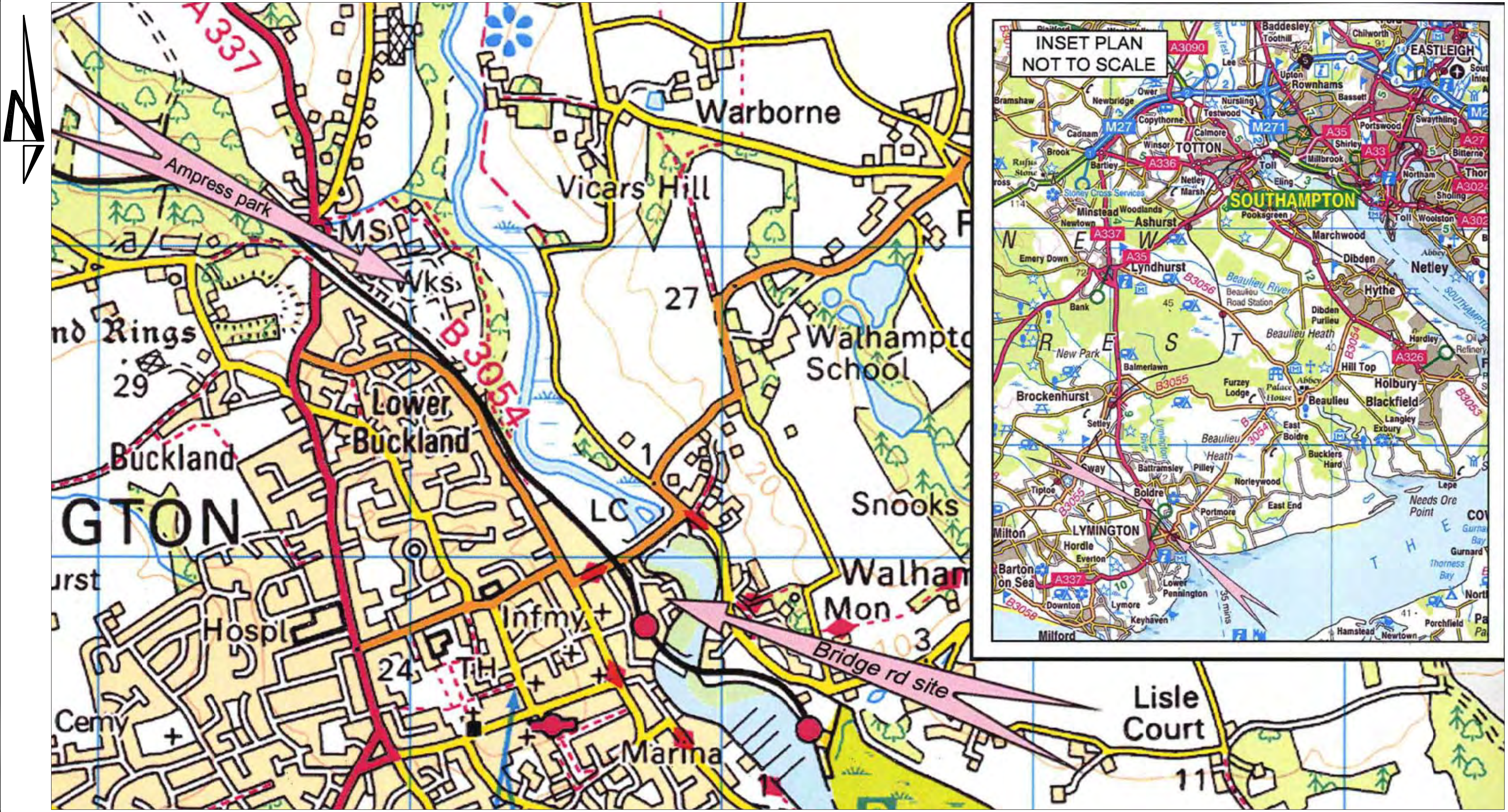
Appendix A

SITE LOCATION PLAN & PROPOSED DEVELOPMENT PLAN



Notes:

1.

Rev	Date	Description	Drawn	Checked
A	21/12/07	First issue	AB	MDH

Project: BRIDGE ROAD, LYMINGTON

Title: Site Location Plan

Client: REDROW HOMES (SOUTHERN) LIMITED

Drawing Status: INFORMATION

Job No.: C/07418

Drawn	Checked	Scale at A4	Date	Issue Date
AB	MDH	NTS	21/12/07	21/12/07

Hydrock Consultants
Unit 3, Hawthorn Park
Holdenby Road
Spratton
Northampton NN6 8LD
TEL: 01604 842 888
FAX: 01604 842 666
E-Mail: northampton@hydrock.com
or visit www.hydrock.com

Drawing No.: 07418/D003

Revision: A

Figured dimensions only are to be used. All dimensions to be checked on site. Differences between drawings and between drawings and specification or BQ of quantities to be reported to PRC Fewster.

Revisions:	By	Date
A. Site plan adjusted	ADM	13.10.04
B. Adjustments to allow for EA 6.0m	ADM	17.11.04
C. Adjustments to allow for EA 6.0m zone outside tree canopy	ADM	16.12.04

KEY:

- Slab paving
- Recon granite coloured paving units
- Tegula paving
- Tarmac
- Bound gravel
- Water
- Timber decking
- Proposed shrub planting
- Lawn
- Proposed tree planting
- Existing trees
- Proposed native tree species planting
- Proposed native marginal species shrub planting

PRC FEWSTER ARCHITECTS

ARCHITECTURE
PLANNING
URBAN DESIGN
ENGINEERING
LANDSCAPE
INTERIORS

SURBITON:
32 Victoria Road, Surbiton, Surrey KT6 4JT
Tel: 0208 399 5188 Fax: 0208 390 3963

e-mail: architects@prc-group.com
http://www.prc-group.com

Client:
PAXTON HOLDINGS

Project:
Bridge Road
Lymington

Drawing Title:
LANDSCAPE PROPOSALS
Colour

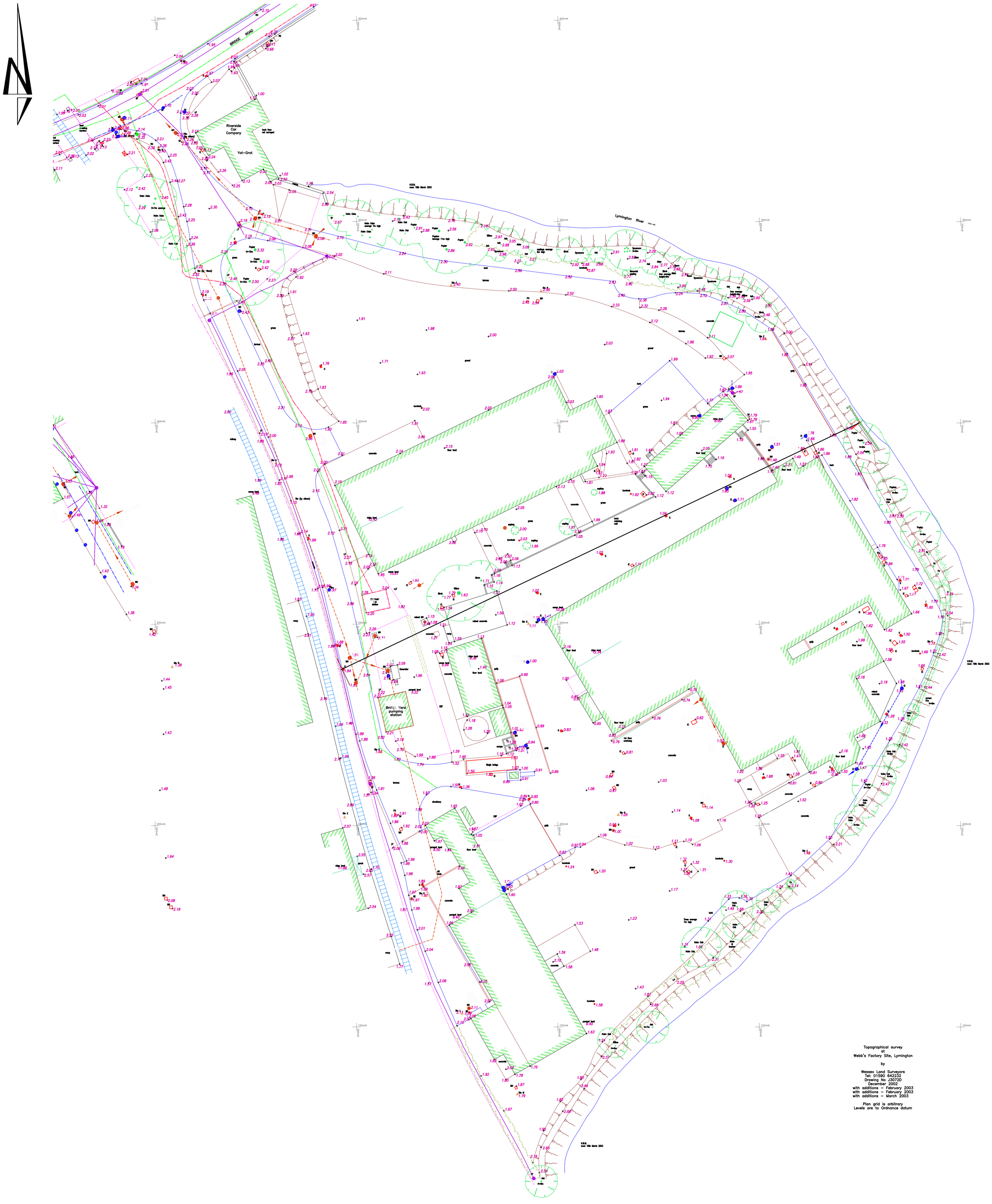
Issue status:
Preliminary ☐ Information ☐ Tender ☐ Approval ☐ Construction ☐

