3.40E-03	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.00E+01	m	Estimated from site data
Plume thickness at source	Sy	4.00E+00	m	to top of chalk
Saturated aquifer thickness	da	8.00E+01	m	Estimated from site data
Bulk density of aquifer materials	p	1.80E+00	g/cm ³	Consim
Effective porosity of aquifer	n	3.70E-01	fraction	Consim
Hydraulic gradient	i	1.70E-03	fraction	Estimate from site data
Hydraulic conductivity of aquifer	K	3.02E-01	m/d	Site data
Distance to compliance point	x	2.00E+01	m	Distance to site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	2.25E+02	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	1.39E-03	m/d
Retardation factor	Rf	9.74E+02	fraction
Decay rate used	λ	3.49E-06	d ⁻¹
Rate of contaminant flow due to retardation	u	1.43E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	7.13E-09	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	4.74E+07	

Remedial Targets

Remedial Target	4.27E+06	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	7.13E-09	mg/l
		9.9E+99	days

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)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient

Kd

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer

foc

4.50E-02

fraction

Organic carbon partition coefficient

Koc

5.00E+03

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species

K_{oc,ri}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

l/kg

acid dissociation constant

pKa

l/kg

Fraction of organic carbon in aquifer

foc

fraction

Soil water partition coefficient

Kd

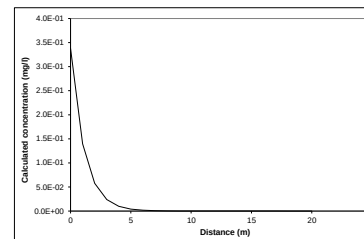
2.25E+02

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-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(log ₁₀ x) ^{-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.

Calculated concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance	Concentration
	mg/l
0	3.4E-01
1.0	1.40E-01
2.0	5.77E-02
3.0	2.39E-02
4.0	9.86E-03
5.0	4.07E-03
6.0	1.68E-03
7.0	6.96E-04
8.0	2.87E-04
9.0	1.19E-04
10.0	4.91E-05
11.0	2.03E-05
12.0	8.38E-06
13.0	3.46E-06
14.0	1.43E-06
15.0	5.92E-07
16.0	2.45E-07
17.0	1.01E-07
18.0	4.18E-08
19.0	1.73E-08
20.0	7.13E-09

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:	Portsmouth Way
Completed by:	PDM
Date:	20/07/2018
Version:	1.1

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	15.00	% wt	(Change this number only if you have specific information)
Particle Density	2.78	tonnes/m ³	
Dry Bulk Density	1.60	tonnes/m ³	
Calculated Parameters			
Voids Ratio	0.74	fraction	
Initial Saturation	56.54	%	
Total porosity	0.424	fraction	
Air Filled Porosity	0.184	fraction	
Water Filled Porosity	0.240	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	1.000	fraction	#DIV/0!
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

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 C12-C16 aromatic

Parameter	Value	Units	Calculations (Refer toTable 4.3, R&D Publication 20)																			
(carried over from input sheet)			Selected option		Calculate for non-polar organic chemicals																	
			calc	calc	Calc Kd	l/kg																
C _T	9.00E-02	mg/l	Calculation of partition coefficient																			
Kd	2.25E+02	l/kg	for ionic organic chemical																			
foc	4.50E-02	fraction																				
koc	5.00E+03	l/kg	Partition coefficient used in Level 1 Assessment																			
θ _w	2.40E-01	fraction	2.25E+02 l/kg																			
θ _a	1.84E-01	fraction																				
ρ	1.60E+00	g/cm3																				
H	5.30E-02	dimensionless	Factor (partitioning between soil and water)																			
Koc,n		l/kg																				
Koc,i		l/kg																				
pH		pH units																				
pKa																						
foc (ionic)		fraction																				
			<table><tr><td>Calculated Remedial Target</td><td>2.03E+01 mg/kg</td><td>for C12-C16 aromatic</td></tr></table>				Calculated Remedial Target	2.03E+01 mg/kg	for C12-C16 aromatic													
Calculated Remedial Target	2.03E+01 mg/kg	for C12-C16 aromatic																				
			<table><tr><td>Site being assessed:</td><td colspan="3">Portsman Way</td></tr><tr><td>Completed by:</td><td colspan="3">PDM</td></tr><tr><td>Date:</td><td colspan="3">21/06/2018</td></tr><tr><td>Version:</td><td colspan="3">1.1</td></tr></table>				Site being assessed:	Portsman Way			Completed by:	PDM			Date:	21/06/2018			Version:	1.1		
Site being assessed:	Portsman Way																					
Completed by:	PDM																					
Date:	21/06/2018																					
Version:	1.1																					

Level 2 Calculation Sheet

Contaminant C12-C16 aromatic

Site assessed:	Portsman Wa
Date:	21/06/2018
Version:	1.1

Parameter **Value** **Units**
(carried over from input sheet)

Mz	2.51E+01	m
L	3.00E+01	m
da	8.00E+01	m
Inf	4.40E-04	m/d
K	3.02E-01	m/d
i	1.70E-03	m3/d
A	1.50E+02	m2
		m3/d
Cc	0.00E+00	mg/l
C _T	9.00E-02	mg/l
Cu	0.00E+00	mg/l
w	6.00E+01	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Calculated
Dilution Factor

1.98E+00

#DIV/0!

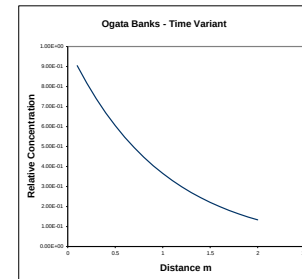


Contaminant :12-C16 aromatic

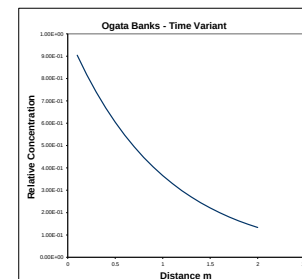
OGATA BANKS SOLUTION

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	Relative Concentration
C _T	9.000E-02	mg/l	1	0.1	0.13	-1.01E-01	9.04E-01	-8.42E+46	2	6.01E-01	1.82E+00	8.42E+46	0	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.04E-01
DF	1.979E+00		2	0.2	0.13	-2.01E-01	8.18E-01	-8.42E+46	2	1.20E+00	3.32E+00	8.42E+46	0	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	8.18E-01
			3	0.3	0.13	-3.02E-01	7.39E-01	-8.42E+46	2	1.80E+00	6.06E+00	8.42E+46	0	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	7.39E-01
			4	0.4	0.13	-4.03E-01	6.68E-01	-8.42E+46	2	2.40E+00	1.11E+01	8.42E+46	0	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	6.68E-01
λ	3.489E-06	days ⁻¹	5	0.5	0.13	-5.03E-01	6.04E-01	-8.42E+46	2	3.00E+00	2.02E+01	8.42E+46	0	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	6.04E-01
Sz	6.000E+01	m	6	0.6	0.13	-6.04E-01	5.47E-01	-8.42E+46	2	3.60E+00	3.68E+01	8.42E+46	0	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	5.47E-01
Sy	2.514E+01	m	7	0.7	0.13	-7.05E-01	4.94E-01	-8.42E+46	2	4.20E+00	6.70E+01	8.42E+46	0	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	4.94E-01
Kd	2.250E+02	l/kg	8	0.8	0.13	-8.06E-01	4.47E-01	-8.42E+46	2	4.81E+00	1.22E+02	8.42E+46	0	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	4.47E-01
ρ	1.600E+00	g/cm ³	9	0.9	0.13	-9.06E-01	4.04E-01	-8.42E+46	2	5.41E+00	2.23E+02	8.42E+46	0	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	4.04E-01
n	3.700E-01		10	1	0.13	-1.01E+00	3.65E-01	-8.42E+46	2	6.01E+00	4.06E+02	8.42E+46	0	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	3.65E-01
i	3.436E-03		11	1.1	0.13	-1.11E+00	3.30E-01	-8.42E+46	2	6.61E+00	7.41E+02	8.42E+46	0	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	3.30E-01
K	3.024E-01	m/d	12	1.2	0.13	-1.21E+00	2.99E-01	-8.42E+46	2	7.21E+00	1.35E+03	8.42E+46	0	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	2.99E-01
x	2.000E+00	m	13	1.3	0.13	-1.31E+00	2.70E-01	-8.42E+46	2	7.81E+00	2.46E+03	8.42E+46	0	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	2.70E-01
z	0.000E+00	m	14	1.4	0.13	-1.41E+00	2.44E-01	-8.42E+46	2	8.41E+00	4.49E+03	8.42E+46	0	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	2.44E-01
y	0.000E+00	m	15	1.5	0.13	-1.51E+00	2.21E-01	-8.42E+46	2	9.01E+00	8.19E+03	8.42E+46	0	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	2.21E-01
t	1.000E+99	days	16	1.6	0.13	-1.61E+00	2.00E-01	-8.42E+46	2	9.61E+00	1.49E+04	8.42E+46	0	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	2.00E-01
ax	2.000E-01	m	17	1.7	0.13	-1.71E+00	1.81E-01	-8.42E+46	2	1.02E+01	2.72E+04	8.42E+46	0	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	1.81E-01
az	2.000E-02	m	18	1.8	0.13	-1.81E+00	1.63E-01	-8.42E+46	2	1.08E+01	4.96E+04	8.42E+46	0	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	1.63E-01
ay	2.000E-03	m	19	1.9	0.13	-1.91E+00	1.48E-01	-8.42E+46	2	1.14E+01	9.05E+04	8.42E+46	0	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	1.48E-01
			20	2	0.13	-2.01E+00	1.33E-01	-8.42E+46	2	1.20E+01	1.65E+05	8.42E+46	0	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	1.33E-01



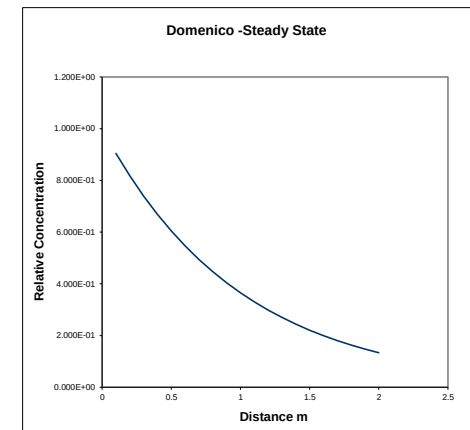
Calc	Value			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
v	0.0028	m/d	1	0.1	0.13	-1.01E-01	9.04E-01	-8.42E+46	2	6.01E-01	1.82E+00	8.42E+46	0	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.04E-01
Rc	973.9730		2	0.2	0.13	-2.01E-01	8.18E-01	-8.42E+46	2	1.20E+00	3.32E+00	8.42E+46	0	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	8.18E-01
u	0.0000	m/d	3	0.3	0.13	-3.02E-01	7.39E-01	-8.42E+46	2	1.80E+00	6.06E+00	8.42E+46	0	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	7.39E-01
			4	0.4	0.13	-4.03E-01	6.68E-01	-8.42E+46	2	2.40E+00	1.11E+01	8.42E+46	0	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	6.68E-01
			5	0.5	0.13	-5.03E-01	6.04E-01	-8.42E+46	2	3.00E+00	2.02E+01	8.42E+46	0	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	6.04E-01
			6	0.6	0.13	-6.04E-01	5.47E-01	-8.42E+46	2	3.60E+00	3.68E+01	8.42E+46	0	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	5.47E-01
			7	0.7	0.13	-7.05E-01	4.94E-01	-8.42E+46	2	4.20E+00	6.70E+01	8.42E+46	0	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	4.94E-01
			8	0.8	0.13	-8.06E-01	4.47E-01	-8.42E+46	2	4.81E+00	1.22E+02	8.42E+46	0	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	4.47E-01
			9	0.9	0.13	-9.06E-01	4.04E-01	-8.42E+46	2	5.41E+00	2.23E+02	8.42E+46	0	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	4.04E-01
			10	1	0.13	-1.01E+00	3.65E-01	-8.42E+46	2	6.01E+00	4.06E+02	8.42E+46	0	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	3.65E-01
			11	1.1	0.13	-1.11E+00	3.30E-01	-8.42E+46	2	6.61E+00	7.41E+02	8.42E+46	0	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	3.30E-01
			12	1.2	0.13	-1.21E+00	2.99E-01	-8.42E+46	2	7.21E+00	1.35E+03	8.42E+46	0	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	2.99E-01
			13	1.3	0.13	-1.31E+00	2.70E-01	-8.42E+46	2	7.81E+00	2.46E+03	8.42E+46	0	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	2.70E-01
			14	1.4	0.13	-1.41E+00	2.44E-01	-8.42E+46	2	8.41E+00	4.49E+03	8.42E+46	0	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	2.44E-01
			15	1.5	0.13	-1.51E+00	2.21E-01	-8.42E+46	2	9.01E+00	8.19E+03	8.42E+46	0	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	2.21E-01
			16	1.6	0.13	-1.61E+00	2.00E-01	-8.42E+46	2	9.61E+00	1.49E+04	8.42E+46	0	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	2.00E-01
			17	1.7	0.13	-1.71E+00	1.81E-01	-8.42E+46	2	1.02E+01	2.72E+04	8.42E+46	0	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	1.81E-01
			18	1.8	0.13	-1.81E+00	1.63E-01	-8.42E+46	2	1.08E+01	4.96E+04	8.42E+46	0	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	1.63E-01
			19	1.9	0.13	-1.91E+00	1.48E-01	-8.42E+46	2	1.14E+01	9.05E+04	8.42E+46	0	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	1.48E-01
			20	2	0.13	-2.01E+00	1.33E-01	-8.42E+46	2	1.20E+01	1.65E+05	8.42E+46	0	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	1.33E-01



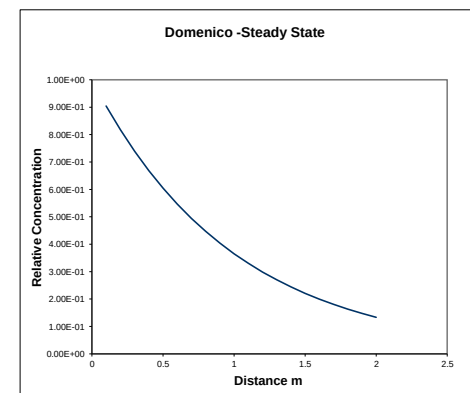
Date: 21/06/2018
Version: 1.1

Contaminant		DOMENICO (STEADY STATE)														
I2-C16 aromatic		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	9.000E-02	mg/l	1	0.1	0.25	-1.01E-01	9.04E-01	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.042E-01
DF	1.979E+00		2	0.2	0.25	-2.01E-01	8.18E-01	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	8.176E-01
			3	0.3	0.25	-3.02E-01	7.39E-01	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	7.393E-01
			4	0.4	0.25	-4.03E-01	6.68E-01	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	6.684E-01
λ	3.489E-06	days ⁻¹	5	0.5	0.25	-5.03E-01	6.04E-01	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	6.044E-01
Sz	6.000E+01	m	6	0.6	0.25	-6.04E-01	5.47E-01	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	5.465E-01
Sy	2.514E+01	m	7	0.7	0.25	-7.05E-01	4.94E-01	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	4.942E-01
Kd	2.250E+02	l/kg	8	0.8	0.25	-8.06E-01	4.47E-01	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	4.468E-01
ρ	1.600E+00	g/cm3	9	0.9	0.25	-9.06E-01	4.04E-01	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	4.040E-01
n	3.700E-01		10	1	0.25	-1.01E+00	3.65E-01	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	3.653E-01
i	3.436E-03		11	1.1	0.25	-1.11E+00	3.30E-01	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	3.303E-01
K	3.024E-01	m/d	12	1.2	0.25	-1.21E+00	2.99E-01	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	2.987E-01
x	2.000E+00	m	13	1.3	0.25	-1.31E+00	2.70E-01	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	2.701E-01
z	0.000E+00	m	14	1.4	0.25	-1.41E+00	2.44E-01	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	2.442E-01
y	0.000E+00	m	15	1.5	0.25	-1.51E+00	2.21E-01	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	2.208E-01
ax	2.000E-01	m	16	1.6	0.25	-1.61E+00	2.00E-01	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	1.997E-01
az	2.000E-02	m	17	1.7	0.25	-1.71E+00	1.81E-01	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	1.805E-01
ay	2.000E-03	m	18	1.8	0.25	-1.81E+00	1.63E-01	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	1.632E-01
			19	1.9	0.25	-1.91E+00	1.48E-01	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	1.476E-01
			20	2	0.25	-2.01E+00	1.33E-01	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	1.335E-01

Relative Concentration



Calc	Value	DOMENICO (STEADY STATE)														
		Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT														
v	2.81E-03	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration	
Rc	9.74E+02															
u	2.88E-06	m/d	1	0.1	0.25	-1.01E-01	9.04E-01	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.04E-01
			2	0.2	0.25	-2.01E-01	8.18E-01	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	8.18E-01
			3	0.3	0.25	-3.02E-01	7.39E-01	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	7.39E-01
			4	0.4	0.25	-4.03E-01	6.68E-01	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	6.68E-01
			5	0.5	0.25	-5.03E-01	6.04E-01	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	6.04E-01
			6	0.6	0.25	-6.04E-01	5.47E-01	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	5.47E-01
			7	0.7	0.25	-7.05E-01	4.94E-01	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	4.94E-01
			8	0.8	0.25	-8.06E-01	4.47E-01	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	4.47E-01
			9	0.9	0.25	-9.06E-01	4.04E-01	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	4.04E-01
			10	1	0.25	-1.01E+00	3.65E-01	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	3.65E-01
			11	1.1	0.25	-1.11E+00	3.30E-01	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	3.30E-01
			12	1.2	0.25	-1.21E+00	2.99E-01	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	2.99E-01
			13	1.3	0.25	-1.31E+00	2.70E-01	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	2.70E-01
			14	1.4	0.25	-1.41E+00	2.44E-01	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	2.44E-01
			15	1.5	0.25	-1.51E+00	2.21E-01	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	2.21E-01
			16	1.6	0.25	-1.61E+00	2.00E-01	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	2.00E-01
			17	1.7	0.25	-1.71E+00	1.81E-01	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	1.81E-01
			18	1.8	0.25	-1.81E+00	1.63E-01	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	1.63E-01
			19	1.9	0.25	-1.91E+00	1.48E-01	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	1.48E-01
			20	2	0.25	-2.01E+00	1.33E-01	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	1.33E-01
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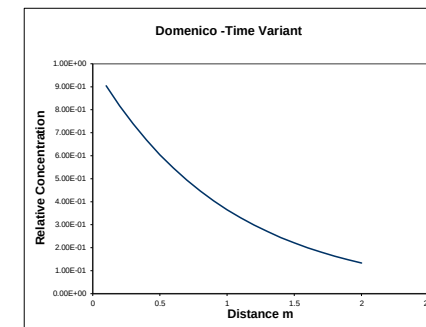
Date: 21/06/2018
Version: 1.1

DOMENICO (TIME VARIANT)

Contaminant 12-C16 aromatic

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	0.09	mg/l	1	0.1	0.125	-1.01E-01	9.04E-01	-8.42E+6	2	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.04E-01
DF	1.9790		2	0.2	0.125	-2.01E-01	8.18E-01	-8.42E+6	2	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	8.18E-01
			3	0.3	0.125	-3.02E-01	7.39E-01	-8.42E+6	2	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	7.39E-01
			4	0.4	0.125	-4.03E-01	6.68E-01	-8.42E+6	2	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	6.68E-01
λ	3.489E-06	days ⁻¹	5	0.5	0.125	-5.03E-01	6.04E-01	-8.42E+6	2	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	6.04E-01
Sz	6.000E+01	m	6	0.6	0.125	-6.04E-01	5.47E-01	-8.42E+6	2	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	5.47E-01
Sy	2.514E+01	m	7	0.7	0.125	-7.05E-01	4.94E-01	-8.42E+6	2	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	4.94E-01
Kd	2.250E+02	l/kg	8	0.8	0.125	-8.06E-01	4.47E-01	-8.42E+6	2	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	4.47E-01
ρ	1.600E+00	g/cm3	9	0.9	0.125	-9.06E-01	4.04E-01	-8.42E+6	2	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	4.04E-01
n	3.700E-01		10	1	0.125	-1.01E+00	3.65E-01	-8.42E+6	2	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	3.65E-01
i	3.436E-03		11	1.1	0.125	-1.11E+00	3.30E-01	-8.42E+6	2	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	3.30E-01
K	3.024E-01	m/d	12	1.2	0.125	-1.21E+00	2.99E-01	-8.42E+6	2	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	2.99E-01
x	2.000E+00	m	13	1.3	0.125	-1.31E+00	2.70E-01	-8.42E+6	2	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	2.70E-01
z	0.000E+00	m	14	1.4	0.125	-1.41E+00	2.44E-01	-8.42E+6	2	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	2.44E-01
y	0.000E+00	m	15	1.5	0.125	-1.51E+00	2.21E-01	-8.42E+6	2	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	2.21E-01
t	1.000E+99	days	16	1.6	0.125	-1.61E+00	2.00E-01	-8.42E+6	2	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	2.00E-01
ax	2.000E-01	m	17	1.7	0.125	-1.71E+00	1.81E-01	-8.42E+6	2	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	1.81E-01
az	2.000E-02	m	18	1.8	0.125	-1.81E+00	1.63E-01	-8.42E+6	2	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	1.63E-01
ay	2.000E-03	m	19	1.9	0.125	-1.91E+00	1.48E-01	-8.42E+6	2	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	1.48E-01
			20	2	0.125	-2.01E+00	1.33E-01	-8.42E+6	2	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	1.33E-01

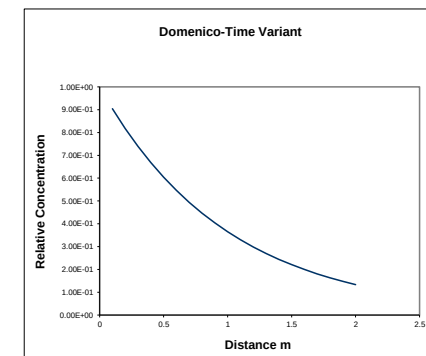


Calc

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	2.81E-03	m/d	m															
Rc	9.74E+02		1	0.1	0.125	-1.01E-01	9.04E-01	-8.42E+6	2	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.04E-01
u	2.88E-06	m/d	2	0.2	0.125	-2.01E-01	8.18E-01	-8.42E+6	2	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	8.18E-01
			3	0.3	0.125	-3.02E-01	7.39E-01	-8.42E+6	2	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	7.39E-01
			4	0.4	0.125	-4.03E-01	6.68E-01	-8.42E+6	2	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	6.68E-01
			5	0.5	0.125	-5.03E-01	6.04E-01	-8.42E+6	2	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	6.04E-01
			6	0.6	0.125	-6.04E-01	5.47E-01	-8.42E+6	2	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	5.47E-01
			7	0.7	0.125	-7.05E-01	4.94E-01	-8.42E+6	2	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	4.94E-01
			8	0.8	0.125	-8.06E-01	4.47E-01	-8.42E+6	2	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	4.47E-01
			9	0.9	0.125	-9.06E-01	4.04E-01	-8.42E+6	2	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	4.04E-01
			10	1	0.125	-1.01E+00	3.65E-01	-8.42E+6	2	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	3.65E-01
			11	1.1	0.125	-1.11E+00	3.30E-01	-8.42E+6	2	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	3.30E-01
			12	1.2	0.125	-1.21E+00	2.99E-01	-8.42E+6	2	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	2.99E-01
			13	1.3	0.125	-1.31E+00	2.70E-01	-8.42E+6	2	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	2.70E-01
			14	1.4	0.125	-1.41E+00	2.44E-01	-8.42E+6	2	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	2.44E-01
			15	1.5	0.125	-1.51E+00	2.21E-01	-8.42E+6	2	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	2.21E-01
			16	1.6	0.125	-1.61E+00	2.00E-01	-8.42E+6	2	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	2.00E-01
			17	1.7	0.125	-1.71E+00	1.81E-01	-8.42E+6	2	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	1.81E-01
			18	1.8	0.125	-1.81E+00	1.63E-01	-8.42E+6	2	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	1.63E-01
			19	1.9	0.125	-1.91E+00	1.48E-01	-8.42E+6	2	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	1.48E-01
			20	2	0.125	-2.01E+00	1.33E-01	-8.42E+6	2	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	1.33E-01



Date: 21/06/2018
Version: 1.1

OGATA BANKS SOLUTION																						
Contaminant	:12-C16 aromatic		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	0.09	mg/l	1	1	0.04225	-8.8E-01	4.1E-01	-1.9E+07	2.000	1.4E+00	4.0E+00	1.9E+07	0.000	3.4E+01	1	-3.4E+01	-1	7.1E+00	1	-7.1E+00	-1	1.40E-01
			2	2	0.04225	-1.8E+00	1.7E-01	-1.9E+07	2.000	2.8E+00	1.6E+01	1.9E+07	0.000	2.4E+01	1	-2.4E+01	-1	5.0E+00	1	-5.0E+00	-1	5.77E-02
			3	3	0.04225	-2.7E+00	7.1E-02	-1.9E+07	2.000	4.2E+00	6.4E+01	1.9E+07	0.000	1.9E+01	1	-1.9E+01	-1	4.1E+00	1	-4.1E+00	-1	2.39E-02
Co	3.38E-01	mg/l	4	4	0.04225	-3.5E+00	2.9E-02	-1.9E+07	2.000	5.5E+00	2.5E+02	1.9E+07	0.000	1.7E+01	1	-1.7E+01	-1	3.5E+00	1	-3.5E+00	-1	9.86E-03
λ	3.49E-06	days ⁻¹	5	5	0.04225	-4.4E+00	1.2E-02	-1.9E+07	2.000	6.9E+00	1.0E+03	1.9E+07	0.000	1.5E+01	1	-1.5E+01	-1	3.2E+00	1	-3.2E+00	-0.99999	4.07E-03
Sz	6.00E+01	m	6	6	0.04225	-5.3E+00	5.0E-03	-1.9E+07	2.000	8.3E+00	4.0E+03	1.9E+07	0.000	1.4E+01	1	-1.4E+01	-1	2.9E+00	1	-2.9E+00	-0.99996	1.68E-03
Sy	4.00E+00	m	7	7	0.04225	-6.2E+00	2.1E-03	-1.9E+07	2.000	9.7E+00	1.6E+04	1.9E+07	0.000	1.3E+01	1	-1.3E+01	-1	2.7E+00	0.9998	-2.7E+00	-0.99984	6.96E-04
Kd	2.25E+02	l/kg	8	8	0.04225	-7.1E+00	8.5E-04	-1.9E+07	2.000	1.1E+01	6.4E+04	1.9E+07	0.000	1.2E+01	1	-1.2E+01	-1	2.5E+00	0.9996	-2.5E+00	-0.99959	2.87E-04
ρ	1.60E+00	g/cm3	9	9	0.04225	-8.0E+00	3.5E-04	-1.9E+07	2.000	1.2E+01	2.6E+05	1.9E+07	0.000	1.1E+01	1	-1.1E+01	-1	2.4E+00	0.9991	-2.4E+00	-0.99914	1.19E-04
n	3.70E-01	m	10	10	0.04225	-8.8E+00	1.5E-04	-1.9E+07	2.000	1.4E+01	1.0E+06	1.9E+07	0.000	1.1E+01	1	-1.1E+01	-1	2.2E+00	0.9984	-2.2E+00	-0.99843	4.90E-05
i	1.70E-03	m	11	11	0.04225	-9.7E+00	6.0E-05	-1.9E+07	2.000	1.5E+01	4.1E+06	1.9E+07	0.000	1.0E+01	1	-1.0E+01	-1	2.1E+00	0.9974	-2.1E+00	-0.99743	2.02E-05
K	3.02E-01	m/d	12	12	0.04225	-1.1E+01	2.5E-05	-1.9E+07	2.000	1.7E+01	1.6E+07	1.9E+07	0.000	9.7E+00	1	-9.7E+00	-1	2.0E+00	0.9961	-2.0E+00	-0.99611	8.35E-06
x	2.00E+01	m	13	13	0.04225	-1.1E+01	1.0E-05	-1.9E+07	2.000	1.8E+01	6.5E+07	1.9E+07	0.000	9.3E+00	1	-9.3E+00	-1	2.0E+00	0.9945	-2.0E+00	-0.99445	3.45E-06
z	0.00E+00	m	14	14	0.04225	-1.2E+01	4.2E-06	-1.9E+07	2.000	1.9E+01	2.6E+08	1.9E+07	0.000	9.0E+00	1	-9.0E+00	-1	1.9E+00	0.9925	-1.9E+00	-0.99247	1.42E-06
y	0.00E+00	m	15	15	0.04225	-1.3E+01	1.8E-06	-1.9E+07	2.000	2.1E+01	1.0E+09	1.9E+07	0.000	8.7E+00	1	-8.7E+00	-1	1.8E+00	0.9902	-1.8E+00	-0.99018	5.86E-07
t	9.90E+99	days	16	16	0.04225	-1.4E+01	7.2E-07	-1.9E+07	2.000	2.2E+01	4.1E+09	1.9E+07	0.000	8.4E+00	1	-8.4E+00	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	2.41E-07
ax	2.00E+00	m	17	17	0.04225	-1.5E+01	3.0E-07	-1.9E+07	2.000	2.4E+01	1.6E+10	1.9E+07	0.000	8.1E+00	1	-8.1E+00	-1	1.7E+00	0.9847	-1.7E+00	-0.98471	9.95E-08
az	2.00E-01	m	18	18	0.04225	-1.6E+01	1.2E-07	-1.9E+07	2.000	2.5E+01	6.6E+10	1.9E+07	0.000	7.9E+00	1	-7.9E+00	-1	1.7E+00	0.9816	-1.7E+00	-0.98158	4.10E-08
ay	2.00E-02	m	19	19	0.04225	-1.7E+01	5.1E-08	-1.9E+07	2.000	2.6E+01	2.6E+11	1.9E+07	0.000	7.7E+00	1	-7.7E+00	-1	1.6E+00	0.9782	-1.6E+00	-0.97822	1.69E-08
			20	20	0.04225	-1.8E+01	2.1E-08	-1.9E+07	2.000	2.8E+01	1.0E+12	1.9E+07	0.000	7.5E+00	1	-7.5E+00	-1	1.6E+00	0.9747	-1.6E+00	-0.97465	6.95E-09

