A38 Derby Junctions

TR010022

Volume 6

6.14 Environmental Statement Addendum

Regulation 5(2)(q)

Planning Act 2008

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and Procedure) Regulations 2009**

A38 Derby Junctions
Development Consent Order 202[ ]

Environmental Statement Addendum

Regulation Number	Regulation 5(2)(q)
Planning Inspectorate Scheme Reference	TR010022
Application Document Reference	6.14
Author	A38 Derby Junctions Project Team, Highways England

Version	Date	Status of Version
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Table of contents

Chapter **Pages**

List of Tables

List of Appendices

Appendix 1: 8.38 – Cross Section of Kingsway Junction Northern Dumbbell – 19.12.19 [**REP2-022**]

Appendix 2: 8.48 – Additional Air Quality Information Submitted to Derby City Council (DCiC) – 19.12.19 [**REP3-019**]

Appendix 3: 8.75 – Updated Air Quality Compliance Risk Assessment – 3.3.20 [**REP6-020**]

Appendix 4: 8.86 – Supplement to Air Quality Compliance Risk Assessment – 10.3.20 [**REP7-009**]

Appendix 5: 8.47 – WHS Photomontages – 19.12.19 [**REP3-018**]

Appendix 6: 8.37 – Additional Photomontages – 19.11.19 [**REP2-021**]

Appendix 7: 8.85 – Veteran Tree Loss T358 – 10.3.20 [**REP7-008**]

Appendix 8: 8.50 – Hedgerows within the Order Limits – 19.12.19 [**REP3-021**]

Appendix 9: 8.61 – Ecological Impact Assessment of Alfreton Road Local Wildlife Site (LWS) – 3.2.20 [**REP4-023**]

Appendix 10: 8.77 – Technical Note on Noise Assessment – The Averaging Time (T) and the Duration of Impact – 3.3.20 [**REP6-021**]

Appendix 11: 8.49 – Additional Soil and Groundwater Contamination Information submitted to the Environment Agency (EA) – 19.12.19 [**REP3-020**]

Appendix 12: 8.57 – Technical Note on Controlled Waters Quantitative Risk Assessment – 3.2.20 [**REP4-019**]

Appendix 13: 8.45 – Little Eaton Junction Existing & Proposed Rights of Way Plan – 19.12.19 [**REP3-016**]

Appendix 14: 8.58 – Floodplain Compensation Area – Contours Before and After Excavation Works – 3.2.20 [**REP4-020**]

Environmental Statement Addendum

1. Introduction

1.1 Purpose of the report

1.1.1 An Environmental Impact Assessment (EIA) has been undertaken for the A38 Derby Junctions scheme (referred to herein as 'the Scheme') and an Environmental Statement (ES) has been prepared in accordance with the Infrastructure Planning (Environmental Impact Assessment) Regulations 2017 (as amended 2018) (the EIA Regulations). In accordance with the requirements of the EIA Regulations, the ES contains an assessment of the potential significant effects on the environment that may be caused during construction, operation and maintenance of the Scheme and describes proposed mitigation measures.

1.1.2 The ES for the Scheme comprises the following:

- ES Chapters [TR010022/APP/6.1]
- ES Figures [TR010022/APP/6.2]
- ES Appendices [TR010022/APP/6.3]
- ES Non-technical Summary (NTS) [TR010022/APP/6.4]

1.1.3 The ES for the Scheme was submitted to the Planning Inspectorate as part of the Development Consent Order (DCO) application on 23 April 2019. The DCO Examination stage commenced on 8 October 2019, with the last hearings being held on 10 June 2020. During the Examination various changes have been made to some ES chapters, figures and appendices as follows:

- ES Chapter 7: Landscape and Visual [**REP2-008**];
- ES Chapter 8: Biodiversity [**REP9-009**];
- ES Chapter 12: People and Communities [**REP9-011**];
- ES Figure 7.1A: Kingsway and Markeaton Zone of Theoretical Visibility (ZTV) [**REP2-010**];
- ES Figure 7.5 Representative Viewpoints 1 – 24 [**REP9-013**];
- ES Appendix 2.2: Environmental Mitigation Schedule (version submitted at Deadline 14);
- ES Appendix 7.2: Arboricultural Impact Assessment Report [**REP9-014**];
- ES Appendix 2.1: Outline Environmental Management Plan (OEMP) (version submitted at Deadline 14 – same as DCO document 6.12);
- ES Appendix 8.20 Summary of Biodiversity Effects [**REP9-015**];
- ES Appendix 13.2A: Kingsway Flood Risk Assessment [**REP9-017**];
- ES Appendix 13.2B: Markeaton Flood Risk Assessment [**REP9-018**].

1.1.4 These ES updates have previously been submitted to the Examination and a full record of those revisions and applicable document references are provided in the Guide to the Application [**TR010022/APP/8.2**], which comprises the master list of all documents submitted and updated during the Examination.

1.1.5 In addition to ES updates as detailed above, during the Examination additional technical information, figures and assessments have been prepared and submitted in response to questions from the Examining Authority (ExA) and stakeholders.

1.1.6 This document comprises an ES Addendum and contains additional technical information and assessments of relevance to the ES, as detailed in Table 1.1. Table 1.1 also details how the information as contained in this ES Addendum relates to the ES.

1.1.7 It is noted that the information as contained in this ES Addendum does not change the finding of the ES, including the levels of effect significance.

Table 1.1: ES Addendum contents

Appendix No	Document Name/ Date	Details	Relationship with the ES	Examination Reference no
1	8.38 – Cross Section of Kingsway Junction Northern Dumbbell – 19.12.19	Comprises two cross sections of the Kingsway junction northern dumbbell roundabout, showing associated planting (as requested by the Examining Authority).	This would form a new figure to ES Chapter 2: The Scheme [**APP-040**]	[**REP2-022**]
2	8.48 – Additional Air Quality Information Submitted to Derby City Council (DCiC) – 19.12.19	Comprises additional information on air quality as submitted to DCiC regarding air quality compliance with the EU limit value for nitrogen dioxide (NO_2).	This information would form a new appendix to ES Chapter 5: Air Quality [**APP-043**]	[**REP3-019**]
3	8.75 – Updated Air Quality Compliance Risk Assessment – 3.3.20	Comprises additional information regarding Highways England's approach to the updated compliance risk assessment in line with Design Manual for Roads and Bridges (DMRB) LA 105 Air Quality.	This information would form a new appendix to ES Chapter 5: Air Quality [**APP-043**]	[**REP6-020**]

Appendix No	Document Name/ Date	Details	Relationship with the ES	Examination Reference no
4	8.86 – Supplement to Air Quality Compliance Risk Assessment – 10.3.20	Contains additional information to that provided in 8.75 Updated Air Quality Compliance Risk Assessment [REP6-020] following a request from DCiC - includes predicted NO_2 concentrations at qualifying features in 2021 and a more detailed map showing the location of Pollution Climate Mapping (PCM) links and qualifying features.	This information would form a new appendix to ES Chapter 5: Air Quality [**APP-043**]	[**REP7-009**]
5	8.47 – WHS Photomontages – 19.12.19	Comprises additional photomontages as requested by DCiC as related to Scheme impacts upon the Derwent Valley Mills World Heritage Site (DVMWHS).	These photomontages would form a new appendix to ES Chapter 6: Cultural Heritage [**APP-044**]	[**REP3-018**]
6	8.37 – Additional Photomontages – 19.11.19	Comprises additional photomontages from selected locations as requested by the Examining Authority.	These photomontages would form a new appendix to ES Chapter 7: Landscape and Visual [**APP-045**]	[**REP2-021**]
7	8.85 – Veteran Tree Loss T358 – 10.3.20	Comprises details of Highways England's approach to veteran oak tree T358 located near the existing Markeaton footbridge (north of Markeaton junction).	This information would form a new appendix to ES Chapter 7: Landscape and Visual [**APP-045**]	[**REP7-008**]
8	8.50 – Hedgerows within the Order Limits – 19.12.19	Plan showing hedgerows within the Order Limits, including the identification of which hedgerows would be retained and lost due to the Scheme (plus details of hedgerow ecological and cultural heritage interest).	This would form a new figure to ES Chapter 7: Landscape and Visual [**APP-045**]	[**REP3-021**]

Appendix No	Document Name/ Date	Details	Relationship with the ES	Examination Reference no
9	8.61 – Ecological Impact Assessment of Alfreton Road Local Wildlife Site (LWS) – 3.2.20	As requested by Derbyshire Wildlife Trust (DWT) and Erewash Borough Council (EBC) during a site visit to Alfreton Road Rough Grassland Local Wildlife Site (LWS) on the 22nd January 2020, this Technical Note provides a summary of the biodiversity assessment based on significance of effects as presented in the Environmental Statement (ES) Chapter 8: Biodiversity [**APP-046**] and the proposed mitigation and monitoring measures for the LWS set out in the Outline Environmental Management Plan (OEMP).	This information would form a new appendix to ES Chapter 8: Biodiversity [**REP9-009**]	[**REP4-023**]
10	8.77 – Technical Note on Noise Assessment – The Averaging Time (T) and the Duration of Impact – 3.3.20	Comprises a Technical Note providing details how the Averaging Time (T) and the Duration of Impact have been used during the determination of noise effects (as requested by the Examining Authority).	This information would form a new appendix to ES Chapter 9: Noise and Vibration [**APP-047**]	[**REP6-021**]
11	8.49 – Additional Soil and Groundwater Contamination Information submitted to the Environment Agency (EA) – 19.12.19	Comprises additional information as sent to the EA regarding groundwater quality in the areas of the A38 junctions, namely tables of chemical data and figures presenting borehole locations where exceedances of the Tier 1 groundwater risk assessment were recorded.	This information would form a new appendix to ES Chapter 10: Geology and Soils [**APP-048**]	[**REP3-020**]
12	8.57 – Technical Note on Controlled Waters Quantitative Risk Assessment – 3.2.20	Comprises additional information as issued to the EA regarding the controlled waters Quantitative Risk Assessment (QRA).	This information would form a new appendix to ES Chapter 10: Geology and Soils [**APP-048**]	[**REP4-019**]

Appendix No	Document Name/ Date	Details	Relationship with the ES	Examination Reference no
13	8.45 – Little Eaton Junction Existing & Proposed Rights of Way Plan – 19.12.19	Comprises a plan showing existing and proposed footpaths and public rights of way at Little Eaton junction (as requested by the Examining Authority).	This would form a new figure to ES Chapter 12: People and Communities [**REP9-011**]	[**REP3-016**]
14	8.58 – Floodplain Compensation Area – Contours Before and After Excavation Works – 3.2.20	Comprises a figure showing land contours at the floodplain compensation area at Little Eaton junction before and after excavation works (as requested by the Examining Authority).	This would form a new figure to ES Chapter 13: Road Drainage and the Water Environment [**APP-051**]	[**REP4-020**]

Appendix 1: 8.38 – Cross Section of Kingsway Junction Northern Dumbbell – 19.12.19 [REP2-022]