Scale: @A1	Project Coordinator	Date:
1:250	ADM	Aug 04
Job No:	Stage Drawing No:	Revision:
6726	PL 12.101	C

Offices also at :
LONDON ■ FARNHAM ■ CORK ■ MILTON KEYNES ■ WARSAW

Appendix B

CURRENT SITE LAYOUT AND EXPLORATORY HOLE LOCATION PLAN



LEGEND

Rev	Date	Description	By	Ckd
A	04/12/07	First Issue	AB	MDH

Client
REDROW

Project
BRIDGE ROAD,
LYMINGTON

Title
Site Survey

Hydrock
Consultants
Unit 3, Hawthorn Park
Holdenby Road
Spratton
Northampton NN6 8LD
TEL: 01604 842 888
FAX: 01604 842 666
E-Mail: northampton@hydrock.com
or visit www.hydrock.com

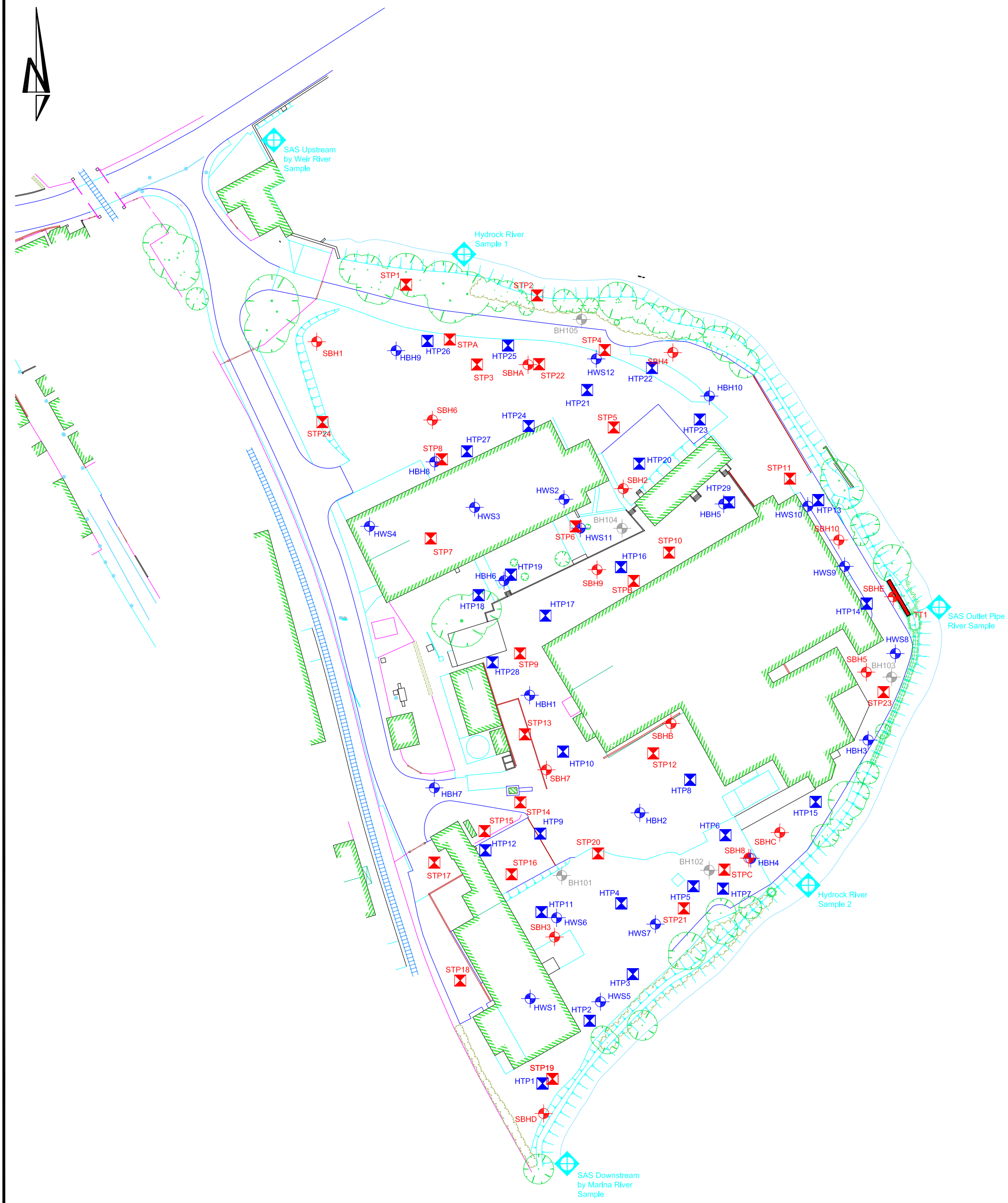
Drawing Status
INFORMATION

Job No.
C/07418

Drawn	Checked	Scale at A1	Date	Issue Date
AB	MDH	1:500	04/12/07	04/12/07

Drawing No.
07418/D004

Revision
A



Notes:

Key

- Shell and Auger and Dynamic Sample Boreholes (Hydrock,2007/08)
- Trial Pits (Hydrock,2007/08)
- Shell and Auger Boreholes (Site Analytical Services,2003)
- Trial Pits (Site Analytical Services,2003)
- Previous Borehole (Unknown investigation)
- River Sample Locations (Hydrock, 2007/08 & Site Analytical Services,2003)

Rev	Date	Description	By	Ckd
A	04/02/08	First Issue	DM	AB

Client: REDROW HOMES

Project: BRIDGE ROAD, LYMINGTON

Title: Exploratory Hole Location Plan

Hydrock Consultants
Unit 3, Hawthorn Park
Holdenby Road
Spratton
Northampton NN6 8LD
TEL: 01604 842 888
FAX: 01604 842 666
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or visit www.hydrock.com

Drawing Status: INFORMATION

Job No.: C/07418

Drawn	Checked	Scale at A3	Date	Issue Date
DM	AB	1:1000	04/02/08	04/02/08

Drawing No.: 07418/D008

Revision: A

Appendix C

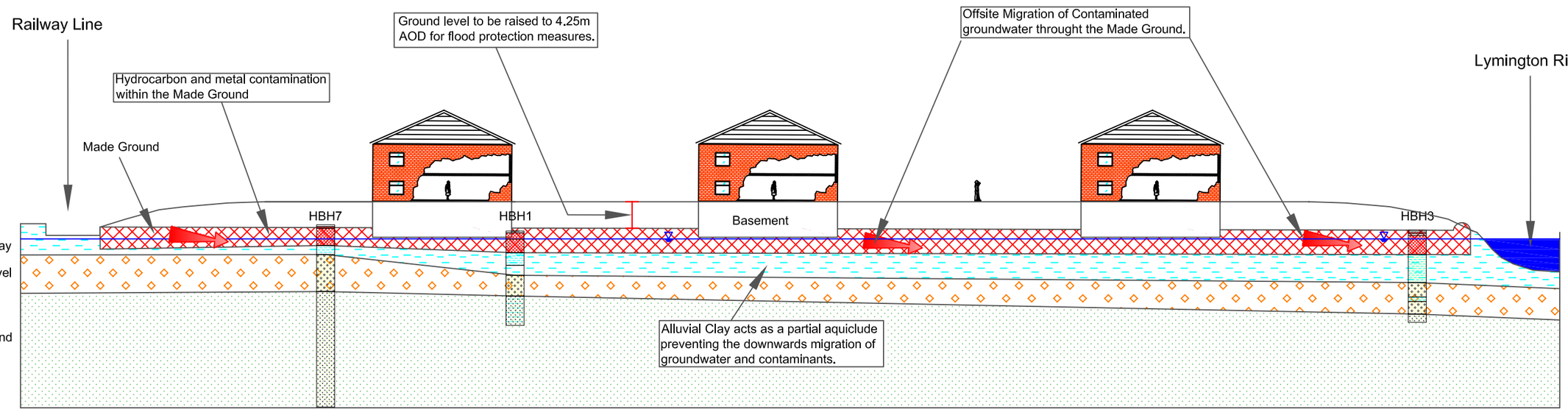
CONCEPTUAL MODEL AND GROUNDWATER CONTOUR MODELING

SITE

WEST

EAST

There are 2 separate hydrogeological units consisting of:
- Made Ground (flowing southeast); and
- Alluvial Sequence and Bracklesham and Bagshot Beds (flowing east); (flowing south)



Notes:

Rev	Date	Description	By	Ckd
A	14/02/08	First Issue	AC	AB

Client: REDROW

Project: BRIDGE ROAD, LYMINGTON

Title: Conceptual Model

Hydrock Consultants
Unit 3, Hawthorn Park
Holdenby Road
Spratton
Northampton NN6 8LD
TEL: 01604 842 666
FAX: 01604 667 810
E-Mail: northampton@hydrock.com
or visit www.hydrock.com