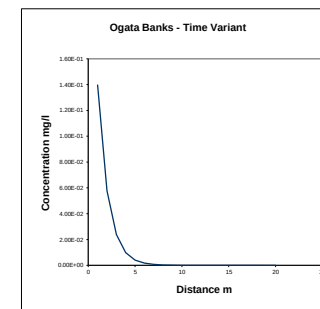
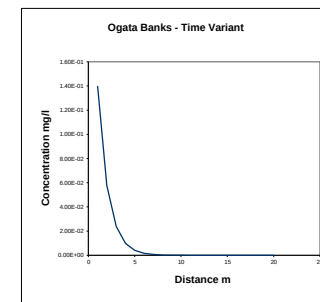
Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc		Value	Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT																			Concentration
			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	1.39E-03	m/d	1	1	0.04225	-8.8E-01	4.1E-01	-1.9E+07	2.000	1.4E+00	4.0E+00	1.9E+07	0.000	3.4E+01	1	-3.4E+01	-1	1.4E+01	1	-1.4E+01	-1	1.40E-01
Rc	9.74E+02		2	2	0.04225	-1.8E+00	1.7E-01	-1.9E+07	2.000	2.8E+00	1.6E+01	1.9E+07	0.000	2.4E+01	1	-2.4E+01	-1	1.0E+01	1	-1.0E+01	-1	5.77E-02
u	1.43E-06	m/d	3	3	0.04225	-2.7E+00	7.1E-02	-1.9E+07	2.000	4.2E+00	6.4E+01	1.9E+07	0.000	1.9E+01	1	-1.9E+01	-1	8.2E+00	1	-8.2E+00	-1	2.39E-02
			4	4	0.04225	-3.5E+00	2.9E-02	-1.9E+07	2.000	5.5E+00	2.5E+02	1.9E+07	0.000	1.7E+01	1	-1.7E+01	-1	7.1E+00	1	-7.1E+00	-1	9.86E-03
			5	5	0.04225	-4.4E+00	1.2E-02	-1.9E+07	2.000	6.9E+00	1.0E+03	1.9E+07	0.000	1.5E+01	1	-1.5E+01	-1	6.3E+00	1	-6.3E+00	-1	4.07E-03
			6	6	0.04225	-5.3E+00	5.0E-03	-1.9E+07	2.000	8.3E+00	4.0E+03	1.9E+07	0.000	1.4E+01	1	-1.4E+01	-1	5.8E+00	1	-5.8E+00	-1	1.68E-03
			7	7	0.04225	-6.2E+00	2.1E-03	-1.9E+07	2.000	9.7E+00	1.6E+04	1.9E+07	0.000	1.3E+01	1	-1.3E+01	-1	5.3E+00	1	-5.3E+00	-1	6.96E-04
			8	8	0.04225	-7.1E+00	8.5E-04	-1.9E+07	2.000	1.1E+01	6.4E+04	1.9E+07	0.000	1.2E+01	1	-1.2E+01	-1	5.0E+00	1	-5.0E+00	-1	2.87E-04
			9	9	0.04225	-8.0E+00	3.5E-04	-1.9E+07	2.000	1.2E+01	2.6E+05	1.9E+07	0.000	1.1E+01	1	-1.1E+01	-1	4.7E+00	1	-4.7E+00	-1	1.19E-04
			10	10	0.04225	-8.8E+00	1.5E-04	-1.9E+07	2.000	1.4E+01	1.0E+06	1.9E+07	0.000	1.1E+01	1	-1.1E+01	-1	4.5E+00	1	-4.5E+00	-1	4.91E-05
			11	11	0.04225	-9.7E+00	6.0E-05	-1.9E+07	2.000	1.5E+01	4.1E+06	1.9E+07	0.000	1.0E+01	1	-1.0E+01	-1	4.3E+00	1	-4.3E+00	-1	2.03E-05
			12	12	0.04225	-1.1E+01	2.5E-05	-1.9E+07	2.000	1.7E+01	1.6E+07	1.9E+07	0.000	9.7E+00	1	-9.7E+00	-1	4.1E+00	1	-4.1E+00	-1	8.38E-06
			13	13	0.04225	-1.1E+01	1.0E-05	-1.9E+07	2.000	1.8E+01	6.5E+07	1.9E+07	0.000	9.3E+00	1	-9.3E+00	-1	3.9E+00	1	-3.9E+00	-1	3.46E-06
			14	14	0.04225	-1.2E+01	4.2E-06	-1.9E+07	2.000	1.9E+01	2.6E+08	1.9E+07	0.000	9.0E+00	1	-9.0E+00	-1	3.8E+00	1	-3.8E+00	-1	1.43E-06
			15	15	0.04225	-1.3E+01	1.8E-06	-1.9E+07	2.000	2.1E+01	1.0E+09	1.9E+07	0.000	8.7E+00	1	-8.7E+00	-1	3.7E+00	1	-3.7E+00	-1	5.92E-07
			16	16	0.04225	-1.4E+01	7.2E-07	-1.9E+07	2.000	2.2E+01	4.1E+09	1.9E+07	0.000	8.4E+00	1	-8.4E+00	-1	3.5E+00	1	-3.5E+00	-1	2.45E-07
			17	17	0.04225	-1.5E+01	3.0E-07	-1.9E+07	2.000	2.4E+01	1.6E+10	1.9E+07	0.000	8.1E+00	1	-8.1E+00	-1	3.4E+00	1	-3.4E+00	-1	1.01E-07
			18	18	0.04225	-1.6E+01	1.2E-07	-1.9E+07	2.000	2.5E+01	6.6E+10	1.9E+07	0.000	7.9E+00	1	-7.9E+00	-1	3.3E+00	1	-3.3E+00	-1	4.18E-08
			19	19	0.04225	-1.7E+01	5.1E-08	-1.9E+07	2.000	2.6E+01	2.6E+11	1.9E+07	0.000	7.7E+00	1	-7.7E+00	-1	3.2E+00	1	-3.2E+00	-1	1.73E-08
			20	20	0.04225	-1.8E+01	2.1E-08	-1.9E+07	2.000	2.8E+01	1.0E+12	1.9E+07	0.000	7.5E+00	1	-7.5E+00	-1	3.2E+00	1	-3.2E+00	-0.99999	7.13E-09

Date: 21/06/2018

Version: 1.1

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Contaminant L2-C16 aromatic

DOMENICO (STEADY STATE)

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	Concentration	
Input	Value	Units														
C _T	0.09	mg/l	1	1	0.0845	-8.84E-01	4.13E-01	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	1.40E-01
			2	2	0.0845	-1.77E+00	1.71E-01	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	5.77E-02
			3	3	0.0845	-2.65E+00	7.06E-02	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	2.39E-02
Co	3.38E-01	mg/l	4	4	0.0845	-3.53E+00	2.92E-02	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	9.86E-03
λ	3.49E-06	days ⁻¹	5	5	0.0845	-4.42E+00	1.21E-02	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	4.07E-03
Sz	6.00E+01	m	6	6	0.0845	-5.30E+00	4.98E-03	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	1.68E-03
Sy	4.00E+00	m	7	7	0.0845	-6.19E+00	2.06E-03	1.27E+01	1	-1.27E+01	-1	2.67E+00	1	-2.67E+00	-0.9998	6.96E-04
Kd	2.25E+02	l/kg	8	8	0.0845	-7.07E+00	8.51E-04	1.19E+01	1	-1.19E+01	-1	2.50E+00	1	-2.50E+00	-0.9996	2.87E-04
ρ	1.60E+00	g/cm3	9	9	0.0845	-7.95E+00	3.51E-04	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.999	-2.36E+00	-0.9991	1.19E-04
n	3.70E-01		10	10	0.0845	-8.84E+00	1.45E-04	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.998	-2.24E+00	-0.9984	4.90E-05
i	1.70E-03		11	11	0.0845	-9.72E+00	6.00E-05	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.997	-2.13E+00	-0.9974	2.02E-05
K	3.02E-01	m/d	12	12	0.0845	-1.06E+01	2.48E-05	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.996	-2.04E+00	-0.9961	8.35E-06
x	2.00E+01	m	13	13	0.0845	-1.15E+01	1.03E-05	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.994	-1.96E+00	-0.9945	3.45E-06
z	0.00E+00	m	14	14	0.0845	-1.24E+01	4.24E-06	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.992	-1.89E+00	-0.9925	1.42E-06
y	0.00E+00	m	15	15	0.0845	-1.33E+01	1.75E-06	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.99	-1.83E+00	-0.9902	5.86E-07
			16	16	0.0845	-1.41E+01	7.23E-07	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.988	-1.77E+00	-0.9876	2.41E-07
ax	2.00E+00	m	17	17	0.0845	-1.50E+01	2.99E-07	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.985	-1.71E+00	-0.9847	9.95E-08
az	2.00E-01	m	18	18	0.0845	-1.59E+01	1.24E-07	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.982	-1.67E+00	-0.9816	4.10E-08
ay	2.00E-02	m	19	19	0.0845	-1.68E+01	5.11E-08	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.978	-1.62E+00	-0.9782	1.69E-08
			20	20	0.0845	-1.77E+01	2.11E-08	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.975	-1.58E+00	-0.9747	6.95E-09

Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc

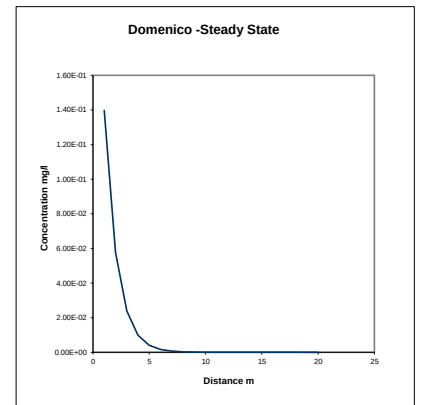
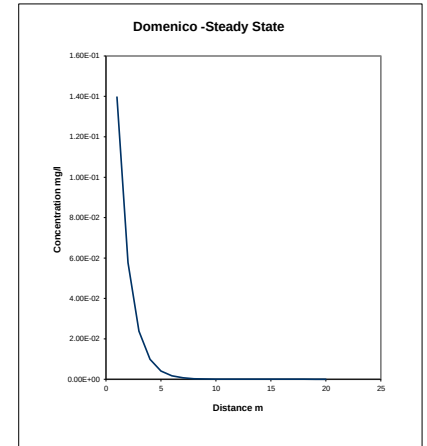
Value

DOMENICO (STEADY STATE)

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

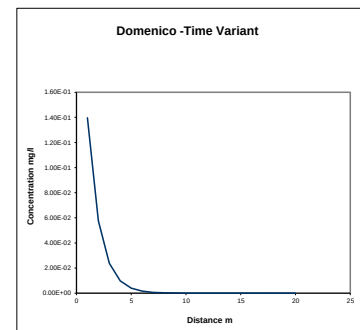
				X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
v Rc u	1.39E-03	m/d														
	9.74E+02															
	1.43E-06	m/d	1	1	0.0845	-8.84E-01	4.13E-01	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	1.40E-01
			2	2	0.0845	-1.77E+00	1.71E-01	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	5.77E-02
			3	3	0.0845	-2.65E+00	7.06E-02	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	2.39E-02
			4	4	0.0845	-3.53E+00	2.92E-02	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	9.86E-03
			5	5	0.0845	-4.42E+00	1.21E-02	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	4.07E-03
			6	6	0.0845	-5.30E+00	4.98E-03	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	1.68E-03
			7	7	0.0845	-6.19E+00	2.06E-03	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	6.96E-04
			8	8	0.0845	-7.07E+00	8.51E-04	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	2.87E-04
			9	9	0.0845	-7.95E+00	3.51E-04	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	1.19E-04
			10	10	0.0845	-8.84E+00	1.45E-04	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	4.91E-05
			11	11	0.0845	-9.72E+00	6.00E-05	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	2.03E-05
			12	12	0.0845	-1.06E+01	2.48E-05	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	8.38E-06
			13	13	0.0845	-1.15E+01	1.03E-05	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	3.46E-06
			14	14	0.0845	-1.24E+01	4.24E-06	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	1.43E-06
			15	15	0.0845	-1.33E+01	1.75E-06	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	5.92E-07
			16	16	0.0845	-1.41E+01	7.23E-07	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	2.45E-07
			17	17	0.0845	-1.50E+01	2.99E-07	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	1.01E-07
			18	18	0.0845	-1.59E+01	1.24E-07	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	4.18E-08
	21/06/2018		19	19	0.0845	-1.68E+01	5.11E-08	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	1.73E-08
n:	1.1		20	20	0.0845	-1.77E+01	2.11E-08	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	7.13E-09

Date: 21/06/2018
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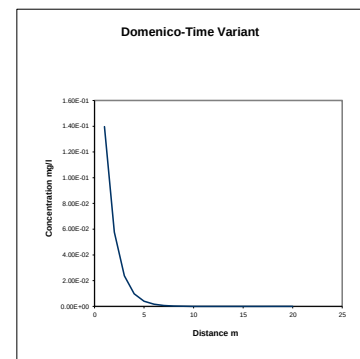
DOMENICO (TIME VARIANT)

Contaminant	12-C16 aromatic		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	0.09	mg/l	m															
Co	3.38E-01	mg/l	1	1	0.04225	-8.84E-01	4.13E-01	-1.91E+47	2	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	1.40E-01
			2	2	0.04225	-1.77E+00	1.71E-01	-1.91E+47	2	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	5.77E-02
			3	3	0.04225	-2.65E+00	7.06E-02	-1.91E+47	2	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	2.39E-02
λ	3.49E-06	days ⁻¹	4	4	0.04225	-3.53E+00	2.92E-02	-1.91E+47	2	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	9.86E-03
Sz	6.00E+01	m	5	5	0.04225	-4.42E+00	1.21E-02	-1.91E+47	2	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	4.07E-03
Sy	4.00E+00	m	6	6	0.04225	-5.30E+00	4.98E-03	-1.91E+47	2	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	1.68E-03
Kd	2.25E+02	l/kg	7	7	0.04225	-6.19E+00	2.06E-03	-1.91E+47	2	1.27E+01	1	-1.27E+01	-1	2.67E+00	0.9998	-2.67E+00	-1	6.96E-04
ρ	1.60E+00	g/cm3	8	8	0.04225	-7.07E+00	8.51E-04	-1.91E+47	2	1.19E+01	1	-1.19E+01	-1	2.50E+00	0.9996	-2.50E+00	-1	2.87E-04
n	3.70E-01		9	9	0.04225	-7.95E+00	3.51E-04	-1.91E+47	2	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.9991	-2.36E+00	-0.999	1.19E-04
i	1.70E-03		10	10	0.04225	-8.84E+00	1.45E-04	-1.91E+47	2	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.9984	-2.24E+00	-0.998	4.90E-05
K	3.02E-01	m/d	11	11	0.04225	-9.72E+00	6.00E-05	-1.91E+47	2	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.9974	-2.13E+00	-0.997	2.02E-05
x	2.00E+01	m	12	12	0.04225	-1.06E+01	2.48E-05	-1.91E+47	2	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.9961	-2.04E+00	-0.996	8.35E-06
z	0.00E+00	m	13	13	0.04225	-1.15E+01	1.03E-05	-1.91E+47	2	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.9945	-1.96E+00	-0.994	3.45E-06
y	0.00E+00	m	14	14	0.04225	-1.24E+01	4.24E-06	-1.91E+47	2	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.9925	-1.89E+00	-0.992	1.42E-06
t	9.90E+99	days	15	15	0.04225	-1.33E+01	1.75E-06	-1.91E+47	2	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.9902	-1.83E+00	-0.99	5.86E-07
ax	2.00E+00	m	16	16	0.04225	-1.41E+01	7.23E-07	-1.91E+47	2	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.9876	-1.77E+00	-0.988	2.41E-07
az	2.00E-01	m	17	17	0.04225	-1.50E+01	2.99E-07	-1.91E+47	2	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.9847	-1.71E+00	-0.985	9.95E-08
ay	2.00E-02	m	18	18	0.04225	-1.59E+01	1.24E-07	-1.91E+47	2	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.9816	-1.67E+00	-0.982	4.10E-08
			19	19	0.04225	-1.68E+01	5.11E-08	-1.91E+47	2	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.9782	-1.62E+00	-0.978	1.69E-08
			20	20	0.04225	-1.77E+01	2.11E-08	-1.91E+47	2	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.9747	-1.58E+00	-0.975	6.95E-09



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															Concentration	
		X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF			
v	1.39E-03	m/d																
Rc	9.74E+02		1	1	0.04225	-8.84E-01	4.13E-01	-1.91E+47	2	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	1.40E-01
u	1.43E-06	m/d	2	2	0.04225	-1.77E+00	1.71E-01	-1.91E+47	2	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	5.77E-02
			3	3	0.04225	-2.65E+00	7.06E-02	-1.91E+47	2	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	2.39E-02
			4	4	0.04225	-3.53E+00	2.92E-02	-1.91E+47	2	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	9.86E-03
			5	5	0.04225	-4.42E+00	1.21E-02	-1.91E+47	2	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	4.07E-03
			6	6	0.04225	-5.30E+00	4.98E-03	-1.91E+47	2	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	1.68E-03
			7	7	0.04225	-6.19E+00	2.06E-03	-1.91E+47	2	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	6.96E-04
			8	8	0.04225	-7.07E+00	8.51E-04	-1.91E+47	2	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	2.87E-04
			9	9	0.04225	-7.95E+00	3.51E-04	-1.91E+47	2	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	1.19E-04
			10	10	0.04225	-8.84E+00	1.45E-04	-1.91E+47	2	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	4.91E-05
			11	11	0.04225	-9.72E+00	6.00E-05	-1.91E+47	2	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	2.03E-05
			12	12	0.04225	-1.06E+01	2.48E-05	-1.91E+47	2	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	8.38E-06
			13	13	0.04225	-1.15E+01	1.03E-05	-1.91E+47	2	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	3.46E-06
			14	14	0.04225	-1.24E+01	4.24E-06	-1.91E+47	2	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	1.43E-06
			15	15	0.04225	-1.33E+01	1.75E-06	-1.91E+47	2	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	5.92E-07
			16	16	0.04225	-1.41E+01	7.23E-07	-1.91E+47	2	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	2.45E-07
			17	17	0.04225	-1.50E+01	2.99E-07	-1.91E+47	2	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	1.01E-07
			18	18	0.04225	-1.59E+01	1.24E-07	-1.91E+47	2	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	4.18E-08
			19	19	0.04225	-1.68E+01	5.11E-08	-1.91E+47	2	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	1.73E-08
			20	20	0.04225	-1.77E+01	2.11E-08	-1.91E+47	2	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	7.13E-09
	21/06/2018																	
	1.1																	



Date: 21/06/2018
Version: 1.1



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.

© Environment Agency, 2006. (Produced by the Environment Agency's Science Group)

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:	Portman Road		
Site Address:	Reading		
Completed by:	PDM	Version:	1.1
Date:	21-Jun-18		
Contaminant	C10-C12 aliphatic		
Target Concentration (C_T)	3.00E-01	mg/l	Origin of C_T: WHO

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T
0.3 mg/l

Input Parameters Standard entry

Variable Value Unit Source of parameter value

Water filled soil porosity

θ_w 2.40E-01 fraction

calculated

Air filled soil porosity

θ_a 1.84E-01 fraction

calculated

Bulk density of soil zone material

ρ 1.60E+00 g/cm³

R & D Technical report sand fill

Henry's Law constant

H 1.20E+02 dimensionless

Total Petroleum Hydrocarbon Criteria Working Group

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 soil)

f_{oc} 4.50E-02 fraction

Site data

Organic carbon partition coefficient

K_{oc} 2.50E+05 l/kg

CLAIRE 2017 Hydrocarbons in Groundwater

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 1.13E+04 l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

3.38E+03 mg/kg

(for comparison with soil analyses)

or

0.3 mg/l

(for comparison with leachate test results)

Site being assessed: Portman Road

Completed by: PDM

Date: 21-Jun-18

Version: 1.1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

C10-C12 aliphatic
0.3

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
Area of contaminant source

Inf
A

4.40E-04
1.50E+02

m/d
m²

96-2000 30% pf values River Thames at Reading 70%
Area of boiler house and tank farm

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow
Saturated aquifer thickness
Hydraulic Conductivity of aquifer in which dilution occurs
Hydraulic gradient of water table
Width of contaminant source perpendicular to groundwater flow
Background concentration of contaminant in groundwater beneath site

L
da
K
i
w
Cu

3.00E+01
8.00E+01
3.02E-01
1.70E-03
6.00E+01
0.00E+00

m
m
m/d
fraction
m
mg/l

Width of source area between PH2 and PH6
assumed vale to base of chalk
site data
Estimate
Length of source area between PH2 and PH6
Estimated

Not used in calculation

Define mixing zone depth by specifying or calculating depth (using pull down list)

Enter mixing zone thickness
Calculated mixing zone thickness

Mz
Mz

Calculate
2.51E+01

m
m

Calculated Parameters

Dilution Factor

DF

1.98E+00

Level 2 Remedial Target

5.94E-01
or
6.69E+03
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)

C_c

0.00E+00

mg/l

Calculated concentration within receptor (dilution only)

0.00E+00

mg/l

0

Site being assessed: Portman Road
Completed by: PDM
Date: 21-Jun-18
Version: 1.1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		C10-C12 aliphatic		from Level 1
Target Concentration	C _t	0.3	mg/l	from Level 1
Dilution Factor	DF	1.98E+00		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 dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	522	mg/kg	
Enter soil concentration	1.75E+03	days	
Half life for degradation of contaminant in water	3.96E-04	days ⁻¹	calculated
Width of plume in aquifer at source	6.00E+01	m	from Level 2
Plume thickness in aquifer at source	2.51E+01	m	from Level 2
Bulk density of aquifer materials	1.60E+00	g/cm ³	R & D Technical Report P13
Effective porosity of aquifer	3.70E-01	fraction	Consim
Hydraulic gradient	3.44E-03	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	3.02E-01	m/d	from Level 2
Distance to compliance point	2.00E+00	m	Estimated Depth to water table
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	1.13E+04	l/kg see options
Longitudinal dispersivity	ax	0.200	m see options
Transverse dispersivity	az	0.020	m see options
Vertical dispersivity	av	0.002	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	2.81E-03	m/d
Retardation factor	4.86E+04	fraction
Decay rate used	8.14E-09	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	3.44E-03	fraction
Rate of contaminant flow due to retardation	5.77E-08	m/d
Ratio of Compliance Point to Source Concentration	C ₁₀ /C ₀	7.60E-01
Attenuation factor (C ₁₀ /C ₁₀₀)	AF	1.32E+00
Calculated soil leachate concentration	Co	4.63E-02

Remedial Targets

Level 3 Remedial Target	7.81E-01	mg/l	For comparison with measured pore water concentration.
Ogata Banks	8.80E+03	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2	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 ₁₀ /C ₀	7.60E-01	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 non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 4.50E-02 fractionOrganic carbon partition coefficient K_{oc} 2.50E+05 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,ri} l/kgSorption 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 1.13E+04 l/kg

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

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

Longitudinal dispersivity

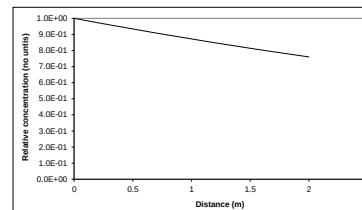
Transverse dispersivity

Vertical dispersivity

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀)^{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 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

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	2.34E-02
0.1	9.86E-01	2.31E-02
0.2	9.73E-01	2.28E-02
0.3	9.60E-01	2.25E-02
0.4	9.47E-01	2.22E-02
0.5	9.34E-01	2.19E-02
0.6	9.21E-01	2.16E-02
0.7	9.08E-01	2.13E-02
0.8	8.96E-01	2.10E-02
0.9	8.84E-01	2.07E-02
1.0	8.72E-01	2.04E-02
1.1	8.60E-01	2.01E-02
1.2	8.48E-01	1.99E-02
1.3	8.37E-01	1.96E-02
1.4	8.25E-01	1.93E-02
1.5	8.14E-01	1.91E-02
1.6	8.03E-01	1.88E-02
1.7	7.92E-01	1.85E-02
1.8	7.81E-01	1.83E-02
1.9	7.70E-01	1.80E-02
2.0	7.60E-01	1.78E-02

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:	Portman Road
Completed by:	PDM
Date:	#####
Version:	1.1

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters
Soil contaminant concentration C_0 2.00E-01 mg/kg

Level 1 Parameters

Water filled soil porosity	θ_w	2.40E-01	fraction
Air filled soil porosity	θ_a	1.84E-01	fraction
Bulk density	ρ	1.60E+00	g/cm ³
Henry's Law constant	H	1.20E+02	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	1.13E+04	l/kg
Factor (partitioning between soil and water)		1.13E+04	dimensionless

Level 2 Parameters

Dilution Factor DF 1.98E+00

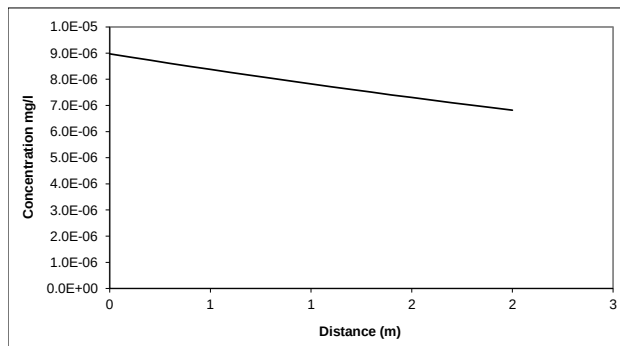
Level 3 Parameters

Attenuation factor (C_0/C_{ED}) AF 1.32E+00

Predicted concentrations at compliance point

Level 1	C	1.78E-05	mg/l	No dilution or attenuation
Level 2	C	8.97E-06	mg/l	Dilution taken into account
Level 3	C	6.82E-06	mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	8.97E-06
0.10	8.85E-06
0.20	8.73E-06
0.30	8.61E-06
0.40	8.49E-06
0.50	8.38E-06
0.60	8.26E-06
0.70	8.15E-06
0.80	8.04E-06
0.90	7.93E-06
1.00	7.82E-06
1.10	7.71E-06
1.20	7.61E-06
1.30	7.51E-06
1.40	7.40E-06
1.50	7.30E-06
1.60	7.20E-06
1.70	7.10E-06
1.80	7.01E-06
1.90	6.91E-06
2.00	6.82E-06

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant				from Level 1
Target Concentration	C _T	C10-C12 aliphatic 3.00E-01	mg/l	from Level 1

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

Ogata Banks	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	1.17E-01	mg/l	Site data
Half life for degradation of contaminant in water	t _{1/2}	1.75E+03	days	Canada Wide Standards for PHC in Soils
Calculated decay rate	λ	3.96E-04	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.00E+01	m	Estimated from site data
Plume thickness at source	Sy	4.00E+00	m	to top of chalk
Saturated aquifer thickness	da	8.00E+01	m	Estimated from site data
Bulk density of aquifer materials	p	1.80E+00	g/cm ³	Consim
Effective porosity of aquifer	n	3.70E-01	fraction	Consim
Hydraulic gradient	i	1.70E-03	fraction	Estimate from site data
Hydraulic conductivity of aquifer	K	3.02E-01	m/d	Site data
Distance to compliance point	x	2.00E+01	m	Distance to site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	1.13E+04	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	1.39E-03	m/d
Retardation factor	Rf	4.86E+04	fraction
Decay rate used	λ	8.14E-09	d ⁻¹
Rate of contaminant flow due to retardation	u	2.86E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	2.03E-03	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	5.78E+01	

Remedial Targets

Remedial Target	1.73E+01	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	2.03E-03 9.9E+99	mg/l days
			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.

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient

Kd

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer

f_{oc}

4.50E-02

fraction

Organic carbon partition coefficient

K_{oc}

2.50E+05

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species

K_{oc,r}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

l/kg

acid dissociation constant

pKa

l/kg

Fraction of organic carbon in aquifer

f_{oc}

fraction

Soil water partition coefficient

Kd

1.13E+04

l/kg

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

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

Longitudinal dispersivity

ax

2.00E+00

m

Transverse dispersivity

az

2.00E-01

m

Vertical dispersivity

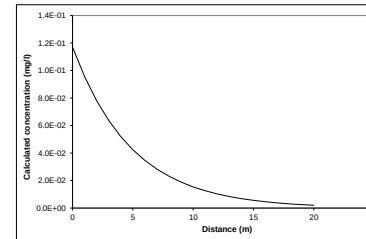
ay

2.00E-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)^{-0.14}, 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:	Portman Road
Completed by:	POM
Date:	20/07/2018
Version:	1.1

Calculated concentrations for distance-concentration graph

Ogata Banks

From calculation sheet

Distance Concentration

mg/l

0 1.2E-01

1.0 9.55E-02

2.0 7.80E-02

3.0 6.37E-02

4.0 5.20E-02

5.0 4.24E-02

6.0 3.46E-02

7.0 2.83E-02

8.0 2.31E-02

9.0 1.89E-02

10.0 1.54E-02

11.0 1.26E-02

12.0 1.03E-02

13.0 8.38E-03

14.0 6.84E-03

15.0 5.58E-03

16.0 4.56E-03

17.0 3.72E-03

18.0 3.04E-03

19.0 2.48E-03

20.0 2.03E-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	15.00	% wt	(Change this number only if you have specific information)
Particle Density	2.78	tonnes/m ³	
Dry Bulk Density	1.60	tonnes/m ³	
Calculated Parameters			
Voids Ratio	0.74	fraction	
Initial Saturation	56.54	%	
Total porosity	0.424	fraction	
Air Filled Porosity	0.184	fraction	
Water Filled Porosity	0.240	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	1.000	fraction	#DIV/0!
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

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 C10-C12 aliphatic

Parameter	Value	Units	Calculations (Refer toTable 4.3, R&D Publication 20)											
(carried over from input sheet)			Selected option		Calculate for non-polar organic chemicals									
			calc	calc	Calc Kd	l/kg								
C _T	3.00E-01	mg/l	Calculation of partition coefficient											
Kd	1.13E+04	l/kg	for ionic organic chemical											
foc	4.50E-02	fraction												
koc	2.50E+05	l/kg	Partition coefficient used in Level 1 Assessment											
θ _w	2.40E-01	fraction	1.13E+04 l/kg											
θ _a	1.84E-01	fraction												
ρ	1.60E+00	g/cm3												
H	1.20E+02	dimensionless	Factor (partitioning between soil and water)											
Koc,n		l/kg												
Koc,i		l/kg												
pH		pH units												
pKa														
foc (ionic)		fraction												
			<table><tr><td>Calculated Remedial Target</td><td>3.38E+03 mg/kg</td><td>for C10-C12 aliphatic</td></tr></table>				Calculated Remedial Target	3.38E+03 mg/kg	for C10-C12 aliphatic					
Calculated Remedial Target	3.38E+03 mg/kg	for C10-C12 aliphatic												
			<table><tr><td>Site being assessed:</td><td>Portman Road</td></tr><tr><td>Completed by:</td><td>PDM</td></tr><tr><td>Date:</td><td>21/06/2018</td></tr><tr><td>Version:</td><td>1.1</td></tr></table>				Site being assessed:	Portman Road	Completed by:	PDM	Date:	21/06/2018	Version:	1.1
Site being assessed:	Portman Road													
Completed by:	PDM													
Date:	21/06/2018													
Version:	1.1													

Level 2 Calculation Sheet

Contaminant C10-C12 aliphatic

Site assessed:	Portman Road
Date:	21/06/2018
Version:	1.1

Parameter Value Units
(carried over from input sheet)

Mz	2.51E+01	m
L	3.00E+01	m
da	8.00E+01	m
Inf	4.40E-04	m/d
K	3.02E-01	m/d
i	1.70E-03	m3/d
A	1.50E+02	m2
Cc	0.00E+00	mg/l
C _T	3.00E-01	mg/l
Cu	0.00E+00	mg/l
w	6.00E+01	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Calculated
Dilution Factor

1.98E+00

#DIV/0!