A38 Derby Junctions

TR010022

8.38 Cross Section of Kingsway Junction Northern Dumbbell

Volume 8.38

Rule 8 (1)(c)(ii)

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November 2019

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

A38 Derby Junctions

Development Consent Order 202[ ]

Cross Section of Kingsway Junction Northern Dumbbell

Regulation Number	Rule 8 (1)(c)(ii)
Planning Inspectorate Scheme Reference	TR010022
Application Document Reference	8.38
Author	A38 Derby Junctions AECOM Project Team and Highways England

Version	**Date**	**Status of Version**
1	November 2019	Deadline 2 Submission

Drawing Number	Drawing Title	Revision
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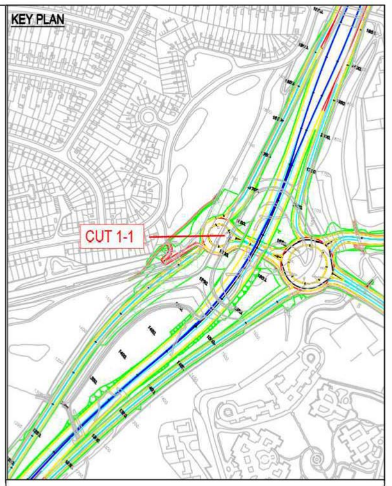
HE514503-ACM-HGN-A38_Z1_ZZ_ZZ-DR-SK-0002	KINGSWAY CROSS SECTION CUT 2-2	P01.1



NOTES

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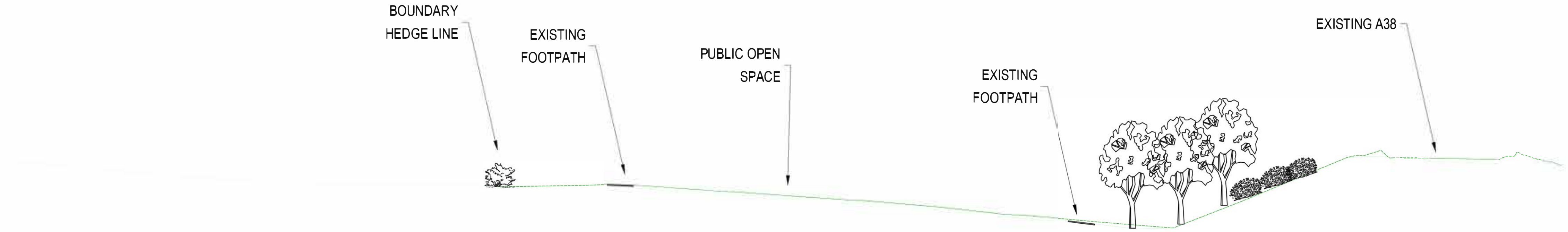

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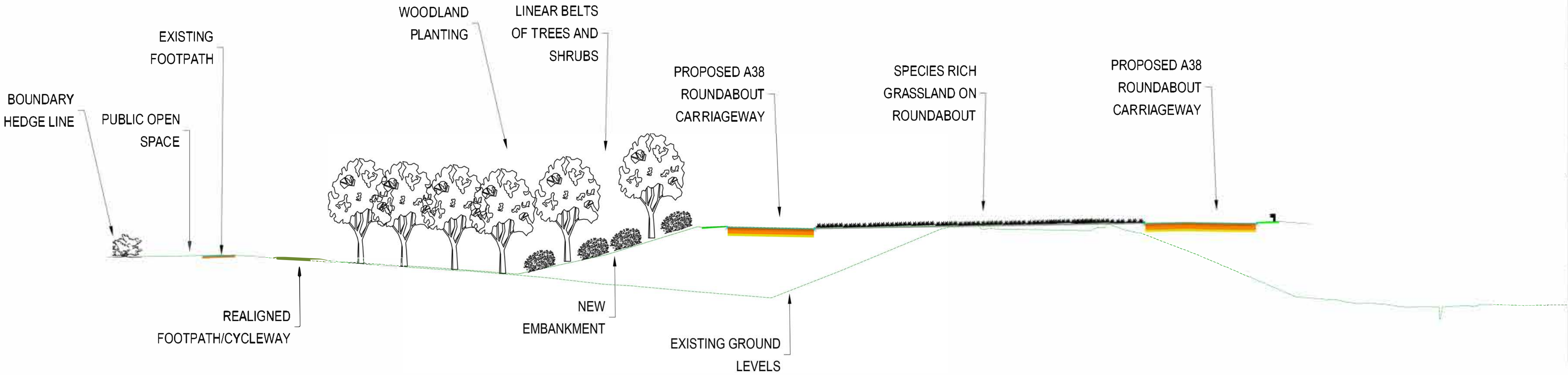

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First Issue	--- / ---	11/11/19	P01.1
Revision Details	By / Check	Date	Suffix

Purpose of issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
KINGSWAY CROSS SECTION
CUT 1-1

Designed	Drawn	Checked	Approved	Date
GS		SW	SW	15/11/19

Internal Project No.	Suitability
60533462	D7
Scale @ A1	Zone
---	A38/A5111 Kingsway

Drawing Number
Highways England PIN | Originator | Volume
CH -ACM -HGN -
Z1_ZW_ZZ_ZZ -DR -SK -0001
Location | Type | Role | Number

Rev
P01.1

Plot Date 15 November 2019 11:21:18
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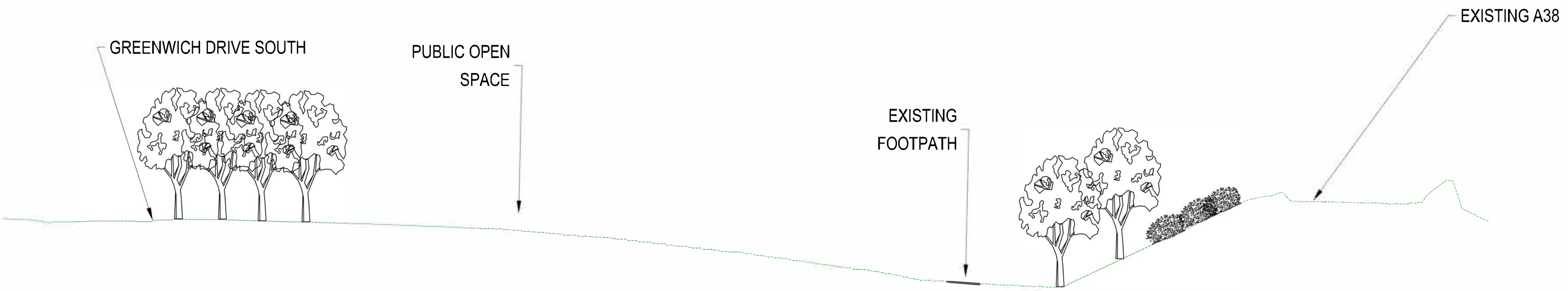

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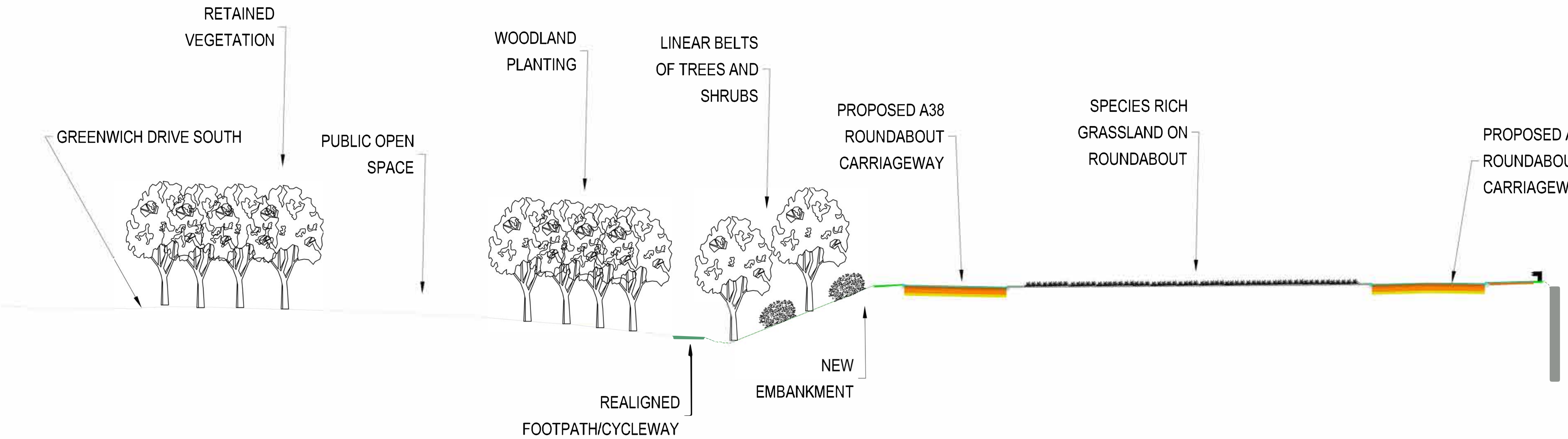

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PROPOSED
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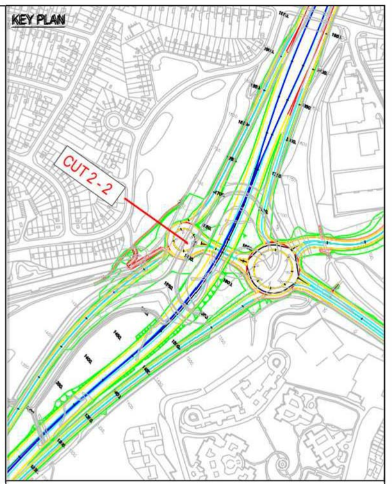
KEY PLAN



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First Issue	— / —	11/11/19	P01.1
Revision Details	By / Check	Date	Suffix

Purpose of issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
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Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
KINGSWAY CROSS SECTION
CUT 2-2

Designed	Drawn	Checked	Approved	Date
GS		SW	SW	15/11/19

Internal Project No.: 60533462
Suitability: D7
Scale @ A1: 1:200
Zone: A38/A5111 Kingsway

Drawing Number
Highways England PIN | Originator | Volume
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Location | Type | Role | Number
Rev P01.1

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Appendix 2: 8.48 – Additional Air Quality Information Submitted to Derby City Council (DCiC) – 19.12.19 [REP3-019]

A38 Derby Junctions

TR010022

8.48 Additional Air Quality Information Submitted to DCiC

Planning Act 2008

Rule 8 (1)(c)(ii)

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The Infrastructure Planning (Examination Procedure) Rules 2010

A38 Derby Junctions
Development Consent Order 202[ ]

Additional Air Quality Information Submitted to DCiC

Regulation Number	Rule 8(1)(c)(ii)
Planning Inspectorate Scheme Reference	TR010022
Application Document Reference	8.48
Author	A38 Derby Junctions Project Team, Highways England

Version	Date	Status of Version
1	19 December 2019	Deadline 3 Submission

1 Additional Information Issued to Derby City Council (DCiC) on 2.12.19 regarding Air Quality Compliance with the EU Limit Value for Nitrogen Dioxide (NO_2)

In response to the ExA's first round of written questions, question 5.25, relating to exceedances of EU limit values for NO_2, further work has been carried out by Highways England.