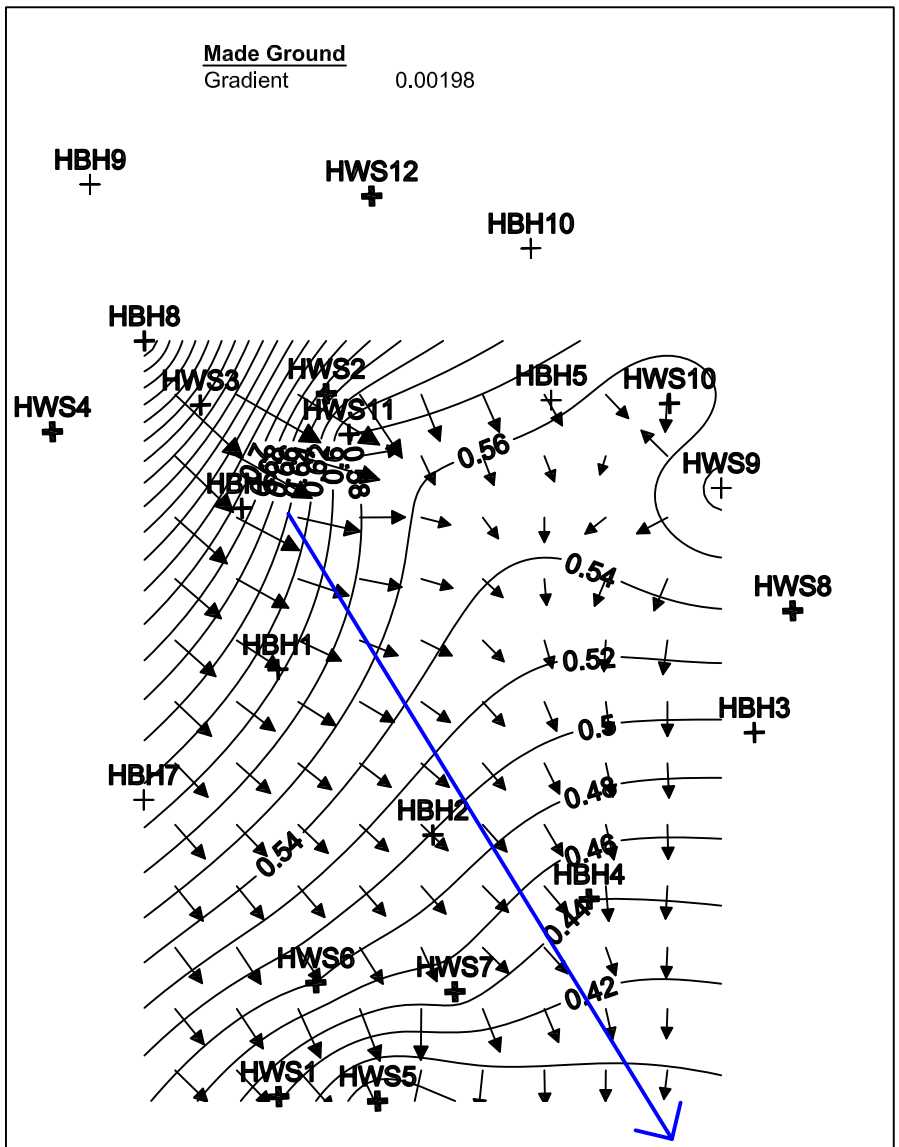
Drawing Status: INFORMATION

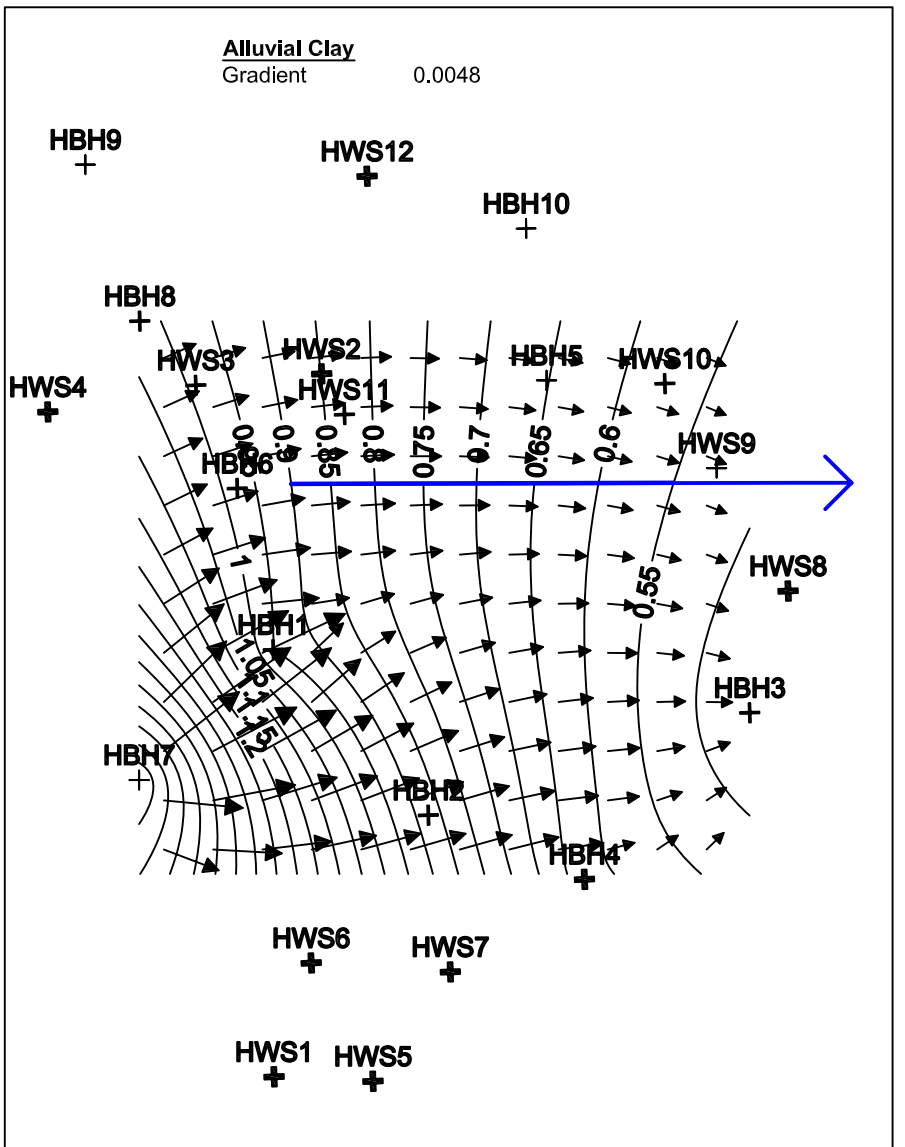
Job No.: C/07418

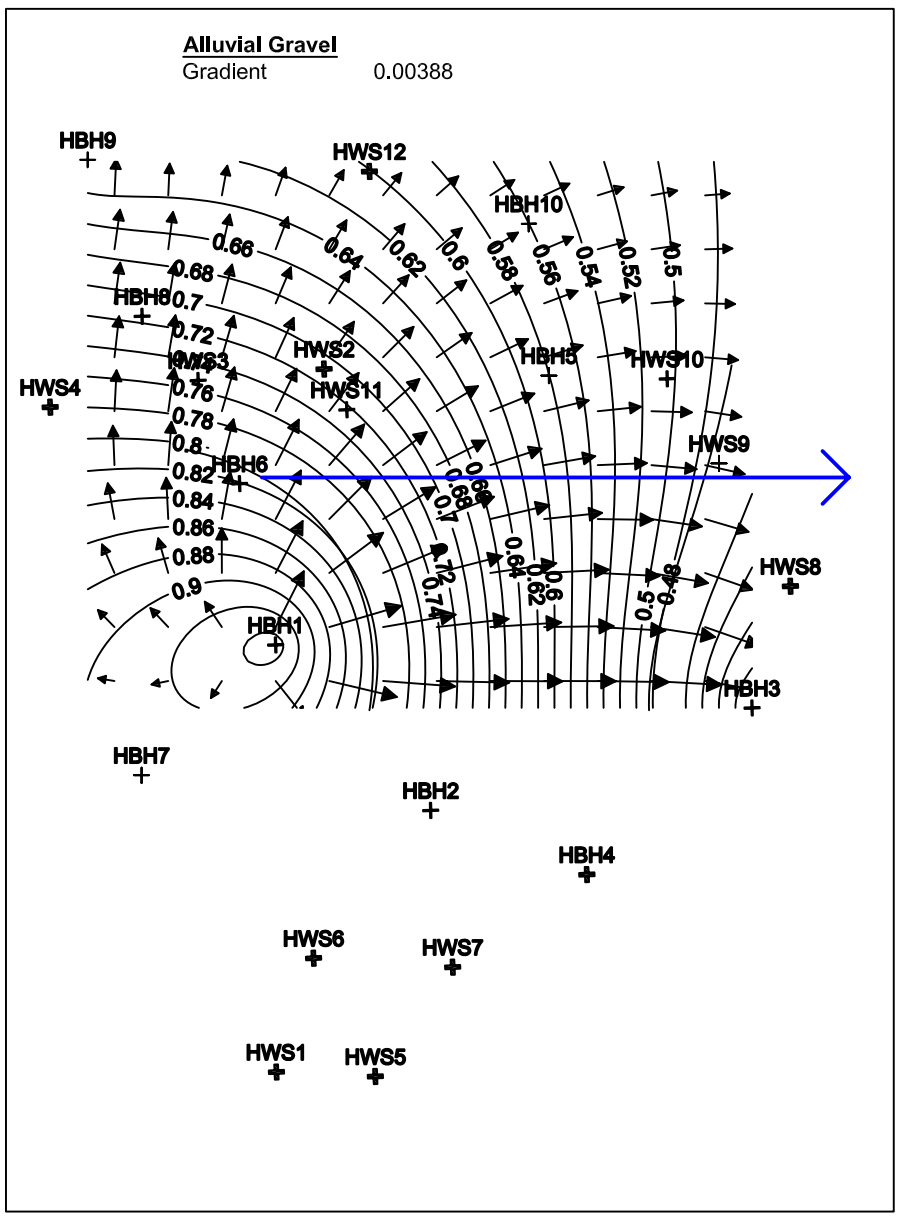
Drawn	Checked	Scale at A3	Date	Issue Date
AC	AB	1:500	14/02/08	14/02/08