Ogata Banks - Time Variant

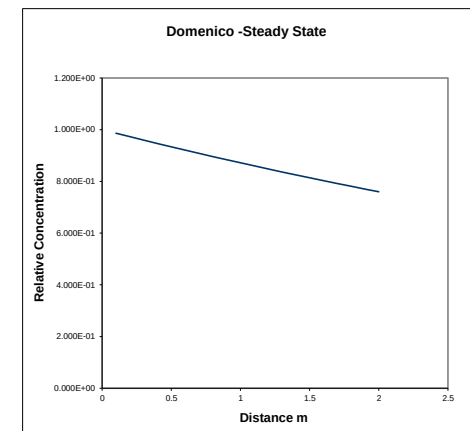
Distance m	Relative Concentration
0.1	0.10
0.5	0.085
1.0	0.075
1.5	0.065
2.0	0.055

Contaminant I0-C12 aliphatic

DOMENICO (STEADY STATE)

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	3.000E-01	mg/l	1	0.1	0.25	-1.37E-02	9.86E-01	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.864E-01
DF	1.979E+00		2	0.2	0.25	-2.75E-02	9.73E-01	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	9.729E-01
			3	0.3	0.25	-4.12E-02	9.60E-01	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	9.597E-01
			4	0.4	0.25	-5.49E-02	9.47E-01	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	9.466E-01
λ	8.142E-09	days ⁻¹	5	0.5	0.25	-6.86E-02	9.34E-01	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	9.337E-01
Sz	6.000E+01	m	6	0.6	0.25	-8.24E-02	9.21E-01	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	9.209E-01
Sy	2.514E+01	m	7	0.7	0.25	-9.61E-02	9.08E-01	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	9.084E-01
Kd	1.125E+04	l/kg	8	0.8	0.25	-1.10E-01	8.96E-01	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	8.960E-01
ρ	1.600E+00	g/cm3	9	0.9	0.25	-1.24E-01	8.84E-01	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	8.838E-01
n	3.700E-01		10	1	0.25	-1.37E-01	8.72E-01	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	8.717E-01
i	3.436E-03		11	1.1	0.25	-1.51E-01	8.60E-01	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	8.599E-01
K	3.024E-01	m/d	12	1.2	0.25	-1.65E-01	8.48E-01	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	8.481E-01
x	2.000E+00	m	13	1.3	0.25	-1.78E-01	8.37E-01	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	8.366E-01
z	0.000E+00	m	14	1.4	0.25	-1.92E-01	8.25E-01	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	8.252E-01
y	0.000E+00	m	15	1.5	0.25	-2.06E-01	8.14E-01	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	8.139E-01
ax	2.000E-01	m	16	1.6	0.25	-2.20E-01	8.03E-01	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	8.028E-01
az	2.000E-02	m	17	1.7	0.25	-2.33E-01	7.92E-01	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	7.919E-01
ay	2.000E-03	m	18	1.8	0.25	-2.47E-01	7.81E-01	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	7.811E-01
			19	1.9	0.25	-2.61E-01	7.70E-01	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	7.704E-01
			20	2	0.25	-2.75E-01	7.60E-01	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	7.599E-01



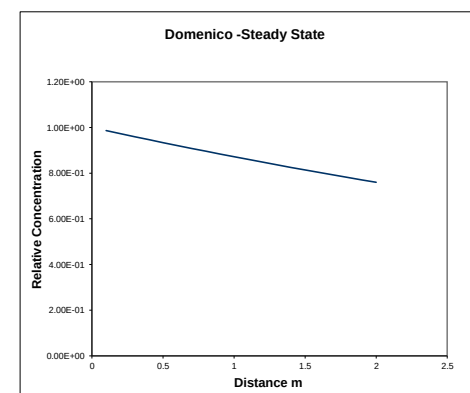
Calc

Value

DOMENICO (STEADY STATE)

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

	2.81E-03	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration	
Rc	4.86E+04															
u	5.77E-08	m/d	1	0.1	0.25	-1.37E-02	9.86E-01	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.86E-01
			2	0.2	0.25	-2.75E-02	9.73E-01	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	9.73E-01
			3	0.3	0.25	-4.12E-02	9.60E-01	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	9.60E-01
			4	0.4	0.25	-5.49E-02	9.47E-01	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	9.47E-01
			5	0.5	0.25	-6.86E-02	9.34E-01	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	9.34E-01
			6	0.6	0.25	-8.24E-02	9.21E-01	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	9.21E-01
			7	0.7	0.25	-9.61E-02	9.08E-01	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	9.08E-01
			8	0.8	0.25	-1.10E-01	8.96E-01	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	8.96E-01
			9	0.9	0.25	-1.24E-01	8.84E-01	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	8.84E-01
			10	1	0.25	-1.37E-01	8.72E-01	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	8.72E-01
			11	1.1	0.25	-1.51E-01	8.60E-01	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	8.60E-01
			12	1.2	0.25	-1.65E-01	8.48E-01	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	8.48E-01
			13	1.3	0.25	-1.78E-01	8.37E-01	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	8.37E-01
			14	1.4	0.25	-1.92E-01	8.25E-01	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	8.25E-01
			15	1.5	0.25	-2.06E-01	8.14E-01	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	8.14E-01
			16	1.6	0.25	-2.20E-01	8.03E-01	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	8.03E-01
			17	1.7	0.25	-2.33E-01	7.92E-01	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	7.92E-01
			18	1.8	0.25	-2.47E-01	7.81E-01	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	7.81E-01
			19	1.9	0.25	-2.61E-01	7.70E-01	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	7.70E-01
			20	2	0.25	-2.75E-01	7.60E-01	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	7.60E-01
	21/06/2018															
n:	1.1		20	2	0.25	-2.75E-01	7.60E-01	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	7.60E-01



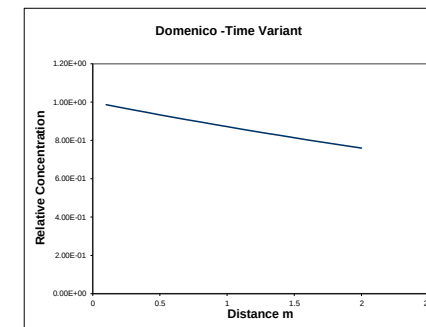
Date: 21/06/2018
Version: 1.1

DOMENICO (TIME VARIANT)

Contaminant 10-C12 aliphatic

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	0.3	mg/l	1	0.1	0.125	-1.37E-02	9.86E-01	-8.96E+45	2	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.86E-01
DF	1.9790		2	0.2	0.125	-2.75E-02	9.73E-01	-8.96E+45	2	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	9.73E-01
			3	0.3	0.125	-4.12E-02	9.60E-01	-8.96E+45	2	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	9.60E-01
			4	0.4	0.125	-5.49E-02	9.47E-01	-8.96E+45	2	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	9.47E-01
λ	8.142E-09	days ⁻¹	5	0.5	0.125	-6.86E-02	9.34E-01	-8.96E+45	2	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	9.34E-01
Sz	6.000E+01	m	6	0.6	0.125	-8.24E-02	9.21E-01	-8.96E+45	2	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	9.21E-01
Sy	2.514E+01	m	7	0.7	0.125	-9.61E-02	9.08E-01	-8.96E+45	2	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	9.08E-01
Kd	1.125E+04	l/kg	8	0.8	0.125	-1.10E-01	8.96E-01	-8.96E+45	2	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	8.96E-01
ρ	1.600E+00	g/cm3	9	0.9	0.125	-1.24E-01	8.84E-01	-8.96E+45	2	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	8.84E-01
n	3.700E-01		10	1	0.125	-1.37E-01	8.72E-01	-8.96E+45	2	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	8.72E-01
i	3.436E-03		11	1.1	0.125	-1.51E-01	8.60E-01	-8.96E+45	2	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	8.60E-01
K	3.024E-01	m/d	12	1.2	0.125	-1.65E-01	8.48E-01	-8.96E+45	2	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	8.48E-01
x	2.000E+00	m	13	1.3	0.125	-1.78E-01	8.37E-01	-8.96E+45	2	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	8.37E-01
z	0.000E+00	m	14	1.4	0.125	-1.92E-01	8.25E-01	-8.96E+45	2	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	8.25E-01
y	0.000E+00	m	15	1.5	0.125	-2.06E-01	8.14E-01	-8.96E+45	2	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	8.14E-01
t	1.000E+99	days	16	1.6	0.125	-2.20E-01	8.03E-01	-8.96E+45	2	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	8.03E-01
ax	2.000E-01	m	17	1.7	0.125	-2.33E-01	7.92E-01	-8.96E+45	2	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	7.92E-01
az	2.000E-02	m	18	1.8	0.125	-2.47E-01	7.81E-01	-8.96E+45	2	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	7.81E-01
ay	2.000E-03	m	19	1.9	0.125	-2.61E-01	7.70E-01	-8.96E+45	2	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	7.70E-01
			20	2	0.125	-2.75E-01	7.60E-01	-8.96E+45	2	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	7.60E-01

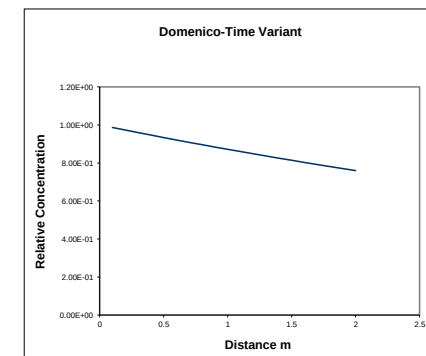


Calc

Value

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

		Calculated: 100															
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Date: 21/06/2018
Version: 1.1

OGATA BANKS SOLUTION																						
Contaminant	:10-C12 aliphatic		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	0.3	mg/l	1	1	0.01463	-2.0E-01	8.2E-01	-1.1E+46	2.000	7.0E-01	2.0E+00	1.1E+46	0.000	3.4E+01	1	-3.4E+01	-1	7.1E+00	1	-7.1E+00	-1	9.55E-02
			2	2	0.01463	-4.1E-01	6.7E-01	-1.1E+46	2.000	1.4E+00	4.1E+00	1.1E+46	0.000	2.4E+01	1	-2.4E+01	-1	5.0E+00	1	-5.0E+00	-1	7.80E-02
			3	3	0.01463	-6.1E-01	5.4E-01	-1.1E+46	2.000	2.1E+00	8.2E+00	1.1E+46	0.000	1.9E+01	1	-1.9E+01	-1	4.1E+00	1	-4.1E+00	-1	6.37E-02
Co	1.17E-01	mg/l	4	4	0.01463	-8.1E-01	4.4E-01	-1.1E+46	2.000	2.8E+00	1.7E+01	1.1E+46	0.000	1.7E+01	1	-1.7E+01	-1	3.5E+00	1	-3.5E+00	-1	5.20E-02
λ	8.14E-09	days ⁻¹	5	5	0.01463	-1.0E+00	3.6E-01	-1.1E+46	2.000	3.5E+00	3.4E+01	1.1E+46	0.000	1.5E+01	1	-1.5E+01	-1	3.2E+00	1	-3.2E+00	-0.99999	4.24E-02
Sz	6.00E+01	m	6	6	0.01463	-1.2E+00	3.0E-01	-1.1E+46	2.000	4.2E+00	6.8E+01	1.1E+46	0.000	1.4E+01	1	-1.4E+01	-1	2.9E+00	1	-2.9E+00	-0.99996	3.46E-02
Sy	4.00E+00	m	7	7	0.01463	-1.4E+00	2.4E-01	-1.1E+46	2.000	4.9E+00	1.4E+02	1.1E+46	0.000	1.3E+01	1	-1.3E+01	-1	2.7E+00	0.9998	-2.7E+00	-0.99984	2.83E-02
Kd	1.13E+04	l/kg	8	8	0.01463	-1.6E+00	2.0E-01	-1.1E+46	2.000	5.6E+00	2.8E+02	1.1E+46	0.000	1.2E+01	1	-1.2E+01	-1	2.5E+00	0.9996	-2.5E+00	-0.99959	2.31E-02
ρ	1.60E+00	g/cm3	9	9	0.01463	-1.8E+00	1.6E-01	-1.1E+46	2.000	6.3E+00	5.6E+02	1.1E+46	0.000	1.1E+01	1	-1.1E+01	-1	2.4E+00	0.9991	-2.4E+00	-0.99914	1.88E-02
n	3.70E-01		10	10	0.01463	-2.0E+00	1.3E-01	-1.1E+46	2.000	7.0E+00	1.1E+03	1.1E+46	0.000	1.1E+01	1	-1.1E+01	-1	2.2E+00	0.9984	-2.2E+00	-0.99843	1.54E-02
i	1.70E-03		11	11	0.01463	-2.2E+00	1.1E-01	-1.1E+46	2.000	7.7E+00	2.3E+03	1.1E+46	0.000	1.0E+01	1	-1.0E+01	-1	2.1E+00	0.9974	-2.1E+00	-0.99743	1.25E-02
K	3.02E-01	m/d	12	12	0.01463	-2.4E+00	8.8E-02	-1.1E+46	2.000	8.4E+00	4.6E+03	1.1E+46	0.000	9.7E+00	1	-9.7E+00	-1	2.0E+00	0.9961	-2.0E+00	-0.99611	1.02E-02
x	2.00E+01	m	13	13	0.01463	-2.6E+00	7.2E-02	-1.1E+46	2.000	9.1E+00	9.3E+03	1.1E+46	0.000	9.3E+00	1	-9.3E+00	-1	2.0E+00	0.9945	-2.0E+00	-0.99445	8.33E-03
z	0.00E+00	m	14	14	0.01463	-2.8E+00	5.8E-02	-1.1E+46	2.000	9.8E+00	1.9E+04	1.1E+46	0.000	9.0E+00	1	-9.0E+00	-1	1.9E+00	0.9925	-1.9E+00	-0.99247	6.79E-03
y	0.00E+00	m	15	15	0.01463	-3.0E+00	4.8E-02	-1.1E+46	2.000	1.1E+01	3.8E+04	1.1E+46	0.000	8.7E+00	1	-8.7E+00	-1	1.8E+00	0.9902	-1.8E+00	-0.99018	5.53E-03
t	9.90E+99	days	16	16	0.01463	-3.2E+00	3.9E-02	-1.1E+46	2.000	1.1E+01	7.7E+04	1.1E+46	0.000	8.4E+00	1	-8.4E+00	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	4.50E-03
ax	2.00E+00	m	17	17	0.01463	-3.4E+00	3.2E-02	-1.1E+46	2.000	1.2E+01	1.5E+05	1.1E+46	0.000	8.1E+00	1	-8.1E+00	-1	1.7E+00	0.9847	-1.7E+00	-0.98471	3.67E-03
az	2.00E-01	m	18	18	0.01463	-3.7E+00	2.6E-02	-1.1E+46	2.000	1.3E+01	3.1E+05	1.1E+46	0.000	7.9E+00	1	-7.9E+00	-1	1.7E+00	0.9816	-1.7E+00	-0.98158	2.98E-03
ay	2.00E-02	m	19	19	0.01463	-3.9E+00	2.1E-02	-1.1E+46	2.000	1.3E+01	6.3E+05	1.1E+46	0.000	7.7E+00	1	-7.7E+00	-1	1.6E+00	0.9782	-1.6E+00	-0.97822	2.43E-03
			20	20	0.01463	-4.1E+00	1.7E-02	-1.1E+46	2.000	1.4E+01	1.3E+06	1.1E+46	0.000	7.5E+00	1	-7.5E+00	-1	1.6E+00	0.9747	-1.6E+00	-0.97465	1.97E-03

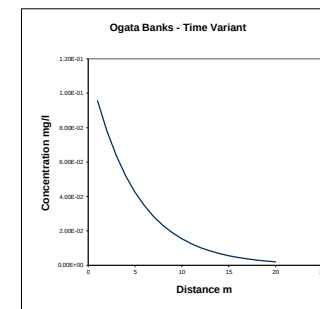
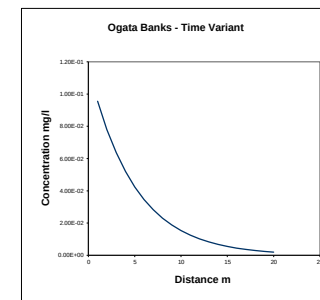
Vertical dispersion option Simulate vertical dispersion in 1 direction

Calc		Value		Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT																			
				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	1.39E-03	m/d																					
Rc	4.86E+04		1	1	0.01463	-2.0E-01	8.2E-01	-1.1E+46	2.000	7.0E-01	2.0E+00	1.1E+46	0.000	3.4E+01	1	-3.4E+01	-1	1.4E+01	1	-1.4E+01	-1	9.55E-02	
u	2.86E-08	m/d	2	2	0.01463	-4.1E-01	6.7E-01	-1.1E+46	2.000	1.4E+00	4.1E+00	1.1E+46	0.000	2.4E+01	1	-2.4E+01	-1	1.0E+01	1	-1.0E+01	-1	7.80E-02	
			3	3	0.01463	-6.1E-01	5.4E-01	-1.1E+46	2.000	2.1E+00	8.2E+00	1.1E+46	0.000	1.9E+01	1	-1.9E+01	-1	8.2E+00	1	-8.2E+00	-1	6.37E-02	
			4	4	0.01463	-8.1E-01	4.4E-01	-1.1E+46	2.000	2.8E+00	1.7E+01	1.1E+46	0.000	1.7E+01	1	-1.7E+01	-1	7.1E+00	1	-7.1E+00	-1	5.20E-02	
			5	5	0.01463	-1.0E+00	3.6E-01	-1.1E+46	2.000	3.5E+00	3.4E+01	1.1E+46	0.000	1.5E+01	1	-1.5E+01	-1	6.3E+00	1	-6.3E+00	-1	4.24E-02	
			6	6	0.01463	-1.2E+00	3.0E-01	-1.1E+46	2.000	4.2E+00	6.8E+01	1.1E+46	0.000	1.4E+01	1	-1.4E+01	-1	5.8E+00	1	-5.8E+00	-1	3.46E-02	
			7	7	0.01463	-1.4E+00	2.4E-01	-1.1E+46	2.000	4.9E+00	1.4E+02	1.1E+46	0.000	1.3E+01	1	-1.3E+01	-1	5.3E+00	1	-5.3E+00	-1	2.83E-02	
			8	8	0.01463	-1.6E+00	2.0E-01	-1.1E+46	2.000	5.6E+00	2.8E+02	1.1E+46	0.000	1.2E+01	1	-1.2E+01	-1	5.0E+00	1	-5.0E+00	-1	2.31E-02	
			9	9	0.01463	-1.8E+00	1.6E-01	-1.1E+46	2.000	6.3E+00	5.6E+02	1.1E+46	0.000	1.1E+01	1	-1.1E+01	-1	4.7E+00	1	-4.7E+00	-1	1.89E-02	
			10	10	0.01463	-2.0E+00	1.3E-01	-1.1E+46	2.000	7.0E+00	1.1E+03	1.1E+46	0.000	1.1E+01	1	-1.1E+01	-1	4.5E+00	1	-4.5E+00	-1	1.54E-02	
			11	11	0.01463	-2.2E+00	1.1E-01	-1.1E+46	2.000	7.7E+00	2.3E+03	1.1E+46	0.000	1.0E+01	1	-1.0E+01	-1	4.3E+00	1	-4.3E+00	-1	1.26E-02	
			12	12	0.01463	-2.4E+00	8.8E-02	-1.1E+46	2.000	8.4E+00	4.6E+03	1.1E+46	0.000	9.7E+00	1	-9.7E+00	-1	4.1E+00	1	-4.1E+00	-1	1.03E-02	
			13	13	0.01463	-2.6E+00	7.2E-02	-1.1E+46	2.000	9.1E+00	9.3E+03	1.1E+46	0.000	9.3E+00	1	-9.3E+00	-1	3.9E+00	1	-3.9E+00	-1	8.38E-03	
			14	14	0.01463	-2.8E+00	5.8E-02	-1.1E+46	2.000	9.8E+00	1.9E+04	1.1E+46	0.000	9.0E+00	1	-9.0E+00	-1	3.8E+00	1	-3.8E+00	-1	6.84E-03	
			15	15	0.01463	-3.0E+00	4.8E-02	-1.1E+46	2.000	1.1E+01	3.8E+04	1.1E+46	0.000	8.7E+00	1	-8.7E+00	-1	3.7E+00	1	-3.7E+00	-1	5.58E-03	
			16	16	0.01463	-3.2E+00	3.9E-02	-1.1E+46	2.000	1.1E+01	7.7E+04	1.1E+46	0.000	8.4E+00	1	-8.4E+00	-1	3.5E+00	1	-3.5E+00	-1	4.56E-03	
			17	17	0.01463	-3.4E+00	3.2E-02	-1.1E+46	2.000	1.2E+01	1.5E+05	1.1E+46	0.000	8.1E+00	1	-8.1E+00	-1	3.4E+00	1	-3.4E+00	-1	3.72E-03	
			18	18	0.01463	-3.7E+00	2.6E-02	-1.1E+46	2.000	1.3E+01	3.1E+05	1.1E+46	0.000	7.9E+00	1	-7.9E+00	-1	3.3E+00	1	-3.3E+00	-1	3.04E-03	
			19	19	0.01463	-3.9E+00	2.1E-02	-1.1E+46	2.000	1.3E+01	6.3E+05	1.1E+46	0.000	7.7E+00	1	-7.7E+00	-1	3.2E+00	1	-3.2E+00	-1	2.48E-03	
			20	20	0.01463	-4.1E+00	1.7E-02	-1.1E+46	2.000	1.4E+01	1.3E+06	1.1E+46	0.000	7.5E+00	1	-7.5E+00	-1	3.2E+00	1	-3.2E+00	-0.99999	2.03E-03	

Date: 21/06/2018

Version: 1.1

Date: 21/06/2018
Version: 1.1



Contaminant I0-C12 aliphatic

DOMENICO (STEADY STATE)

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	Concentration	
Input	Value	Units														
C _T	0.3	mg/l	1	1	0.02925	-2.03E-01	8.16E-01	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	9.55E-02
			2	2	0.02925	-4.06E-01	6.67E-01	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	7.80E-02
			3	3	0.02925	-6.08E-01	5.44E-01	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	6.37E-02
Co	1.17E-01	mg/l	4	4	0.02925	-8.11E-01	4.44E-01	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	5.20E-02
λ	8.14E-09	days ⁻¹	5	5	0.02925	-1.01E+00	3.63E-01	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	4.24E-02
Sz	6.00E+01	m	6	6	0.02925	-1.22E+00	2.96E-01	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	3.46E-02
Sy	4.00E+00	m	7	7	0.02925	-1.42E+00	2.42E-01	1.27E+01	1	-1.27E+01	-1	2.67E+00	1	-2.67E+00	-0.9998	2.83E-02
Kd	1.13E+04	l/kg	8	8	0.02925	-1.62E+00	1.97E-01	1.19E+01	1	-1.19E+01	-1	2.50E+00	1	-2.50E+00	-0.9996	2.31E-02
ρ	1.60E+00	g/cm3	9	9	0.02925	-1.83E+00	1.61E-01	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.999	-2.36E+00	-0.9991	1.88E-02
n	3.70E-01		10	10	0.02925	-2.03E+00	1.32E-01	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.998	-2.24E+00	-0.9984	1.54E-02
i	1.70E-03		11	11	0.02925	-2.23E+00	1.07E-01	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.997	-2.13E+00	-0.9974	1.25E-02
K	3.02E-01	m/d	12	12	0.02925	-2.43E+00	8.77E-02	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.996	-2.04E+00	-0.9961	1.02E-02
x	2.00E+01	m	13	13	0.02925	-2.64E+00	7.16E-02	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.994	-1.96E+00	-0.9945	8.33E-03
z	0.00E+00	m	14	14	0.02925	-2.84E+00	5.85E-02	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.992	-1.89E+00	-0.9925	6.79E-03
y	0.00E+00	m	15	15	0.02925	-3.04E+00	4.77E-02	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.99	-1.83E+00	-0.9902	5.53E-03
			16	16	0.02925	-3.25E+00	3.90E-02	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.988	-1.77E+00	-0.9876	4.50E-03
ax	2.00E+00	m	17	17	0.02925	-3.45E+00	3.18E-02	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.985	-1.71E+00	-0.9847	3.67E-03
az	2.00E-01	m	18	18	0.02925	-3.65E+00	2.60E-02	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.982	-1.67E+00	-0.9816	2.98E-03
ay	2.00E-02	m	19	19	0.02925	-3.85E+00	2.12E-02	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.978	-1.62E+00	-0.9782	2.43E-03
			20	20	0.02925	-4.06E+00	1.73E-02	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.975	-1.58E+00	-0.9747	1.97E-03

Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc

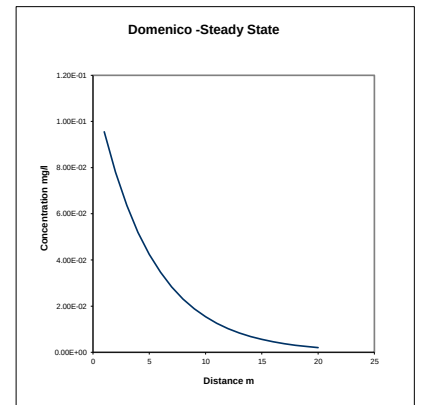
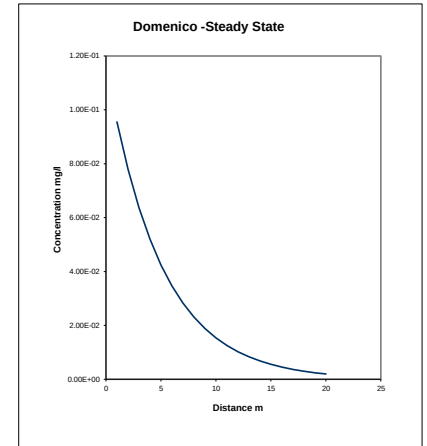
Value

DOMENICO (STEADY STATE)

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

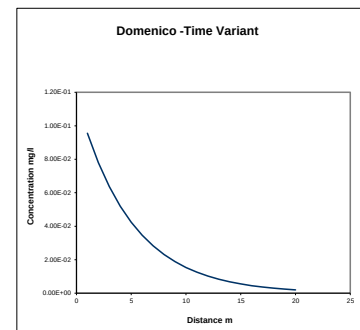
	1.39E-03	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration	
Rc u	4.86E+04															
	2.86E-08	m/d	1	1	0.02925	-2.03E-01	8.16E-01	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	9.55E-02
			2	2	0.02925	-4.06E-01	6.67E-01	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	7.80E-02
			3	3	0.02925	-6.08E-01	5.44E-01	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	6.37E-02
			4	4	0.02925	-8.11E-01	4.44E-01	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	5.20E-02
			5	5	0.02925	-1.01E+00	3.63E-01	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	4.24E-02
			6	6	0.02925	-1.22E+00	2.96E-01	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	3.46E-02
			7	7	0.02925	-1.42E+00	2.42E-01	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	2.83E-02
			8	8	0.02925	-1.62E+00	1.97E-01	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	2.31E-02
			9	9	0.02925	-1.83E+00	1.61E-01	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	1.89E-02
			10	10	0.02925	-2.03E+00	1.32E-01	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	1.54E-02
			11	11	0.02925	-2.23E+00	1.07E-01	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	1.26E-02
			12	12	0.02925	-2.43E+00	8.77E-02	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	1.03E-02
			13	13	0.02925	-2.64E+00	7.16E-02	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	8.38E-03
			14	14	0.02925	-2.84E+00	5.85E-02	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	6.84E-03
			15	15	0.02925	-3.04E+00	4.77E-02	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	5.58E-03
			16	16	0.02925	-3.25E+00	3.90E-02	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	4.56E-03
			17	17	0.02925	-3.45E+00	3.18E-02	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	3.72E-03
			18	18	0.02925	-3.65E+00	2.60E-02	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	3.04E-03
			19	19	0.02925	-3.85E+00	2.12E-02	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	2.48E-03
		20	20	0.02925	-4.06E+00	1.73E-02	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	2.03E-03	
	21/06/2018															
n:	1.1															

Date: 21/06/2018
Version: 1.1



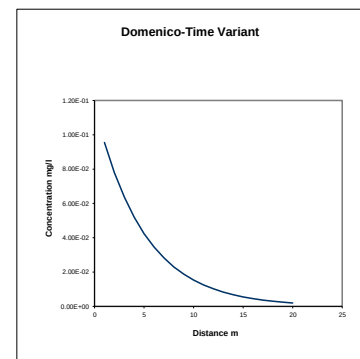
DOMENICO (TIME VARIANT)