The ExA question asked whether the local authorities agreed with the areas identified by the Applicant as exceeding the EU limit value for NO_2 and if they did not agree, why not and how do they consider that the areas identified should be amended. DCiC responded [REP1-034] to this question with:

"Currently, thus is not fully agreed. In terms of the methodology used in the ES for compliance-checking against the EU AQ Directive for annual average NO_2, there is an underlaying disparity between it and the methodology used to predict potential exceedances of the EU limit value for annual average NO_2, as prescribed by Defra. This relates to the location of modelled receptors, which is standardised in the Defra methodology to a point exactly 4 metres from the kerb, whereas the approach utilised within the ES uses a point at the façade of the closest receptor to the kerb.

In the majority of cases, the A38 Scheme ES approach will be more conservative and therefore is of little concern regarding a potential EU Directive exceedance, however further sense-checking is needed in relation to some of the modelled receptor points against the Defra methodology, utilising a modelled point at 4m from the kerb. This would need to include any receptors which:

- *Are located adjacent to a road link which is predicted to experience a notable increase in traffic volume AADT's post-scheme completion, AND*
- *Which are located between 4m and 10m from the kerb, AND*
- *Which already experience annual average NO_2 concentrations close to, or higher than, 40 $\mu g/m^3$."*

DCiC provided Highways England with their modelled NO_2 concentrations at receptors 4m from the kerb for 2016 and 2020. These predictions are the most up to date for compliance reporting. NO_2 concentrations in the Scheme construction year of 2021 and opening year of 2024 were estimated from the 2020 concentrations by linear extrapolation based on the rate of change between 2016 and 2020.

Roads which were predicted to experience a notable change in traffic flows or realignment are included in the affected road network and are shown in ES Figures 5.2 and 5.3 [APP-072 and APP-073]. Roads with concentrations above 35$\mu g/m^3$ in 2020 in the compliance assessment and are expected to be affected by the Scheme were identified as these roads are most at risk of being non-compliant should the Scheme increase NO_2 concentrations. The largest change in NO_2 concentrations predicted due to the Scheme was 5.0$\mu g/m^3$.

Where the road alignment is not changed due to the Scheme, the change in NO_2 concentrations at a Scheme receptor is due to changes in traffic flows and speeds resulting from the Scheme. In some areas, realignment of the A38 will also cause a change in NO_2 concentrations. Changes to the A38 alignment could affect the location of the compliance receptors as these are required to be 4m from the kerb. The Ambient Air Quality Directive (2008/50/EC) sets the limit values for NO_2. The Directive notes in Annex III that compliance with the limit values directed at the protection of human health should not be assessed at any locations situated within areas where members of the public do not have access and there is no fixed habitation. During Scheme construction, some of the compliance receptors will be located within the Scheme construction site where members of the public would not have access, it is therefore not appropriate to assess concentrations within the construction site so these compliance receptors should be relocated to somewhere more appropriate.

The A38 was divided into six sections between the junctions for the assessment where traffic flows will be similar. The compliance receptor with the highest concentration in each A38 section was identified and included in the assessment. All of the Scheme receptors near each section of the A38 were identified and the receptor with the largest increase with each scenario was used in the assessment. For other roads with compliance receptor concentrations above 35µg/m^3, the closest Scheme receptor to the compliance receptor was included in the assessment.

As the Scheme receptors are at various distances from the nearest road and compliance receptors are required to be located 4m from the kerb, a relationship between NO_2 concentration and distance from a road (AQC, NO_2 Concentrations and Distance from Roads, 2008) was identified. This relationship was based on measured total NO_2 concentrations near the M25 and was found to be:

$$NO_2 = -8.0726 \ln(\text{distance}) + 67.536$$

This equation was used to adjust modelled Scheme concentrations at various distances from a road to a concentration at 4m from the kerb as the change in concentrations at 4m is greater than that further from the road. The factors used are shown in Table 1 for the Scheme receptors.

Table 1: Distance Adjustment Factors for Scheme Receptors

Scheme Receptor	NO_2 concentration adjustment factor for distance
R37	1.22
R41	1.17
R48	1.11
R82	1.22
R136	1.31
R156	1.57
R157	1.55
R164	1.40
R176	1.31
R177	1.22
R246	1.39
H2	1.67
C5	1.15
R170, R230, R231	1.00

Table 2 below shows the compliance receptor results for 2020 and extrapolated results for 2021 and 2024. The change in NO_2 concentrations expected at 4m from the kerb due to the Scheme are also shown in the table for each of the construction scenarios and the Scheme opening year. The changes due to the Scheme can be added onto the compliance receptor result to determine whether the Scheme would cause non-compliance. One of the compliance receptors, FID 1623, is located on the edge of the A38 near Queensway and the Markeaton junction. This compliance receptor location will be within the construction site during Scheme construction and on the carriageway during Scheme operation. This compliance receptor has therefore been relocated to 4m from the edge of the new carriageway near the Royal School for the Deaf. Rather than predicting the change in NO_2 concentrations at this new receptor, the total concentration has been estimated and this is shown in the table.

The assessment is conservative as the changes due to the Scheme are based on predictions reported in Chapter 5: Air Quality of the Environmental Statement [APP-043] which tends to overestimate NO_2 concentrations in future years. The highest concentration at a compliance receptor near each section of the A38 has been used in the assessment together with the largest increase at a Scheme receptor for each section of the A38. In addition, construction scenario 2 is expected to occur in 2022 and construction scenario 4 in 2023 when concentrations will be lower than in 2021 whereas the assessment has assumed that all construction scenarios would occur in 2021.

Table 2 indicates that NO_2 concentrations at the compliance receptors are within the limit value with all construction scenarios and during the Scheme opening year. The closest results to the limit value (above 38.5µg/m^3) are near Markeaton junction close to the Royal School for Deaf during construction scenario 4 and near Lyttelton Street/ A38 during construction scenario 2.

Table 2: Estimated Change in NO_2 Concentrations at Compliance Receptors due to the Scheme

Road Link	**Compliance receptor concentration without Scheme**	**Increase in NO_2 at compliance receptor 4m from kerb (µg/m^3)** *** total NO_2 concentration (µg/m^3) at relocated receptor 4m from kerb** ***(*xxx: y) denotes the Scheme receptor number and value at that receptor**			
		Operation (2024)	**Construction Scenario 0 (2021)**	**Construction Scenario 2 (2021)**	**Construction Scenario 4 (2021)**
A38 south of A516 (west of A38)	FID 2107 2020: 35.97 2021: 35.84 2024: 35.43	0.0	0.0	0.1 (R246: 0.1)	<0.0
A38 north of A516 (west of A38) and south of A516 (east of A38 off slip)	FID 370 2020: 39.62 2021: 37.84 2024: 32.51	0.7 (R164: 0.5)	0.0	0.4 (R164: 0.3)	<0.0
A38 north of A516 (east of A38) and south of Kingsway junction	FID 1051 2020: 32.07 2021: 30.48 2024: 25.71	<0.0	0.0	0.2 (H2: 0.1)	<0.0
A38 north of Kingsway junction and south of Markeaton junction	FID 1159 2020: 37.42 2021: 35.65 2024: 30.33	1.7 (R157: 1.1)	1.2 (R136: 0.9)	4.1 (R156: 2.6)	0.5 (R157: 0.3)
A38 north of Markeaton junction and south of Kedleston Road	FID 1623 * 2020: 35.79 2021: 34.07 2024: 28.90	*Concentration of 31.7µg/m^3 (R176: 24.2)	*Concentration of 32.5µg/m^3 (R176: 24.8)	*Concentration of 38.1µg/m^3 (R176: 29.1)	*Concentration of 38.9µg/m^3 (R176: 29.7)
A38 north of Kedleston Rd and south of A6	FID 1988 2020: 35.80 2021: 33.73 2024: 27.50	2.1 (R48:1.9)	0.3 (R37: 0.2, R41: 0.2)	0.3 (R37: 0.2, R41 0.2)	<0.0
A601 / King St	FID 1416 2020: 37.74 2021: 36.40 2024: 32.39	-	0.0 (R230: 0.0)	0.5 (R230: 0.5)	0.4 (R230: 0.4)
St Alkmunds Way / Eastgate	FID 1248 2020: 37.57 2021: 36.22 2024: 32.18	-	0.0 (R231: 0.0)	0.1 (R231: 0.1)	0.1 (R231: 0.1)
A601 Traffic St	FID 1072 2020: 37.97 2021: 36.17 2024: 30.75	0.4 (R170: 0.4)	0.0 (R170 :0.0)	-0.1 (R170: -0.1)	0.0 (R170 :0.0)
A601 St Alkmunds Way / Agard St	FID 1451 2020: 36.61 2021: 35.48 2024: 32.07	-0.2 (C5: -0.2)	0.0 (C5: 0.0)	-0.2 (C5: -0.2)	0.0 (C5: 0.0)
A601 Causey Bridge	FID 1257 2020: 36.64 2021: 35.27 2024: 31.14	-	0.0 (R231: 0.0)	0.1 (R231: 0.1)	0.1 (R231: 0.1)
A601 Causey Bridge	FID 1256 2020: 36.43 2021: 35.08 2024: 31.01	-	0.0 (R231: 0.0)	0.1 (R231: 0.1)	0.1 (R231: 0.1)
A601 Stafford St with traffic management	FID 1454 2020: 35.5 2021: <35.5 2024: <35.5	-1.2 (R197:-1.2)	0.1 (R197: 0.1)	-0.1 (R197:-0.1)	-0.5 (R197:-0.5)

* receptor relocated to 4m from new carriageway

Appendix 3: 8.75 – Updated Air Quality Compliance Risk Assessment – 3.3.20 [REP6-020]

A38 Derby Junctions

TR010022

8.75 Updated Air Quality Compliance Risk Assessment

Planning Act 2008

Rule 8 (1)(c)(ii)

The Infrastructure Planning (Examination Procedure) Rules 2010

Volume 8

March 2020

Infrastructure Planning

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The Infrastructure Planning (Examination Procedure) Rules 2010

A38 Derby Junctions
Development Consent Order 202[ ]

Updated Air Quality Compliance Risk Assessment

Regulation Number	Rule 8(1)(c)(ii)
Planning Inspectorate Scheme Reference	TR010022
Application Document Reference	8.75
Author	A38 Derby Junctions Project Team & Highways England

Version	Date	Status of Version
1	3 March 2020	Deadline 6 Submission

Introduction

In November 2019, Highways England (HE) released revised air quality guidance entitled: LA105 Air quality. The new air quality guidance was discussed at the A38 Derby Junctions (referred to herein as “the Scheme”) Issue Specific Hearing on 11th December 2019 [REP3-015, Question 17a] and its implications for the Scheme’s air quality assessment considered in response to two written questions [REP 4 – 024, Questions 3.1 and 3.5]. Further questions were raised for the Issue Specific Hearing (ISH4) on 19th February 2020 [EV-014 item 5] as to whether applying the revised guidance would affect the potential for significant air quality effects.