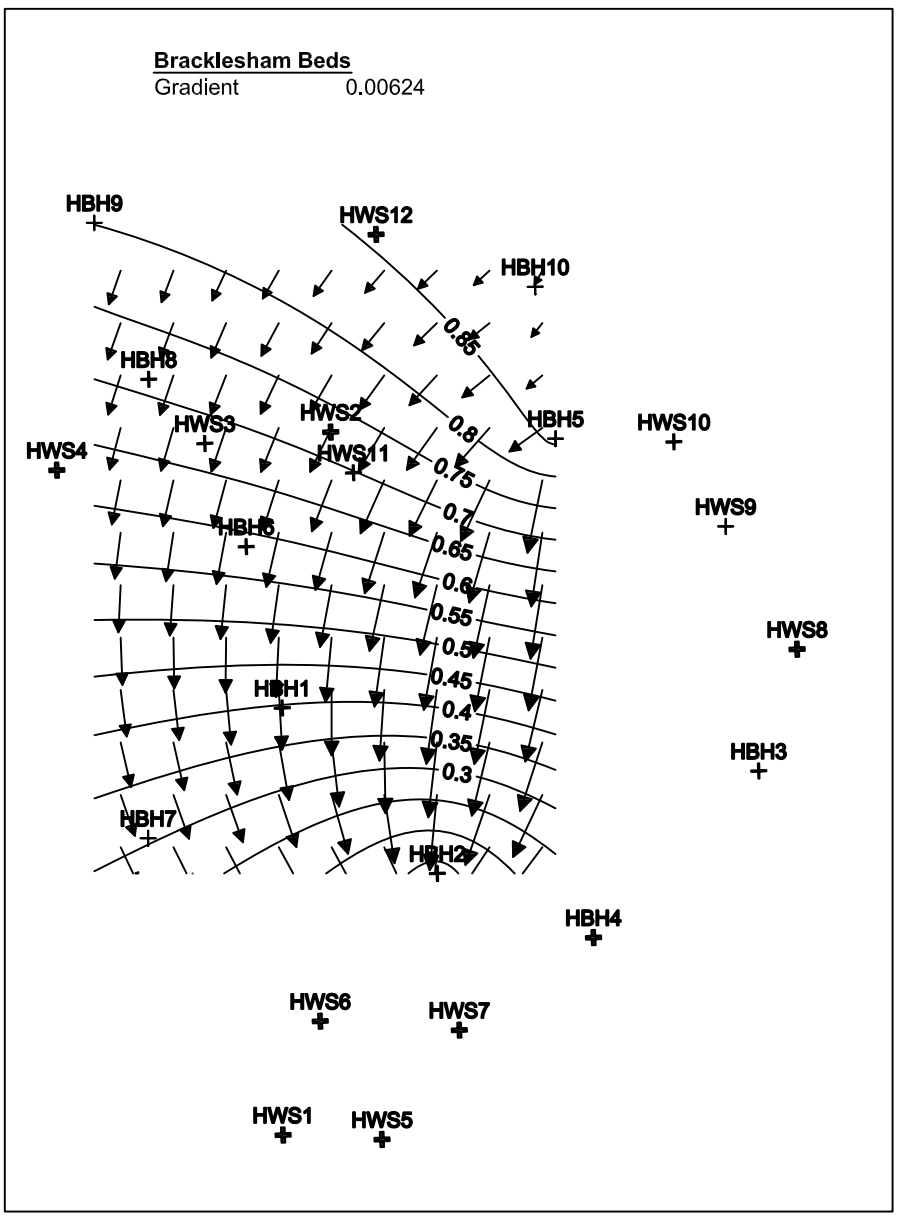
Drawing No.: 07418/D012

Revision: A









Notes:

Insufficient monitoring data is available for accurate modelling of the Bracklesham Beds. Groundwater flow direction in the Bracklesham Beds is assumed to be the same as the Alluvial Deposits.

Rev	Date	Description	By	Ckd
A	05/02/08	First Issue	AC	AB

Client: REDROW HOMES

Project: BRIDGE ROAD, LYMINGTON

Title: Groundwater Contour Modeling

Hydrock Consultants
Unit 3, Hawthorn Park
Holdenby Road
Spratton
Northampton NN6 8LD
TEL: 01604 842 888
FAX: 01604 842 666
E-Mail: northampton@hydrock.com
or visit www.hydrock.com

Drawing Status: ALL IN CAPS

Job No.: C/07418

Drawn	Checked	Scale at A3	Date	Issue Date
AC	AB	NTS	05/02/08	05/02/08

Drawing No.: 07418/D011

Revision: A

Appendix D

GROUNDWATER RISK ASSESSMENT REMEDIAL TARGETS WORKSHEETS

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.1

Date of Workbook Issue: October 2006

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.

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

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:	Bridge Road			
Site Address:	Lymington			
Completed by:	AC			
Date:	29-Feb-08		Version:	3.1
Contaminant	Chromium			
Target Concentration (C_T)	0.43	mg/l	Origin of C_T:	Using level 4 dilution factor see report section 5.5.1

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 comparision 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 3.1

Level 1 - Soil

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

User specified value for partition coefficient

Contaminant		**Chromium**		
Target concentration	C_T	**0.43**	**mg/l**	

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_w	3.49E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.81E+00	g/cm^3	Maximum sand value (Consim)
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	6.70E+01	l/kg	*Consim*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**6.70E+01**	**l/kg**	*Specified value*

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.

Level 1 Remedial Target

Level 1 Remedial Target	**2.89E+01**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.43	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Bridge Road
Completed by:	AC
Date:	29-Feb-08
Version:	3.1

Remedial Targets Worksheet , Release 3.1

Level 2 - Soil

Contaminant		**Chromium**	from Level 1	This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).
Target concentration	C_T	**0.43** mg/l	from Level 1	

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 contamiantion' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value	
Standard entry					
Infiltration	Inf	6.55E-04	m/d	om www.nwl.ac.uk (20% of rainfall plus 10% for drair	
Area of contaminant source	A	7.50E+03	m^2	Site Data	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.00E+01	m	Site Data	
Saturated aquifer thickness	da	1.32E+00	m	Av MG thickness minus Av Groundwater depth	
Hydraulic Conductivity of aquifer in which dilution occurs	K	5.18E+02	m/d	Minimum Gravel value (Consim)	
Hydraulic gradient of water table	i	1.98E-03	fraction	Site Data	
Width of contaminant source perpendicular to groundwater flow	w	1.50E+02	m	Site Data	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		Calculate			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	1.32E+00	m		

Calculated Parameters

Dilution Factor	**DF**	**1.04E+02**		
Level 2 Remedial Target		**4.49E+01**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentra**
		or		
		3.01E+03	**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:	Bridge Road
Completed by:	AC
Date:	29-Feb-08
Version:	3.1

R&D Publication 20 Remedial Targets Worksheet, Release 3.1

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Chromium		from Level 1
Target Concentration	C_T	4.30E-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	1.00E+02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	*New Zealand Ministry for the Environment*
Calculated decay rate	λ	6.93E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.40E+02	m	*Site Data*
Plume thickness at source	Sy	1.27E+00	m	*Site Data*
Saturated aquifer thickness	da	1.32E+00	m	*Av MG thickness minus Av Groundwater d*
Bulk density of aquifer materials	ρ	1.81E+00	g/cm^3	Maximum sand value (Consim)
Effective porosity of aquifer	n	3.49E-01	fraction	*Porosity Calculator*
Hydraulic gradient	i	1.98E-03	fraction	*Site Data*
Hydraulic conductivity of aquifer	K	5.18E+02	m/d	*Minimum gravel value (Consim)*
Distance to compliance point	x	2.00E+01	m	*Site Data*
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	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	6.70E+01	l/kg	*see options*
Longitudinal dispersivity	ax	1.57E+00	m	*see options*
Transverse dispersivity	az	1.57E-01	m	*see options*
Vertical dispersivity	ay	1.57E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.94E+00	m/d
Retardation factor	Rf	3.48E+02	fraction
Decay rate used	λ	1.99E-103	d^{-1}
Rate of contaminant flow due to retardation	u	8.43E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	8.91E+01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.12E+00**	

Remedial Targets

Remedial Target		**4.82E-01**	**mg/l**
Ogata Banks			
Distance to compliance point		**20**	**m**
Concentration of contaminant at compliance point	C_{ED}/C_0	**8.91E+01**	**mg/l**
after		**1.0E+100**	**days**

For comparison with measured groundwater concentration.

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)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	6.70E+01	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	6.70E+01	l/kg

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

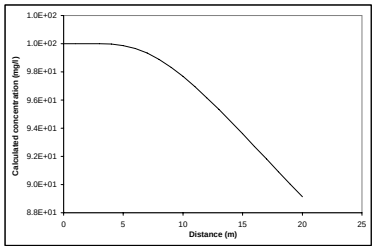
Dispersivity based on Xu & Eckstein (1995)

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+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	

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



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

Note

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

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

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

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

Site being assessed:	Bridge Road
Completed by:	AC
Date:	29/2/2008
Version:	3.1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+02
1.0	1.00E+02
2.0	1.00E+02
3.0	1.00E+02
4.0	1.00E+02
5.0	9.99E+01
6.0	9.97E+01
7.0	9.93E+01
8.0	9.89E+01
9.0	9.83E+01
10.0	9.77E+01
11.0	9.69E+01
12.0	9.62E+01
13.0	9.53E+01
14.0	9.45E+01
15.0	9.36E+01
16.0	9.27E+01
17.0	9.18E+01
18.0	9.09E+01
19.0	9.00E+01
20.0	8.91E+01

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.1

Date of Workbook Issue: October 2006

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.