Contaminant	10-C12 aliphatic	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	Concentration
C _T	0.3	mg/l	m														
			1	0.01463	-2.03E-01	8.16E-01	-1.08E+46	2	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	9.55E-02
			2	0.01463	-4.06E-01	6.67E-01	-1.08E+46	2	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	7.80E-02
			3	0.01463	-6.08E-01	5.44E-01	-1.08E+46	2	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	6.37E-02
Co	1.17E-01	mg/l	4	0.01463	-8.11E-01	4.44E-01	-1.08E+46	2	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	5.20E-02
λ	8.14E-09	days ⁻¹	5	0.01463	-1.01E+00	3.63E-01	-1.08E+46	2	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	4.24E-02
Sz	6.00E+01	m	6	0.01463	-1.22E+00	2.96E-01	-1.08E+46	2	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	3.46E-02
Sy	4.00E+00	m	7	0.01463	-1.42E+00	2.42E-01	-1.08E+46	2	1.27E+01	1	-1.27E+01	-1	2.67E+00	0.9998	-2.67E+00	-1	2.83E-02
Kd	1.13E+04	l/kg	8	0.01463	-1.62E+00	1.97E-01	-1.08E+46	2	1.19E+01	1	-1.19E+01	-1	2.50E+00	0.9996	-2.50E+00	-1	2.31E-02
ρ	1.60E+00	g/cm3	9	0.01463	-1.83E+00	1.61E-01	-1.08E+46	2	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.9991	-2.36E+00	-0.999	1.88E-02
n	3.70E-01		10	0.01463	-2.03E+00	1.32E-01	-1.08E+46	2	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.9984	-2.24E+00	-0.998	1.54E-02
i	1.70E-03		11	0.01463	-2.23E+00	1.07E-01	-1.08E+46	2	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.9974	-2.13E+00	-0.997	1.25E-02
K	3.02E-01	m/d	12	0.01463	-2.43E+00	8.77E-02	-1.08E+46	2	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.9961	-2.04E+00	-0.996	1.02E-02
x	2.00E+01	m	13	0.01463	-2.64E+00	7.16E-02	-1.08E+46	2	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.9945	-1.96E+00	-0.994	8.33E-03
z	0.00E+00	m	14	0.01463	-2.84E+00	5.85E-02	-1.08E+46	2	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.9925	-1.89E+00	-0.992	6.79E-03
y	0.00E+00	m	15	0.01463	-3.04E+00	4.77E-02	-1.08E+46	2	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.9902	-1.83E+00	-0.99	5.53E-03
t	9.90E+99	days	16	0.01463	-3.25E+00	3.90E-02	-1.08E+46	2	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.9876	-1.77E+00	-0.988	4.50E-03
ax	2.00E+00	m	17	0.01463	-3.45E+00	3.18E-02	-1.08E+46	2	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.9847	-1.71E+00	-0.985	3.67E-03
az	2.00E-01	m	18	0.01463	-3.65E+00	2.60E-02	-1.08E+46	2	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.9816	-1.67E+00	-0.982	2.98E-03
ay	2.00E-02	m	19	0.01463	-3.85E+00	2.12E-02	-1.08E+46	2	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.9782	-1.62E+00	-0.978	2.43E-03
			20	0.01463	-4.06E+00	1.73E-02	-1.08E+46	2	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.9747	-1.58E+00	-0.975	1.97E-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 only) - USED FOR LEVEL ASSESSMENT															Concentration
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
v	1.39E-03	m/d	m														
Rc	4.86E+04		1	0.01463	-2.03E-01	8.16E-01	-1.08E+46	2	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	9.55E-02
u	2.86E-08	m/d	2	0.01463	-4.06E-01	6.67E-01	-1.08E+46	2	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	7.80E-02
			3	0.01463	-6.08E-01	5.44E-01	-1.08E+46	2	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	6.37E-02
			4	0.01463	-8.11E-01	4.44E-01	-1.08E+46	2	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	5.20E-02
			5	0.01463	-1.01E+00	3.63E-01	-1.08E+46	2	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	4.24E-02
			6	0.01463	-1.22E+00	2.96E-01	-1.08E+46	2	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	3.46E-02
			7	0.01463	-1.42E+00	2.42E-01	-1.08E+46	2	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	2.83E-02
			8	0.01463	-1.62E+00	1.97E-01	-1.08E+46	2	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	2.31E-02
			9	0.01463	-1.83E+00	1.61E-01	-1.08E+46	2	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	1.89E-02
			10	0.01463	-2.03E+00	1.32E-01	-1.08E+46	2	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	1.54E-02
			11	0.01463	-2.23E+00	1.07E-01	-1.08E+46	2	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	1.26E-02
			12	0.01463	-2.43E+00	8.77E-02	-1.08E+46	2	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	1.03E-02
			13	0.01463	-2.64E+00	7.16E-02	-1.08E+46	2	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	8.38E-03
			14	0.01463	-2.84E+00	5.85E-02	-1.08E+46	2	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	6.84E-03
			15	0.01463	-3.04E+00	4.77E-02	-1.08E+46	2	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	5.58E-03
			16	0.01463	-3.25E+00	3.90E-02	-1.08E+46	2	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	4.56E-03
			17	0.01463	-3.45E+00	3.18E-02	-1.08E+46	2	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	3.72E-03
			18	0.01463	-3.65E+00	2.60E-02	-1.08E+46	2	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	3.04E-03
			19	0.01463	-3.85E+00	2.12E-02	-1.08E+46	2	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	2.48E-03
			20	0.01463	-4.06E+00	1.73E-02	-1.08E+46	2	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	2.03E-03



Date: 21/06/2018
Version: 1.1



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:	Portmans Way		
Site Address:	Reading		
Completed by:	PDM	Version:	1.1
Date:	21-Jun-18		
Contaminant	C16-C21 aliphatic		
Target Concentration (C_T)	3.00E-01	mg/l	Origin of C_T: WHO

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T
0.3 mg/l

Input Parameters Standard entry

Variable Value Unit Source of parameter value

Water filled soil porosity

θ_w 2.40E-01 fraction

calculated

Air filled soil porosity

θ_a 1.84E-01 fraction

calculated

Bulk density of soil zone material

ρ 1.60E+00 g/cm³

R & D Technical report sand fill

Henry's Law constant

H 4.90E+03 dimensionless

Total Petroleum Hydrocarbon Criteria Working Group

Entry if specify partition coefficient (option)

Soil water partition coefficient

K_d I/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon (in soil)

f_{oc} 4.50E-02 fraction

Consim drift deposits Sand

Organic carbon partition coefficient

K_{oc} 6.30E+08 l/kg

CLAIRE 2017 Hydrocarbons in Groundwater

Entry for ionic organic chemicals (option)

Sorption coefficient for neutral species

K_{oc,n} I/kg

Sorption coefficient for ionised species

K_{oc,i} I/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 2.84E+07 I/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

8.51E+06 mg/kg

(for comparison with soil analyses)

or

0.3 mg/l

(for comparison with leachate test results)

Site being assessed: Portmans Way

Completed by: PDM

Date: 21-Jun-18

Version: 1.1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T C16-C21 aliphatic
0.3 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
Area of contaminant source

Inf
A

4.40E-04
1.50E+02

m/d
m²

96-2000 30% pf values River Thames at Reading 70%
Area of boiler house and tank farm

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow
Saturated aquifer thickness
Hydraulic Conductivity of aquifer in which dilution occurs
Hydraulic gradient of water table
Width of contaminant source perpendicular to groundwater flow
Background concentration of contaminant in groundwater beneath site

L
da
K
i
w
Cu

3.00E+01
8.00E+01
3.02E-01
1.70E-03
6.00E+01
0.00E+00

m
m
m/d
fraction
m
mg/l

Width of source area between PH2 and PH6
assumed vale to base of chalk
Site data
Estimate
Length of source area between PH2 and PH6
Estimated

Not used in calculation

Define mixing zone depth by specifying or calculating depth (using pull down list)

Enter mixing zone thickness
Calculated mixing zone thickness

Mz
Mz

Calculate
2.51E+01

m
m

Calculated Parameters

Dilution Factor

DF

1.98E+00

Level 2 Remedial Target

5.94E-01

mg/l

or

1.68E+07

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)

0.00E+00

mg/l

0

Site being assessed: Portmans Way
Completed by: PDM
Date: 21-Jun-18
Version: 1.1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters

Contaminant	C16-C21 aliphatic	from Level 1
Target Concentration	C _t 0.3	from Level 1
Dilution Factor	DF 1.98E+00	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 dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	3900	mg/kg	
Enter soil concentration	1.75E+03	days	
Half life for degradation of contaminant in water	1.75E+03	days	Canada Wide Standards for PHC in Soils
Calculated decay rate	3.96E-04	days ⁻¹	calculated
Width of plume in aquifer at source	6.00E+01	m	from Level 2
Plume thickness in aquifer at source	2.51E+01	m	from Level 2
Bulk density of aquifer materials	1.60E+00	g/cm ³	R & D Technical Report P13
Effective porosity of aquifer	3.70E-01	fraction	Consim
Hydraulic gradient	3.44E-03	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	3.02E-01	m/d	from Level 2
Distance to compliance point	2.00E+00	m	Estimated Depth to water table
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 2.84E+07	l/kg	see options
Longitudinal dispersivity	ax 0.200	m	see options
Transverse dispersivity	az 0.020	m	see options
Vertical dispersivity	av 0.002	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Groundwater flow velocity	V 2.81E-03	m/d
Retardation factor	Rf 1.23E+08	fraction
Decay rate used	λ 3.23E-12	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i 3.44E-03	fraction
Rate of contaminant flow due to retardation	u 2.29E-11	m/d
Ratio of Compliance Point to Source Concentration	C ₁₀ /C ₀ 7.60E-01	fraction
Attenuation factor (C ₁₀ /C ₁₀₀)	AF 1.32E+00	fraction
Calculated soil leachate concentration	Co 1.38E-04	mg/l

Remedial Targets

Level 3 Remedial Target	7.81E-01	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	2.21E+07	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	2	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₁₀ /C ₀ 7.60E-01	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 non-polar organic chemicals

Entry if specify partition coefficient (option)

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

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer	foc	4.50E-02	fraction
Organic carbon partition coefficient	Koc	6.30E+08	l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species	K _{oc,li}		l/kg
Sorption coefficient for ionised species	K _{oc,li}		l/kg
pH value	pH		
Acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction

Soil water partition coefficient	Kd	2.84E+07	l/kg
----------------------------------	----	----------	------

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

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

Longitudinal dispersivity

Enter value Calc value Xu & Eckstein

Transverse dispersivity

ax 0.00E+00 2.00E-01 4.58E-02 m

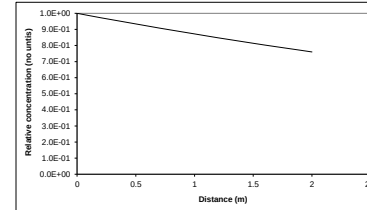
Vertical dispersivity

az 0.00E+00 2.00E-02 4.58E-03 m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀)^{0.4+14}; 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

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	6.95E-05
0.1	9.86E-01	6.86E-05
0.2	9.73E-01	6.76E-05
0.3	9.60E-01	6.67E-05
0.4	9.47E-01	6.58E-05
0.5	9.34E-01	6.49E-05
0.6	9.21E-01	6.40E-05
0.7	9.08E-01	6.31E-05
0.8	8.96E-01	6.23E-05
0.9	8.84E-01	6.14E-05
1.0	8.72E-01	6.06E-05
1.1	8.60E-01	5.98E-05
1.2	8.48E-01	5.90E-05
1.3	8.37E-01	5.82E-05
1.4	8.25E-01	5.74E-05
1.5	8.14E-01	5.66E-05
1.6	8.03E-01	5.58E-05
1.7	7.92E-01	5.50E-05
1.8	7.81E-01	5.43E-05
1.9	7.70E-01	5.36E-05
2.0	7.60E-01	5.28E-05

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:	Portmans Way
Completed by:	PDM
Date:	#####
Version:	1.1

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters
Soil contaminant concentration C_0 2.00E-01 mg/kg

Level 1 Parameters

Water filled soil porosity	θ_w	2.40E-01	fraction
Air filled soil porosity	θ_a	1.84E-01	fraction
Bulk density	ρ	1.60E+00	g/cm ³
Henry's Law constant	H	4.90E+03	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	2.84E+07	l/kg
Factor (partitioning between soil and water)		2.84E+07	dimensionless

Level 2 Parameters

Dilution Factor DF 1.98E+00

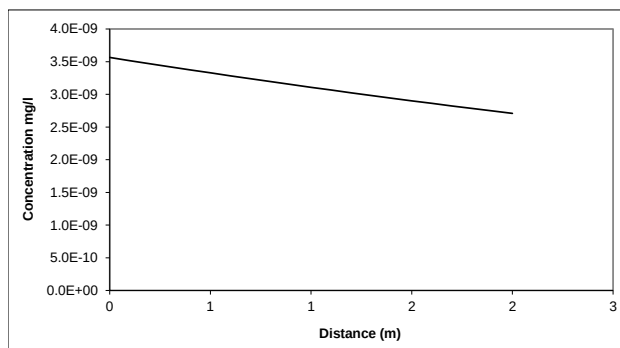
Level 3 Parameters

Attenuation factor (C_0/C_{ED}) AF 1.32E+00

Predicted concentrations at compliance point

Level 1	C	7.05E-09 mg/l	No dilution or attenuation
Level 2	C	3.56E-09 mg/l	Dilution taken into account
Level 3	C	2.71E-09 mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	3.56E-09
0.10	3.52E-09
0.20	3.47E-09
0.30	3.42E-09
0.40	3.37E-09
0.50	3.33E-09
0.60	3.28E-09
0.70	3.24E-09
0.80	3.19E-09
0.90	3.15E-09
1.00	3.11E-09
1.10	3.07E-09
1.20	3.02E-09
1.30	2.98E-09
1.40	2.94E-09
1.50	2.90E-09
1.60	2.86E-09
1.70	2.82E-09
1.80	2.78E-09
1.90	2.75E-09
2.00	2.71E-09

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	C16-C21 aliphatic		from Level 1
Target Concentration	C _T	3.00E-01	mg/l from Level 1

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

Ogata Banks	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	1.40E+00	mg/l	Site data
Half life for degradation of contaminant in water	t _{1/2}	1.75E+03	days	Canada Wide Standards for PHC in Soils
Calculated decay rate	λ	3.96E-04	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.00E+01	m	Estimated from site data
Plume thickness at source	Sy	4.00E+00	m	to top of chalk
Saturated aquifer thickness	da	8.00E+01	m	Estimated from site data
Bulk density of aquifer materials	p	1.80E+00	g/cm ³	consim
Effective porosity of aquifer	n	3.70E-01	fraction	Consim
Hydraulic gradient	i	1.70E-03	fraction	Estimate from site data
Hydraulic conductivity of aquifer	K	3.02E-01	m/d	Site data
Distance to compliance point	x	2.00E+01	m	Distance to site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	2.84E+07	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	1.39E-03	m/d
Retardation factor	Rf	1.23E+08	fraction
Decay rate used	λ	3.23E-12	d ⁻¹
Rate of contaminant flow due to retardation	u	1.13E-11	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	2.42E-02	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	5.78E+01	

Remedial Targets

Remedial Target	1.73E+01	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	2.42E-02	mg/l
		9.9E+99	days

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)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient

Kd

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer

foc

4.50E-02

fraction

Organic carbon partition coefficient

Koc

6.30E+08

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species

K_{oc,ri}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

l/kg

acid dissociation constant

pKa

l/kg

Fraction of organic carbon in aquifer

foc

fraction

Soil water partition coefficient

Kd

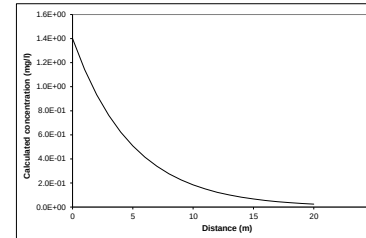
2.84E+07

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-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(log ₁₀ x) ^{-0.14} , 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:	Portmans Way
Completed by:	PDM
Date:	20/07/2018
Version:	1.1



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	15.00	% wt	(Change this number only if you have specific information)
Particle Density	2.78	tonnes/m ³	
Dry Bulk Density	1.60	tonnes/m ³	
Calculated Parameters			
Voids Ratio	0.74	fraction	
Initial Saturation	56.54	%	
Total porosity	0.424	fraction	
Air Filled Porosity	0.184	fraction	
Water Filled Porosity	0.240	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	1.000	fraction	#DIV/0!
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

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 C16-C21 aliphatic

Parameter	Value	Units	Calculations (Refer toTable 4.3, R&D Publication 20)																			
(carried over from input sheet)			Selected option		Calculate for non-polar organic chemicals																	
			calc	calc	Calc Kd	l/kg																
C _T	3.00E-01	mg/l	Calculation of partition coefficient																			
Kd	2.84E+07	l/kg	for ionic organic chemical																			
foc	4.50E-02	fraction																				
koc	6.30E+08	l/kg	Partition coefficient used in Level 1 Assessment																			
θ _w	2.40E-01	fraction																				
θ _a	1.84E-01	fraction																				
ρ	1.60E+00	g/cm3																				
H	4.90E+03	dimensionless	Factor (partitioning between soil and water)																			
Koc,n		l/kg																				
Koc,i		l/kg																				
pH		pH units																				
pKa																						
foc (ionic)		fraction																				
			<table><tr><td>Calculated Remedial Target</td><td>8.51E+06 mg/kg</td><td>for C16-C21 aliphatic</td></tr></table>				Calculated Remedial Target	8.51E+06 mg/kg	for C16-C21 aliphatic													
Calculated Remedial Target	8.51E+06 mg/kg	for C16-C21 aliphatic																				
			<table><tr><td>Site being assessed:</td><td colspan="3">Portmans Way</td></tr><tr><td>Completed by:</td><td colspan="3">PDM</td></tr><tr><td>Date:</td><td colspan="3">21/06/2018</td></tr><tr><td>Version:</td><td colspan="3">1.1</td></tr></table>				Site being assessed:	Portmans Way			Completed by:	PDM			Date:	21/06/2018			Version:	1.1		
Site being assessed:	Portmans Way																					
Completed by:	PDM																					
Date:	21/06/2018																					
Version:	1.1																					

Level 2 Calculation Sheet

Contaminant C16-C21 aliphatic

Site assessed:	Portmans Wa
Date:	21/06/2018
Version:	1.1

Parameter **Value** **Units**
(carried over from input sheet)

Mz	2.51E+01	m
L	3.00E+01	m
da	8.00E+01	m
Inf	4.40E-04	m/d
K	3.02E-01	m/d
i	1.70E-03	m3/d
A	1.50E+02	m2
Cc	0.00E+00	mg/l
C _T	3.00E-01	mg/l
Cu	0.00E+00	mg/l
w	6.00E+01	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Calculated
Dilution Factor

1.98E+00

#DIV/0!



Ogata Banks - Time Variant

Distance m	Relative Concentration
0.1	0.98
0.5	0.90
1.0	0.83
1.5	0.78
2.0	0.76

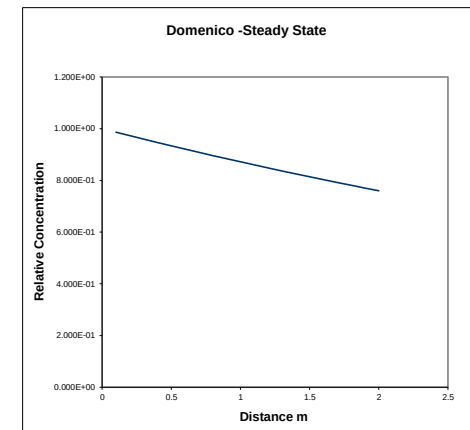
Contaminant I6-C21 aliphatic

DOMENICO (STEADY STATE)

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	3.000E-01	mg/l	1	0.1	0.25	-1.37E-02	9.86E-01	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.864E-01
DF	1.979E+00		2	0.2	0.25	-2.75E-02	9.73E-01	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	9.729E-01
			3	0.3	0.25	-4.12E-02	9.60E-01	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	9.597E-01
			4	0.4	0.25	-5.49E-02	9.47E-01	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	9.466E-01
λ	3.231E-12	days ⁻¹	5	0.5	0.25	-6.86E-02	9.34E-01	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	9.337E-01
Sz	6.000E+01	m	6	0.6	0.25	-8.24E-02	9.21E-01	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	9.209E-01
Sy	2.514E+01	m	7	0.7	0.25	-9.61E-02	9.08E-01	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	9.084E-01
Kd	2.835E+07	l/kg	8	0.8	0.25	-1.10E-01	8.96E-01	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	8.960E-01
ρ	1.600E+00	g/cm3	9	0.9	0.25	-1.24E-01	8.84E-01	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	8.838E-01
n	3.700E-01		10	1	0.25	-1.37E-01	8.72E-01	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	8.717E-01
i	3.436E-03		11	1.1	0.25	-1.51E-01	8.60E-01	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	8.599E-01
K	3.024E-01	m/d	12	1.2	0.25	-1.65E-01	8.48E-01	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	8.481E-01
x	2.000E+00	m	13	1.3	0.25	-1.78E-01	8.37E-01	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	8.366E-01
z	0.000E+00	m	14	1.4	0.25	-1.92E-01	8.25E-01	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	8.252E-01
y	0.000E+00	m	15	1.5	0.25	-2.06E-01	8.14E-01	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	8.139E-01
ax	2.000E-01	m	16	1.6	0.25	-2.20E-01	8.03E-01	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	8.028E-01
az	2.000E-02	m	17	1.7	0.25	-2.33E-01	7.92E-01	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	7.919E-01
ay	2.000E-03	m	18	1.8	0.25	-2.47E-01	7.81E-01	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	7.811E-01
			19	1.9	0.25	-2.61E-01	7.70E-01	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	7.704E-01
			20	2	0.25	-2.75E-01	7.60E-01	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	7.599E-01

Relative Concentration



Calc

Value

DOMENICO (STEADY STATE)

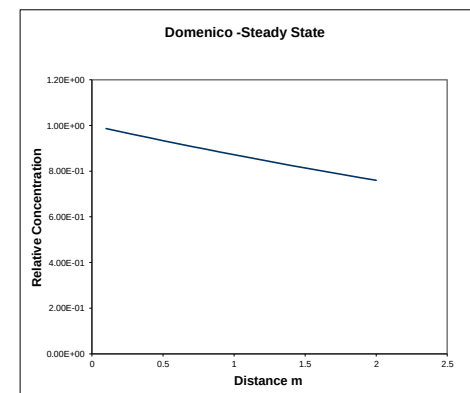
Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	2.81E-03	m/d	X		Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
Rc	1.23E+08															
u	2.29E-11	m/d	1	0.1	0.25	-1.37E-02	9.86E-01	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.86E-01
			2	0.2	0.25	-2.75E-02	9.73E-01	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	9.73E-01
			3	0.3	0.25	-4.12E-02	9.60E-01	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	9.60E-01
			4	0.4	0.25	-5.49E-02	9.47E-01	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	9.47E-01
			5	0.5	0.25	-6.86E-02	9.34E-01	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	9.34E-01
			6	0.6	0.25	-8.24E-02	9.21E-01	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	9.21E-01
			7	0.7	0.25	-9.61E-02	9.08E-01	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	9.08E-01
			8	0.8	0.25	-1.10E-01	8.96E-01	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	8.96E-01
			9	0.9	0.25	-1.24E-01	8.84E-01	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	8.84E-01
			10	1	0.25	-1.37E-01	8.72E-01	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	8.72E-01
			11	1.1	0.25	-1.51E-01	8.60E-01	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	8.60E-01
			12	1.2	0.25	-1.65E-01	8.48E-01	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	8.48E-01
			13	1.3	0.25	-1.78E-01	8.37E-01	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	8.37E-01
			14	1.4	0.25	-1.92E-01	8.25E-01	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	8.25E-01
			15	1.5	0.25	-2.06E-01	8.14E-01	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	8.14E-01
			16	1.6	0.25	-2.20E-01	8.03E-01	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	8.03E-01
			17	1.7	0.25	-2.33E-01	7.92E-01	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	7.92E-01
			18	1.8	0.25	-2.47E-01	7.81E-01	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	7.81E-01
			19	1.9	0.25	-2.61E-01	7.70E-01	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	7.70E-01
			20	2	0.25	-2.75E-01	7.60E-01	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	7.60E-01

21/06/2018

1.1

Relative Concentration



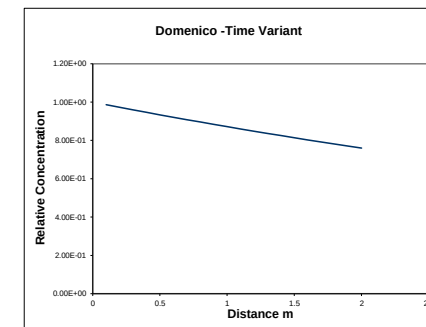
Date: 21/06/2018
Version: 1.1

DOMENICO (TIME VARIANT)

Contaminant 16-C21 aliphatic

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	0.3	mg/l	1	0.1	0.125	-1.37E-02	9.86E-01	-1.79E+44	2	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.86E-01
DF	1.9790		2	0.2	0.125	-2.75E-02	9.73E-01	-1.79E+44	2	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	9.73E-01
			3	0.3	0.125	-4.12E-02	9.60E-01	-1.79E+44	2	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	9.60E-01
			4	0.4	0.125	-5.49E-02	9.47E-01	-1.79E+44	2	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	9.47E-01
λ	3.231E-12	days ⁻¹	5	0.5	0.125	-6.86E-02	9.34E-01	-1.79E+44	2	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	9.34E-01
Sz	6.000E+01	m	6	0.6	0.125	-8.24E-02	9.21E-01	-1.79E+44	2	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	9.21E-01
Sy	2.514E+01	m	7	0.7	0.125	-9.61E-02	9.08E-01	-1.79E+44	2	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	9.08E-01
Kd	2.835E+07	l/kg	8	0.8	0.125	-1.10E-01	8.96E-01	-1.79E+44	2	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	8.96E-01
ρ	1.600E+00	g/cm3	9	0.9	0.125	-1.24E-01	8.84E-01	-1.79E+44	2	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	8.84E-01
n	3.700E-01		10	1	0.125	-1.37E-01	8.72E-01	-1.79E+44	2	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	8.72E-01
i	3.436E-03		11	1.1	0.125	-1.51E-01	8.60E-01	-1.79E+44	2	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	8.60E-01
K	3.024E-01	m/d	12	1.2	0.125	-1.65E-01	8.48E-01	-1.79E+44	2	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	8.48E-01
x	2.000E+00	m	13	1.3	0.125	-1.78E-01	8.37E-01	-1.79E+44	2	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	8.37E-01
z	0.000E+00	m	14	1.4	0.125	-1.92E-01	8.25E-01	-1.79E+44	2	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	8.25E-01
y	0.000E+00	m	15	1.5	0.125	-2.06E-01	8.14E-01	-1.79E+44	2	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	8.14E-01
t	1.000E+99	days	16	1.6	0.125	-2.20E-01	8.03E-01	-1.79E+44	2	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	8.03E-01
ax	2.000E-01	m	17	1.7	0.125	-2.33E-01	7.92E-01	-1.79E+44	2	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	7.92E-01
az	2.000E-02	m	18	1.8	0.125	-2.47E-01	7.81E-01	-1.79E+44	2	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	7.81E-01
ay	2.000E-03	m	19	1.9	0.125	-2.61E-01	7.70E-01	-1.79E+44	2	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	7.70E-01
			20	2	0.125	-2.75E-01	7.60E-01	-1.79E+44	2	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	7.60E-01



Calc

Value

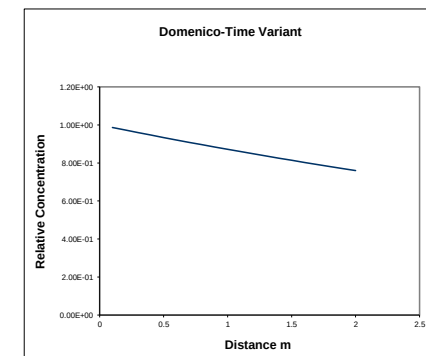
Calculations for source located at top of aquifer (ie vertical dispersion in one direction only) - USED FOR LEVEL ASSESSMENT

				X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Relative Concentration
v	2.81E-03	m/d		m														
Rc	1.23E+08		1	0.1	0.125	-1.37E-02	9.86E-01	-1.79E+44	2	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.86E-01
u	2.29E-11	m/d	2	0.2	0.125	-2.75E-02	9.73E-01	-1.79E+44	2	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	9.73E-01
			3	0.3	0.125	-4.12E-02	9.60E-01	-1.79E+44	2	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	9.60E-01
			4	0.4	0.125	-5.49E-02	9.47E-01	-1.79E+44	2	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	9.47E-01
			5	0.5	0.125	-6.86E-02	9.34E-01	-1.79E+44	2	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	9.34E-01
			6	0.6	0.125	-8.24E-02	9.21E-01	-1.79E+44	2	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	9.21E-01
			7	0.7	0.125	-9.61E-02	9.08E-01	-1.79E+44	2	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	9.08E-01
			8	0.8	0.125	-1.10E-01	8.96E-01	-1.79E+44	2	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	8.96E-01
			9	0.9	0.125	-1.24E-01	8.84E-01	-1.79E+44	2	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	8.84E-01
			10	1	0.125	-1.37E-01	8.72E-01	-1.79E+44	2	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	8.72E-01
			11	1.1	0.125	-1.51E-01	8.60E-01	-1.79E+44	2	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	8.60E-01
			12	1.2	0.125	-1.65E-01	8.48E-01	-1.79E+44	2	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	8.48E-01
			13	1.3	0.125	-1.78E-01	8.37E-01	-1.79E+44	2	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	8.37E-01
			14	1.4	0.125	-1.92E-01	8.25E-01	-1.79E+44	2	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	8.25E-01
			15	1.5	0.125	-2.06E-01	8.14E-01	-1.79E+44	2	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	8.14E-01
			16	1.6	0.125	-2.20E-01	8.03E-01	-1.79E+44	2	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	8.03E-01
			17	1.7	0.125	-2.33E-01	7.92E-01	-1.79E+44	2	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	7.92E-01
			18	1.8	0.125	-2.47E-01	7.81E-01	-1.79E+44	2	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	7.81E-01
			19	1.9	0.125	-2.61E-01	7.70E-01	-1.79E+44	2	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	7.70E-01
			20	2	0.125	-2.75E-01	7.60E-01	-1.79E+44	2	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	7.60E-01

Relative Concentration

21/06/2018

1.1



Date: 21/06/2018
Version: 1.1

Ogata Banks - Time Variant

Distance m	Concentration mg/l
0	1.15E+00
5	0.45E+00
10	0.20E+00
15	0.08E+00
20	0.00E+00

Ogata Banks - Time Variant

Distance m	Concentration mg/l
1	1.15E+00
2	6.00E-01
3	3.50E-01
4	2.00E-01
5	1.10E-01
6	6.00E-02
7	3.50E-02
8	2.00E-02
9	1.10E-02
10	6.00E-03
11	3.50E-03
12	2.00E-03
13	1.10E-03
14	6.00E-04
15	3.50E-04
16	2.00E-04
17	1.10E-04
18	6.00E-05
19	3.50E-05
20	2.00E-05

Ogata Banks - Time Variant

Distance m	Concentration mg/l
1	1.15E+00
2	6.00E-01
3	3.50E-01
4	2.00E-01
5	1.10E-01
6	6.00E-02
7	3.50E-02
8	2.00E-02
9	1.10E-02
10	6.00E-03
11	3.50E-03
12	2.00E-03
13	1.10E-03
14	6.00E-04
15	3.50E-04
16	2.00E-04
17	1.10E-04
18	6.00E-05
19	3.50E-05
20	2.00E-05

Contaminant I6-C21 aliphatic

DOMENICO (STEADY STATE)

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	0.3	mg/l	1	1	0.35	-2.03E-01	8.16E-01	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	1.14E+00
			2	2	0.35	-4.06E-01	6.67E-01	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	9.33E-01
			3	3	0.35	-6.08E-01	5.44E-01	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	7.62E-01
Co	1.40E+00	mg/l	4	4	0.35	-8.11E-01	4.44E-01	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	6.22E-01
λ	3.23E-12	days ⁻¹	5	5	0.35	-1.01E+00	3.63E-01	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	5.08E-01
Sz	6.00E+01	m	6	6	0.35	-1.22E+00	2.96E-01	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	4.15E-01
Sy	4.00E+00	m	7	7	0.35	-1.42E+00	2.42E-01	1.27E+01	1	-1.27E+01	-1	2.67E+00	1	-2.67E+00	-0.9998	3.38E-01
Kd	2.84E+07	l/kg	8	8	0.35	-1.62E+00	1.97E-01	1.19E+01	1	-1.19E+01	-1	2.50E+00	1	-2.50E+00	-0.9996	2.76E-01
ρ	1.60E+00	g/cm3	9	9	0.35	-1.83E+00	1.61E-01	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.999	-2.36E+00	-0.9991	2.25E-01
n	3.70E-01		10	10	0.35	-2.03E+00	1.32E-01	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.998	-2.24E+00	-0.9984	1.84E-01
i	1.70E-03		11	11	0.35	-2.23E+00	1.07E-01	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.997	-2.13E+00	-0.9974	1.50E-01
K	3.02E-01	m/d	12	12	0.35	-2.43E+00	8.77E-02	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.996	-2.04E+00	-0.9961	1.22E-01
x	2.00E+01	m	13	13	0.35	-2.64E+00	7.16E-02	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.994	-1.96E+00	-0.9945	9.97E-02
z	0.00E+00	m	14	14	0.35	-2.84E+00	5.85E-02	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.992	-1.89E+00	-0.9925	8.12E-02
y	0.00E+00	m	15	15	0.35	-3.04E+00	4.77E-02	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.99	-1.83E+00	-0.9902	6.62E-02
			16	16	0.35	-3.25E+00	3.90E-02	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.988	-1.77E+00	-0.9876	5.39E-02
ax	2.00E+00	m	17	17	0.35	-3.45E+00	3.18E-02	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.985	-1.71E+00	-0.9847	4.39E-02
az	2.00E-01	m	18	18	0.35	-3.65E+00	2.60E-02	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.982	-1.67E+00	-0.9816	3.57E-02
ay	2.00E-02	m	19	19	0.35	-3.85E+00	2.12E-02	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.978	-1.62E+00	-0.9782	2.90E-02
			20	20	0.35	-4.06E+00	1.73E-02	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.975	-1.58E+00	-0.9747	2.36E-02

Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc

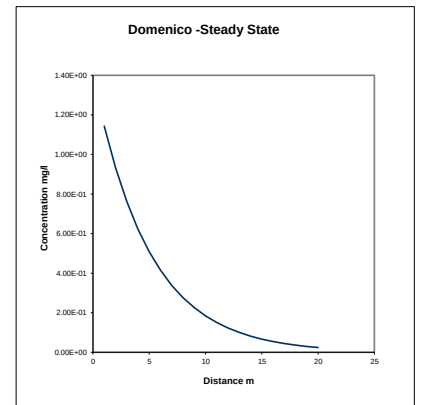
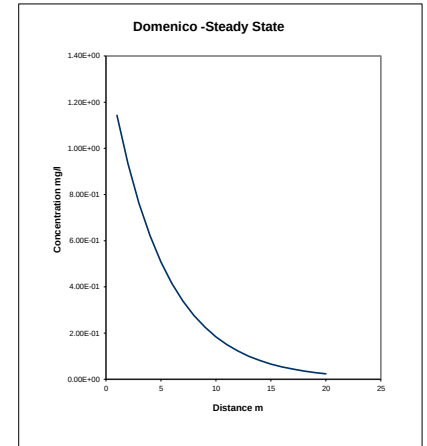
Value

DOMENICO (STEADY STATE)

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

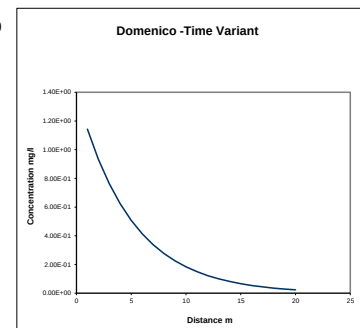
	1.39E-03	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration	
Rc	1.23E+08															
u	1.13E-11	m/d	1	1	0.35	-2.03E-01	8.16E-01	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	1.14E+00
			2	2	0.35	-4.06E-01	6.67E-01	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	9.33E-01
			3	3	0.35	-6.08E-01	5.44E-01	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	7.62E-01
			4	4	0.35	-8.11E-01	4.44E-01	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	6.22E-01
			5	5	0.35	-1.01E+00	3.63E-01	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	5.08E-01
			6	6	0.35	-1.22E+00	2.96E-01	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	4.15E-01
			7	7	0.35	-1.42E+00	2.42E-01	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	3.38E-01
			8	8	0.35	-1.62E+00	1.97E-01	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	2.76E-01
			9	9	0.35	-1.83E+00	1.61E-01	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	2.26E-01
			10	10	0.35	-2.03E+00	1.32E-01	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	1.84E-01
			11	11	0.35	-2.23E+00	1.07E-01	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	1.50E-01
			12	12	0.35	-2.43E+00	8.77E-02	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	1.23E-01
			13	13	0.35	-2.64E+00	7.16E-02	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	1.00E-01
			14	14	0.35	-2.84E+00	5.85E-02	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	8.18E-02
			15	15	0.35	-3.04E+00	4.77E-02	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	6.68E-02
			16	16	0.35	-3.25E+00	3.90E-02	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	5.46E-02
			17	17	0.35	-3.45E+00	3.18E-02	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	4.45E-02
			18	18	0.35	-3.65E+00	2.60E-02	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	3.64E-02
	21/06/2018		19	19	0.35	-3.85E+00	2.12E-02	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	2.97E-02
	1.1		20	20	0.35	-4.06E+00	1.73E-02	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	2.42E-02

Date: 21/06/2018
Version: 1.1



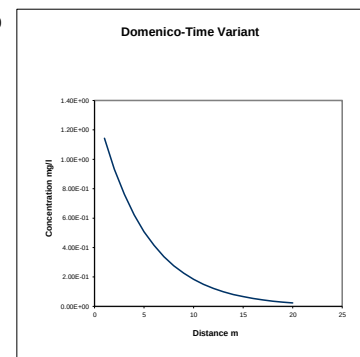
DOMENICO (TIME VARIANT)

Contaminant	16-C21 aliphatic	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	Concentration
C _T	0.3	mg/l	m														
			1	0.175	-2.03E-01	8.16E-01	-2.15E+44	2	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	1.14E+00
			2	0.175	-4.06E-01	6.67E-01	-2.15E+44	2	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	9.33E-01
			3	0.175	-6.08E-01	5.44E-01	-2.15E+44	2	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	7.62E-01
Co	1.40E+00	mg/l	4	0.175	-8.11E-01	4.44E-01	-2.15E+44	2	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	6.22E-01
λ	3.23E-12	days ⁻¹	5	0.175	-1.01E+00	3.63E-01	-2.15E+44	2	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	5.08E-01
Sz	6.00E+01	m	6	0.175	-1.22E+00	2.96E-01	-2.15E+44	2	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	4.15E-01
Sy	4.00E+00	m	7	0.175	-1.42E+00	2.42E-01	-2.15E+44	2	1.27E+01	1	-1.27E+01	-1	2.67E+00	0.9998	-2.67E+00	-1	3.38E-01
Kd	2.84E+07	l/kg	8	0.175	-1.62E+00	1.97E-01	-2.15E+44	2	1.19E+01	1	-1.19E+01	-1	2.50E+00	0.9996	-2.50E+00	-1	2.76E-01
ρ	1.60E+00	g/cm3	9	0.175	-1.83E+00	1.61E-01	-2.15E+44	2	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.9991	-2.36E+00	-0.999	2.25E-01
n	3.70E-01		10	0.175	-2.03E+00	1.32E-01	-2.15E+44	2	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.9984	-2.24E+00	-0.998	1.84E-01
i	1.70E-03		11	0.175	-2.23E+00	1.07E-01	-2.15E+44	2	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.9974	-2.13E+00	-0.997	1.50E-01
K	3.02E-01	m/d	12	0.175	-2.43E+00	8.77E-02	-2.15E+44	2	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.9961	-2.04E+00	-0.996	1.22E-01
x	2.00E+01	m	13	0.175	-2.64E+00	7.16E-02	-2.15E+44	2	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.9945	-1.96E+00	-0.994	9.97E-02
z	0.00E+00	m	14	0.175	-2.84E+00	5.85E-02	-2.15E+44	2	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.9925	-1.89E+00	-0.992	8.12E-02
y	0.00E+00	m	15	0.175	-3.04E+00	4.77E-02	-2.15E+44	2	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.9902	-1.83E+00	-0.99	6.62E-02
t	9.90E+99	days	16	0.175	-3.25E+00	3.90E-02	-2.15E+44	2	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.9876	-1.77E+00	-0.988	5.39E-02
ax	2.00E+00	m	17	0.175	-3.45E+00	3.18E-02	-2.15E+44	2	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.9847	-1.71E+00	-0.985	4.39E-02
az	2.00E-01	m	18	0.175	-3.65E+00	2.60E-02	-2.15E+44	2	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.9816	-1.67E+00	-0.982	3.57E-02
ay	2.00E-02	m	19	0.175	-3.85E+00	2.12E-02	-2.15E+44	2	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.9782	-1.62E+00	-0.978	2.90E-02
			20	0.175	-4.06E+00	1.73E-02	-2.15E+44	2	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.9747	-1.58E+00	-0.975	2.36E-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															Concentration
			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4A	ERF	Term 4B	ERF	Term 5A	ERF	Term 5B	ERF	Concentration
v	1.39E-03	m/d	m														
Rc	1.23E+08		1	0.175	-2.03E-01	8.16E-01	-2.15E+44	2	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	1.14E+00
u	1.13E-11	m/d	2	0.175	-4.06E-01	6.67E-01	-2.15E+44	2	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	9.33E-01
			3	0.175	-6.08E-01	5.44E-01	-2.15E+44	2	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	7.62E-01
			4	0.175	-8.11E-01	4.44E-01	-2.15E+44	2	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	6.22E-01
			5	0.175	-1.01E+00	3.63E-01	-2.15E+44	2	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	5.08E-01
			6	0.175	-1.22E+00	2.96E-01	-2.15E+44	2	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	4.15E-01
			7	0.175	-1.42E+00	2.42E-01	-2.15E+44	2	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	3.38E-01
			8	0.175	-1.62E+00	1.97E-01	-2.15E+44	2	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	2.76E-01
			9	0.175	-1.83E+00	1.61E-01	-2.15E+44	2	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	2.26E-01
			10	0.175	-2.03E+00	1.32E-01	-2.15E+44	2	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	1.84E-01
			11	0.175	-2.23E+00	1.07E-01	-2.15E+44	2	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	1.50E-01
			12	0.175	-2.43E+00	8.77E-02	-2.15E+44	2	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	1.23E-01
			13	0.175	-2.64E+00	7.16E-02	-2.15E+44	2	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	1.00E-01
			14	0.175	-2.84E+00	5.85E-02	-2.15E+44	2	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	8.18E-02
			15	0.175	-3.04E+00	4.77E-02	-2.15E+44	2	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	6.68E-02
			16	0.175	-3.25E+00	3.90E-02	-2.15E+44	2	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	5.46E-02
			17	0.175	-3.45E+00	3.18E-02	-2.15E+44	2	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	4.45E-02
			18	0.175	-3.65E+00	2.60E-02	-2.15E+44	2	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	3.64E-02
			19	0.175	-3.85E+00	2.12E-02	-2.15E+44	2	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	2.97E-02
			20	0.175	-4.06E+00	1.73E-02	-2.15E+44	2	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	2.42E-02



Date: 21/06/2018
Version: 1.1



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:	Portsman Way		
Site Address:	Reading		
Completed by:	PDM	Version:	1.1
Date:	21-Jun-18		
Contaminant	C12-C16 aliphatic		
Target Concentration (C_T)	3.00E-01	mg/l	Origin of C_T: WHO

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

C12-C16 aliphatic
0.3 mg/l

Input Parameters Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

2.40E-01

fraction

calculated

Air filled soil porosity

θ_a

1.84E-01

fraction

calculated

Bulk density of soil zone material

ρ

1.60E+00

g/cm³

R & D Technical report sand fill

Henry's Law constant

H

5.20E+02

dimensionless

Total Petroleum Hydrocarbon Criteria Working Group

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 soil)

f_{oc}

4.50E-01

fraction

site data

Organic carbon partition coefficient

K_{oc}

5.00E+06

l/kg

CLAIRE 2017 Hydrocarbons in Groundwater

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

2.25E+06

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

6.75E+05

mg/kg

(for comparison with soil analyses)

or

0.3

mg/l

(for comparison with leachate test results)

Site being assessed: Portsman Way

Completed by: PDM

Date: 21-Jun-18

Version: 1.1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

C12-C16 aliphatic
0.3

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
Area of contaminant source

Inf
A

4.40E-04
1.50E+02

m/d
m²

96-2000 30% pf values River Thames at Reading 70%
Area of boiler house and tank farm

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow
Saturated aquifer thickness
Hydraulic Conductivity of aquifer in which dilution occurs
Hydraulic gradient of water table
Width of contaminant source perpendicular to groundwater flow
Background concentration of contaminant in groundwater beneath site

L
da
K
i
w
Cu

3.00E+01
8.00E+01
3.02E-01
1.70E-03
6.00E+01
0.00E+00

m
m
m/d
fraction
m
mg/l

Width of source area between PH2 and PH6
assumed vale to base of chalk
site data
Estimate
Length of source area between PH2 and PH6
Estimated

Not used in calculation

Define mixing zone depth by specifying or calculating depth (using pull down list)

Enter mixing zone thickness
Calculated mixing zone thickness

Mz
Mz

Calculate
2.51E+01

m
m

Calculated Parameters

Dilution Factor DF

1.98E+00

Level 2 Remedial Target

5.94E-01
or
1.34E+06
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)

C_c

0.00E+00

mg/l

Calculated concentration within receptor (dilution only)

0.00E+00

mg/l

0

Site being assessed: Portsman Way
Completed by: PDM
Date: 21-Jun-18
Version: 1.1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		C12-C16 aliphatic		from Level 1
Target Concentration	C _t	0.3	mg/l	from Level 1
Dilution Factor	DF	1.98E+00		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 dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration			
Enter soil concentration	689	mg/kg	
Half life for degradation of contaminant in water	t _{1/2}	days	Canada Wide Standards for PHC in Soils
Calculated decay rate	λ	days ⁻¹	calculated
Width of plume in aquifer at source	Sz	m	from Level 2
Plume thickness in aquifer at source	Sy	m	from Level 2
Bulk density of aquifer materials	ρ	g/cm ³	R & D Technical Report P13
Effective porosity of aquifer	n	fraction	Consim
Hydraulic gradient	i	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	K	m/d	from Level 2
Distance to compliance point	x	m	Estimated Depth to water table
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	days	time variant options only
Parameters values determined from options			
Partition coefficient	Kd	l/kg	see options
Longitudinal dispersivity	ax	m	see options
Transverse dispersivity	az	m	see options
Vertical dispersivity	av	m	see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Groundwater flow velocity	V	2.81E-03	m/d
Retardation factor	Rf	9.73E+05	fraction
Decay rate used	λ	4.07E-10	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	i	3.44E-03	fraction
Rate of contaminant flow due to retardation	u	2.89E-09	m/d
Ratio of Compliance Point to Source Concentration	C ₁₀ /C ₀	7.60E-01	fraction
Attenuation factor (C ₁₀ /C ₁₀₀)	AF	1.32E+00	fraction
Calculated soil leachate concentration	Co	3.06E-04	mg/l

Remedial Targets

Level 3 Remedial Target	7.81E-01	mg/l	For comparison with measured pore water concentration.
Ogata Banks	or		This assumes Level 1 Remedial Target is based on Target Concentration.
	1.76E+06	mg/kg	For comparison with measured soil concentration. This
Distance to compliance point	2	m	assumes Level 1 Remedial Target calculated from soil-water partitioning equation.
Ratio of Compliance Point to Source Concentration	C ₁₀ /C ₀	7.60E-01	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 non-polar organic chemicals

Entry if specify partition coefficient (option)

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

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer	foc	4.50E-02	fraction
Organic carbon partition coefficient	Koc	5.00E+06	l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species	K _{oc,li}		l/kg
Sorption coefficient for ionised species	K _{oc,li}		l/kg
pH value	pH		
Acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction

Soil water partition coefficient	Kd	2.25E+05	l/kg
----------------------------------	----	----------	------

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

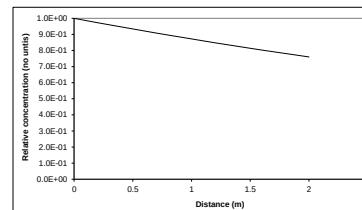
Dispersivities 10%, 1%, 0.1% of pathway length

Longitudinal dispersivity	ax	0.00E+00	2.00E-01	4.58E-02	m
Transverse dispersivity	az	0.00E+00	2.00E-02	4.58E-03	m
Vertical dispersivity	ay	0.00E+00	2.00E-03	4.58E-04	m

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀)^{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 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

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	1.55E-04
0.1	9.86E-01	1.53E-04
0.2	9.73E-01	1.51E-04
0.3	9.60E-01	1.48E-04
0.4	9.47E-01	1.46E-04
0.5	9.34E-01	1.44E-04
0.6	9.21E-01	1.42E-04
0.7	9.08E-01	1.41E-04
0.8	8.96E-01	1.39E-04
0.9	8.84E-01	1.37E-04
1.0	8.72E-01	1.35E-04
1.1	8.60E-01	1.33E-04
1.2	8.48E-01	1.31E-04
1.3	8.37E-01	1.29E-04
1.4	8.25E-01	1.28E-04
1.5	8.14E-01	1.26E-04
1.6	8.03E-01	1.24E-04
1.7	7.92E-01	1.23E-04
1.8	7.81E-01	1.21E-04
1.9	7.70E-01	1.19E-04
2.0	7.60E-01	1.18E-04

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:	Portman Way
Completed by:	PDM
Date:	#####
Version:	1.1

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters
Soil contaminant concentration C_0 2.00E-01 mg/kg

Level 1 Parameters

Water filled soil porosity	θ_w	2.40E-01	fraction
Air filled soil porosity	θ_a	1.84E-01	fraction
Bulk density	ρ	1.60E+00	g/cm ³
Henry's Law constant	H	5.20E+02	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	2.25E+06	l/kg
Factor (partitioning between soil and water)		2.25E+06	dimensionless

Level 2 Parameters

Dilution Factor DF 1.98E+00

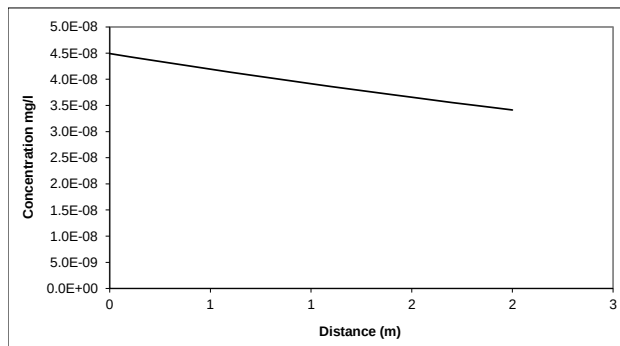
Level 3 Parameters

Attenuation factor (C_0/C_{ED}) AF 1.32E+00

Predicted concentrations at compliance point

Level 1	C	8.89E-08 mg/l	No dilution or attenuation
Level 2	C	4.49E-08 mg/l	Dilution taken into account
Level 3	C	3.41E-08 mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	4.49E-08
0.10	4.43E-08
0.20	4.37E-08
0.30	4.31E-08
0.40	4.25E-08
0.50	4.19E-08
0.60	4.14E-08
0.70	4.08E-08
0.80	4.02E-08
0.90	3.97E-08
1.00	3.92E-08
1.10	3.86E-08
1.20	3.81E-08
1.30	3.76E-08
1.40	3.71E-08
1.50	3.66E-08
1.60	3.61E-08
1.70	3.56E-08
1.80	3.51E-08
1.90	3.46E-08
2.00	3.41E-08

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	C12-C16 aliphatic		from Level 1
Target Concentration	C _T	3.00E-01	mg/l from Level 1

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

Ogata Banks	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	6.89E-01	mg/l	Site data
Half life for degradation of contaminant in water	t _{1/2}	1.75E+03	days	Canada Wide Standards for PHC in Soils
Calculated decay rate	λ	3.96E-04	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.00E+01	m	Estimated from site data
Plume thickness at source	Sy	4.00E+00	m	to top of chalk
Saturated aquifer thickness	da	8.00E+01	m	Estimated from site data
Bulk density of aquifer materials	p	1.80E+00	g/cm ³	Consim
Effective porosity of aquifer	n	3.70E-01	fraction	Consim
Hydraulic gradient	i	1.70E-03	fraction	Estimate from site data
Hydraulic conductivity of aquifer	K	3.02E-01	m/d	Site data
Distance to compliance point	x	2.00E+01	m	Distance to site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	2.25E+05	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	1.39E-03	m/d
Retardation factor	Rf	9.73E+05	fraction
Decay rate used	λ	4.07E-10	d ⁻¹
Rate of contaminant flow due to retardation	U	1.43E-09	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	1.19E-02	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	5.78E+01	

Remedial Targets

Remedial Target	1.73E+01	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	1.19E-02	mg/l
		9.9E+99	days

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)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Entry for ionic organic chemicals (option)

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer	f _{oc}	4.50E-02	fraction
Organic carbon partition coefficient	K _{oc}	5.00E+06	l/kg
Sorption coefficient for related species	K _{oc,ri}		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	2.25E+05	l/kg

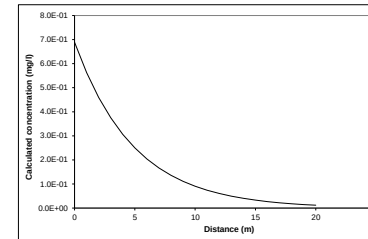
Define dispersivity (click brown cell and use pull down list)

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

Longitudinal dispersivity	ax	2.00E+00	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(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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	6.9E-01
1.0	5.63E-01
2.0	4.59E-01
3.0	3.75E-01
4.0	3.06E-01
5.0	2.50E-01
6.0	2.04E-01
7.0	1.67E-01
8.0	1.36E-01
9.0	1.11E-01
10.0	9.07E-02
11.0	7.40E-02
12.0	6.04E-02
13.0	4.93E-02
14.0	4.03E-02
15.0	3.29E-02
16.0	2.68E-02
17.0	2.19E-02
18.0	1.79E-02
19.0	1.46E-02
20.0	1.19E-02

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:	Portsmouth Way
Completed by:	PDM
Date:	20/07/2018
Version:	1.1

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	15.00	% wt	(Change this number only if you have specific information)
Particle Density	2.78	tonnes/m ³	
Dry Bulk Density	1.60	tonnes/m ³	
Calculated Parameters			
Voids Ratio	0.74	fraction	
Initial Saturation	56.54	%	
Total porosity	0.424	fraction	
Air Filled Porosity	0.184	fraction	
Water Filled Porosity	0.240	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	1.000	fraction	#DIV/0!
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

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 C12-C16 aliphatic

Parameter	Value	Units	Calculations (Refer to Table 4.3, R&D Publication 20)		
(carried over from input sheet)			Selected option	Calculate for non-polar organic chemicals	
			calc	calc	Calc Kd l/kg
C _T	3.00E-01	mg/l	Calculation of partition coefficient		
K _d	2.25E+06	l/kg	for ionic organic chemical		
f _{oc}	4.50E-01	fraction			
k _{oc}	5.00E+06	l/kg	Partition coefficient used in Level 1 Assessment		
θ _w	2.40E-01	fraction	2.25E+06 l/kg		
θ _a	1.84E-01	fraction			
ρ	1.60E+00	g/cm ³			
H	5.20E+02	dimensionless	Factor (partitioning between soil and water)		
K _{oc,n}		l/kg			
K _{oc,i}		l/kg			
pH		pH units			
pK _a					
f _{oc} (ionic)		fraction			
			Calculated Remedial Target 6.75E+05 mg/kg for C12-C16 aliphatic		
			Site being assessed: Portsman Way Completed by: PDM Date: 21/06/2018 Version: 1.1		

Level 2 Calculation Sheet

Contaminant C12-C16 aliphatic

Site assessed:	Portsman Wa
Date:	21/06/2018
Version:	1.1

Parameter Value Units
(carried over from input sheet)

Mz	2.51E+01	m
L	3.00E+01	m
da	8.00E+01	m
Inf	4.40E-04	m/d
K	3.02E-01	m/d
i	1.70E-03	m3/d
A	1.50E+02	m2
Cc	0.00E+00	mg/l
C _T	3.00E-01	mg/l
Cu	0.00E+00	mg/l
w	6.00E+01	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Calculated
Dilution Factor

1.98E+00

#DIV/0!



Ogata Banks - Time Variant

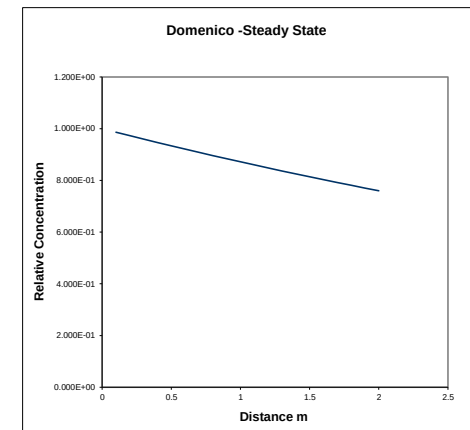
Distance m	Relative Concentration
0.1	0.98
0.5	0.90
1.0	0.83
1.5	0.78
2.0	0.76

Contaminant I2-C16 aliphatic

DOMENICO (STEADY STATE)

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	3.000E-01	mg/l	1	0.1	0.25	-1.37E-02	9.86E-01	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.864E-01
DF	1.979E+00		2	0.2	0.25	-2.75E-02	9.73E-01	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	9.729E-01
			3	0.3	0.25	-4.12E-02	9.60E-01	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	9.597E-01
			4	0.4	0.25	-5.49E-02	9.47E-01	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	9.466E-01
λ	4.071E-10	days ⁻¹	5	0.5	0.25	-6.86E-02	9.34E-01	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	9.337E-01
Sz	6.000E+01	m	6	0.6	0.25	-8.24E-02	9.21E-01	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	9.209E-01
Sy	2.514E+01	m	7	0.7	0.25	-9.61E-02	9.08E-01	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	9.084E-01
Kd	2.250E+05	l/kg	8	0.8	0.25	-1.10E-01	8.96E-01	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	8.960E-01
ρ	1.600E+00	g/cm3	9	0.9	0.25	-1.24E-01	8.84E-01	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	8.838E-01
n	3.700E-01		10	1	0.25	-1.37E-01	8.72E-01	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	8.717E-01
i	3.436E-03		11	1.1	0.25	-1.51E-01	8.60E-01	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	8.599E-01
K	3.024E-01	m/d	12	1.2	0.25	-1.65E-01	8.48E-01	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	8.481E-01
x	2.000E+00	m	13	1.3	0.25	-1.78E-01	8.37E-01	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	8.366E-01
z	0.000E+00	m	14	1.4	0.25	-1.92E-01	8.25E-01	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	8.252E-01
y	0.000E+00	m	15	1.5	0.25	-2.06E-01	8.14E-01	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	8.139E-01
ax	2.000E-01	m	16	1.6	0.25	-2.20E-01	8.03E-01	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	8.028E-01
az	2.000E-02	m	17	1.7	0.25	-2.33E-01	7.92E-01	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	7.919E-01
ay	2.000E-03	m	18	1.8	0.25	-2.47E-01	7.81E-01	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	7.811E-01
			19	1.9	0.25	-2.61E-01	7.70E-01	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	7.704E-01
			20	2	0.25	-2.75E-01	7.60E-01	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	7.599E-01



Calc

Value

DOMENICO (STEADY STATE)

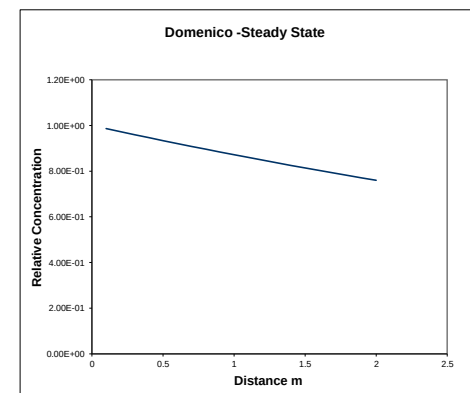
Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT

	2.81E-03	m/d	X		Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration
Rc	9.73E+05															
u	2.89E-09	m/d	1	0.1	0.25	-1.37E-02	9.86E-01	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.86E-01
			2	0.2	0.25	-2.75E-02	9.73E-01	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	9.73E-01
			3	0.3	0.25	-4.12E-02	9.60E-01	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	9.60E-01
			4	0.4	0.25	-5.49E-02	9.47E-01	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	9.47E-01
			5	0.5	0.25	-6.86E-02	9.34E-01	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	9.34E-01
			6	0.6	0.25	-8.24E-02	9.21E-01	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	9.21E-01
			7	0.7	0.25	-9.61E-02	9.08E-01	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	9.08E-01
			8	0.8	0.25	-1.10E-01	8.96E-01	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	8.96E-01
			9	0.9	0.25	-1.24E-01	8.84E-01	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	8.84E-01
			10	1	0.25	-1.37E-01	8.72E-01	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	8.72E-01
			11	1.1	0.25	-1.51E-01	8.60E-01	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	8.60E-01
			12	1.2	0.25	-1.65E-01	8.48E-01	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	8.48E-01
			13	1.3	0.25	-1.78E-01	8.37E-01	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	8.37E-01
			14	1.4	0.25	-1.92E-01	8.25E-01	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	8.25E-01
			15	1.5	0.25	-2.06E-01	8.14E-01	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	8.14E-01
			16	1.6	0.25	-2.20E-01	8.03E-01	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	8.03E-01
			17	1.7	0.25	-2.33E-01	7.92E-01	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	7.92E-01
			18	1.8	0.25	-2.47E-01	7.81E-01	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	7.81E-01
			19	1.9	0.25	-2.61E-01	7.70E-01	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	7.70E-01
			20	2	0.25	-2.75E-01	7.60E-01	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	7.60E-01

21/06/2018

1.1

Relative Concentration



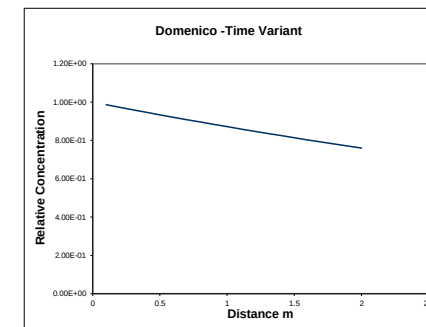
Date: 21/06/2018
Version: 1.1

DOMENICO (TIME VARIANT)