HE responded to the second round of written questions that application of the new guidance was not anticipated to trigger a significant air quality effect or affect reported compliance with the Ambient Air Quality Directive (2008/50/EC) [REP 4 – 024, Questions 3.1 and 3.5].

This note sets out:

- Highways England’s approach to the updated compliance risk assessment in line with LA105; and
- Updates the information previously provided to this examination relating to Derby City Council (Appendix B), although this is not a requirement of LA105.

Updated Air Quality Compliance Risk Assessment (LA 105)

The new LA105 guidance requires the assessment to be made at “qualifying features” within 15m of the running lane and the assessment to be based on local modelled results. The Defra/DfT Joint Air Quality Unit (JAQU) requires qualifying features to be next to a Pollution Climate Mapping (PCM) link as defined by JAQU, these include residential properties, schools and footpaths running parallel to a carriageway. Qualifying features do not include pedestrian crossings or areas within 25m of junctions.

Road links in Defra’s PCM model within the A38 Derby Junctions air quality study area have been identified for this compliance assessment as these roads are assessed for compliance by Defra. These roads include the A38, A601 Inner Ring Road, A52 Ashbourne Road, A516 Uttoxeter New Road and A6 Duffield Road. These roads are the focus of this LA105 compliance risk assessment.

Scheme Compliance Assessment

The LA105 guidance requires compliance to be assessed at qualifying features which includes footpaths. This was not a requirement of the previous compliance guidance (Interim Advice Note 175/13) and therefore footpaths adjacent to roads were not considered in the original compliance assessment for the A38 Derby Junctions scheme.

There are footpaths located adjacent to the A38 carriageway near Markeaton junction and across the air quality study area.

Qualifying features within 15m of the running lane were identified for 24 PCM links covered by the affected road network for this Scheme. Receptors representing the nearest qualifying feature for all PCM links included in the study have been assessed. The footpaths alongside the A38 have been repositioned for the purposes of the assessment where they would be realigned as part of the Scheme. Annual mean NO_2 concentrations were modelled at the qualifying features for the opening year of the Scheme (2024) presented in Table 1 and for the three construction scenarios (Scenarios 0, 2 and 4) in 2021 alongside the A38 only. A figure illustrating the PCM links considered in this assessment is provided in Appendix A.

Update to Model Verification

As footpaths had not been considered prior to the release of LA105, monitoring data from around the study area has been reviewed to identify whether there was any additional monitoring data for footpaths. Monitoring by DCiC had commenced at a location close to a footpath next to the A38, located approximately 200m south of Markeaton junction in 2016 (Site DT34 as included in Appendix 5.1: Air Quality Monitoring Data, Table 2 [APP-170]) and shown on ES Figure 5.4 [APP-074]).

NO_2 concentrations have been measured above the annual mean EU limit value at this site with measurements of 60 $\mu g/m^3$ in 2016 and 2017. Measured concentrations at this site were higher than at other locations near the A38, for example a kerbside site (DJ032) on the western side of the A38 which measured 45 $\mu g/m^3$ in 2015. Site DT34 was not included in the study wide model verification.

There are a number of monitoring locations around the A38 and they have been reviewed to see whether a more local verification factor would be more appropriate to describe qualifying features within 15m of the PCM links (e.g. footpaths) in this locality or whether the general verification developed for the modelling to date was still representative. With the exception of DT34, the previous model verification factor provided a reasonable representation of modelled concentrations alongside the A38. However, the model continued to under-predict the annual mean NO_2 concentrations at DT34, representative of the footpath on the eastern side of the A38.

As the long term monitored annual mean NO_2 concentrations are above the EU limit value and the diffusion tube managed by DCiC is located at a site representative of the local footpath to the east of the A38 it has been used to develop a local verification factor for this footpath. A local model verification adjustment factor of 3.83 has been calculated to cover this section of footpath alongside the A38. This was to ensure that the absolute concentrations predicted at a qualifying feature were not under-predicted.

Modelled Results

Table 1: Predicted NO_2 Concentrations in Opening Year 2024 at Qualifying Features

PCM Link ID	2024 Do-Minimum (µg/m³)	2024 Do-Something (µg/m³)	Change (µg/m³)
6167	26.3	26.4	0.1
7702	27.8	28	0.2
7877	33	33.1	0.1
16361 (1)	23.1	32.6	9.5
16361 (2)	31.2	15.8	-15.4
16361 (3)	22.2	20.3	-1.9
16520	29.5	29.8	0.3
28014	26.3	26	-0.3
37288 (1)	25.1	24.5	-0.6
37288 (2)	26.5	25.6	-0.9
37288 (3)	26.5	25.6	-0.9
37405	23.4	22.7	-0.7
37967	32.5	32.1	-0.4
38236 (1)	27.5	27.6	0.1
38236 (2)	30.6	30.3	-0.3
46394	18.8	15.5	-3.3
46556 (1)	27.7	27.6	-0.1
46556 (2)	27.7	27.6	-0.1
47986	35.5	35.2	-0.3
56162	21.5	23	1.5
56563	19.3	21.4	2.1
57767 (1)	28.7	20.7	-8
57767 (2)	32.2	20.4	-11.8
57767 (3)	37.5	22.2	-15.3
57767 (4)	33.9	34.1	0.2
57767 (5)	37.3	31.6	-5.7
57767 (6)	27.1	23.5	-3.6
73359	28.5	28.3	-0.2
74456	22.9	23.9	1
75410	25.5	25.8	0.3
75411	24	23.9	-0.1
81247	31.3	31.2	-0.1
83044	35.1	34.1	-1
89268	27.1	25.5	-1.6

27766 (1)	21.6	21.7	0.1
27766 (2)	19	20.8	1.8

Notes:
(1) Individual sections along PCM links with modelled differences in concentrations associated with changes in traffic flows or re-alignment of the A38.

Discussion

As presented in Table 1 the modelled annual mean NO_2 concentrations at qualifying features for all PCM links with the Do-Minimum and Do-Something scenarios in 2024 were below the annual mean limit value near the A38 and across Derby and are therefore compliant for the requirements of the Air Quality Directive.

Concentrations at fixed locations such as residential buildings are shown in ES Chapter 5: Air Quality [APP-043] and Appendix 5.3 [APP-172] and are below the annual mean NO_2 EU limit value in all instances.

The updated air quality assessment has been considered against the published requirements of the National Policy Statement on National Networks (NPS NN) in particular paragraphs 5.12 and 5.13 advice for Decision Makers. The NPS NN states

'5.12. The Secretary of State must give air quality considerations substantial weight where, after taking into account mitigation, a project would lead to a significant air quality impact in relation to EIA and / or where they lead to a deterioration in air quality in a zone / agglomeration.

'5.13 The Secretary of State should refuse consent where, after taking into account mitigation, the air quality impacts of the Scheme will:

- *Result in a zone /agglomeration which is currently reported as being compliant with the Air Quality Directive becoming non-compliant; or*
- *Affect the ability of a non-compliant area to achieve compliance within the most recent timescales reported to the European Commission at the time of the decision.'*

The A38 Scheme is within the East Midlands zone which is currently non-compliant and so the second bullet point of 5.13 is relevant to this Scheme.

Having carried out further work involving detailed modelling for the compliance risk assessment in-line with the LA105 guidance, the conclusion remains the same as given in response to Q5.26 of the first written questions [REP1-005]. The Scheme is not expected to delay the East Midlands zone achieving compliance.

Updated Information for Derby City Council

DCiC has modelled NO_2 concentrations across the city in line with the guidance issued by JAQU to local authorities to support delivery of the Government's National Air Quality Plan. Nitrogen dioxide (NO_2) concentrations were predicted in 2016 and 2020 by DCiC and these have been provided to HE. These concentrations were modelled at 4m from the road. In DCiC's air quality modelling report (AQ3)[1] submitted to JAQU, they acknowledge monitored exceedances alongside the A38. The following is an extract from DCiC's AQ3 report,

"DT34 A38 Kingsway – showing levels between 49 and 51 µg/m³ for all scenarios except the 2025 reference case. Again, this is of little concern with respect to direct health implications as there is no relevant exposure under LAQM standards. This is part of Highways England's strategic road network, rather than Derby City Council's local road network and will be strongly influenced by the proposed A38 improvements with compliance shown in 2025 when this scheme is completed. As such Derby City Council are committed to sharing the outcome of this study and working with Highways England to consider this as appropriate in association with the planned A38 work."

This note considers the likely impacts of assessment of footpaths as qualifying features alongside the A38 and the implications for compliance with the Air Quality Directive in the shortest timescales possible. It is not directly comparable with DCiC's results which were based on modelling at 4m from the road only.

As agreed with DCiC [REP3-019] annual mean NO_2 concentrations in the earliest Scheme construction year (2021) and Scheme opening year (2024) have been modelled, and are provided in Appendix B for information only as they are not a requirement of LA105.

As shown in Appendix B the assessment illustrates that there is a predicted exceedance of the EU Limit Value at DCiC receptor FID1553 in the Do-Something construction scenario SC0. However, as the increase is short term for this construction scenario (which lasts approximately 8 months), the impacts of the construction activities on ambient air quality would not delay compliance as there would be an exceedance on this PCM Link regardless of construction of the scheme. As the construction progresses through the various phases there is subsequently an improvement on PCM links alongside the A38 (PCM Link ID 57767, Appendix A) as the footpaths are realigned as a result of the scheme. This demonstrates that construction will not impact on achievement of compliance in the shortest timescales possible.