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

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:	Bridge Road			
Site Address:	Lymington			
Completed by:	AC			
Date:	29-Feb-08		Version:	3.1
Contaminant	Copper			
Target Concentration (C_T)	0.14	mg/l	Origin of C_T:	Using level 4 dilution factor see report section 5.5.1

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 comparision 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 3.1

Level 1 - Soil

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

User specified value for partition coefficient

Contaminant		**Copper**		
Target concentration	C_T	**0.14**	**mg/l**	

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_w	3.49E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.81E+00	g/cm^3	Maximum sand value (Consim)
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	2.95E+02	l/kg	*Consim*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**2.95E+02**	**l/kg**	*Specified value*

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.

Level 1 Remedial Target

Level 1 Remedial Target	**4.13E+01**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.14	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Bridge Road
Completed by:	AC
Date:	29-Feb-08
Version:	3.1

Remedial Targets Worksheet , Release 3.1

Level 2 - Soil

Contaminant		**Copper**		from Level 1	This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).
Target concentration	C_T	**0.14**	**mg/l**	from Level 1	

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 contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	6.55E-04	m/d	**om www.nwl.ac.uk (20% of rainfall plus 10% for drair**	
Area of contaminant source	A	7.50E+03	m^2	**Site Data**	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.00E+01	m	**Site Data**	
Saturated aquifer thickness	da	1.32E+00	m	**Av MG thickness minus Av Groundwater depth**	
Hydraulic Conductivity of aquifer in which dilution occurs	K	5.18E+02	m/d	**Minimum Gravel value (Consim)**	
Hydraulic gradient of water table	i	1.98E-03	fraction	**Site Data**	
Width of contaminant source perpendicular to groundwater flow	w	1.50E+02	m	**Site Data**	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	1.32E+00	m		

Calculated Parameters

Dilution Factor	**DF**	**1.04E+02**		
Level 2 Remedial Target		**1.46E+01**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentra**
		or		
		4.31E+03	**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:	Bridge Road
Completed by:	AC
Date:	29-Feb-08
Version:	3.1

R&D Publication 20 Remedial Targets Worksheet, Release 3.1

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Copper		from Level 1
Target Concentration	C_T	1.40E-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	1.00E+00	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	*New Zealand Ministry for the Environment*
Calculated decay rate	λ	6.93E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.50E+02	m	*Site Data*
Plume thickness at source	Sy	1.27E+00	m	*Site Data*
Saturated aquifer thickness	da	1.32E+00	m	*Av MG thickness minus Av Groundwater d*
Bulk density of aquifer materials	ρ	1.81E+00	g/cm^3	Maximum sand value (Consim)
Effective porosity of aquifer	n	3.49E-01	fraction	*Porosity Calculator*
Hydraulic gradient	i	1.98E-03	fraction	*Site Data*
Hydraulic conductivity of aquifer	K	5.18E+02	m/d	*Minimum gravel value (Consim)*
Distance to compliance point	x	2.00E+01	m	*Site Data*
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	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.95E+02	l/kg	*see options*
Longitudinal dispersivity	ax	1.57E+00	m	*see options*
Transverse dispersivity	az	1.57E-01	m	*see options*
Vertical dispersivity	ay	1.57E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.94E+00	m/d
Retardation factor	Rf	1.53E+03	fraction
Decay rate used	λ	4.53E-104	d^{-1}
Rate of contaminant flow due to retardation	u	1.92E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	8.91E-01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.12E+00**	

Remedial Targets

Remedial Target		**1.57E-01**	**mg/l**
Ogata Banks			
Distance to compliance point		**20**	**m**
Concentration of contaminant at compliance point after	**C_{ED}/C_0**	**8.91E-01**	**mg/l**
		1.0E+100	**days**

For comparison with measured groundwater concentration.

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)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	2.95E+02	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	2.95E+02	l/kg

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

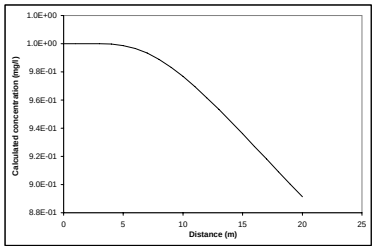
Dispersivity based on Xu & Eckstein (1995)

		Enter value	Calc value Xu & Eckstein		
Longitudinal dispersivity	**ax**	0.00E+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	

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



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

Note

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

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

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

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

Site being assessed:	Bridge Road
Completed by:	AC
Date:	29/2/2008
Version:	3.1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+00
1.0	1.00E+00
2.0	1.00E+00
3.0	1.00E+00
4.0	1.00E+00
5.0	9.99E-01
6.0	9.97E-01
7.0	9.93E-01
8.0	9.89E-01
9.0	9.83E-01
10.0	9.77E-01
11.0	9.69E-01
12.0	9.62E-01
13.0	9.53E-01
14.0	9.45E-01
15.0	9.36E-01
16.0	9.27E-01
17.0	9.18E-01
18.0	9.09E-01
19.0	9.00E-01
20.0	8.91E-01

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.1

Date of Workbook Issue: October 2006

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.

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

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:	Bridge Road			
Site Address:	Lymington			
Completed by:	AC			
Date:	29-Feb-08		Version:	3.1
Contaminant	Lead			
Target Concentration (C_T)	0.72	mg/l	Origin of C_T:	Using level 4 dilution factor see report section 5.5.1

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 comparision 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 3.1

Level 1 - Soil

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

User specified value for partition coefficient

Contaminant		**Lead**	
Target concentration	C_T	**0.72**	**mg/l**

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_w	3.49E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.81E+00	g/cm^3	Maximum sand value (Consim)
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	2.70E+02	l/kg	*Consim*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**2.70E+02**	**l/kg**	*Specified value*

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.

Level 1 Remedial Target

Level 1 Remedial Target	**1.95E+02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.72	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Bridge Road
Completed by:	AC
Date:	29-Feb-08
Version:	3.1

Remedial Targets Worksheet , Release 3.1

Level 2 - Soil

Contaminant		**Lead**	from Level 1	This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).
Target concentration	C_T	**0.72** mg/l	from Level 1	

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 contamiantion' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value	
Standard entry					
Infiltration	Inf	6.55E-04	m/d	**om www.nwl.ac.uk (20% of rainfall plus 10% for drair**	
Area of contaminant source	A	7.50E+03	m^2	**Site Data**	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.06E+02	m	**Site Data**	
Saturated aquifer thickness	da	1.32E+00	m	**Av MG thickness minus Av Groundwater depth**	
Hydraulic Conductivity of aquifer in which dilution occurs	K	5.18E+02	m/d	**Minimum Gravel value (Consim)**	
Hydraulic gradient of water table	i	1.98E-03	fraction	**Site Data**	
Width of contaminant source perpendicular to groundwater flow	w	1.50E+02	m	**Site Data**	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	1.32E+00	m		

Calculated Parameters

Dilution Factor	**DF**	**1.10E+01**		
Level 2 Remedial Target		**7.94E+00**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentra**
		or		
		2.15E+03	**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:	Bridge Road
Completed by:	AC
Date:	29-Feb-08
Version:	3.1

R&D Publication 20 Remedial Targets Worksheet, Release 3.1

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Lead		from Level 1
Target Concentration	C_T	7.20E-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	1.00E+02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	*New Zealand Ministry for the Environment*
Calculated decay rate	λ	6.93E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.50E+02	m	*Site Data*
Plume thickness at source	Sy	1.27E+00	m	*Site Data*
Saturated aquifer thickness	da	1.32E+00	m	*Av MG thickness minus Av Groundwater d*
Bulk density of aquifer materials	ρ	1.81E+00	g/cm^3	Maximum sand value (Consim)
Effective porosity of aquifer	n	3.49E-01	fraction	*Porosity Calculator*
Hydraulic gradient	i	1.98E-03	fraction	*Site Data*
Hydraulic conductivity of aquifer	K	5.18E+02	m/d	*Minimum gravel value (Consim)*
Distance to compliance point	x	1.00E+01	m	*Site Data*
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	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.70E+02	l/kg	*see options*
Longitudinal dispersivity	ax	8.30E-01	m	*see options*
Transverse dispersivity	az	8.30E-02	m	*see options*
Vertical dispersivity	ay	8.30E-03	m	*see options*

Calculated Parameters

	Variable	
Groundwater flow velocity	v	2.94E+00 m/d
Retardation factor	Rf	1.40E+03 fraction
Decay rate used	λ	4.95E-104 d^{-1}
Rate of contaminant flow due to retardation	u	2.10E-03 m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	9.98E+01 mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.00E+00**

Remedial Targets

Remedial Target		**7.21E-01**	**mg/l**
Ogata Banks			
Distance to compliance point		**10**	**m**
Concentration of contaminant at compliance point	C_{ED}/C_0	**9.98E+01**	**mg/l**
after		**1.0E+100**	**days**

For comparison with measured groundwater concentration.

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)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	2.70E+02	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	2.70E+02	l/kg

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

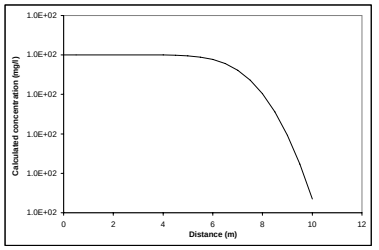
Dispersivity based on Xu & Eckstein (1995)

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	1.00E+00	8.30E-01	m
Transverse dispersivity	**az**	0.00E+00	1.00E-01	8.30E-02	m
Vertical dispersivity	**ay**	0.00E+00	1.00E-02	8.30E-03	

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



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

Note

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

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

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

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

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

Site being assessed:	Bridge Road
Completed by:	AC
Date:	29/2/2008
Version:	3.1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+02
0.5	1.00E+02
1.0	1.00E+02
1.5	1.00E+02
2.0	1.00E+02
2.5	1.00E+02
3.0	1.00E+02
3.5	1.00E+02
4.0	1.00E+02
4.5	1.00E+02
5.0	1.00E+02
5.5	1.00E+02
6.0	1.00E+02
6.5	1.00E+02
7.0	1.00E+02
7.5	1.00E+02
8.0	1.00E+02
8.5	9.99E+01
9.0	9.99E+01
9.5	9.99E+01
10.0	9.98E+01

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.1

Date of Workbook Issue: October 2006

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.