Contaminant 12-C16 aliphatic

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	0.3	mg/l	1	0.1	0.125	-1.37E-02	9.86E-01	-2.00E+45	2	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.86E-01
DF	1.9790		2	0.2	0.125	-2.75E-02	9.73E-01	-2.00E+45	2	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	9.73E-01
			3	0.3	0.125	-4.12E-02	9.60E-01	-2.00E+45	2	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	9.60E-01
			4	0.4	0.125	-5.49E-02	9.47E-01	-2.00E+45	2	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	9.47E-01
λ	4.071E-10	days ⁻¹	5	0.5	0.125	-6.86E-02	9.34E-01	-2.00E+45	2	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	9.34E-01
Sz	6.000E+01	m	6	0.6	0.125	-8.24E-02	9.21E-01	-2.00E+45	2	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	9.21E-01
Sy	2.514E+01	m	7	0.7	0.125	-9.61E-02	9.08E-01	-2.00E+45	2	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	9.08E-01
Kd	2.250E+05	l/kg	8	0.8	0.125	-1.10E-01	8.96E-01	-2.00E+45	2	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	8.96E-01
ρ	1.600E+00	g/cm3	9	0.9	0.125	-1.24E-01	8.84E-01	-2.00E+45	2	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	8.84E-01
n	3.700E-01		10	1	0.125	-1.37E-01	8.72E-01	-2.00E+45	2	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	8.72E-01
i	3.436E-03		11	1.1	0.125	-1.51E-01	8.60E-01	-2.00E+45	2	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	8.60E-01
K	3.024E-01	m/d	12	1.2	0.125	-1.65E-01	8.48E-01	-2.00E+45	2	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	8.48E-01
x	2.000E+00	m	13	1.3	0.125	-1.78E-01	8.37E-01	-2.00E+45	2	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	8.37E-01
z	0.000E+00	m	14	1.4	0.125	-1.92E-01	8.25E-01	-2.00E+45	2	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	8.25E-01
y	0.000E+00	m	15	1.5	0.125	-2.06E-01	8.14E-01	-2.00E+45	2	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	8.14E-01
t	1.000E+99	days	16	1.6	0.125	-2.20E-01	8.03E-01	-2.00E+45	2	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	8.03E-01
ax	2.000E-01	m	17	1.7	0.125	-2.33E-01	7.92E-01	-2.00E+45	2	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	7.92E-01
az	2.000E-02	m	18	1.8	0.125	-2.47E-01	7.81E-01	-2.00E+45	2	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	7.81E-01
ay	2.000E-03	m	19	1.9	0.125	-2.61E-01	7.70E-01	-2.00E+45	2	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	7.70E-01
			20	2	0.125	-2.75E-01	7.60E-01	-2.00E+45	2	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	7.60E-01

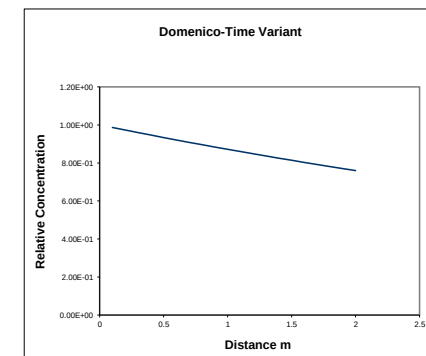


Calc

Value

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

		Calculated: 100															
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Date: 21/06/2018
Version: 1.1

Contaminant		12-C16 aliphatic		OGATA BANKS SOLUTION																				
				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	0.3	mg/l	1	1	0.08613	-2.0E-01	8.2E-01	-2.4E+45	2.000	7.0E-01	2.0E+00	2.4E+45	0.000	3.4E+01	1	-3.4E+01	-1	7.1E+00	1	-7.1E+00	-1	5.63E-01		
			2	2	0.08613	-4.1E-01	6.7E-01	-2.4E+45	2.000	1.4E+00	4.1E+00	2.4E+45	0.000	2.4E+01	1	-2.4E+01	-1	5.0E+00	1	-5.0E+00	-1	4.59E-01		
			3	3	0.08613	-6.1E-01	5.4E-01	-2.4E+45	2.000	2.1E+00	8.2E+00	2.4E+45	0.000	1.9E+01	1	-1.9E+01	-1	4.1E+00	1	-4.1E+00	-1	3.75E-01		
			4	4	0.08613	-8.1E-01	4.4E-01	-2.4E+45	2.000	2.8E+00	1.7E+01	2.4E+45	0.000	1.7E+01	1	-1.7E+01	-1	3.5E+00	1	-3.5E+00	-1	3.06E-01		
Co	6.89E-01	mg/l	4	4	0.08613	-8.1E-01	4.4E-01	-2.4E+45	2.000	2.8E+00	1.7E+01	2.4E+45	0.000	1.7E+01	1	-1.7E+01	-1	3.5E+00	1	-3.5E+00	-1	3.06E-01		
λ	4.07E-10	days ⁻¹	5	5	0.08613	-1.0E+00	3.6E-01	-2.4E+45	2.000	3.5E+00	3.4E+01	2.4E+45	0.000	1.5E+01	1	-1.5E+01	-1	3.2E+00	1	-3.2E+00	-0.99999	2.50E-01		
Sz	6.00E+01	m	6	6	0.08613	-1.2E+00	3.0E-01	-2.4E+45	2.000	4.2E+00	6.8E+01	2.4E+45	0.000	1.4E+01	1	-1.4E+01	-1	2.9E+00	1	-2.9E+00	-0.99996	2.04E-01		
Sy	4.00E+00	m	7	7	0.08613	-1.4E+00	2.4E-01	-2.4E+45	2.000	4.9E+00	1.4E+02	2.4E+45	0.000	1.3E+01	1	-1.3E+01	-1	2.7E+00	0.9998	-2.7E+00	-0.99984	1.67E-01		
Kd	2.25E+05	l/kg	8	8	0.08613	-1.6E+00	2.0E-01	-2.4E+45	2.000	5.6E+00	2.8E+02	2.4E+45	0.000	1.2E+01	1	-1.2E+01	-1	2.5E+00	0.9996	-2.5E+00	-0.99959	1.36E-01		
ρ	1.60E+00	g/cm3	9	9	0.08613	-1.8E+00	1.6E-01	-2.4E+45	2.000	6.3E+00	5.6E+02	2.4E+45	0.000	1.1E+01	1	-1.1E+01	-1	2.4E+00	0.9991	-2.4E+00	-0.99914	1.11E-01		
n	3.70E-01		10	10	0.08613	-2.0E+00	1.3E-01	-2.4E+45	2.000	7.0E+00	1.1E+03	2.4E+45	0.000	1.1E+01	1	-1.1E+01	-1	2.2E+00	0.9984	-2.2E+00	-0.99843	9.05E-02		
i	1.70E-03		11	11	0.08613	-2.2E+00	1.1E-01	-2.4E+45	2.000	7.7E+00	2.3E+03	2.4E+45	0.000	1.0E+01	1	-1.0E+01	-1	2.1E+00	0.9974	-2.1E+00	-0.99743	7.38E-02		
K	3.02E-01	m/d	12	12	0.08613	-2.4E+00	8.8E-02	-2.4E+45	2.000	8.4E+00	4.6E+03	2.4E+45	0.000	9.7E+00	1	-9.7E+00	-1	2.0E+00	0.9961	-2.0E+00	-0.99611	6.02E-02		
x	2.00E+01	m	13	13	0.08613	-2.6E+00	7.2E-02	-2.4E+45	2.000	9.1E+00	9.3E+03	2.4E+45	0.000	9.3E+00	1	-9.3E+00	-1	2.0E+00	0.9945	-2.0E+00	-0.99445	4.91E-02		
z	0.00E+00	m	14	14	0.08613	-2.8E+00	5.8E-02	-2.4E+45	2.000	9.8E+00	1.9E+04	2.4E+45	0.000	9.0E+00	1	-9.0E+00	-1	1.9E+00	0.9925	-1.9E+00	-0.99247	4.00E-02		
y	0.00E+00	m	15	15	0.08613	-3.0E+00	4.8E-02	-2.4E+45	2.000	1.1E+01	3.8E+04	2.4E+45	0.000	8.7E+00	1	-8.7E+00	-1	1.8E+00	0.9902	-1.8E+00	-0.99018	3.26E-02		
t	9.90E+99	days	16	16	0.08613	-3.2E+00	3.9E-02	-2.4E+45	2.000	1.1E+01	7.7E+04	2.4E+45	0.000	8.4E+00	1	-8.4E+00	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	2.65E-02		
ax	2.00E+00	m	17	17	0.08613	-3.4E+00	3.2E-02	-2.4E+45	2.000	1.2E+01	1.5E+05	2.4E+45	0.000	8.1E+00	1	-8.1E+00	-1	1.7E+00	0.9847	-1.7E+00	-0.98471	2.16E-02		
az	2.00E-01	m	18	18	0.08613	-3.7E+00	2.6E-02	-2.4E+45	2.000	1.3E+01	3.1E+05	2.4E+45	0.000	7.9E+00	1	-7.9E+00	-1	1.7E+00	0.9816	-1.7E+00	-0.98158	1.76E-02		
ay	2.00E-02	m	19	19	0.08613	-3.9E+00	2.1E-02	-2.4E+45	2.000	1.3E+01	6.3E+05	2.4E+45	0.000	7.7E+00	1	-7.7E+00	-1	1.6E+00	0.9782	-1.6E+00	-0.97822	1.43E-02		
			20	20	0.08613	-4.1E+00	1.7E-02	-2.4E+45	2.000	1.4E+01	1.3E+06	2.4E+45	0.000	7.5E+00	1	-7.5E+00	-1	1.6E+00	0.9747	-1.6E+00	-0.97465	1.16E-02		

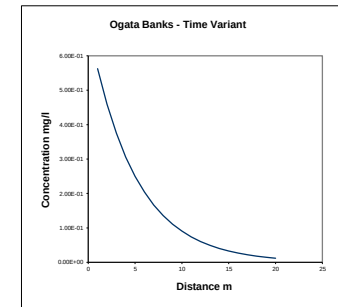
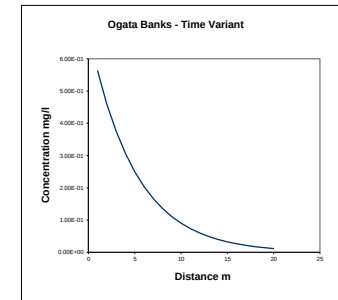
Vertical dispersion option Simulate vertical dispersion in 1 direction

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	1.39E-03	m/d	1	1	0.08613	-2.0E-01	8.2E-01	-2.4E+45	2.000	7.0E-01	2.0E+00	2.4E+45	0.000	3.4E+01	1	-3.4E+01	-1	1.4E+01	1	-1.4E+01	-1	5.63E-01	
Rc	9.73E+05		2	2	0.08613	-4.1E-01	6.7E-01	-2.4E+45	2.000	1.4E+00	4.1E+00	2.4E+45	0.000	2.4E+01	1	-2.4E+01	-1	1.0E+01	1	-1.0E+01	-1	4.59E-01	
u	1.43E-09	m/d	3	3	0.08613	-6.1E-01	5.4E-01	-2.4E+45	2.000	2.1E+00	8.2E+00	2.4E+45	0.000	1.9E+01	1	-1.9E+01	-1	8.2E+00	1	-8.2E+00	-1	3.75E-01	
			4	4	0.08613	-8.1E-01	4.4E-01	-2.4E+45	2.000	2.8E+00	1.7E+01	2.4E+45	0.000	1.7E+01	1	-1.7E+01	-1	7.1E+00	1	-7.1E+00	-1	3.06E-01	
			5	5	0.08613	-1.0E+00	3.6E-01	-2.4E+45	2.000	3.5E+00	3.4E+01	2.4E+45	0.000	1.5E+01	1	-1.5E+01	-1	6.3E+00	1	-6.3E+00	-1	2.50E-01	
			6	6	0.08613	-1.2E+00	3.0E-01	-2.4E+45	2.000	4.2E+00	6.8E+01	2.4E+45	0.000	1.4E+01	1	-1.4E+01	-1	5.8E+00	1	-5.8E+00	-1	2.04E-01	
			7	7	0.08613	-1.4E+00	2.4E-01	-2.4E+45	2.000	4.9E+00	1.4E+02	2.4E+45	0.000	1.3E+01	1	-1.3E+01	-1	5.3E+00	1	-5.3E+00	-1	1.67E-01	
			8	8	0.08613	-1.6E+00	2.0E-01	-2.4E+45	2.000	5.6E+00	2.8E+02	2.4E+45	0.000	1.2E+01	1	-1.2E+01	-1	5.0E+00	1	-5.0E+00	-1	1.36E-01	
			9	9	0.08613	-1.8E+00	1.6E-01	-2.4E+45	2.000	6.3E+00	5.6E+02	2.4E+45	0.000	1.1E+01	1	-1.1E+01	-1	4.7E+00	1	-4.7E+00	-1	1.11E-01	
			10	10	0.08613	-2.0E+00	1.3E-01	-2.4E+45	2.000	7.0E+00	1.1E+03	2.4E+45	0.000	1.1E+01	1	-1.1E+01	-1	4.5E+00	1	-4.5E+00	-1	9.07E-02	
			11	11	0.08613	-2.2E+00	1.1E-01	-2.4E+45	2.000	7.7E+00	2.3E+03	2.4E+45	0.000	1.0E+01	1	-1.0E+01	-1	4.3E+00	1	-4.3E+00	-1	7.40E-02	
			12	12	0.08613	-2.4E+00	8.8E-02	-2.4E+45	2.000	8.4E+00	4.6E+03	2.4E+45	0.000	9.7E+00	1	-9.7E+00	-1	4.1E+00	1	-4.1E+00	-1	6.04E-02	
			13	13	0.08613	-2.6E+00	7.2E-02	-2.4E+45	2.000	9.1E+00	9.3E+03	2.4E+45	0.000	9.3E+00	1	-9.3E+00	-1	3.9E+00	1	-3.9E+00	-1	4.93E-02	
			14	14	0.08613	-2.8E+00	5.8E-02	-2.4E+45	2.000	9.8E+00	1.9E+04	2.4E+45	0.000	9.0E+00	1	-9.0E+00	-1	3.8E+00	1	-3.8E+00	-1	4.03E-02	
			15	15	0.08613	-3.0E+00	4.8E-02	-2.4E+45	2.000	1.1E+01	3.8E+04	2.4E+45	0.000	8.7E+00	1	-8.7E+00	-1	3.7E+00	1	-3.7E+00	-1	3.29E-02	
			16	16	0.08613	-3.2E+00	3.9E-02	-2.4E+45	2.000	1.1E+01	7.7E+04	2.4E+45	0.000	8.4E+00	1	-8.4E+00	-1	3.5E+00	1	-3.5E+00	-1	2.68E-02	
			17	17	0.08613	-3.4E+00	3.2E-02	-2.4E+45	2.000	1.2E+01	1.5E+05	2.4E+45	0.000	8.1E+00	1	-8.1E+00	-1	3.4E+00	1	-3.4E+00	-1	2.19E-02	
			18	18	0.08613	-3.7E+00	2.6E-02	-2.4E+45	2.000	1.3E+01	3.1E+05	2.4E+45	0.000	7.9E+00	1	-7.9E+00	-1	3.3E+00	1	-3.3E+00	-1	1.79E-02	
			19	19	0.08613	-3.9E+00	2.1E-02	-2.4E+45	2.000	1.3E+01	6.3E+05	2.4E+45	0.000	7.7E+00	1	-7.7E+00	-1	3.2E+00	1	-3.2E+00	-1	1.46E-02	
			20	20	0.08613	-4.1E+00	1.7E-02	-2.4E+45	2.000	1.4E+01	1.3E+06	2.4E+45	0.000	7.5E+00	1	-7.5E+00	-1	3.2E+00	1	-3.2E+00	-0.99999	1.19E-02	

Date: 21/06/2018

Version: 1.1

Date: 21/06/2018
Version: 1.1



Contaminant L2-C16 aliphatic

DOMENICO (STEADY STATE)

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	Concentration	
Input	Value	Units														
C _T	0.3	mg/l	1	1	0.17225	-2.03E-01	8.16E-01	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	5.63E-01
			2	2	0.17225	-4.06E-01	6.67E-01	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	4.59E-01
			3	3	0.17225	-6.08E-01	5.44E-01	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	3.75E-01
Co	6.89E-01	mg/l	4	4	0.17225	-8.11E-01	4.44E-01	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	3.06E-01
λ	4.07E-10	days ⁻¹	5	5	0.17225	-1.01E+00	3.63E-01	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	2.50E-01
Sz	6.00E+01	m	6	6	0.17225	-1.22E+00	2.96E-01	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	2.04E-01
Sy	4.00E+00	m	7	7	0.17225	-1.42E+00	2.42E-01	1.27E+01	1	-1.27E+01	-1	2.67E+00	1	-2.67E+00	-0.9998	1.67E-01
Kd	2.25E+05	l/kg	8	8	0.17225	-1.62E+00	1.97E-01	1.19E+01	1	-1.19E+01	-1	2.50E+00	1	-2.50E+00	-0.9996	1.36E-01
ρ	1.60E+00	g/cm3	9	9	0.17225	-1.83E+00	1.61E-01	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.999	-2.36E+00	-0.9991	1.11E-01
n	3.70E-01		10	10	0.17225	-2.03E+00	1.32E-01	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.998	-2.24E+00	-0.9984	9.05E-02
i	1.70E-03		11	11	0.17225	-2.23E+00	1.07E-01	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.997	-2.13E+00	-0.9974	7.38E-02
K	3.02E-01	m/d	12	12	0.17225	-2.43E+00	8.77E-02	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.996	-2.04E+00	-0.9961	6.02E-02
x	2.00E+01	m	13	13	0.17225	-2.64E+00	7.16E-02	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.994	-1.96E+00	-0.9945	4.91E-02
z	0.00E+00	m	14	14	0.17225	-2.84E+00	5.85E-02	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.992	-1.89E+00	-0.9925	4.00E-02
y	0.00E+00	m	15	15	0.17225	-3.04E+00	4.77E-02	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.99	-1.83E+00	-0.9902	3.26E-02
			16	16	0.17225	-3.25E+00	3.90E-02	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.988	-1.77E+00	-0.9876	2.65E-02
ax	2.00E+00	m	17	17	0.17225	-3.45E+00	3.18E-02	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.985	-1.71E+00	-0.9847	2.16E-02
az	2.00E-01	m	18	18	0.17225	-3.65E+00	2.60E-02	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.982	-1.67E+00	-0.9816	1.76E-02
ay	2.00E-02	m	19	19	0.17225	-3.85E+00	2.12E-02	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.978	-1.62E+00	-0.9782	1.43E-02
			20	20	0.17225	-4.06E+00	1.73E-02	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.975	-1.58E+00	-0.9747	1.16E-02

Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc

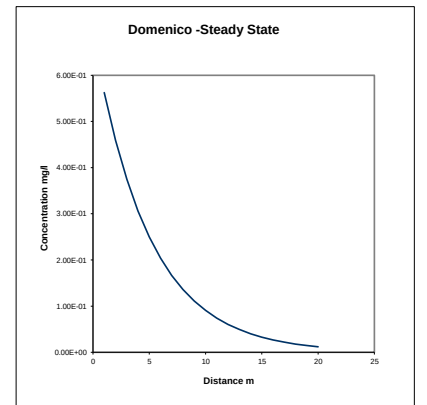
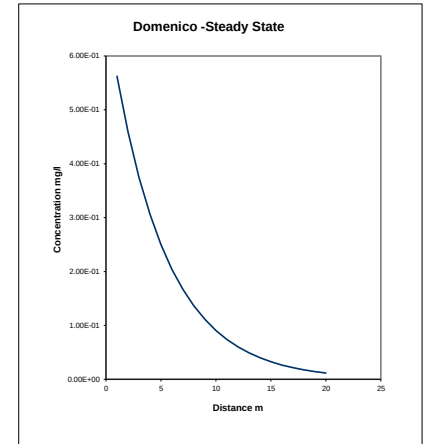
Value

DOMENICO (STEADY STATE)

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

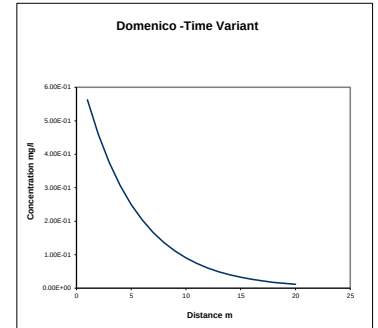
				X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
v Rc u	1.39E-03	m/d														
	9.73E+05															
	1.43E-09	m/d	1	1	0.17225	-2.03E-01	8.16E-01	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	5.63E-01
			2	2	0.17225	-4.06E-01	6.67E-01	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	4.59E-01
			3	3	0.17225	-6.08E-01	5.44E-01	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	3.75E-01
			4	4	0.17225	-8.11E-01	4.44E-01	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	3.06E-01
			5	5	0.17225	-1.01E+00	3.63E-01	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	2.50E-01
			6	6	0.17225	-1.22E+00	2.96E-01	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	2.04E-01
			7	7	0.17225	-1.42E+00	2.42E-01	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	1.67E-01
			8	8	0.17225	-1.62E+00	1.97E-01	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	1.36E-01
			9	9	0.17225	-1.83E+00	1.61E-01	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	1.11E-01
			10	10	0.17225	-2.03E+00	1.32E-01	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	9.07E-02
			11	11	0.17225	-2.23E+00	1.07E-01	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	7.40E-02
			12	12	0.17225	-2.43E+00	8.77E-02	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	6.04E-02
			13	13	0.17225	-2.64E+00	7.16E-02	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	4.93E-02
			14	14	0.17225	-2.84E+00	5.85E-02	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	4.03E-02
			15	15	0.17225	-3.04E+00	4.77E-02	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	3.29E-02
			16	16	0.17225	-3.25E+00	3.90E-02	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	2.68E-02
			17	17	0.17225	-3.45E+00	3.18E-02	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	2.19E-02
			18	18	0.17225	-3.65E+00	2.60E-02	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	1.79E-02
		19	19	0.17225	-3.85E+00	2.12E-02	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	1.46E-02	
		20	20	0.17225	-4.06E+00	1.73E-02	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	1.19E-02	
	21/06/2018															
n:	1.1															

Date: 21/06/2018
Version: 1.1



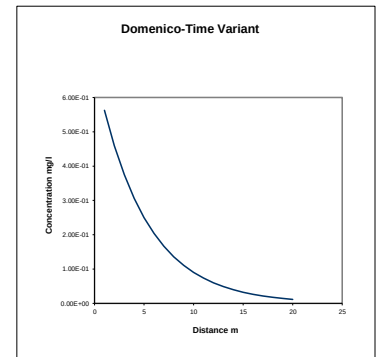
DOMENICO (TIME VARIANT)

Contaminant	12-C16 aliphatic		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	0.3	mg/l	1	1	0.08613	-2.03E-01	8.16E-01	-2.41E+45	2	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	5.63E-01
			2	2	0.08613	-4.06E-01	6.67E-01	-2.41E+45	2	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	4.59E-01
			3	3	0.08613	-6.08E-01	5.44E-01	-2.41E+45	2	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	3.75E-01
Co	6.89E-01	mg/l	4	4	0.08613	-8.11E-01	4.44E-01	-2.41E+45	2	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	3.06E-01
λ	4.07E-10	days ⁻¹	5	5	0.08613	-1.01E+00	3.63E-01	-2.41E+45	2	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	2.50E-01
Sz	6.00E+01	m	6	6	0.08613	-1.22E+00	2.96E-01	-2.41E+45	2	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	2.04E-01
Sy	4.00E+00	m	7	7	0.08613	-1.42E+00	2.42E-01	-2.41E+45	2	1.27E+01	1	-1.27E+01	-1	2.67E+00	0.9998	-2.67E+00	-1	1.67E-01
Kd	2.25E+05	l/kg	8	8	0.08613	-1.62E+00	1.97E-01	-2.41E+45	2	1.19E+01	1	-1.19E+01	-1	2.50E+00	0.9996	-2.50E+00	-1	1.36E-01
ρ	1.60E+00	g/cm3	9	9	0.08613	-1.83E+00	1.61E-01	-2.41E+45	2	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.9991	-2.36E+00	-0.999	1.11E-01
n	3.70E-01		10	10	0.08613	-2.03E+00	1.32E-01	-2.41E+45	2	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.9984	-2.24E+00	-0.998	9.05E-02
i	1.70E-03		11	11	0.08613	-2.23E+00	1.07E-01	-2.41E+45	2	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.9974	-2.13E+00	-0.997	7.38E-02
K	3.02E-01	m/d	12	12	0.08613	-2.43E+00	8.77E-02	-2.41E+45	2	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.9961	-2.04E+00	-0.996	6.02E-02
x	2.00E+01	m	13	13	0.08613	-2.64E+00	7.16E-02	-2.41E+45	2	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.9945	-1.96E+00	-0.994	4.91E-02
z	0.00E+00	m	14	14	0.08613	-2.84E+00	5.85E-02	-2.41E+45	2	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.9925	-1.89E+00	-0.992	4.00E-02
y	0.00E+00	m	15	15	0.08613	-3.04E+00	4.77E-02	-2.41E+45	2	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.9902	-1.83E+00	-0.99	3.26E-02
t	9.90E+99	days	16	16	0.08613	-3.25E+00	3.90E-02	-2.41E+45	2	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.9876	-1.77E+00	-0.988	2.65E-02
ax	2.00E+00	m	17	17	0.08613	-3.45E+00	3.18E-02	-2.41E+45	2	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.9847	-1.71E+00	-0.985	2.16E-02
az	2.00E-01	m	18	18	0.08613	-3.65E+00	2.60E-02	-2.41E+45	2	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.9816	-1.67E+00	-0.982	1.76E-02
ay	2.00E-02	m	19	19	0.08613	-3.85E+00	2.12E-02	-2.41E+45	2	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.9782	-1.62E+00	-0.978	1.43E-02
			20	20	0.08613	-4.06E+00	1.73E-02	-2.41E+45	2	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.9747	-1.58E+00	-0.975	1.16E-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	1.39E-03	m/d																
Rc	9.73E+05		1	1	0.08613	-2.03E-01	8.16E-01	-2.41E+45	2	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	5.63E-01
u	1.43E-09	m/d	2	2	0.08613	-4.06E-01	6.67E-01	-2.41E+45	2	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	4.59E-01
			3	3	0.08613	-6.08E-01	5.44E-01	-2.41E+45	2	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	3.75E-01
			4	4	0.08613	-8.11E-01	4.44E-01	-2.41E+45	2	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	3.06E-01
			5	5	0.08613	-1.01E+00	3.63E-01	-2.41E+45	2	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	2.50E-01
			6	6	0.08613	-1.22E+00	2.96E-01	-2.41E+45	2	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	2.04E-01
			7	7	0.08613	-1.42E+00	2.42E-01	-2.41E+45	2	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	1.67E-01
			8	8	0.08613	-1.62E+00	1.97E-01	-2.41E+45	2	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	1.36E-01
			9	9	0.08613	-1.83E+00	1.61E-01	-2.41E+45	2	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	1.11E-01
			10	10	0.08613	-2.03E+00	1.32E-01	-2.41E+45	2	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	9.07E-02
			11	11	0.08613	-2.23E+00	1.07E-01	-2.41E+45	2	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	7.40E-02
			12	12	0.08613	-2.43E+00	8.77E-02	-2.41E+45	2	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	6.04E-02
			13	13	0.08613	-2.64E+00	7.16E-02	-2.41E+45	2	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	4.93E-02
			14	14	0.08613	-2.84E+00	5.85E-02	-2.41E+45	2	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	4.03E-02
			15	15	0.08613	-3.04E+00	4.77E-02	-2.41E+45	2	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	3.29E-02
			16	16	0.08613	-3.25E+00	3.90E-02	-2.41E+45	2	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	2.68E-02
			17	17	0.08613	-3.45E+00	3.18E-02	-2.41E+45	2	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	2.19E-02
			18	18	0.08613	-3.65E+00	2.60E-02	-2.41E+45	2	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	1.79E-02
			19	19	0.08613	-3.85E+00	2.12E-02	-2.41E+45	2	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	1.46E-02
			20	20	0.08613	-4.06E+00	1.73E-02	-2.41E+45	2	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	1.19E-02
	21/06/2018																	
	1.1																	



Date: 21/06/2018
Version: 1.1



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:	Portsman Way		
Site Address:	Reading		
Completed by:	PDM	Version:	1.1
Date:	21-Jun-18		
Contaminant	C21-C35 aliphatic		
Target Concentration (C_T)	3.00E-01	mg/l	Origin of C_T: WHO

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

Calculate for non-polar organic chemicals

Contaminant
Target concentration

C_T

C21-C35 aliphatic
0.3 mg/l

Input Parameters Standard entry

Variable

Value

Unit

Source of parameter value

Water filled soil porosity

θ_w

2.40E-01

fraction

calculated

Air filled soil porosity

θ_a

1.84E-01

fraction

calculated

Bulk density of soil zone material

ρ

1.60E+00

g/cm³

R & D Technical report sand fill

Henry's Law constant

H

4.90E+03

dimensionless

Total Petroleum Hydrocarbon Criteria Working Group

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 soil)

f_{oc}

4.50E-02

fraction

site data

Organic carbon partition coefficient

K_{oc}

6.31E+08

l/kg

Total Petroleum Hydrocarbon Criteria Working Group

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

2.84E+07

l/kg

Calculated value

Level 1 Remedial Target

Level 1 Remedial Target

8.52E+06

mg/kg

(for comparison with soil analyses)

or

0.3

mg/l

(for comparison with leachate test results)

Site being assessed: Portsman Way

Completed by: PDM

Date: 21-Jun-18

Version: 1.1

Remedial Targets Worksheet , Release 3.2



Level 2 - Soil

Contaminant
Target concentration

C_T

C21-C35 aliphatic
0.3

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
Area of contaminant source

Inf
A

4.40E-04
1.50E+02

m/d
m²

96-2000 30% pf values River Thames at Reading 70%
Area of boiler house and tank farm

Not used in calculation

Entry for groundwater flow below site

Length of contaminant source in direction of groundwater flow
Saturated aquifer thickness
Hydraulic Conductivity of aquifer in which dilution occurs
Hydraulic gradient of water table
Width of contaminant source perpendicular to groundwater flow
Background concentration of contaminant in groundwater beneath site

L
da
K
i
w
Cu

3.00E+01
8.00E+01
3.02E-01
1.70E-03
6.00E+01
0.00E+00

m
m
m/d
fraction
m
mg/l

Width of source area between PH2 and PH6
assumed vale to base of chalk
site data
Estimate
Length of source area between PH2 and PH6
Estimated

Not used in calculation

Define mixing zone depth by specifying or calculating depth (using pull down list)

Enter mixing zone thickness
Calculated mixing zone thickness

Mz
Mz

Calculate
2.51E+01

m
m

Calculated Parameters

Dilution Factor

DF

1.98E+00

Level 2 Remedial Target

5.94E-01
or
1.69E+07
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)

C_c

0.00E+00

mg/l

Calculated concentration within receptor (dilution only)

0.00E+00

mg/l

0

Site being assessed: Portsman Way
Completed by: PDM
Date: 21-Jun-18
Version: 1.1

Remedial Targets Worksheet , Release 3.2

Level 3 - Soil

See Note



Input Parameters	Variable	Value	Unit	Source
Contaminant		C21-C35 aliphatic		from Level 1
Target Concentration	C _t	0.3	mg/l	from Level 1
Dilution Factor	DF	1.98E+00		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 dissolved pollutants only

Variable	Value	Unit	Source of parameter value
Soil concentration as mg/kg			
Enter source concentration	827	mg/kg	
Enter soil concentration	1.75E+03	days	
Half life for degradation of contaminant in water	1.75E+03	days	Canada Wide Standards for PHC in Soils
Calculated decay rate	3.96E-04	days ⁻¹	calculated
Width of plume in aquifer at source	6.00E+01	m	from Level 2
Plume thickness in aquifer at source	2.51E+01	m	from Level 2
Bulk density of aquifer materials	1.60E+00	g/cm ³	R & D Technical Report P13
Effective porosity of aquifer	3.70E-01	fraction	Consim
Hydraulic gradient	3.44E-03	fraction	from Level 2 (adjusted)
Hydraulic conductivity of saturated aquifer	3.02E-01	m/d	from Level 2
Distance to compliance point	2.00E+00	m	Estimated Depth to water table
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	2.84E+07	l/kg see options
Longitudinal dispersivity	ax	0.200	m see options
Transverse dispersivity	az	0.020	m see options
Vertical dispersivity	av	0.002	m see options