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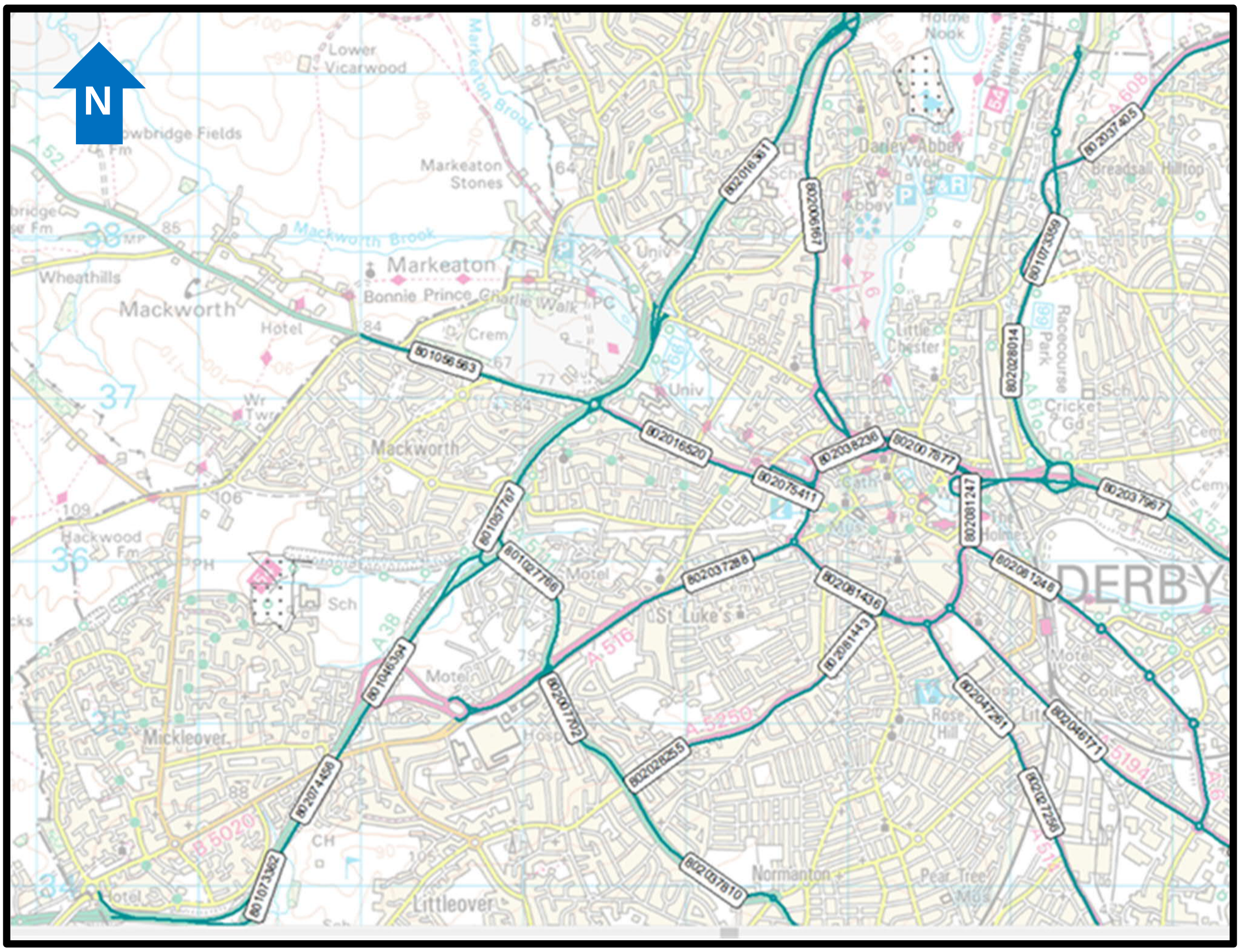
[1] https://www.derby.gov.uk/media/derbycitycouncil/contentassets/documents/transport/airqualityplan/finalbusinesscase/AQ3%20Derby%20Air%20Quality%20Modelling%20Report%20March%202019.pdf

Appendix A: Map of PCM Links Included in the Compliance Risk Assessment



Appendix B: Compliance at DCiC receptors

Table B1: Predicted NO_2 Concentrations in the Opening Year (2024) at DCiC Compliance Receptors (4m point from the edge of the running lane)

DCiC Receptor	**Location**	**DCiC Model**	**Scheme Model (µg/m^3)**		
		Do-Minimum	**Do-Minimum**	**Do-Something**	**Change**
FID370	A38 in between A516 merges	32.5	22.9	23.9	1.0
FID1051	A38 north of A516 and south of Kingsway junction	25.7	20.8	22.3	1.5
FID1159	A38 north of Kingsway junction and south of Markeaton junction	30.3	24.2	22.6	-1.6
FID1621	A38 north of Markeaton junction and south of Kedleston Rd	28.0	24.4	23.1	-1.3
FID1988	A38 north of Kedleston Rd and south of A6	27.5	22.5	24.5	2.0
FID1416	A601 / King St	32.4	29.3	29.2	-0.1
FID1248	St Alkmunds Way / Eastgate	32.2	29.9	29.9	0.1
FID1072	A601 Traffic St	30.8	32.6	32.4	-0.2
FID1451	A601 St Alkmunds Way / Agard St	32.1	27.8	27.6	-0.3
FID1257	A601 St Alkmund's Way / Alice St	31.1	29.9	30.0	0.1
FID1454	A601 Stafford St	<35.5	35.1	34.1	-1.0
Near Markeaton junction					
FID1553	A38 south east of junction	27.6	32.2	19.8	-12.4
FID1575	A38 south west of junction	24.1	31.9	21.0	-10.9
FID1604	A38 north west of junction	26.3	27.3	17.6	-9.7
FID1623	A38 north east of junction	28.9	28.0	22.0	-6.0

Table B2: Predicted NO_2 Concentrations in 2021 with Construction Scenario 0 at DCiC Compliance Receptors (4m point from the edge of the running lane)

DCiC Receptor	Location	DCiC Model	Scheme Model (µg/m^3)		
		Do-Minimum	Do-Minimum	Do-Something	Change
FID2107	A38 south of A516	35.8	25.7	25.7	0.0
FID370	A38 in between A516 merges	37.8	28.8	28.8	0.0
FID1051	A38 north of A516 and south of Kingsway junction	30.5	25.8	25.7	-0.1
FID1159	A38 north of Kingsway junction and south of Markeaton junction	35.7	30.6	30.6	0.0
FID1621	A38 north of Markeaton junction and south of Kedleston Rd	34.1	31.2	31.4	0.2
FID1988	A38 north of Kedleston Rd and south of A6	33.7	28.4	28.4	0.0
FID1416	A601 / King St	36.4	35.2	35.2	0.0
FID1248	St Alkmunds Way / Eastgate	36.2	36.0	36.0	0.0
FID1072	A601 Traffic St	36.2	38.0	38.0	0.0
FID1451	A601 St Alkmunds Way / Agard St	35.6	32.6	32.6	0.0
FID1257	A601 St Alkmund’s Way / Alice St	35.3	36.3	36.3	0.0
FID1454	A601 Stafford St	<35.5	38.6	38.7	0.1
Near Markeaton junction					
FID1553	A38 south east of junction	32.4	**40.2**	**40.5**	0.3
FID1575	A38 south west of junction	28.5	39.4	39.8	0.4
FID1604	A38 north west of junction	31.4	34.4	34.7	0.3
FID1623	A38 north east of junction	34.1	35.1	35.5	0.4

Bold denotes location exceeds the annual mean NO_2 limit value

Table B3: Predicted NO_2 Concentrations in 2021 with Construction Scenario 2 at DCiC Compliance Receptors (4m point from the edge of the running lane)

DCiC Receptor	Location	DCiC Model	Scheme Model (µg/m^3)		
		Do-Minimum	Do-Minimum	Do-Something	Change
FID2107	A38 south of A516	35.8	25.7	25.8	0.1
FID370	A38 inbetween A516 merges	37.8	28.8	29.1	0.3
FID1051	A38 north of A516 and south of Kingsway junction	30.5	25.8	26.0	0.3
FID1159	A38 north of Kingsway junction and south of Markeaton junction	35.7	30.6	32.3	1.7
FID1621	A38 north of Markeaton junction and south of Kedleston Rd	34.1	31.2	27.7	-3.5
FID1988	A38 north of Kedleston Rd and south of A6	33.7	28.4	28.6	0.2
FID1416	A601 / King St	36.4	35.2	35.6	0.4
FID1248	St Alkmunds Way / Eastgate	36.2	36.0	35.9	-0.1
FID1072	A601 Traffic St	36.2	38.0	37.9	-0.1
FID1451	A601 St Alkmunds Way / Agard St	35.6	32.6	32.3	-0.3
FID1257	A601 St Alkmund's Way / Alice St	35.3	36.3	36.4	0.1
FID1454	A601 Stafford St	<35.5	38.6	38.5	-0.1
Near Markeaton junction					
FID1553	A38 south east of junction	32.4	**40.2**	33.0	-7.2
FID1575	A38 south west of junction	28.5	39.4	38.9	-0.5
FID1604	A38 north west of junction	31.4	34.4	30.8	-3.6
FID1623	A38 north east of junction	34.1	35.1	39.6	+4.5

Bold denotes location exceeds the annual mean NO_2 limit value

Table B4: Predicted NO_2 Concentrations in 2021 with Construction Scenario 4 at DCiC Compliance Receptors (4m point from the edge of the running lane)

DCiC Receptor	Location	DCiC Model	Scheme Model ($\mu g/m^3$)		
		Do-Minimum	Do-Minimum	Do-Something	Change
FID2107	A38 south of A516	35.8	25.7	25.5	-0.2
FID370	A38 inbetween A516 merges	37.8	28.8	28.4	-0.4
FID1051	A38 north of A516 and south of Kingsway junction	30.5	25.8	25.7	-0.1
FID1159	A38 north of Kingsway junction and south of Markeaton junction	35.7	30.6	28.6	-2.0
FID1621	A38 north of Markeaton junction and south of Kedleston Rd	34.1	31.2	26.7	-4.5
FID1988	A38 north of Kedleston Rd and south of A6	33.7	28.4	27.9	-0.5
FID1416	A601 / King St	36.4	35.2	35.6	0.4
FID1248	St Alkmunds Way / Eastgate	36.2	36.0	36.1	0.1
FID1072	A601 Traffic St	36.2	38.0	38.0	0.1
FID1451	A601 St Alkmunds Way / Agard St	35.6	32.6	32.5	-0.1
FID1257	A601 St Alkmund’s Way / Alice St	35.3	36.3	36.4	0.1
FID1454	A601 Stafford St	<35.5	38.6	38.1	-0.5
Near Markeaton junction					
FID1553	A38 south east of junction	32.4	**40.2**	31.1	-9.1
FID1575	A38 south west of junction	28.5	39.4	38.9	-0.5
FID1604	A38 north west of junction	31.4	34.4	30.8	-3.6
FID1623	A38 north east of junction	34.1	35.1	39.6	+4.5

Bold denotes location exceeds the annual mean NO_2 limit value

Appendix 4: 8.86 – Supplement to Air Quality Compliance Risk Assessment – 10.3.20 [REP7-009]

A38 Derby Junctions

TR010022

8.86 Supplement to Air Quality Compliance Risk Assessment

Planning Act 2008

Rule 8 (1)(c)(ii)

The Infrastructure Planning (Examination Procedure) Rules 2010

Volume 8

March 2020

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010

A38 Derby Junctions
Development Consent Order 202[ ]

Supplement to Air Quality Compliance Risk Assessment

Regulation Number	Rule 8(1)(c)(ii)
Planning Inspectorate Scheme Reference	TR010022
Application Document Reference	8.86
Author	A38 Derby Junctions Project Team, Highways England

Version	Date	Status of Version
1	10 March 2020	Deadline 7 Submission

Introduction

This technical note contains additional information to that provided in 8.75 Updated Air Quality Compliance Risk Assessment (REP6-020) submitted for Deadline 6, following a request from Derby City Council. This information includes predicted nitrogen dioxide (NO_2) concentrations at qualifying features in 2021 and a more detailed map showing the location of PCM links and qualifying features (refer to Appendix A).

Results

The compliance assessment has also been undertaken at the qualifying features in 2021, the results of which are presented in Table 1.