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

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:	Bridge Road			
Site Address:	Lymington			
Completed by:	AC			
Date:	29-Feb-08		Version:	3.1
Contaminant	Nickel			
Target Concentration (C_T)	0.86	mg/l	Origin of C_T:	Using level 4 dilution factor see report section 5.5.1

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 comparision 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 3.1

Level 1 - Soil

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

User specified value for partition coefficient

Contaminant		**Nickel**		
Target concentration	C_T	**0.86**	**mg/l**	

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_w	3.49E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.81E+00	g/cm^3	Maximum sand value (Consim)
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	4.00E+02	l/kg	*Consim*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**4.00E+02**	**l/kg**	*Specified value*

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.

Level 1 Remedial Target

Level 1 Remedial Target	**3.44E+02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.86	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Bridge Road
Completed by:	AC
Date:	29-Feb-08
Version:	3.1

Remedial Targets Worksheet , Release 3.1

Level 2 - Soil

Contaminant		**Nickel**	from Level 1	This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).
Target concentration	C_T	**0.86** mg/l	from Level 1	

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 contamiantion' (Environment Agency 2006)

Input Parameters	Variable	Value	Unit	Source of parameter value	
Standard entry					
Infiltration	Inf	6.55E-04	m/d	**om www.nwl.ac.uk (20% of rainfall plus 10% for drair**	
Area of contaminant source	A	7.50E+03	m^2	**Site Data**	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.06E+02	m	**Site Data**	
Saturated aquifer thickness	da	1.32E+00	m	**Av MG thickness minus Av Groundwater depth**	
Hydraulic Conductivity of aquifer in which dilution occurs	K	5.18E+02	m/d	**Minimum Gravel value (Consim)**	
Hydraulic gradient of water table	i	1.98E-03	fraction	**Site Data**	
Width of contaminant source perpendicular to groundwater flow	w	1.50E+02	m	**Site Data**	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	1.32E+00	m		

Calculated Parameters

Dilution Factor	**DF**	**1.10E+01**		
Level 2 Remedial Target		**9.49E+00**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentra**
		or		
		3.80E+03	**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:	Bridge Road
Completed by:	AC
Date:	29-Feb-08
Version:	3.1

R&D Publication 20 Remedial Targets Worksheet, Release 3.1

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Nickel		from Level 1
Target Concentration	C_T	8.60E-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	1.00E+02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	*New Zealand Ministry for the Environment*
Calculated decay rate	λ	6.93E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.50E+02	m	*Site Data*
Plume thickness at source	Sy	1.27E+00	m	*Site Data*
Saturated aquifer thickness	da	1.32E+00	m	*Av MG thickness minus Av Groundwater d*
Bulk density of aquifer materials	ρ	1.81E+00	g/cm^3	Maximum sand value (Consim)
Effective porosity of aquifer	n	3.49E-01	fraction	*Porosity Calculator*
Hydraulic gradient	i	1.98E-03	fraction	*Site Data*
Hydraulic conductivity of aquifer	K	5.18E+02	m/d	*Minimum gravel value (Consim)*
Distance to compliance point	x	2.00E+01	m	*Site Data*
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	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	4.00E+02	l/kg	*see options*
Longitudinal dispersivity	ax	1.57E+00	m	*see options*
Transverse dispersivity	az	1.57E-01	m	*see options*
Vertical dispersivity	ay	1.57E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.94E+00	m/d
Retardation factor	Rf	2.08E+03	fraction
Decay rate used	λ	3.34E-104	d^{-1}
Rate of contaminant flow due to retardation	u	1.42E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	8.91E+01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.12E+00**	

Remedial Targets

Remedial Target		**9.65E-01**	**mg/l**
Ogata Banks			
Distance to compliance point		**20**	**m**
Concentration of contaminant at compliance point after	**C_{ED}/C_0**	**8.91E+01** **1.0E+100**	**mg/l** **days**

For comparison with measured groundwater concentration.

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)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	4.00E+02	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	4.00E+02	l/kg

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

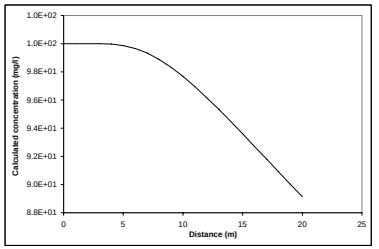
Dispersivity based on Xu & Eckstein (1995)

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+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	

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



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

Note

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

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

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

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

Site being assessed:	Bridge Road
Completed by:	AC
Date:	29/2/2008
Version:	3.1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+02
1.0	1.00E+02
2.0	1.00E+02
3.0	1.00E+02
4.0	1.00E+02
5.0	9.99E+01
6.0	9.97E+01
7.0	9.93E+01
8.0	9.89E+01
9.0	9.83E+01
10.0	9.77E+01
11.0	9.69E+01
12.0	9.62E+01
13.0	9.53E+01
14.0	9.45E+01
15.0	9.36E+01
16.0	9.27E+01
17.0	9.18E+01
18.0	9.09E+01
19.0	9.00E+01
20.0	8.91E+01

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.1

Date of Workbook Issue: October 2006

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.

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

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:	Bridge Road			
Site Address:	Lymington			
Completed by:	AC			
Date:	29-Feb-08		Version:	3.1
Contaminant	Zinc			
Target Concentration (C_T)	1.15	mg/l	Origin of C_T:	Using level 4 dilution factor see report section 5.5.1

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 comparision 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 3.1

Level 1 - Soil

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

User specified value for partition coefficient

Contaminant		**Zinc**		
Target concentration	C_T	**1.15**	**mg/l**	

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_w	3.49E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.81E+00	g/cm^3	Maximum sand value (Consim)
Henry's Law constant	H	0.00E+00	dimensionless	
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	2.00E+02	l/kg	*Consim*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	

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.

Soil water partition coefficient used in Level Assessment	**Kd**	**2.00E+02**	**l/kg**	*Specified value*

Level 1 Remedial Target

Level 1 Remedial Target	**2.30E+02**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	1.15	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Bridge Road
Completed by:	AC
Date:	29-Feb-08
Version:	3.1

Remedial Targets Worksheet , Release 3.1

Level 2 - Soil

Contaminant		**Zinc**	from Level 1	This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).
Target concentration	C_T	**1.15** **mg/l**	from Level 1	

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 contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	6.55E-04	m/d	**om www.nwl.ac.uk (20% of rainfall plus 10% for drair**	
Area of contaminant source	A	7.50E+03	m^2	**Site Data**	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.06E+02	m	**Site Data**	
Saturated aquifer thickness	da	1.32E+00	m	**Av MG thickness minus Av Groundwater depth**	
Hydraulic Conductivity of aquifer in which dilution occurs	K	5.18E+02	m/d	**Minimum Gravel value (Consim)**	
Hydraulic gradient of water table	i	1.98E-03	fraction	**Site Data**	
Width of contaminant source perpendicular to groundwater flow	w	1.50E+02	m	**Site Data**	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	1.32E+00	m		

Calculated Parameters

Dilution Factor	**DF**	**1.10E+01**		
Level 2 Remedial Target		**1.27E+01**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentra**
		or		
		2.54E+03	**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:	Bridge Road
Completed by:	AC
Date:	29-Feb-08
Version:	3.1

R&D Publication 20 Remedial Targets Worksheet, Release 3.1

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Zinc		from Level 1
Target Concentration	C_T	1.15E+00	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	1.00E+02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	*New Zealand Ministry for the Environment*
Calculated decay rate	λ	6.93E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.50E+02	m	*Site Data*
Plume thickness at source	Sy	1.27E+00	m	*Site Data*
Saturated aquifer thickness	da	1.32E+00	m	*Av MG thickness minus Av Groundwater d*
Bulk density of aquifer materials	ρ	1.81E+00	g/cm^3	Maximum sand value (Consim)
Effective porosity of aquifer	n	3.49E-01	fraction	*Porosity Calculator*
Hydraulic gradient	i	1.98E-03	fraction	*Site Data*
Hydraulic conductivity of aquifer	K	5.18E+02	m/d	*Minimum gravel value (Consim)*
Distance to compliance point	x	2.00E+01	m	*Site Data*
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	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.00E+02	l/kg	*see options*
Longitudinal dispersivity	ax	1.57E+00	m	*see options*
Transverse dispersivity	az	1.57E-01	m	*see options*
Vertical dispersivity	ay	1.57E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.94E+00	m/d
Retardation factor	Rf	1.04E+03	fraction
Decay rate used	λ	6.68E-104	d^{-1}
Rate of contaminant flow due to retardation	u	2.83E-03	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	8.91E+01	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.12E+00**	

Remedial Targets

Remedial Target		**1.29E+00**	**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	**8.91E+01** **1.0E+100**	**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)

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	2.00E+02	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	2.00E+02	l/kg

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

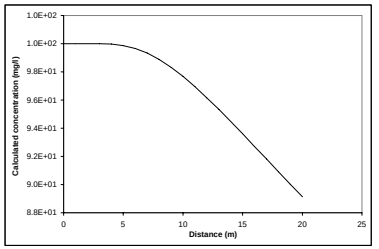
Dispersivity based on Xu & Eckstein (1995)

		Enter value	Calc value Xu & Eckstein		
Longitudinal dispersivity	**ax**	0.00E+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	

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



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

Note

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

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

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

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

Site being assessed:	Bridge Road
Completed by:	AC
Date:	29/2/2008
Version:	3.1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+02
1.0	1.00E+02
2.0	1.00E+02
3.0	1.00E+02
4.0	1.00E+02
5.0	9.99E+01
6.0	9.97E+01
7.0	9.93E+01
8.0	9.89E+01
9.0	9.83E+01
10.0	9.77E+01
11.0	9.69E+01
12.0	9.62E+01
13.0	9.53E+01
14.0	9.45E+01
15.0	9.36E+01
16.0	9.27E+01
17.0	9.18E+01
18.0	9.09E+01
19.0	9.00E+01
20.0	8.91E+01

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.1

Date of Workbook Issue: October 2006

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.