Parameter values should be checked against Level 1 and 2

Calculated Parameters

Variable	Value	Unit
Groundwater flow velocity	2.81E-03	m/d
Retardation factor	1.23E+08	fraction
Decay rate used	3.23E-12	d ⁻¹
Hydraulic gradient used in aquifer flow down-gradient	3.44E-03	fraction
Rate of contaminant flow due to retardation	2.29E-11	m/d
Ratio of Compliance Point to Source Concentration	C ₁₀ /C ₀	fraction
Attenuation factor (C ₁₀ /C ₁₀₀)	AF	1.32E+00
Calculated soil leachate concentration	Co	2.91E-05

Remedial Targets

Level 3 Remedial Target	7.81E-01	mg/l	For comparison with measured pore water concentration.
Ogata Banks	2.22E+07	mg/kg	This assumes Level 1 Remedial Target is based on Target Concentration.
Distance to compliance point	2	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 ₁₀ /C ₀	7.60E-01	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 non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient Kd l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer f_{oc} 4.50E-02 fractionOrganic carbon partition coefficient K_{oc} 6.31E+08 l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species K_{oc,ri} l/kgSorption 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 2.84E+07 l/kg

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

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

Longitudinal dispersivity

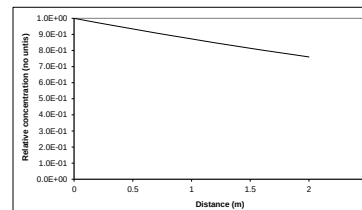
Transverse dispersivity

Vertical dispersivity

Note values of dispersivity must be > 0

Xu & Eckstein (1995) report ax = 0.83(log₁₀)^{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 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

Distance	Relative concentration	Concentration
	(No units)	mg/l
0	1.0E+00	1.47E-05
0.1	9.86E-01	1.45E-05
0.2	9.73E-01	1.43E-05
0.3	9.60E-01	1.41E-05
0.4	9.47E-01	1.39E-05
0.5	9.34E-01	1.37E-05
0.6	9.21E-01	1.36E-05
0.7	9.08E-01	1.34E-05
0.8	8.96E-01	1.32E-05
0.9	8.84E-01	1.30E-05
1.0	8.72E-01	1.28E-05
1.1	8.60E-01	1.27E-05
1.2	8.48E-01	1.25E-05
1.3	8.37E-01	1.23E-05
1.4	8.25E-01	1.21E-05
1.5	8.14E-01	1.20E-05
1.6	8.03E-01	1.18E-05
1.7	7.92E-01	1.17E-05
1.8	7.81E-01	1.15E-05
1.9	7.70E-01	1.13E-05
2.0	7.60E-01	1.12E-05

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:	Portemans Way
Completed by:	PDM
Date:	#####
Version:	1.1

Remedial Targets Worksheet , Release 3.2

Calculation of contaminant concentration in groundwater from a soil source

Only input required is Soil Contaminant Concentration

Input Parameters
Soil contaminant concentration C_0 2.00E-01 mg/kg

Level 1 Parameters

Water filled soil porosity	θ_w	2.40E-01	fraction
Air filled soil porosity	θ_a	1.84E-01	fraction
Bulk density	ρ	1.60E+00	g/cm ³
Henry's Law constant	H	4.90E+03	dimensionless
Soil water partition coefficient used in Level Assessment	Kd	2.84E+07	l/kg
Factor (partitioning between soil and water)		2.84E+07	dimensionless

Level 2 Parameters

Dilution Factor DF 1.98E+00

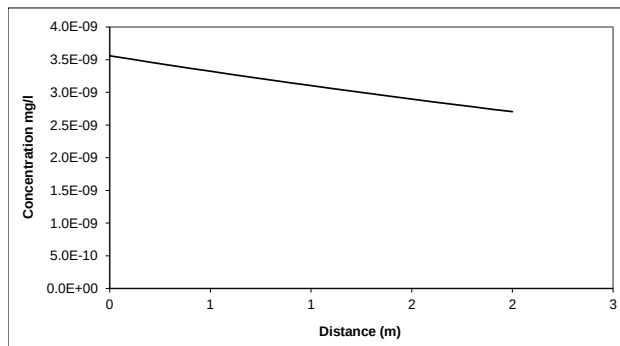
Level 3 Parameters

Attenuation factor (C_0/C_{ED}) AF 1.32E+00

Predicted concentrations at compliance point

Level 1	C	7.04E-09 mg/l	No dilution or attenuation
Level 2	C	3.56E-09 mg/l	Dilution taken into account
Level 3	C	2.70E-09 mg/l	Dilution and attenuation taken into account

Predicted concentrations between source and compliance point - Level 3



Distance m	Concentration mg/l
0.00	3.56E-09
0.10	3.51E-09
0.20	3.46E-09
0.30	3.42E-09
0.40	3.37E-09
0.50	3.32E-09
0.60	3.28E-09
0.70	3.23E-09
0.80	3.19E-09
0.90	3.15E-09
1.00	3.10E-09
1.10	3.06E-09
1.20	3.02E-09
1.30	2.98E-09
1.40	2.94E-09
1.50	2.90E-09
1.60	2.86E-09
1.70	2.82E-09
1.80	2.78E-09
1.90	2.74E-09
2.00	2.70E-09

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Contaminant	C21-C35 aliphatic		from Level 1
Target Concentration	C _T	3.00E-01	mg/l from Level 1

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

Ogata Banks	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	4.48E-02	mg/l	Site data
Half life for degradation of contaminant in water	t _{1/2}	1.75E+03	days	Canada Wide Standards for PHC in Soils
Calculated decay rate	λ	3.96E-04	days ⁻¹	
Width of plume in aquifer at source (perpendicular to flow)	Sz	6.00E+01	m	Estimated from site data
Plume thickness at source	Sy	4.00E+00	m	to top of chalk
Saturated aquifer thickness	da	8.00E+01	m	Estimated from site data
Bulk density of aquifer materials	p	1.80E+00	g/cm ³	consim
Effective porosity of aquifer	n	3.70E-01	fraction	Consim
Hydraulic gradient	i	1.70E-03	fraction	Estimate from site data
Hydraulic conductivity of aquifer	K	3.02E-01	m/d	Site data
Distance to compliance point	x	2.00E+01	m	Distance to site boundary
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	time variant options only

Parameters values determined from options

Partition coefficient	Kd	2.84E+07	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	1.39E-03	m/d
Retardation factor	Rf	1.23E+08	fraction
Decay rate used	λ	3.23E-12	d ⁻¹
Rate of contaminant flow due to retardation	u	1.13E-11	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C _{ED}	7.76E-04	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	AF	5.78E+01	

Remedial Targets

Remedial Target	1.73E+01	mg/l	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	20	m	
Concentration of contaminant at compliance point after	C _{ED} /C ₀	7.76E-04	mg/l
		9.9E+99	days

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)

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)

Soil water partition coefficient

Kd

l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer

foc

4.50E-02

fraction

Organic carbon partition coefficient

Koc

6.31E+08

l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species

K_{oc,ri}

l/kg

Sorption coefficient for ionised species

K_{oc,i}

l/kg

pH value

pH

l/kg

acid dissociation constant

pKa

l/kg

Fraction of organic carbon in aquifer

foc

fraction

Soil water partition coefficient

Kd

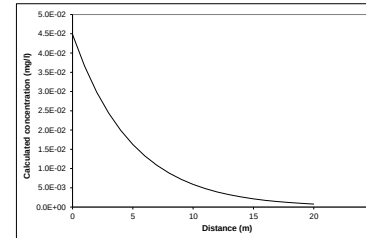
2.84E+07

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-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(log ₁₀ x) ^{-0.14} , 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:	Portsmouth Way
Completed by:	PDM
Date:	20/07/2018
Version:	1.1



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	15.00	% wt	(Change this number only if you have specific information)
Particle Density	2.78	tonnes/m ³	
Dry Bulk Density	1.60	tonnes/m ³	
Calculated Parameters			
Voids Ratio	0.74	fraction	
Initial Saturation	56.54	%	
Total porosity	0.424	fraction	
Air Filled Porosity	0.184	fraction	
Water Filled Porosity	0.240	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	1.000	fraction	#DIV/0!
Air Filled Porosity	#DIV/0!	fraction	
Water Filled Porosity	#DIV/0!	fraction	

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 C21-C35 aliphatic

Parameter (carried over from input sheet)	Value	Units	Calculations (Refer toTable 4.3, R&D Publication 20)																			
			Selected option		Calculate for non-polar organic chemicals																	
				calc	calc	Calc Kd l/kg																
C _T	3.00E-01	mg/l	Calculation of partition coefficient																			
Kd	2.84E+07	l/kg	for ionic organic chemical																			
foc	4.50E-02	fraction																				
koc	6.31E+08	l/kg	Partition coefficient used in Level 1 Assessment			2.84E+07 l/kg																
θ _w	2.40E-01	fraction																				
θ _a	1.84E-01	fraction																				
ρ	1.60E+00	g/cm3																				
H	4.90E+03	dimensionless	Factor (partitioning between soil and water)			2.84E+07																
Koc,n		l/kg																				
Koc,i		l/kg																				
pH		pH units																				
pKa																						
foc (ionic)		fraction																				
			<table><tr><td>Calculated Remedial Target</td><td>8.52E+06 mg/kg</td><td>for C21-C35 aliphatic</td></tr></table>				Calculated Remedial Target	8.52E+06 mg/kg	for C21-C35 aliphatic													
Calculated Remedial Target	8.52E+06 mg/kg	for C21-C35 aliphatic																				
			<table><tr><td>Site being assessed:</td><td colspan="3">Portsman Way</td></tr><tr><td>Completed by:</td><td colspan="3">PDM</td></tr><tr><td>Date:</td><td colspan="3">21/06/2018</td></tr><tr><td>Version:</td><td colspan="3">1.1</td></tr></table>				Site being assessed:	Portsman Way			Completed by:	PDM			Date:	21/06/2018			Version:	1.1		
Site being assessed:	Portsman Way																					
Completed by:	PDM																					
Date:	21/06/2018																					
Version:	1.1																					

Level 2 Calculation Sheet

Contaminant C21-C35 aliphatic

Site assessed:	Portsman Wa
Date:	21/06/2018
Version:	1.1

Parameter Value Units
(carried over from input sheet)

Mz	2.51E+01	m
L	3.00E+01	m
da	8.00E+01	m
Inf	4.40E-04	m/d
K	3.02E-01	m/d
i	1.70E-03	m3/d
A	1.50E+02	m2
Cc	0.00E+00	mg/l
C _T	3.00E-01	mg/l
Cu	0.00E+00	mg/l
w	6.00E+01	m

Calculation based on target concentration

Calculation based on observed contaminant concentration

Calculated
Dilution Factor

1.98E+00

#DIV/0!

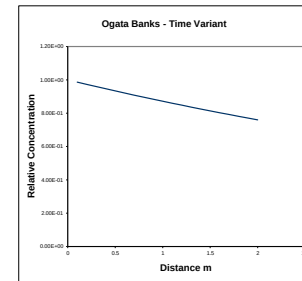


Contaminant :21-C35 aliphatic

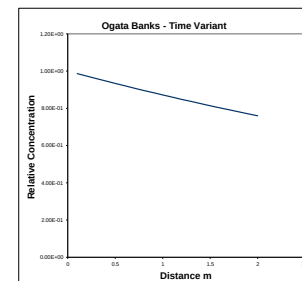
OGATA BANKS SOLUTION

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	Relative Concentration
C _T	3.000E-01	mg/l	1	0.1	0.13	-1.37E-02	9.86E-01	-1.78E+44	2	5.14E-01	1.67E+00	1.78E+44	0	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.86E-01
DF	1.979E+00		2	0.2	0.13	-2.75E-02	9.73E-01	-1.78E+44	2	1.03E+00	2.79E+00	1.78E+44	0	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	9.73E-01
			3	0.3	0.13	-4.12E-02	9.60E-01	-1.78E+44	2	1.54E+00	4.67E+00	1.78E+44	0	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	9.60E-01
			4	0.4	0.13	-5.49E-02	9.47E-01	-1.78E+44	2	2.05E+00	7.81E+00	1.78E+44	0	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	9.47E-01
λ	3.226E-12	days ⁻¹	5	0.5	0.13	-6.86E-02	9.34E-01	-1.78E+44	2	2.57E+00	1.30E+01	1.78E+44	0	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	9.34E-01
Sz	6.000E+01	m	6	0.6	0.13	-8.24E-02	9.21E-01	-1.78E+44	2	3.08E+00	2.18E+01	1.78E+44	0	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	9.21E-01
Sy	2.514E+01	m	7	0.7	0.13	-9.61E-02	9.08E-01	-1.78E+44	2	3.60E+00	3.65E+01	1.78E+44	0	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	9.08E-01
Kd	2.840E+07	l/kg	8	0.8	0.13	-1.10E-01	8.96E-01	-1.78E+44	2	4.11E+00	6.09E+01	1.78E+44	0	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	8.96E-01
ρ	1.600E+00	g/cm ³	9	0.9	0.13	-1.24E-01	8.84E-01	-1.78E+44	2	4.62E+00	1.02E+02	1.78E+44	0	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	8.84E-01
n	3.700E-01		10	1	0.13	-1.37E-01	8.72E-01	-1.78E+44	2	5.14E+00	1.70E+02	1.78E+44	0	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	8.72E-01
i	3.436E-03		11	1.1	0.13	-1.51E-01	8.60E-01	-1.78E+44	2	5.65E+00	2.85E+02	1.78E+44	0	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	8.60E-01
K	3.024E-01	m/d	12	1.2	0.13	-1.65E-01	8.48E-01	-1.78E+44	2	6.16E+00	4.76E+02	1.78E+44	0	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	8.48E-01
x	2.000E+00	m	13	1.3	0.13	-1.78E-01	8.37E-01	-1.78E+44	2	6.68E+00	7.95E+02	1.78E+44	0	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	8.37E-01
z	0.000E+00	m	14	1.4	0.13	-1.92E-01	8.25E-01	-1.78E+44	2	7.19E+00	1.32E+03	1.78E+44	0	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	8.25E-01
y	0.000E+00	m	15	1.5	0.13	-2.06E-01	8.14E-01	-1.78E+44	2	7.71E+00	2.22E+03	1.78E+44	0	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	8.14E-01
t	1.000E+99	days	16	1.6	0.13	-2.20E-01	8.03E-01	-1.78E+44	2	8.22E+00	3.71E+03	1.78E+44	0	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	8.03E-01
ax	2.000E-01	m	17	1.7	0.13	-2.33E-01	7.92E-01	-1.78E+44	2	8.73E+00	6.21E+03	1.78E+44	0	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	7.92E-01
az	2.000E-02	m	18	1.8	0.13	-2.47E-01	7.81E-01	-1.78E+44	2	9.25E+00	1.04E+04	1.78E+44	0	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	7.81E-01
ay	2.000E-03	m	19	1.9	0.13	-2.61E-01	7.70E-01	-1.78E+44	2	9.76E+00	1.73E+04	1.78E+44	0	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	7.70E-01
			20	2	0.13	-2.75E-01	7.60E-01	-1.78E+44	2	1.03E+01	2.90E+04	1.78E+44	0	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	7.60E-01

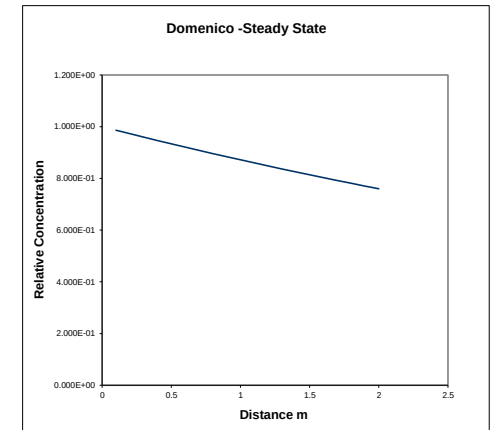


Calc	Value			X	Term 1	Term 2	EXP	Term 3	ERFC	Term 4	EXP	Term 5	ERFC	Term 6a	ERF	Term 6b	ERF	Term 7a	ERF	Term 7b	ERF	Relative Concentration
v	0.0028	m/d	1	0.1	0.13	-1.37E-02	9.86E-01	-1.78E+44	2	5.14E-01	1.67E+00	1.78E+44	0	3.35E+02	1	-3.35E+02	-1	8.89E+02	1	-8.89E+02	-1	9.86E-01
Rc	#####		2	0.2	0.13	-2.75E-02	9.73E-01	-1.78E+44	2	1.03E+00	2.79E+00	1.78E+44	0	2.37E+02	1	-2.37E+02	-1	6.28E+02	1	-6.28E+02	-1	9.73E-01
u	0.0000	m/d	3	0.3	0.13	-4.12E-02	9.60E-01	-1.78E+44	2	1.54E+00	4.67E+00	1.78E+44	0	1.94E+02	1	-1.94E+02	-1	5.13E+02	1	-5.13E+02	-1	9.60E-01
			4	0.4	0.13	-5.49E-02	9.47E-01	-1.78E+44	2	2.05E+00	7.81E+00	1.78E+44	0	1.68E+02	1	-1.68E+02	-1	4.44E+02	1	-4.44E+02	-1	9.47E-01
			5	0.5	0.13	-6.86E-02	9.34E-01	-1.78E+44	2	2.57E+00	1.30E+01	1.78E+44	0	1.50E+02	1	-1.50E+02	-1	3.97E+02	1	-3.97E+02	-1	9.34E-01
			6	0.6	0.13	-8.24E-02	9.21E-01	-1.78E+44	2	3.08E+00	2.18E+01	1.78E+44	0	1.37E+02	1	-1.37E+02	-1	3.63E+02	1	-3.63E+02	-1	9.21E-01
			7	0.7	0.13	-9.61E-02	9.08E-01	-1.78E+44	2	3.60E+00	3.65E+01	1.78E+44	0	1.27E+02	1	-1.27E+02	-1	3.36E+02	1	-3.36E+02	-1	9.08E-01
			8	0.8	0.13	-1.10E-01	8.96E-01	-1.78E+44	2	4.11E+00	6.09E+01	1.78E+44	0	1.19E+02	1	-1.19E+02	-1	3.14E+02	1	-3.14E+02	-1	8.96E-01
			9	0.9	0.13	-1.24E-01	8.84E-01	-1.78E+44	2	4.62E+00	1.02E+02	1.78E+44	0	1.12E+02	1	-1.12E+02	-1	2.96E+02	1	-2.96E+02	-1	8.84E-01
			10	1	0.13	-1.37E-01	8.72E-01	-1.78E+44	2	5.14E+00	1.70E+02	1.78E+44	0	1.06E+02	1	-1.06E+02	-1	2.81E+02	1	-2.81E+02	-1	8.72E-01
			11	1.1	0.13	-1.51E-01	8.60E-01	-1.78E+44	2	5.65E+00	2.85E+02	1.78E+44	0	1.01E+02	1	-1.01E+02	-1	2.68E+02	1	-2.68E+02	-1	8.60E-01
			12	1.2	0.13	-1.65E-01	8.48E-01	-1.78E+44	2	6.16E+00	4.76E+02	1.78E+44	0	9.68E+01	1	-9.68E+01	-1	2.57E+02	1	-2.57E+02	-1	8.48E-01
			13	1.3	0.13	-1.78E-01	8.37E-01	-1.78E+44	2	6.68E+00	7.95E+02	1.78E+44	0	9.30E+01	1	-9.30E+01	-1	2.47E+02	1	-2.47E+02	-1	8.37E-01
			14	1.4	0.13	-1.92E-01	8.25E-01	-1.78E+44	2	7.19E+00	1.33E+03	1.78E+44	0	8.96E+01	1	-8.96E+01	-1	2.38E+02	1	-2.38E+02	-1	8.25E-01
			15	1.5	0.13	-2.06E-01	8.14E-01	-1.78E+44	2	7.71E+00	2.22E+03	1.78E+44	0	8.66E+01	1	-8.66E+01	-1	2.29E+02	1	-2.29E+02	-1	8.14E-01
			16	1.6	0.13	-2.20E-01	8.03E-01	-1.78E+44	2	8.22E+00	3.71E+03	1.78E+44	0	8.39E+01	1	-8.39E+01	-1	2.22E+02	1	-2.22E+02	-1	8.03E-01
			17	1.7	0.13	-2.33E-01	7.92E-01	-1.78E+44	2	8.73E+00	6.21E+03	1.78E+44	0	8.13E+01	1	-8.13E+01	-1	2.16E+02	1	-2.16E+02	-1	7.92E-01
			18	1.8	0.13	-2.47E-01	7.81E-01	-1.78E+44	2	9.25E+00	1.04E+04	1.78E+44	0	7.91E+01	1	-7.91E+01	-1	2.09E+02	1	-2.09E+02	-1	7.81E-01
			19	1.9	0.13	-2.61E-01	7.70E-01	-1.78E+44	2	9.76E+00	1.73E+04	1.78E+44	0	7.69E+01	1	-7.69E+01	-1	2.04E+02	1	-2.04E+02	-1	7.70E-01
			20	2	0.13	-2.75E-01	7.60E-01	-1.78E+44	2	1.03E+01	2.90E+04	1.78E+44	0	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	7.60E-01

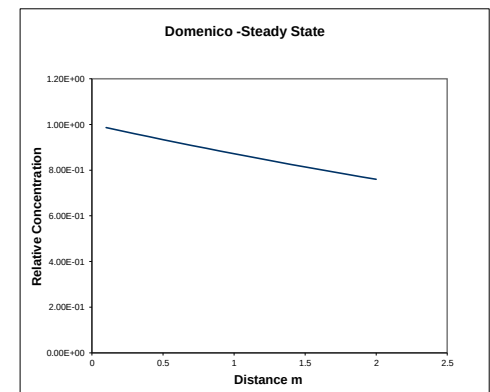


Date: 21/06/2018
Version: 1.1

Contaminant		21-C35 aliphatic		DOMENICO (STEADY STATE)														Relative Concentration
		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			
C _T	3.000E-01	mg/l	1	0.1	0.25	-1.37E-02	9.86E-01	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.864E-01		
DF	1.979E+00		2	0.2	0.25	-2.75E-02	9.73E-01	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	9.729E-01		
			3	0.3	0.25	-4.12E-02	9.60E-01	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	9.597E-01		
			4	0.4	0.25	-5.49E-02	9.47E-01	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	9.466E-01		
λ	3.226E-12	days ⁻¹	5	0.5	0.25	-6.86E-02	9.34E-01	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	9.337E-01		
Sz	6.000E+01	m	6	0.6	0.25	-8.24E-02	9.21E-01	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	9.209E-01		
Sy	2.514E+01	m	7	0.7	0.25	-9.61E-02	9.08E-01	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	9.084E-01		
Kd	2.840E+07	l/kg	8	0.8	0.25	-1.10E-01	8.96E-01	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	8.960E-01		
ρ	1.600E+00	g/cm3	9	0.9	0.25	-1.24E-01	8.84E-01	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	8.838E-01		
n	3.700E-01		10	1	0.25	-1.37E-01	8.72E-01	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	8.717E-01		
i	3.436E-03		11	1.1	0.25	-1.51E-01	8.60E-01	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	8.599E-01		
K	3.024E-01	m/d	12	1.2	0.25	-1.65E-01	8.48E-01	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	8.481E-01		
x	2.000E+00	m	13	1.3	0.25	-1.78E-01	8.37E-01	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	8.366E-01		
z	0.000E+00	m	14	1.4	0.25	-1.92E-01	8.25E-01	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	8.252E-01		
y	0.000E+00	m	15	1.5	0.25	-2.06E-01	8.14E-01	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	8.139E-01		
ax	2.000E-01	m	16	1.6	0.25	-2.20E-01	8.03E-01	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	8.028E-01		
az	2.000E-02	m	17	1.7	0.25	-2.33E-01	7.92E-01	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	7.919E-01		
ay	2.000E-03	m	18	1.8	0.25	-2.47E-01	7.81E-01	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	7.811E-01		
			19	1.9	0.25	-2.61E-01	7.70E-01	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	7.704E-01		
			20	2	0.25	-2.75E-01	7.60E-01	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	7.599E-01		



Calc	Value	DOMENICO (STEADY STATE)																	
Calculations for source located at top of aquifer (ie vertical dispersion in one direction) - USED FOR LEVEL ASSESSMENT																			
v	2.81E-03	m/d	X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Relative Concentration	Relative Concentration			
Rc	1.23E+08	u	2.29E-11	m/d	1	0.1	0.25	-1.37E-02	9.86E-01	3.35E+02	1	-3.35E+02	-1	8.89E+02	1		-8.89E+02	-1	9.86E-01
					2	0.2	0.25	-2.75E-02	9.73E-01	2.37E+02	1	-2.37E+02	-1	6.28E+02	1		-6.28E+02	-1	9.73E-01
					3	0.3	0.25	-4.12E-02	9.60E-01	1.94E+02	1	-1.94E+02	-1	5.13E+02	1		-5.13E+02	-1	9.60E-01
					4	0.4	0.25	-5.49E-02	9.47E-01	1.68E+02	1	-1.68E+02	-1	4.44E+02	1		-4.44E+02	-1	9.47E-01
					5	0.5	0.25	-6.86E-02	9.34E-01	1.50E+02	1	-1.50E+02	-1	3.97E+02	1		-3.97E+02	-1	9.34E-01
					6	0.6	0.25	-8.24E-02	9.21E-01	1.37E+02	1	-1.37E+02	-1	3.63E+02	1		-3.63E+02	-1	9.21E-01
					7	0.7	0.25	-9.61E-02	9.08E-01	1.27E+02	1	-1.27E+02	-1	3.36E+02	1		-3.36E+02	-1	9.08E-01
					8	0.8	0.25	-1.10E-01	8.96E-01	1.19E+02	1	-1.19E+02	-1	3.14E+02	1		-3.14E+02	-1	8.96E-01
					9	0.9	0.25	-1.24E-01	8.84E-01	1.12E+02	1	-1.12E+02	-1	2.96E+02	1		-2.96E+02	-1	8.84E-01
					10	1	0.25	-1.37E-01	8.72E-01	1.06E+02	1	-1.06E+02	-1	2.81E+02	1		-2.81E+02	-1	8.72E-01
					11	1.1	0.25	-1.51E-01	8.60E-01	1.01E+02	1	-1.01E+02	-1	2.68E+02	1		-2.68E+02	-1	8.60E-01
					12	1.2	0.25	-1.65E-01	8.48E-01	9.68E+01	1	-9.68E+01	-1	2.57E+02	1		-2.57E+02	-1	8.48E-01
					13	1.3	0.25	-1.78E-01	8.37E-01	9.30E+01	1	-9.30E+01	-1	2.47E+02	1		-2.47E+02	-1	8.37E-01
					14	1.4	0.25	-1.92E-01	8.25E-01	8.96E+01	1	-8.96E+01	-1	2.38E+02	1		-2.38E+02	-1	8.25E-01
					15	1.5	0.25	-2.06E-01	8.14E-01	8.66E+01	1	-8.66E+01	-1	2.29E+02	1		-2.29E+02	-1	8.14E-01
					16	1.6	0.25	-2.20E-01	8.03E-01	8.39E+01	1	-8.39E+01	-1	2.22E+02	1		-2.22E+02	-1	8.03E-01
					17	1.7	0.25	-2.33E-01	7.92E-01	8.13E+01	1	-8.13E+01	-1	2.16E+02	1		-2.16E+02	-1	7.92E-01
					18	1.8	0.25	-2.47E-01	7.81E-01	7.91E+01	1	-7.91E+01	-1	2.09E+02	1		-2.09E+02	-1	7.81E-01
					19	1.9	0.25	-2.61E-01	7.70E-01	7.69E+01	1	-7.69E+01	-1	2.04E+02	1		-2.04E+02	-1	7.70E-01
n:	21/06/2018				20	2	0.25	-2.75E-01	7.60E-01	7.50E+01	1	-7.50E+01	-1	1.99E+02	1	-1.99E+02	-1	7.60E-01	
	1.1																		



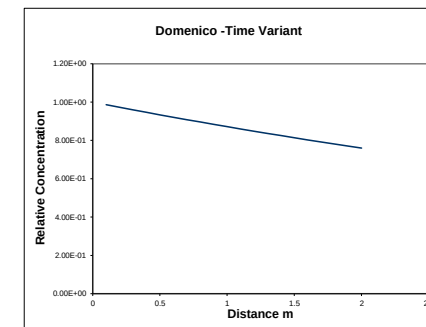
Date: 21/06/2018
Version: 1.1

DOMENICO (TIME VARIANT)

Contaminant 21-C35 aliphatic

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	0.3	mg/l	1	0.1	0.125	-1.37E-02	9.86E-01	-1.78E+44	2	3.35E+02	1	-3.35E+02	-1	4.44E+02	1	-4.44E+02	-1	9.86E-01
DF	1.9790		2	0.2	0.125	-2.75E-02	9.73E-01	-1.78E+44	2	2.37E+02	1	-2.37E+02	-1	3.14E+02	1	-3.14E+02	-1	9.73E-01
			3	0.3	0.125	-4.12E-02	9.60E-01	-1.78E+44	2	1.94E+02	1	-1.94E+02	-1	2.57E+02	1	-2.57E+02	-1	9.60E-01
			4	0.4	0.125	-5.49E-02	9.47E-01	-1.78E+44	2	1.68E+02	1	-1.68E+02	-1	2.22E+02	1	-2.22E+02	-1	9.47E-01
λ	3.226E-12	days ⁻¹	5	0.5	0.125	-6.86E-02	9.34E-01	-1.78E+44	2	1.50E+02	1	-1.50E+02	-1	1.99E+02	1	-1.99E+02	-1	9.34E-01
Sz	6.000E+01		6	0.6	0.125	-8.24E-02	9.21E-01	-1.78E+44	2	1.37E+02	1	-1.37E+02	-1	1.81E+02	1	-1.81E+02	-1	9.21E-01
Sy	2.514E+01	m	7	0.7	0.125	-9.61E-02	9.08E-01	-1.78E+44	2	1.27E+02	1	-1.27E+02	-1	1.68E+02	1	-1.68E+02	-1	9.08E-01
Kd	2.840E+07	l/kg	8	0.8	0.125	-1.10E-01	8.96E-01	-1.78E+44	2	1.19E+02	1	-1.19E+02	-1	1.57E+02	1	-1.57E+02	-1	8.96E-01
ρ	1.600E+00	g/cm3	9	0.9	0.125	-1.24E-01	8.84E-01	-1.78E+44	2	1.12E+02	1	-1.12E+02	-1	1.48E+02	1	-1.48E+02	-1	8.84E-01
n	3.700E-01		10	1	0.125	-1.37E-01	8.72E-01	-1.78E+44	2	1.06E+02	1	-1.06E+02	-1	1.41E+02	1	-1.41E+02	-1	8.72E-01
i	3.436E-03		11	1.1	0.125	-1.51E-01	8.60E-01	-1.78E+44	2	1.01E+02	1	-1.01E+02	-1	1.34E+02	1	-1.34E+02	-1	8.60E-01
K	3.024E-01	m/d	12	1.2	0.125	-1.65E-01	8.48E-01	-1.78E+44	2	9.68E+01	1	-9.68E+01	-1	1.28E+02	1	-1.28E+02	-1	8.48E-01
x	2.000E+00		13	1.3	0.125	-1.78E-01	8.37E-01	-1.78E+44	2	9.30E+01	1	-9.30E+01	-1	1.23E+02	1	-1.23E+02	-1	8.37E-01
z	0.000E+00	m	14	1.4	0.125	-1.92E-01	8.25E-01	-1.78E+44	2	8.96E+01	1	-8.96E+01	-1	1.19E+02	1	-1.19E+02	-1	8.25E-01
y	0.000E+00	m	15	1.5	0.125	-2.06E-01	8.14E-01	-1.78E+44	2	8.66E+01	1	-8.66E+01	-1	1.15E+02	1	-1.15E+02	-1	8.14E-01
t	1.000E+99		16	1.6	0.125	-2.20E-01	8.03E-01	-1.78E+44	2	8.39E+01	1	-8.39E+01	-1	1.11E+02	1	-1.11E+02	-1	8.03E-01
ax	2.000E-01	days	17	1.7	0.125	-2.33E-01	7.92E-01	-1.78E+44	2	8.13E+01	1	-8.13E+01	-1	1.08E+02	1	-1.08E+02	-1	7.92E-01
az	2.000E-02	m	18	1.8	0.125	-2.47E-01	7.81E-01	-1.78E+44	2	7.91E+01	1	-7.91E+01	-1	1.05E+02	1	-1.05E+02	-1	7.81E-01
ay	2.000E-03	m	19	1.9	0.125	-2.61E-01	7.70E-01	-1.78E+44	2	7.69E+01	1	-7.69E+01	-1	1.02E+02	1	-1.02E+02	-1	7.70E-01
			20	2	0.125	-2.75E-01	7.60E-01	-1.78E+44	2	7.50E+01	1	-7.50E+01	-1	9.94E+01	1	-9.94E+01	-1	7.60E-01