Table 1: Predicted NO_2 Concentrations at Qualifying Features near the A38 in 2021 with Scheme Construction Scenarios

PCM Link	2021 (µg/m^3)						
	Do-Minimum	Scenario 0	Sc0 Change	Scenario 2	Sc2 Change	Scenario 4	Sc4 Change
74456	28.8	28.8	0.0	29.1	0.3	28.4	-0.4
46394	23.0	23.1	0.1	23.1	0.1	17.4	-5.6
57767 (1)	36.0	36.2	0.2	30.7	-5.3	29.2	-6.8
57767 (2)	**40.2**	**40.5**	0.3	33.0	-7.2	31.1	-9.1
57767 (3)	**46.4**	**46.9**	0.5	**44.2**	-2.2	**43.7**	-2.7
57767 (4)	33.9	34.1	0.2	31.1	-2.8	29.6	-4.3
57767 (5)	**47.4**	**50.5**	3.1	**42.3**	-5.1	39.8	-7.6
57767 (6)	34.0	36.0	2.0	30.7	-3.3	29.2	-4.8
16361(1)	29.5	29.7	0.2	37.5	8.0	36.0	6.5
16361 (2)	39.5	39.9	0.4	22.7	-16.8	23.1	-16.4
16361 (3)	36.8	37.2	0.4	31.4	-5.4	32.1	-4.7

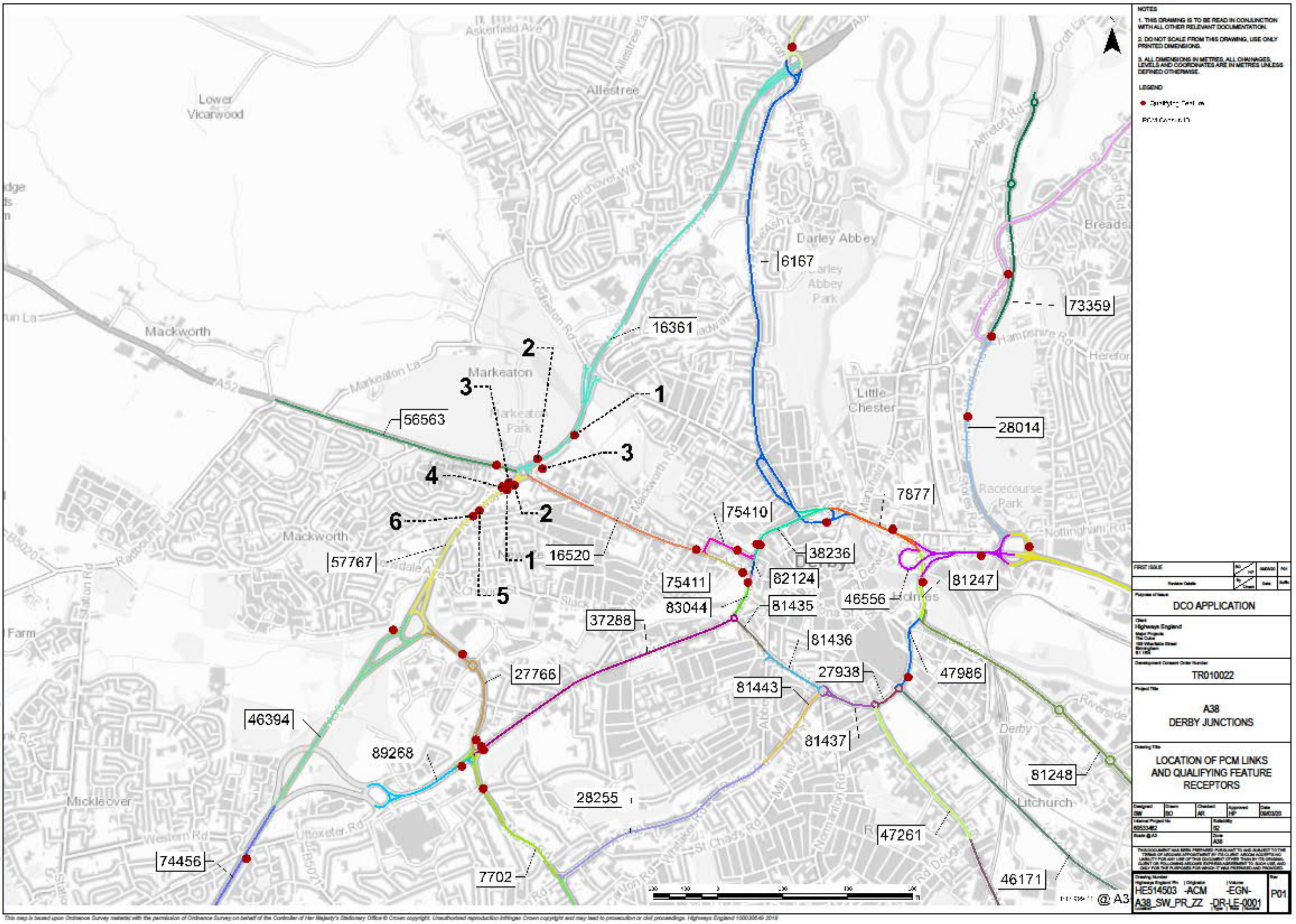
Note: Some sections of footpath may be closed during construction

Discussion

Based on the preliminary Scheme design, the assessment illustrates that there is a predicted exceedance of the EU limit value at one PCM link, link 57767. This link has an increase in annual mean NO_2 concentrations >0.4µg/m³ at some locations. However, as the increase is short term in Scenario Sc0 (which lasts approximately 8 months), the construction activities would not delay compliance as there would be an exceedance on the PCM link regardless of construction of the Scheme beyond 2021. This is based on measured concentrations at DT34 which are likely to exceed beyond 2021 based on historic measured concentrations. As the construction progresses through the various phases there is subsequently an improvement on PCM link 57767 as the footpaths are realigned as a result of the Scheme. This demonstrates that construction will not delay the date for attaining EU limit value compliance along this link. This additional information does not affect the conclusions set out in REP6-020 i.e. that the Scheme does not affect compliance with the Air Quality Directive.

At the detailed design stage when the Scheme construction methods, programmes and traffic management proposals are developed in more detail, air quality at footpaths will be re-assessed. If air quality is expected to be poor during the Scheme construction phase and made worse by construction of the Scheme, alternative routes for some footpaths will be defined where appropriate.

Appendix A: Location of PCM Links and Qualifying Features



Appendix 5: 8.47 – WHS Photomontages – 19.12.19 [REP3-018]

A38 Derby Junctions

TR010022

8.47 WHS Photomontages

Planning Act 2008

Rule 8 (1)(c)(ii)

The Infrastructure Planning (Examination Procedure) Rules 2010

Volume 8

December 2019

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010

A38 Derby Junctions
Development Consent Order 202[ ]

WHS Photomontages

Regulation Number	Rule 8(1)(c)(ii)
Planning Inspectorate Scheme Reference	TR010022
Application Document Reference	8.47
Author	A38 Derby Junctions Project Team, Highways England

Version	Date	Status of Version
1	19 December 2019	Deadline 3 Submission

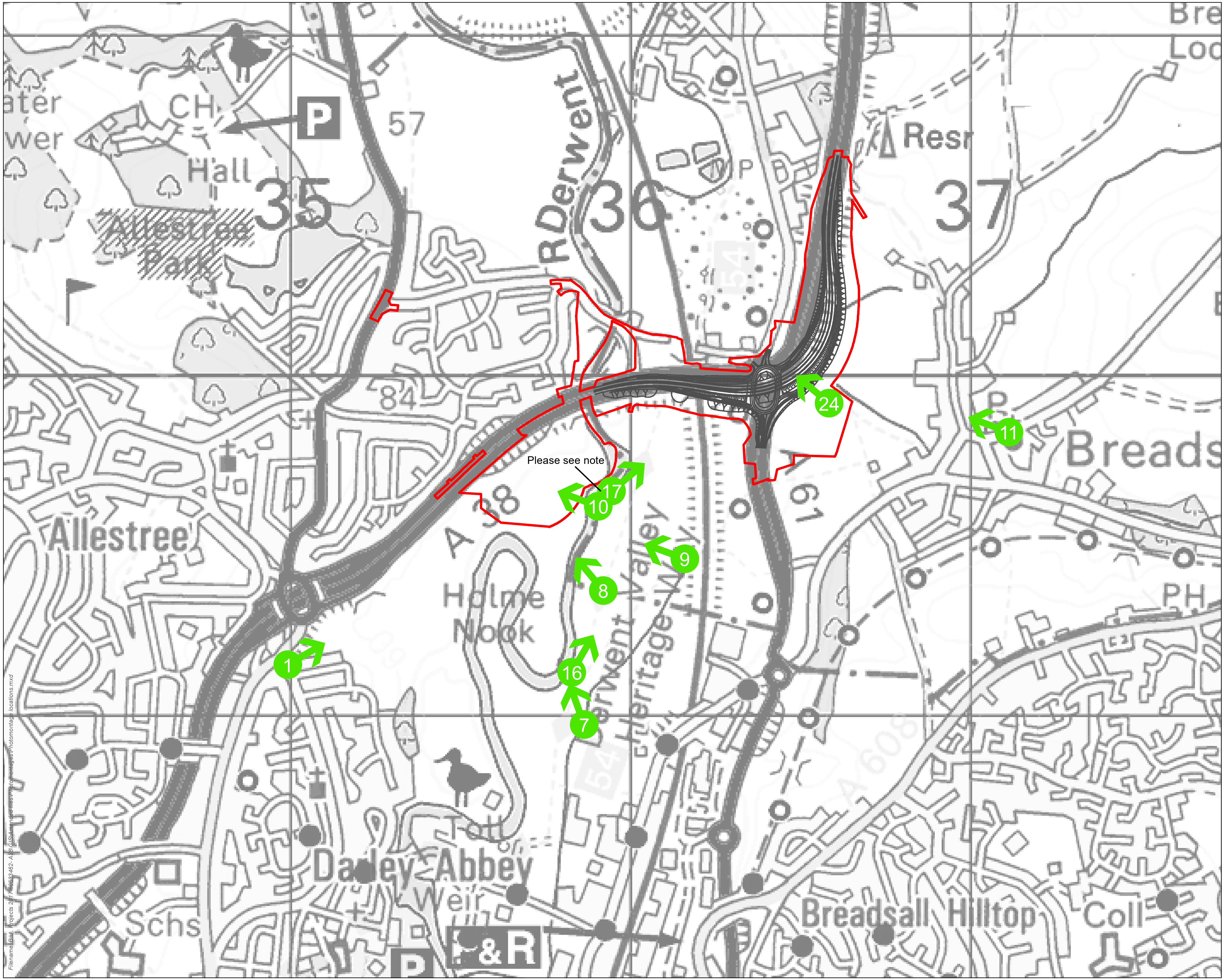
1 Introduction

1.1.1 A number of Scheme photomontages were issued at Deadline 2 as requested by the ExA [REP2-021]. In addition, Derby City Council (DCiC) requested that Highways England prepare a number of additional photomontages that were of relevance to the North Avenue planning inquiry (Planning Ref 09/15/01172) in order to assist their review of Scheme effects upon the Derwent Valley Mills World Heritage Site (DVMWHS).

1.1.2 These photomontages have been completed and issued to DCiC and Derbyshire County Council (DCC), with copies also being made available to the DVMWHS Partnership.