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

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:	Bridge Road			
Site Address:	Lymington			
Completed by:	AC			
Date:	29-Feb-08		Version:	3.1
Contaminant	TPH Aliphatic C12	- C16		
Target Concentration (C_T)	0.86	mg/l	Origin of C_T:	Using level 4 dilution factor see report section 5.5.1

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 comparision 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 3.1

Level 1 - Soil

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

User specified value for partition coefficient

Contaminant		**TPH Aliphatic C12 - C16**		
Target concentration	C_T	**0.86**	**mg/l**	

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_W	3.49E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.81E+00	g/cm^3	Maximum sand value (Consim)
Henry's Law constant	H	5.20E+02	dimensionless	*TPHCWG (at 10 - 25°C)*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	8.02E+04	l/kg	*RIVM 711701015 Appendix 6*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**8.02E+04**	**l/kg**	*Specified value*

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.

Level 1 Remedial Target

Level 1 Remedial Target	**6.89E+04**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	0.86	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Bridge Road
Completed by:	AC
Date:	29-Feb-08
Version:	3.1

Remedial Targets Worksheet , Release 3.1

Level 2 - Soil

Contaminant		**TPH Aliphatic C12 - C16**		from Level 1	This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).
Target concentration	**C_T**	**0.86**	**mg/l**	from Level 1	

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 contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	6.55E-04	m/d	**om www.nwl.ac.uk (20% of rainfall plus 10% for drair**	
Area of contaminant source	A	2.40E+04	m^2	**Site Data**	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.06E+02	m	**Site Data**	
Saturated aquifer thickness	da	1.32E+00	m	**Av MG thickness minus Av Groundwater depth**	
Hydraulic Conductivity of aquifer in which dilution occurs	K	5.18E+02	m/d	**Minimum Gravel value (Consim)**	
Hydraulic gradient of water table	i	1.98E-03	fraction	**Site Data**	
Width of contaminant source perpendicular to groundwater flow	w	1.40E+02	m	**Site Data**	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	1.32E+00	m		

Calculated Parameters

Dilution Factor	**DF**	**1.10E+01**		
Level 2 Remedial Target		**9.49E+00**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentra**
		or		
		7.61E+05	**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:	Bridge Road
Completed by:	AC
Date:	29-Feb-08
Version:	3.1

R&D Publication 20 Remedial Targets Worksheet, Release 3.1

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		TPH Aliphatic C12 - C16		from Level 1
Target Concentration	C_T	8.60E-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	1.00E+02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	*New Zealand Ministry for the Environment*
Calculated decay rate	λ	6.93E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.40E+02	m	*Site Data*
Plume thickness at source	Sy	1.27E+00	m	*Site Data*
Saturated aquifer thickness	da	1.32E+00	m	*Av MG thickness minus Av Groundwater d*
Bulk density of aquifer materials	ρ	1.81E+00	g/cm^3	Maximum sand value (Consim)
Effective porosity of aquifer	n	3.49E-01	fraction	*Porosity Calculator*
Hydraulic gradient	i	1.98E-03	fraction	*Site Data*
Hydraulic conductivity of aquifer	K	5.18E+02	m/d	*Minimum gravel value (Consim)*
Distance to compliance point	x	1.00E+02	m	*Site Data*
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	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	8.02E+04	l/kg	*see options*
Longitudinal dispersivity	ax	4.42E+00	m	*see options*
Transverse dispersivity	az	4.42E-01	m	*see options*
Vertical dispersivity	ay	4.42E-02	m	*see options*

Calculated Parameters

	Variable	
Groundwater flow velocity	v	2.94E+00 m/d
Retardation factor	Rf	4.16E+05 fraction
Decay rate used	λ	1.67E-106 d^{-1}
Rate of contaminant flow due to retardation	u	7.07E-06 m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.31E+01 mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.02E+00**

Remedial Targets

Remedial Target		**2.60E+00**	**mg/l**
Ogata Banks			
Distance to compliance point		**100**	**m**
Concentration of contaminant at compliance point	C_{ED}/C_0	**3.31E+01**	**mg/l**
after		**1.0E+100**	**days**

For comparison with measured groundwater concentration.

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)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient	Kd	8.02E+04	l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	8.02E+04	l/kg

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

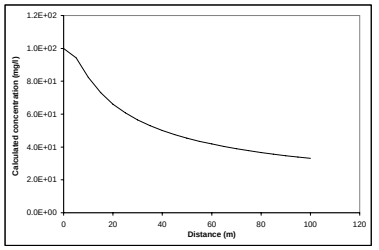
Dispersivity based on Xu & Eckstein (1995)

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	1.00E+00	4.42E+00	m
Transverse dispersivity	**az**	0.00E+00	1.00E+00	4.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.00E-03	4.42E-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 = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



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

Note

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

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

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

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

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

Site being assessed:	Bridge Road
Completed by:	AC
Date:	29/2/2008
Version:	3.1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+02
5.0	9.44E+01
10.0	8.23E+01
15.0	7.30E+01
20.0	6.60E+01
25.0	6.07E+01
30.0	5.64E+01
35.0	5.30E+01
40.0	5.00E+01
45.0	4.76E+01
50.0	4.54E+01
55.0	4.35E+01
60.0	4.19E+01
65.0	4.04E+01
70.0	3.90E+01
75.0	3.78E+01
80.0	3.67E+01
85.0	3.57E+01
90.0	3.47E+01
95.0	3.39E+01
100.0	3.31E+01

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.1

Date of Workbook Issue: October 2006

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.

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

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:	Bridge Road			
Site Address:	Lymington			
Completed by:	AC			
Date:	29-Feb-08		Version:	3.1
Contaminant	TPH Aliphatic C16	- C35		
Target Concentration (C_T)	2.73	mg/l	Origin of C_T:	Using level 4 dilution factor see report section 5.5.1

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 comparision 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 3.1

Level 1 - Soil

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

User specified value for partition coefficient

Contaminant		**TPH Aliphatic C16 - C35**	
Target concentration	**C_T**	**2.73**	**mg/l**

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_w	3.49E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.81E+00	g/cm^3	Maximum sand value (Consim)
Henry's Law constant	H	4.90E+03	dimensionless	*TPHCWG (at 10 - 25°C)*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	1.60E+07	l/kg	*RIVM 711701015 Appendix 6*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**1.60E+07**	**l/kg**	*Specified value*

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.

Level 1 Remedial Target

Level 1 Remedial Target	**4.37E+07**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	2.73	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Bridge Road
Completed by:	AC
Date:	29-Feb-08
Version:	3.1

Remedial Targets Worksheet , Release 3.1

Level 2 - Soil

Contaminant		**TPH Aliphatic C16 - C35**		from Level 1	This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).
Target concentration	**C_T**	**2.73**	**mg/l**	from Level 1	

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 contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	6.55E-04	m/d	**om www.nwl.ac.uk (10% of rainfall plus 10% for drair**	
Area of contaminant source	A	2.40E+04	m^2	**Site Data**	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.06E+02	m	**Site Data**	
Saturated aquifer thickness	da	1.32E+00	m	**Av MG thickness minus Av Groundwater depth**	
Hydraulic Conductivity of aquifer in which dilution occurs	K	5.18E+02	m/d	**Minimum Gravel value (Consim)**	
Hydraulic gradient of water table	i	1.98E-03	fraction	**Site Data**	
Width of contaminant source perpendicular to groundwater flow	w	1.40E+02	m	**Site Data**	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	1.32E+00	m		

Calculated Parameters

Dilution Factor	**DF**	**1.10E+01**		
Level 2 Remedial Target		**3.01E+01**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentra**
		or		
		4.82E+08	**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:	Bridge Road
Completed by:	AC
Date:	29-Feb-08
Version:	3.1

R&D Publication 20 Remedial Targets Worksheet, Release 3.1

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		TPH Aliphatic C16 - C35		from Level 1
Target Concentration	C_T	2.73E+00	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	1.00E+02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	*New Zealand Ministry for the Environment*
Calculated decay rate	λ	6.93E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.40E+02	m	*Site Data*
Plume thickness at source	Sy	1.27E+00	m	*Site Data*
Saturated aquifer thickness	da	1.32E+00	m	*Av MG thickness minus Av Groundwater d*
Bulk density of aquifer materials	ρ	1.81E+00	g/cm^3	Maximum sand value (Consim)
Effective porosity of aquifer	n	3.49E-01	fraction	*Porosity Calculator*
Hydraulic gradient	i	1.98E-03	fraction	*Site Data*
Hydraulic conductivity of aquifer	K	5.18E+02	m/d	*Minimum gravel value (Consim)*
Distance to compliance point	x	1.00E+02	m	*Site Data*
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	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.60E+07	l/kg	*see options*
Longitudinal dispersivity	ax	4.42E+00	m	*see options*
Transverse dispersivity	az	4.42E-01	m	*see options*
Vertical dispersivity	ay	4.42E-02	m	*see options*

Calculated Parameters

	Variable	
Groundwater flow velocity	v	2.94E+00 m/d
Retardation factor	Rf	8.30E+07 fraction
Decay rate used	λ	8.35E-109 d^{-1}
Rate of contaminant flow due to retardation	u	3.54E-08 m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.31E+01 mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.02E+00**

Remedial Targets

Remedial Target		**8.26E+00**	**mg/l**
Ogata Banks			
Distance to compliance point		**100**	**m**
Concentration of contaminant at compliance point	C_{ED}/C_0	**3.31E+01**	**mg/l**
after		**1.0E+100**	**days**

For comparison with measured groundwater concentration.