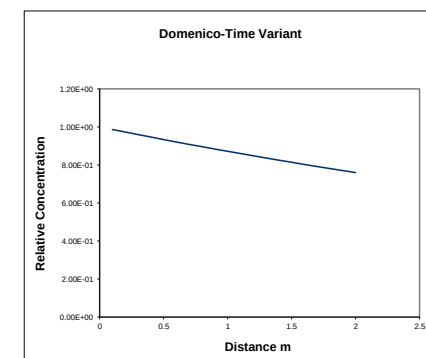


Calc

Value

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

				Calculated: 100													
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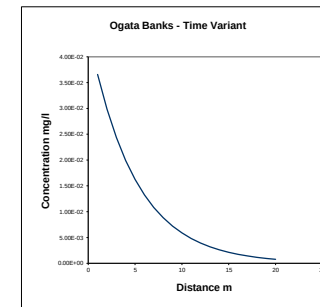
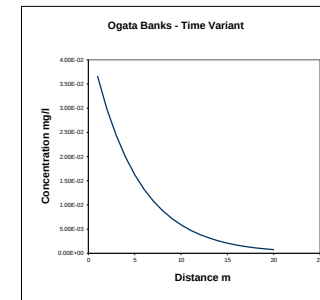
Date: 21/06/2018
Version: 1.1

Contaminant		221-C35 aliphatic		OGATA BANKS SOLUTION																		Concentration
				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	
Input	Value	Units																				
C _T	0.3	mg/l	1	1	0.0056	-2.0E-01	8.2E-01	-2.1E+44	2.000	7.0E-01	2.0E+00	2.1E+44	0.000	3.4E+01	1	-3.4E+01	-1	7.1E+00	1	-7.1E+00	-1	3.66E-02
			2	2	0.0056	-4.1E-01	6.7E-01	-2.1E+44	2.000	1.4E+00	4.1E+00	2.1E+44	0.000	2.4E+01	1	-2.4E+01	-1	5.0E+00	1	-5.0E+00	-1	2.99E-02
			3	3	0.0056	-6.1E-01	5.4E-01	-2.1E+44	2.000	2.1E+00	8.2E+00	2.1E+44	0.000	1.9E+01	1	-1.9E+01	-1	4.1E+00	1	-4.1E+00	-1	2.44E-02
			4	4	0.0056	-8.1E-01	4.4E-01	-2.1E+44	2.000	2.8E+00	1.7E+01	2.1E+44	0.000	1.7E+01	1	-1.7E+01	-1	3.5E+00	1	-3.5E+00	-1	1.99E-02
Co	4.48E-02	mg/l	4	4	0.0056	-8.1E-01	4.4E-01	-2.1E+44	2.000	2.8E+00	1.7E+01	2.1E+44	0.000	1.7E+01	1	-1.7E+01	-1	3.5E+00	1	-3.5E+00	-1	1.99E-02
λ	3.23E-12	days ⁻¹	5	5	0.0056	-1.0E+00	3.6E-01	-2.1E+44	2.000	3.5E+00	3.4E+01	2.1E+44	0.000	1.5E+01	1	-1.5E+01	-1	3.2E+00	1	-3.2E+00	-0.99999	1.63E-02
Sz	6.00E+01	m	6	6	0.0056	-1.2E+00	3.0E-01	-2.1E+44	2.000	4.2E+00	6.8E+01	2.1E+44	0.000	1.4E+01	1	-1.4E+01	-1	2.9E+00	1	-2.9E+00	-0.99996	1.33E-02
Sy	4.00E+00	m	7	7	0.0056	-1.4E+00	2.4E-01	-2.1E+44	2.000	4.9E+00	1.4E+02	2.1E+44	0.000	1.3E+01	1	-1.3E+01	-1	2.7E+00	0.9998	-2.7E+00	-0.99984	1.08E-02
Kd	2.84E+07	l/kg	8	8	0.0056	-1.6E+00	2.0E-01	-2.1E+44	2.000	5.6E+00	2.8E+02	2.1E+44	0.000	1.2E+01	1	-1.2E+01	-1	2.5E+00	0.9996	-2.5E+00	-0.99959	8.84E-03
ρ	1.60E+00	g/cm3	9	9	0.0056	-1.8E+00	1.6E-01	-2.1E+44	2.000	6.3E+00	5.6E+02	2.1E+44	0.000	1.1E+01	1	-1.1E+01	-1	2.4E+00	0.9991	-2.4E+00	-0.99914	7.21E-03
n	3.70E-01		10	10	0.0056	-2.0E+00	1.3E-01	-2.1E+44	2.000	7.0E+00	1.1E+03	2.1E+44	0.000	1.1E+01	1	-1.1E+01	-1	2.2E+00	0.9984	-2.2E+00	-0.99843	5.89E-03
i	1.70E-03		11	11	0.0056	-2.2E+00	1.1E-01	-2.1E+44	2.000	7.7E+00	2.3E+03	2.1E+44	0.000	1.0E+01	1	-1.0E+01	-1	2.1E+00	0.9974	-2.1E+00	-0.99743	4.80E-03
K	3.02E-01	m/d	12	12	0.0056	-2.4E+00	8.8E-02	-2.1E+44	2.000	8.4E+00	4.6E+03	2.1E+44	0.000	9.7E+00	1	-9.7E+00	-1	2.0E+00	0.9961	-2.0E+00	-0.99611	3.91E-03
x	2.00E+01	m	13	13	0.0056	-2.6E+00	7.2E-02	-2.1E+44	2.000	9.1E+00	9.3E+03	2.1E+44	0.000	9.3E+00	1	-9.3E+00	-1	2.0E+00	0.9945	-2.0E+00	-0.99445	3.19E-03
z	0.00E+00	m	14	14	0.0056	-2.8E+00	5.8E-02	-2.1E+44	2.000	9.8E+00	1.9E+04	2.1E+44	0.000	9.0E+00	1	-9.0E+00	-1	1.9E+00	0.9925	-1.9E+00	-0.99247	2.60E-03
y	0.00E+00	m	15	15	0.0056	-3.0E+00	4.8E-02	-2.1E+44	2.000	1.1E+01	3.8E+04	2.1E+44	0.000	8.7E+00	1	-8.7E+00	-1	1.8E+00	0.9902	-1.8E+00	-0.99018	2.12E-03
t	9.90E+99	days	16	16	0.0056	-3.2E+00	3.9E-02	-2.1E+44	2.000	1.1E+01	7.7E+04	2.1E+44	0.000	8.4E+00	1	-8.4E+00	-1	1.8E+00	0.9876	-1.8E+00	-0.98758	1.72E-03
ax	2.00E+00	m	17	17	0.0056	-3.4E+00	3.2E-02	-2.1E+44	2.000	1.2E+01	1.5E+05	2.1E+44	0.000	8.1E+00	1	-8.1E+00	-1	1.7E+00	0.9847	-1.7E+00	-0.98471	1.40E-03
az	2.00E-01	m	18	18	0.0056	-3.7E+00	2.6E-02	-2.1E+44	2.000	1.3E+01	3.1E+05	2.1E+44	0.000	7.9E+00	1	-7.9E+00	-1	1.7E+00	0.9816	-1.7E+00	-0.98158	1.14E-03
ay	2.00E-02	m	19	19	0.0056	-3.9E+00	2.1E-02	-2.1E+44	2.000	1.3E+01	6.3E+05	2.1E+44	0.000	7.7E+00	1	-7.7E+00	-1	1.6E+00	0.9782	-1.6E+00	-0.97822	9.29E-04
			20	20	0.0056	-4.1E+00	1.7E-02	-2.1E+44	2.000	1.4E+01	1.3E+06	2.1E+44	0.000	7.5E+00	1	-7.5E+00	-1	1.6E+00	0.9747	-1.6E+00	-0.97465	7.56E-04

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
				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	1.39E-03	m/d	1	1	0.0056	-2.0E-01	8.2E-01	-2.1E+44	2.000	7.0E-01	2.0E+00	2.1E+44	0.000	3.4E+01	1	-3.4E+01	-1	1.4E+01	1	-1.4E+01	-1	3.66E-02
Rc	1.23E+08		2	2	0.0056	-4.1E-01	6.7E-01	-2.1E+44	2.000	1.4E+00	4.1E+00	2.1E+44	0.000	2.4E+01	1	-2.4E+01	-1	1.0E+01	1	-1.0E+01	-1	2.99E-02
u	1.13E-11	m/d	3	3	0.0056	-6.1E-01	5.4E-01	-2.1E+44	2.000	2.1E+00	8.2E+00	2.1E+44	0.000	1.9E+01	1	-1.9E+01	-1	8.2E+00	1	-8.2E+00	-1	2.44E-02
			4	4	0.0056	-8.1E-01	4.4E-01	-2.1E+44	2.000	2.8E+00	1.7E+01	2.1E+44	0.000	1.7E+01	1	-1.7E+01	-1	7.1E+00	1	-7.1E+00	-1	1.99E-02
			5	5	0.0056	-1.0E+00	3.6E-01	-2.1E+44	2.000	3.5E+00	3.4E+01	2.1E+44	0.000	1.5E+01	1	-1.5E+01	-1	6.3E+00	1	-6.3E+00	-1	1.63E-02
			6	6	0.0056	-1.2E+00	3.0E-01	-2.1E+44	2.000	4.2E+00	6.8E+01	2.1E+44	0.000	1.4E+01	1	-1.4E+01	-1	5.8E+00	1	-5.8E+00	-1	1.33E-02
			7	7	0.0056	-1.4E+00	2.4E-01	-2.1E+44	2.000	4.9E+00	1.4E+02	2.1E+44	0.000	1.3E+01	1	-1.3E+01	-1	5.3E+00	1	-5.3E+00	-1	1.08E-02
			8	8	0.0056	-1.6E+00	2.0E-01	-2.1E+44	2.000	5.6E+00	2.8E+02	2.1E+44	0.000	1.2E+01	1	-1.2E+01	-1	5.0E+00	1	-5.0E+00	-1	8.84E-03
			9	9	0.0056	-1.8E+00	1.6E-01	-2.1E+44	2.000	6.3E+00	5.6E+02	2.1E+44	0.000	1.1E+01	1	-1.1E+01	-1	4.7E+00	1	-4.7E+00	-1	7.22E-03
			10	10	0.0056	-2.0E+00	1.3E-01	-2.1E+44	2.000	7.0E+00	1.1E+03	2.1E+44	0.000	1.1E+01	1	-1.1E+01	-1	4.5E+00	1	-4.5E+00	-1	5.89E-03
			11	11	0.0056	-2.2E+00	1.1E-01	-2.1E+44	2.000	7.7E+00	2.3E+03	2.1E+44	0.000	1.0E+01	1	-1.0E+01	-1	4.3E+00	1	-4.3E+00	-1	4.81E-03
			12	12	0.0056	-2.4E+00	8.8E-02	-2.1E+44	2.000	8.4E+00	4.6E+03	2.1E+44	0.000	9.7E+00	1	-9.7E+00	-1	4.1E+00	1	-4.1E+00	-1	3.93E-03
			13	13	0.0056	-2.6E+00	7.2E-02	-2.1E+44	2.000	9.1E+00	9.3E+03	2.1E+44	0.000	9.3E+00	1	-9.3E+00	-1	3.9E+00	1	-3.9E+00	-1	3.21E-03
			14	14	0.0056	-2.8E+00	5.8E-02	-2.1E+44	2.000	9.8E+00	1.9E+04	2.1E+44	0.000	9.0E+00	1	-9.0E+00	-1	3.8E+00	1	-3.8E+00	-1	2.62E-03
			15	15	0.0056	-3.0E+00	4.8E-02	-2.1E+44	2.000	1.1E+01	3.8E+04	2.1E+44	0.000	8.7E+00	1	-8.7E+00	-1	3.7E+00	1	-3.7E+00	-1	2.14E-03
			16	16	0.0056	-3.2E+00	3.9E-02	-2.1E+44	2.000	1.1E+01	7.7E+04	2.1E+44	0.000	8.4E+00	1	-8.4E+00	-1	3.5E+00	1	-3.5E+00	-1	1.75E-03
			17	17	0.0056	-3.4E+00	3.2E-02	-2.1E+44	2.000	1.2E+01	1.5E+05	2.1E+44	0.000	8.1E+00	1	-8.1E+00	-1	3.4E+00	1	-3.4E+00	-1	1.43E-03
			18	18	0.0056	-3.7E+00	2.6E-02	-2.1E+44	2.000	1.3E+01	3.1E+05	2.1E+44	0.000	7.9E+00	1	-7.9E+00	-1	3.3E+00	1	-3.3E+00	-1	1.16E-03
			19	19	0.0056	-3.9E+00	2.1E-02	-2.1E+44	2.000	1.3E+01	6.3E+05	2.1E+44	0.000	7.7E+00	1	-7.7E+00	-1	3.2E+00	1	-3.2E+00	-1	9.50E-04
			20	20	0.0056	-4.1E+00	1.7E-02	-2.1E+44	2.000	1.4E+01	1.3E+06	2.1E+44	0.000	7.5E+00	1	-7.5E+00	-1	3.2E+00	1	-3.2E+00	-0.99999	7.76E-04
Date:	21/06/2018																					
Version:	1.1																					

Date: 21/06/2018
Version: 1.1



Contaminant 21-C35 aliphatic

DOMENICO (STEADY STATE)

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	Concentration	
Input	Value	Units														
C _T	0.3	mg/l	1	1	0.0112	-2.03E-01	8.16E-01	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	3.66E-02
			2	2	0.0112	-4.06E-01	6.67E-01	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	2.99E-02
			3	3	0.0112	-6.08E-01	5.44E-01	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	2.44E-02
Co	4.48E-02	mg/l	4	4	0.0112	-8.11E-01	4.44E-01	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	1.99E-02
λ	3.23E-12	days ⁻¹	5	5	0.0112	-1.01E+00	3.63E-01	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	1.63E-02
Sz	6.00E+01	m	6	6	0.0112	-1.22E+00	2.96E-01	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	1.33E-02
Sy	4.00E+00	m	7	7	0.0112	-1.42E+00	2.42E-01	1.27E+01	1	-1.27E+01	-1	2.67E+00	1	-2.67E+00	-0.9998	1.08E-02
Kd	2.84E+07	l/kg	8	8	0.0112	-1.62E+00	1.97E-01	1.19E+01	1	-1.19E+01	-1	2.50E+00	1	-2.50E+00	-0.9996	8.84E-03
ρ	1.60E+00	g/cm3	9	9	0.0112	-1.83E+00	1.61E-01	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.999	-2.36E+00	-0.9991	7.21E-03
n	3.70E-01		10	10	0.0112	-2.03E+00	1.32E-01	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.998	-2.24E+00	-0.9984	5.89E-03
i	1.70E-03		11	11	0.0112	-2.23E+00	1.07E-01	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.997	-2.13E+00	-0.9974	4.80E-03
K	3.02E-01	m/d	12	12	0.0112	-2.43E+00	8.77E-02	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.996	-2.04E+00	-0.9961	3.91E-03
x	2.00E+01	m	13	13	0.0112	-2.64E+00	7.16E-02	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.994	-1.96E+00	-0.9945	3.19E-03
z	0.00E+00	m	14	14	0.0112	-2.84E+00	5.85E-02	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.992	-1.89E+00	-0.9925	2.60E-03
y	0.00E+00	m	15	15	0.0112	-3.04E+00	4.77E-02	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.99	-1.83E+00	-0.9902	2.12E-03
			16	16	0.0112	-3.25E+00	3.90E-02	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.988	-1.77E+00	-0.9876	1.72E-03
ax	2.00E+00	m	17	17	0.0112	-3.45E+00	3.18E-02	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.985	-1.71E+00	-0.9847	1.40E-03
az	2.00E-01	m	18	18	0.0112	-3.65E+00	2.60E-02	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.982	-1.67E+00	-0.9816	1.14E-03
ay	2.00E-02	m	19	19	0.0112	-3.85E+00	2.12E-02	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.978	-1.62E+00	-0.9782	9.29E-04
			20	20	0.0112	-4.06E+00	1.73E-02	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.975	-1.58E+00	-0.9747	7.56E-04

Vertical dispersion optio Simulate vertical dispersion in 1 direction

Calc

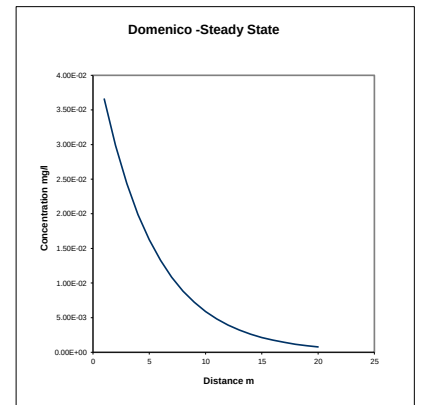
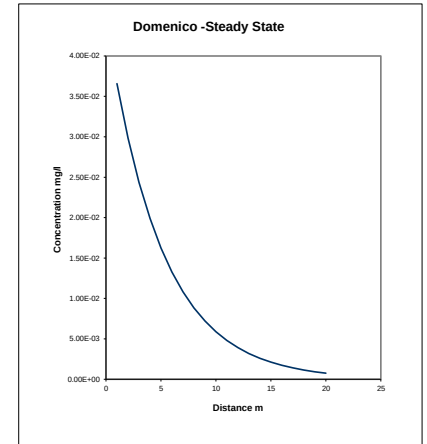
Value

DOMENICO (STEADY STATE)

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

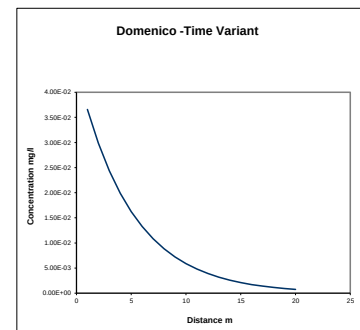
				X	Term 1	Term 2	EXP	Term 3A	ERF	Term 3B	ERF	Term 4A	ERF	Term 4B	ERF	Concentration
v Rc u	1.39E-03	m/d														
	1.23E+08															
	1.13E-11	m/d	1	1	0.0112	-2.03E-01	8.16E-01	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	3.66E-02
			2	2	0.0112	-4.06E-01	6.67E-01	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	2.99E-02
			3	3	0.0112	-6.08E-01	5.44E-01	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	2.44E-02
			4	4	0.0112	-8.11E-01	4.44E-01	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	1.99E-02
			5	5	0.0112	-1.01E+00	3.63E-01	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	1.63E-02
			6	6	0.0112	-1.22E+00	2.96E-01	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	1.33E-02
			7	7	0.0112	-1.42E+00	2.42E-01	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	1.08E-02
			8	8	0.0112	-1.62E+00	1.97E-01	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	8.84E-03
			9	9	0.0112	-1.83E+00	1.61E-01	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	7.22E-03
			10	10	0.0112	-2.03E+00	1.32E-01	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	5.89E-03
			11	11	0.0112	-2.23E+00	1.07E-01	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	4.81E-03
			12	12	0.0112	-2.43E+00	8.77E-02	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	3.93E-03
			13	13	0.0112	-2.64E+00	7.16E-02	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	3.21E-03
			14	14	0.0112	-2.84E+00	5.85E-02	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	2.62E-03
			15	15	0.0112	-3.04E+00	4.77E-02	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	2.14E-03
			16	16	0.0112	-3.25E+00	3.90E-02	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	1.75E-03
			17	17	0.0112	-3.45E+00	3.18E-02	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	1.43E-03
			18	18	0.0112	-3.65E+00	2.60E-02	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	1.16E-03
		19	19	0.0112	-3.85E+00	2.12E-02	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	9.50E-04	
		20	20	0.0112	-4.06E+00	1.73E-02	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	7.76E-04	
	21/06/2018															
n:	1.1															

Date: 21/06/2018
Version: 1.1



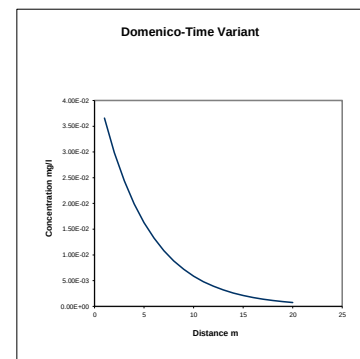
DOMENICO (TIME VARIANT)

Contaminant	21-C35 aliphatic		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	0.3	mg/l	1	m														
Co	4.48E-02	mg/l	1	1	0.0056	-2.03E-01	8.16E-01	-2.14E+44	2	3.35E+01	1	-3.35E+01	-1	7.07E+00	1	-7.07E+00	-1	3.66E-02
			2	2	0.0056	-4.06E-01	6.67E-01	-2.14E+44	2	2.37E+01	1	-2.37E+01	-1	5.00E+00	1	-5.00E+00	-1	2.99E-02
			3	3	0.0056	-6.08E-01	5.44E-01	-2.14E+44	2	1.94E+01	1	-1.94E+01	-1	4.08E+00	1	-4.08E+00	-1	2.44E-02
λ	3.23E-12	days ⁻¹	4	4	0.0056	-8.11E-01	4.44E-01	-2.14E+44	2	1.68E+01	1	-1.68E+01	-1	3.54E+00	1	-3.54E+00	-1	1.99E-02
Sz	6.00E+01	m	5	5	0.0056	-1.01E+00	3.63E-01	-2.14E+44	2	1.50E+01	1	-1.50E+01	-1	3.16E+00	1	-3.16E+00	-1	1.63E-02
Sy	4.00E+00	m	6	6	0.0056	-1.22E+00	2.96E-01	-2.14E+44	2	1.37E+01	1	-1.37E+01	-1	2.89E+00	1	-2.89E+00	-1	1.33E-02
Kd	2.84E+07	l/kg	7	7	0.0056	-1.42E+00	2.42E-01	-2.14E+44	2	1.27E+01	1	-1.27E+01	-1	2.67E+00	0.9998	-2.67E+00	-1	1.08E-02
ρ	1.60E+00	g/cm3	8	8	0.0056	-1.62E+00	1.97E-01	-2.14E+44	2	1.19E+01	1	-1.19E+01	-1	2.50E+00	0.9996	-2.50E+00	-1	8.84E-03
n	3.70E-01		9	9	0.0056	-1.83E+00	1.61E-01	-2.14E+44	2	1.12E+01	1	-1.12E+01	-1	2.36E+00	0.9991	-2.36E+00	-0.999	7.21E-03
i	1.70E-03		10	10	0.0056	-2.03E+00	1.32E-01	-2.14E+44	2	1.06E+01	1	-1.06E+01	-1	2.24E+00	0.9984	-2.24E+00	-0.998	5.89E-03
K	3.02E-01	m/d	11	11	0.0056	-2.23E+00	1.07E-01	-2.14E+44	2	1.01E+01	1	-1.01E+01	-1	2.13E+00	0.9974	-2.13E+00	-0.997	4.80E-03
x	2.00E+01	m	12	12	0.0056	-2.43E+00	8.77E-02	-2.14E+44	2	9.68E+00	1	-9.68E+00	-1	2.04E+00	0.9961	-2.04E+00	-0.996	3.91E-03
z	0.00E+00	m	13	13	0.0056	-2.64E+00	7.16E-02	-2.14E+44	2	9.30E+00	1	-9.30E+00	-1	1.96E+00	0.9945	-1.96E+00	-0.994	3.19E-03
y	0.00E+00	m	14	14	0.0056	-2.84E+00	5.85E-02	-2.14E+44	2	8.96E+00	1	-8.96E+00	-1	1.89E+00	0.9925	-1.89E+00	-0.992	2.60E-03
t	9.90E+99	days	15	15	0.0056	-3.04E+00	4.77E-02	-2.14E+44	2	8.66E+00	1	-8.66E+00	-1	1.83E+00	0.9902	-1.83E+00	-0.99	2.12E-03
ax	2.00E+00	m	16	16	0.0056	-3.25E+00	3.90E-02	-2.14E+44	2	8.39E+00	1	-8.39E+00	-1	1.77E+00	0.9876	-1.77E+00	-0.988	1.72E-03
az	2.00E-01	m	17	17	0.0056	-3.45E+00	3.18E-02	-2.14E+44	2	8.13E+00	1	-8.13E+00	-1	1.71E+00	0.9847	-1.71E+00	-0.985	1.40E-03
ay	2.00E-02	m	18	18	0.0056	-3.65E+00	2.60E-02	-2.14E+44	2	7.91E+00	1	-7.91E+00	-1	1.67E+00	0.9816	-1.67E+00	-0.982	1.14E-03
			19	19	0.0056	-3.85E+00	2.12E-02	-2.14E+44	2	7.69E+00	1	-7.69E+00	-1	1.62E+00	0.9782	-1.62E+00	-0.978	9.29E-04
			20	20	0.0056	-4.06E+00	1.73E-02	-2.14E+44	2	7.50E+00	1	-7.50E+00	-1	1.58E+00	0.9747	-1.58E+00	-0.975	7.56E-04



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	1.39E-03	m/d																
Rc	1.23E+08		1	1	0.0056	-2.03E-01	8.16E-01	-2.14E+44	2	3.35E+01	1	-3.35E+01	-1	1.41E+01	1	-1.41E+01	-1	3.66E-02
u	1.13E-11	m/d	2	2	0.0056	-4.06E-01	6.67E-01	-2.14E+44	2	2.37E+01	1	-2.37E+01	-1	1.00E+01	1	-1.00E+01	-1	2.99E-02
			3	3	0.0056	-6.08E-01	5.44E-01	-2.14E+44	2	1.94E+01	1	-1.94E+01	-1	8.16E+00	1	-8.16E+00	-1	2.44E-02
			4	4	0.0056	-8.11E-01	4.44E-01	-2.14E+44	2	1.68E+01	1	-1.68E+01	-1	7.07E+00	1	-7.07E+00	-1	1.99E-02
			5	5	0.0056	-1.01E+00	3.63E-01	-2.14E+44	2	1.50E+01	1	-1.50E+01	-1	6.32E+00	1	-6.32E+00	-1	1.63E-02
			6	6	0.0056	-1.22E+00	2.96E-01	-2.14E+44	2	1.37E+01	1	-1.37E+01	-1	5.77E+00	1	-5.77E+00	-1	1.33E-02
			7	7	0.0056	-1.42E+00	2.42E-01	-2.14E+44	2	1.27E+01	1	-1.27E+01	-1	5.35E+00	1	-5.35E+00	-1	1.08E-02
			8	8	0.0056	-1.62E+00	1.97E-01	-2.14E+44	2	1.19E+01	1	-1.19E+01	-1	5.00E+00	1	-5.00E+00	-1	8.84E-03
			9	9	0.0056	-1.83E+00	1.61E-01	-2.14E+44	2	1.12E+01	1	-1.12E+01	-1	4.71E+00	1	-4.71E+00	-1	7.22E-03
			10	10	0.0056	-2.03E+00	1.32E-01	-2.14E+44	2	1.06E+01	1	-1.06E+01	-1	4.47E+00	1	-4.47E+00	-1	5.89E-03
			11	11	0.0056	-2.23E+00	1.07E-01	-2.14E+44	2	1.01E+01	1	-1.01E+01	-1	4.26E+00	1	-4.26E+00	-1	4.81E-03
			12	12	0.0056	-2.43E+00	8.77E-02	-2.14E+44	2	9.68E+00	1	-9.68E+00	-1	4.08E+00	1	-4.08E+00	-1	3.93E-03
			13	13	0.0056	-2.64E+00	7.16E-02	-2.14E+44	2	9.30E+00	1	-9.30E+00	-1	3.92E+00	1	-3.92E+00	-1	3.21E-03
			14	14	0.0056	-2.84E+00	5.85E-02	-2.14E+44	2	8.96E+00	1	-8.96E+00	-1	3.78E+00	1	-3.78E+00	-1	2.62E-03
			15	15	0.0056	-3.04E+00	4.77E-02	-2.14E+44	2	8.66E+00	1	-8.66E+00	-1	3.65E+00	1	-3.65E+00	-1	2.14E-03
			16	16	0.0056	-3.25E+00	3.90E-02	-2.14E+44	2	8.39E+00	1	-8.39E+00	-1	3.54E+00	1	-3.54E+00	-1	1.75E-03
			17	17	0.0056	-3.45E+00	3.18E-02	-2.14E+44	2	8.13E+00	1	-8.13E+00	-1	3.43E+00	1	-3.43E+00	-1	1.43E-03
			18	18	0.0056	-3.65E+00	2.60E-02	-2.14E+44	2	7.91E+00	1	-7.91E+00	-1	3.33E+00	1	-3.33E+00	-1	1.16E-03
	21/06/2018		19	19	0.0056	-3.85E+00	2.12E-02	-2.14E+44	2	7.69E+00	1	-7.69E+00	-1	3.24E+00	1	-3.24E+00	-1	9.50E-04
	1.1		20	20	0.0056	-4.06E+00	1.73E-02	-2.14E+44	2	7.50E+00	1	-7.50E+00	-1	3.16E+00	1	-3.16E+00	-1	7.76E-04



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