1.1.3 The figure provided in Appendix A shows a photomontages location figure, whilst Appendix B includes the applicable photomontages.

Appendix A – Photomontage Location Plan



NOTES

1.THIS DRAWING IS TO BE READ IN CONJUNCTION WITH ALL OTHER RELEVANT DOCUMENTATION.

2.DO NOT SCALE FROM THIS DRAWING, USE ONLY PRINTED DIMENSIONS.

3.ALL DIMENSIONS IN METRES, ALL CHAINAGES, LEVELS AND COORDINATES ARE IN METRES UNLESS DEFINED OTHERWISE.

PLEASE NOTE:

VIEWPOINT 17 IS TAKEN FROM THE SAME LOCATION AS VIEWPOINT 10

Revision Details	By / Check	Date	Suffix
FIRST ISSUE	KH / SW	20/11/2019	P01.1

Purpose of Issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
PHOTOMONTAGE LOCATIONS

Designed	Drawn	Checked	Approved	Date
KH	KH	JA	SW	20/11/19

Internal Project No 60533462	Suitability D7
Scale @ A3 N/A	Zone A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0157
Location | Type | Role | Number

Rev
P01.1

Filename: B:\1. Projects 2017\60533462- A38\GIS\Amended files\Photomontages\Photomontage locations.mxd

Appendix B – Photomontages

Viewpoint 1

Without the Scheme

With the Scheme (Year 15) - No View of Scheme

NOTES

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Revision Details	By / Check	Date	Suffix
FIRST ISSUE	KH / SW	28/03/19	P01.1

Purpose of Issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
PHOTOMONTAGE VIEWPOINT 1

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No 60533462	Suitability D7
Scale @ A3 N/A	Zone A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0157
Location | Type | Role | Number

Rev
P01.1

Filename: \\BM-MAN-002\BM_Shared\BM_Landscape\1. Projects 2017\60533462- A38\GIS\Amended files\Photomontages\PM 1.mxd

Viewpoint 7

Without the Scheme

With the Scheme (Year 15) - No View of Scheme

NOTES

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Revision Details	By / Check	Date	Suffix
FIRST ISSUE	KH / SW	28/03/19	P01.1

Purpose of Issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
PHOTOMONTAGE VIEWPOINT 7

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No 60533462	Suitability D7
Scale @ A3 N/A	Zone A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0157
Location | Type | Role | Number

Rev
P01.1

Filename: \\BM-MAN-002\BM_Shared\BM_Landscape\1. Projects 2017\60533462- A38\GIS\Amended files\Photomontages\PM 7.mxd

Viewpoint 8

Without the Scheme

With the Scheme (Year 15)

NOTES

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FIRST ISSUE	KH / SW	28/03/19	P01.

Purpose of Issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
PHOTOMONTAGE VIEWPOINT 8

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No 60533462	Suitability D7
Scale @ A3 N/A	Zone A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0157
Location | Type | Role | Number

Rev
P01.

Filename: \\BM-MAN-002\BM_Shared\BM_Landscape\1. Projects 2017\60533462- A38\GIS\Amended files\Photomontages\PM 8.mxd

Viewpoint 9

Without the Scheme

With the Scheme (Year 15)

NOTES

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Revision Details	By / Check	Date	Suffix

Purpose of Issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
PHOTOMONTAGE VIEWPOINT 9

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No 60533462	Suitability D7
Scale @ A3 N/A	Zone A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0157
Location | Type | Role | Number

Rev
P01.

Filename: \\BM-MAN-002\BM_Shared\BM_Landscape\1. Projects 2017\60533462- A38\GIS\Amended files\Photomontages\PM 9.mxd

Viewpoint 10

Without the Scheme

With the Scheme (Year 15)

NOTES

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FIRST ISSUE	KH / SW	28/03/19	P01.1

Purpose of Issue

DCO APPLICATION

Client

Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number

TR010022

Project Title

A38
DERBY JUNCTIONS

Drawing Title

PHOTOMONTAGE VIEWPOINT 10

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No 60533462	Suitability D7
Scale @ A3 N/A	Zone A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0157
Location | Type | Role | Number

Rev
P01.1

Filename: \\BM-MAN-002\BM_Shared\BM_Landscape\1. Projects 2017\60533462- A38\GIS\Amended files\Photomontages\PM 10.mxd

Viewpoint 11

Without the Scheme

With the Scheme (Year 15) - No View of the Scheme

NOTES

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FIRST ISSUE	KH / SW	28/03/19	P01.

Purpose of Issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
PHOTOMONTAGE VIEWPOINT 11

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No	Suitability
60533462	D7

Scale @ A3	Zone
N/A	A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0157
Location | Type | Role | Number

Rev
P01.

Filename: \\BM-MAN-002\BM_Shared\BM_Landscape\1. Projects 2017\60

Viewpoint 16

Without the Scheme

With the Scheme (Year 15)

Filename: \\BM-MAN-002\BM_Shared\BM_Landscape\1. Projects 2017\60533462- A38\GIS\Amended files\Photomontages\PM 16.mxd

NOTES

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Revision Details	By / Check	Date	Suffix
FIRST ISSUE	KH / SW	28/03/19	P01.1

Purpose of Issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
PHOTOMONTAGE VIEWPOINT 16

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No 60533462	Suitability D7
Scale @ A3 N/A	Zone A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0157
Location | Type | Role | Number

Rev
P01.1

Viewpoint 16

Without the Scheme

With the Scheme (Year 15)

NOTES

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Purpose of Issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
PHOTOMONTAGE VIEWPOINT 16

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No	Suitability
60533462	D7

Scale @ A3	Zone
N/A	A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0157
Location | Type | Role | Number

Rev
P01.1

Filename: \\BM-MAN-002\BM_Shared\BM_Landscape\1. Projects 2017\605334

Viewpoint 17 at Little Eaton junction

Without the Scheme

With the Scheme (Year 15)

NOTES

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Revision Details	By / Check	Date	Suffix
FIRST ISSUE	KH / SW	28/03/19	P01.1

Purpose of Issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
PHOTOMONTAGE
VIEWPOINT 17 AT LITTLE EATON
JUNCTION

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No: 60533462
Suitability: D7
Scale @ A3: N/A
Zone: A38

Drawing Number
Highways England Pin | Originator | Volume | Location | Type | Role | Number
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0157

Rev
P01.1

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Viewpoint 24 at Little Eaton junction

Without the Scheme

With the Scheme (Year 15)

NOTES

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FIRST ISSUE	KH / SW	28/03/19	P01.1

Purpose of Issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
PHOTOMONTAGE
VIEWPOINT 24 AT LITTLE EATON
JUNCTION

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No 60533462	Suitability D7
Scale @ A3 N/A	Zone A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0157
Location | Type | Role | Number

Rev
P01.1

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Viewpoint 24 at Little Eaton junction

Without the Scheme

With the Scheme (Year 15)

NOTES

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FIRST ISSUE	KH / SW	28/03/19	P01.1

Purpose of Issue

DCO APPLICATION

Client

Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number

TR010022

Project Title

A38
DERBY JUNCTIONS

Drawing Title

PHOTOMONTAGE
VIEWPOINT 24 AT LITTLE EATON JUNCTION

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No	Suitability
60533462	D7

Scale @ A3	Zone
N/A	A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0183
Location | Type | Role | Number

Rev
P01.1

Filename: \\BM-MAN-002\BM_Shared\BM_Landscape\1. Projects 2017\60533462- A38\GIS\Amended files\Photomontages\PM 24.mxd

Appendix 6: 8.37 – Additional Photomontages – 19.11.19 [REP2-021]

A38 Derby Junctions
TR010022
Volume 8
8.37 Additional Photomontages

Rule 8 (1)(c)(ii)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed
Forms and Procedure) Regulations 2009

November 2019

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Applications: Prescribed Forms and Procedure) Regulations 2009

A38 Derby Junctions

Development Consent Order 202[ ]

Additional Photomontages

Regulation Number	Rule 8 (1)(c)(ii)
Planning Inspectorate Scheme Reference	TR010022
Application Document Reference	8.37
Author	A38 Derby Junctions Project Team, Highways England

Version	Date	Status of Version
1	November 2019	Deadline 2 Submission

A38 on the railway bridge looking towards Little Eaton junction

Without the Scheme

With the Scheme (Year 15)

NOTES

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Revision Details	By / Check	Date	Suffix
FIRST ISSUE	KH / SW	28/03/19	P01.1

Purpose of Issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
PHOTOMONTAGE
A38 ON THE RAILWAY BRIDGE
LOOKING TOWARDS LITTLE EATON
JUNCTION

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No	Suitability
60533462	D7
Scale @ A3	**Zone**
N/A	A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0157
Location | Type | Role | Number

Rev
P01.1

Filename: \\BM-MAN-002\BM_Shared\BM_Landscape\1. Projects 2017\6053 mended files\Photomontages\PM A.mxd

Greenwich Drive North adjacent and looking towards Work 10a gantry

Without the Scheme

With the Scheme (Year 15)

Filename: \\BM-MAN002\BM_Sha[illegible]\BM_Landscape\1_Projects 2017\60533462_A38\GIS\Amended files\Photomontages\PM B.mxd

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Purpose of Issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
PHOTOMONTAGE
GREENWICH DRIVE NORTH
ADJACENT AND LOOKING
TOWARDS WORK 10A GANTRY

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No
60533462

Suitability
D7

Scale @ A3
N/A

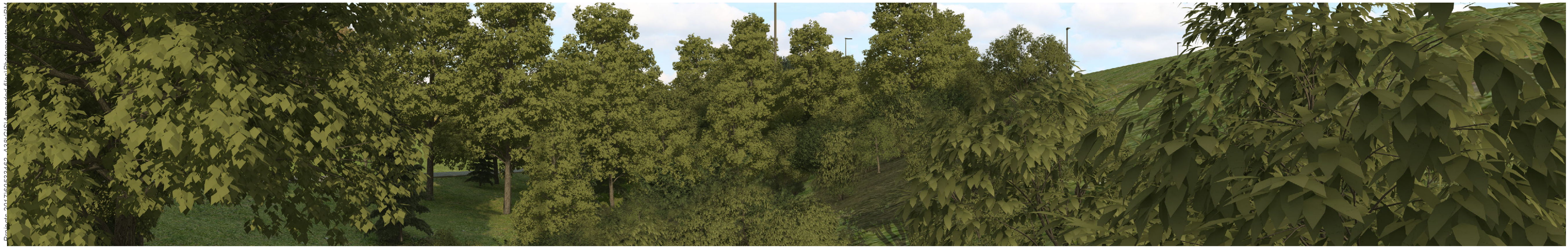
Zone
A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0157
Location | Type | Role | Number

Rev
P01.1

Viewpoint 2 at Kingsway junction

Without the Scheme



With the Scheme (Year 15)

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FIRST ISSUE	KH / SW	28/03/19	P01.1