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)

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient — Kd — 1.60E+07 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer — foc — fraction

Organic carbon partition coefficient — Koc — l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species — $K_{oc,n}$ — l/kg

Sorption coefficient for ionised species — $K_{oc,i}$ — l/kg

pH value — pH

acid dissociation constant — pKa

Fraction of organic carbon in aquifer — foc — fraction

Soil water partition coefficient — Kd — 1.60E+07 l/kg

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

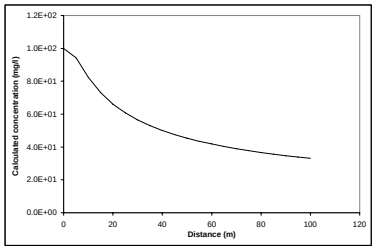
Dispersivity based on Xu & Eckstein (1995)

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	1.00E+00	4.42E+00	m
Transverse dispersivity	**az**	0.00E+00	1.00E+00	4.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.00E-03	4.42E-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 = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



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

Note

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

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

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

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

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

Site being assessed:	Bridge Road
Completed by:	AC
Date:	29/2/2008
Version:	3.1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+02
5.0	9.44E+01
10.0	8.23E+01
15.0	7.30E+01
20.0	6.60E+01
25.0	6.07E+01
30.0	5.64E+01
35.0	5.30E+01
40.0	5.00E+01
45.0	4.76E+01
50.0	4.54E+01
55.0	4.35E+01
60.0	4.19E+01
65.0	4.04E+01
70.0	3.90E+01
75.0	3.78E+01
80.0	3.67E+01
85.0	3.57E+01
90.0	3.47E+01
95.0	3.39E+01
100.0	3.31E+01

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.1

Date of Workbook Issue: October 2006

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.

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

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:	Bridge Road			
Site Address:	Lymington			
Completed by:	AC			
Date:	29-Feb-08		Version:	3.1
Contaminant	TPH Aromatic C21	- C35		
Target Concentration (C_T)	1.4	mg/l	Origin of C_T:	Using level 4 dilution factor see report section 5.5.1

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 comparision 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 3.1

Level 1 - Soil

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

User specified value for partition coefficient

Contaminant		**TPH Aromatic C21 - C35**	
Target concentration	C_T	**1.4**	**mg/l**

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**
Standard entry				
Water filled soil porosity	θ_w	3.49E-01	fraction	Porosity Calculator
Air filled soil porosity	θa	0.00E+00	fraction	Porosity Calculator
Bulk density of soil zone material	ρ	1.81E+00	g/cm^3	Maximum sand value (Consim)
Henry's Law constant	H	6.70E-04	dimensionless	*TPHCWG (at 10 - 25°C)*
Entry if specify partition coefficient (option)				
Soil water partition coefficient	Kd	2.02E+03	l/kg	*RIVM 711701015 Appendix 6*
Entry for non-polar organic chemicals (option)				
Fraction of organic carbon (in soil)	foc		fraction	
Organic carbon partition coefficient	Koc		l/kg	
Entry for ionic organic chemicals (option)				
Sorption coefficient for neutral species	$K_{oc,n}$		l/kg	
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg	
pH value	pH		pH units	
Acid dissociation constant	pKa			
Fraction of organic carbon (in soil)	foc		fraction	
Soil water partition coefficient used in Level Assessment	**Kd**	**2.02E+03**	**l/kg**	*Specified value*

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.

Level 1 Remedial Target

Level 1 Remedial Target	**2.82E+03**	**mg/kg**	**(for comparison with soil analyses)**
	or		
	1.4	**mg/l**	**(for comparison with leachate test results)**

Site being assessed:	Bridge Road
Completed by:	AC
Date:	29-Feb-08
Version:	3.1

Remedial Targets Worksheet , Release 3.1

Level 2 - Soil

Contaminant		**TPH Aromatic C21 - C35**		from Level 1	This sheet calculates the Level 2 remedial target for soils (mg/kg) or for pore water (mg/l).
Target concentration	**C_T**	**1.4**	**mg/l**	from Level 1	

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 contamiantion' (Environment Agency 2006)

Input Parameters	**Variable**	**Value**	**Unit**	**Source of parameter value**	
Standard entry					
Infiltration	Inf	6.55E-04	m/d	**om www.nwl.ac.uk (20% of rainfall plus 10% for drair**	
Area of contaminant source	A	2.40E+04	m^2	**Site Data**	Not used in calculation
Entry for groundwater flow below site					
Length of contaminant source in direction of groundwater flow	L	2.06E+02	m	**Site Data**	
Saturated aquifer thickness	da	1.32E+00	m	**Av MG thickness minus Av Groundwater depth**	
Hydraulic Conductivity of aquifer in which dilution occurs	K	5.18E+02	m/d	**Minimum Gravel value (Consim)**	
Hydraulic gradient of water table	i	1.98E-03	fraction	**Site Data**	
Width of contaminant source perpendicular to groundwater flow	w	1.40E+02	m	**Site Data**	Not used in calculation
Background concentration of contaminant in groundwater beneath site	Cu	0.00E+00	mg/l		
Define mixing zone depth by specifying or calculating depth (using pull down list)		**Calculate**			
Enter mixing zone thickness	Mz		m		
Calculated mixing zone thickness	Mz	1.32E+00	m		

Calculated Parameters

Dilution Factor	**DF**	**1.10E+01**		
Level 2 Remedial Target		**1.54E+01**	**mg/l**	**For comparison with measured pore water concentration. This assumes Level 1 Remedial Target is based on Target Concentra**
		or		
		3.11E+04	**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:	Bridge Road
Completed by:	AC
Date:	29-Feb-08
Version:	3.1

R&D Publication 20 Remedial Targets Worksheet, Release 3.1

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		TPH Aromatic C21 - C35		from Level 1
Target Concentration	C_T	1.40E+00	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	1.00E+02	mg/l	
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+100	days	*New Zealand Ministry for the Environment*
Calculated decay rate	λ	6.93E-101	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.40E+02	m	*Site Data*
Plume thickness at source	Sy	1.27E+00	m	*Site Data*
Saturated aquifer thickness	da	1.32E+00	m	*Av MG thickness minus Av Groundwater d*
Bulk density of aquifer materials	ρ	1.81E+00	g/cm^3	Maximum sand value (Consim)
Effective porosity of aquifer	n	3.49E-01	fraction	*Porosity Calculator*
Hydraulic gradient	i	1.98E-03	fraction	*Site Data*
Hydraulic conductivity of aquifer	K	5.18E+02	m/d	*Minimum gravel value (Consim)*
Distance to compliance point	x	1.00E+02	m	*Site Data*
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	1.00E+100	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.02E+03	l/kg	*see options*
Longitudinal dispersivity	ax	4.42E+00	m	*see options*
Transverse dispersivity	az	4.42E-01	m	*see options*
Vertical dispersivity	ay	4.42E-02	m	*see options*

Calculated Parameters

	Variable	
Groundwater flow velocity	v	2.94E+00 m/d
Retardation factor	Rf	1.05E+04 fraction
Decay rate used	λ	6.63E-105 d^{-1}
Rate of contaminant flow due to retardation	u	2.81E-04 m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.31E+01 mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.02E+00**

Remedial Targets

Remedial Target		**4.23E+00**	**mg/l**
Ogata Banks			
Distance to compliance point		**100**	**m**
Concentration of contaminant at compliance point	C_{ED}/C_0	**3.31E+01**	**mg/l**
after		**1.0E+100**	**days**

For comparison with measured groundwater concentration.

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)

Soil water partition coefficient — Kd — 2.02E+03 l/kg

Entry for non-polar organic chemicals (option)

Fraction of organic carbon in aquifer — foc — fraction

Organic carbon partition coefficient — Koc — l/kg

Entry for ionic organic chemicals (option)

Sorption coefficient for related species — $K_{oc,n}$ — l/kg

Sorption coefficient for ionised species — $K_{oc,i}$ — l/kg

pH value — pH

acid dissociation constant — pKa

Fraction of organic carbon in aquifer — foc — fraction

Soil water partition coefficient — Kd — 2.02E+03 l/kg

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

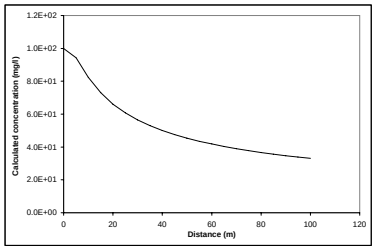
Dispersivity based on Xu & Eckstein (1995)

		Enter value	Calc value	Xu & Eckstein	
Longitudinal dispersivity	**ax**	0.00E+00	1.00E+00	4.42E+00	m
Transverse dispersivity	**az**	0.00E+00	1.00E+00	4.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.00E-03	4.42E-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 = $0.83(\log_{10}x)^{2.414}$; az = ax/10, ay = ax/100 are assumed



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

Note

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

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

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

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

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

Site being assessed:	Bridge Road
Completed by:	AC
Date:	29/2/2008
Version:	3.1

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.0E+02
5.0	9.44E+01
10.0	8.23E+01
15.0	7.30E+01
20.0	6.60E+01
25.0	6.07E+01
30.0	5.64E+01
35.0	5.30E+01
40.0	5.00E+01
45.0	4.76E+01
50.0	4.54E+01
55.0	4.35E+01
60.0	4.19E+01
65.0	4.04E+01
70.0	3.90E+01
75.0	3.78E+01
80.0	3.67E+01
85.0	3.57E+01
90.0	3.47E+01
95.0	3.39E+01
100.0	3.31E+01