Purpose of Issue

DCO APPLICATION

Client

Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number

TR010022

Project Title

A38
DERBY JUNCTIONS

Drawing Title

PHOTOMONTAGE VIEWPOINT 2 AT KINGSWAY JUNCTION

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No 60533462	Suitability D7
Scale @ A3 N/A	Zone A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0157
Location | Type | Role | Number

Rev
P01.1

Viewpoint 17 at Little Eaton junction

Without the Scheme

With the Scheme (Year 15)

NOTES

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Purpose of Issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
PHOTOMONTAGE
VIEWPOINT 17 AT LITTLE EATON
JUNCTION

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No	Suitability
60533462	D7
Scale @ A3	**Zone**
N/A	A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0157
Location | Type | Role | Number

Rev
P01.1

Filename: \\BM-MAN-002\BM_Shared\BM_Landscape\1
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Viewpoint 22 at Little Eaton junction

Without the Scheme

With the Scheme (Year 15)

NOTES

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FIRST ISSUE	KH / SW	28/03/19	P01.1

Purpose of Issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
PHOTOMONTAGE
VIEWPOINT 22 AT LITTLE EATON
JUNCTION

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No: 60533462
Suitability: D7
Scale @ A3: N/A
Zone: A38

Drawing Number
Highways England Pin | Originator | Volume | Location | Type | Role | Number
HE514503 -ACM -EGN-A38_SW_PR_ZZ -DR-LE-0182

Rev
P01.1

Filename: \\BM-MAN-002\BM_Shared\BM_Landscape\1 … files\Photomontages\PM 22.mxd

Viewpoint 24 at Little Eaton junction

Without the Scheme

With the Scheme (Year 15)

Filename: \\BM-MAN-002\BM_Shared\BM_Landscape\1. Projects 2017\60533462- A38\GIS\Amended files\Photomontages\PM 24.mxd

NOTES

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Purpose of Issue
DCO APPLICATION

Client
Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number
TR010022

Project Title
A38
DERBY JUNCTIONS

Drawing Title
PHOTOMONTAGE
VIEWPOINT 24 AT LITTLE EATON
JUNCTION

Designed	Drawn	Checked	Approved	Date
MB	KH	JA	SW	18/11/19

Internal Project No: 60533462
Suitability: D7
Scale @ A3: N/A
Zone: A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0183
Location | Type | Role | Number

Rev
P01.1

Appendix 7: 8.85 – Veteran Tree Loss T358 – 10.3.20 [REP7-008]

A38 Derby Junctions

Scheme Number TR010022

8.85 Veteran Tree Loss T358

Planning Act 2008

Rule 8 (1)(k)

The Infrastructure Planning (Examination Procedure) Rules 2010

Volume 8

March 2020

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010

A38 Derby Junctions
Development Consent Order 202[ ]

Veteran Tree Loss T358

Regulation Number	Rule 8(1)(k)
Planning Inspectorate Scheme Reference	TR010022
Document Reference	8.85
Author	A38 Derby Junctions Project Team, Highways England

Version	**Date**	**Status of Version**
1	10 March 2020	Deadline 7 Submission

Table of contents

Chapter **Pages**

1 Introduction

1.1 This note has been prepared in response to the Examining Authority's request to summarise the reasons behind the reported unavoidable loss of the veteran oak tree T358. This tree is located near the existing Markeaton footbridge (north of Markeaton junction) and it is anticipated that it will be lost as part of the Scheme works. In this note the A38 Derby Junctions Scheme is referred to as "the Scheme", which is a Nationally Significant Infrastructure Project (NSIP).

1.2 As detailed in the National Policy Statement for National Networks (NPSNN) where veteran trees would be affected by a development, the Applicant is required to set out proposals for their conservation or, where their loss is unavoidable, the reasons for this. The loss of tree T358 is reported in the Environmental Statement (ES) Chapter 8: Biodiversity [**APP-046**] and in the ES Appendix 7.2: Arboricultural Impact Assessment Report [**APP-177**]. The Planning Statement and National Policy Statement Accordance Table [**APP-252**] highlights the unavoidable loss of the veteran tree, noting that other veteran trees within the Scheme footprint would be retained. As detailed in ES Chapter 8: Biodiversity [**APP-046**] (refer to para. 8.10.35), given the loss of this veteran tree, it is proposed that the felled tree with its potential bat roost features will be made into a totem pole feature and installed at the edge of Markeaton Park as part of the bat mitigation strategy (refer to Environmental Masterplan as illustrated in Figure 2.12c/d [**APP- 068**]).

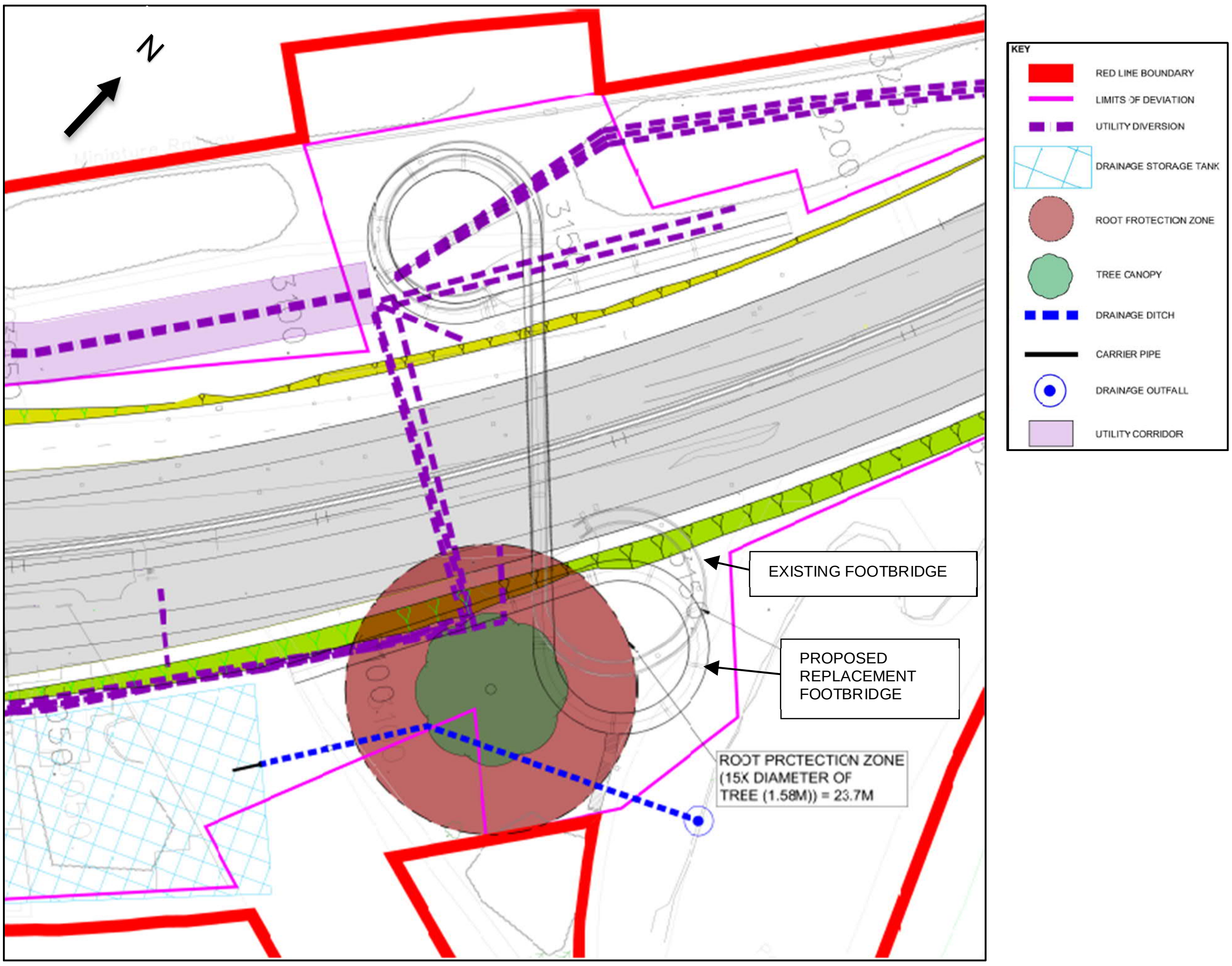
1.3 This note needs to be read in the context of the DCO application, which is for a preliminary design of the Scheme. Any proposals suggested in this note are not to be taken as final design commitments; they are indicative at this stage in order to demonstrate issues that may arise on the basis of the information available to Highways England at this stage of the Examination. No reliance should be placed on these indicative observations in terms of detailed design as the final detailed design of the Scheme is a matter to be determined by the Secretary of State under the terms of the Development Consent Order (once granted).

2 Proposed Works Impacting upon Tree T358

2.1 The Root Protection Area (RPA) around the veteran oak tree, designated as T358 (stem diameter 1,575mm), has been determined in accordance with BS5837: 2012 Annexe C, D and Section 4.6. This area has been defined in ES Appendix 7.2: Arboricultural Impact Assessment Report [**APP-177**] and an explanation for the approach is outlined in that assessment (please refer to the tree constraint plan 17 in Appendix A and the tree retention plan 18 in Appendix D). These plans show the tree T358 and its associated RPA in relation to the Scheme, with the tree retention plans indicating the assumed loss of the tree.

2.2 Figure 1 below prepared specifically for this technical note shows the location of the veteran oak tree T358 and the RPA around it. It also demonstrates indicative proposed engineering infrastructure in the vicinity of T358, including the A38 carriageway, the proposed replacement footbridge location, utilities diversions and highway drainage provisions.

Figure 1: T358 Root Protection Area (RPA) Impacts – shows existing and proposed indicative location of footbridge, plus Scheme features (carriageway, utilities diversions and highway drainage works)



A38 Main Carriageway

2.3 The Preferred Route that was announced in January 2018 was developed through the Scheme’s preliminary design which has formed the basis of the submitted DCO application. This route, whilst removing the houses from Queensway, avoids wider impacts on the public open space of Markeaton Park, Markeaton Lake and the park’s associated trees. The Scheme comprises an alteration of an existing highway, designed with the aim of improving the existing highway infrastructure within a constrained urban environment. As such, the proposed route closely aligns with that of the existing A38 highway.

2.4 The proposed alignment of the altered A38 places the new southbound diverge slip road across land currently occupied by the Queensway houses. As the road extends to the north towards Kedleston Road junction, the proposed carriageway construction extends out into the area of land adjacent to the Mill Pond. As illustrated in the Arboricultural Impact Assessment Report, heavy plant and excavation activities will need to be undertaken within the northern section of the RPA [**APP-177**]. The proposed A38 carriageway construction also has an unavoidable impact on the western side of T358’s RPA. Please refer to Figure 1 which illustrates the interaction between indicative Scheme carriageway works and T358’s RPA.

Highway Drainage

2.5 The proposed A38 main carriageway alignment will pass beneath the Markeaton junction; this excavated feature requires a pumping station to remove surface water runoff from the highway. This water will be attenuated in features installed in the land remaining following the demolition of the Queensway properties (noting that the area will be designated as replacement Public Open Space).

2.6 The proposed drainage attenuation features comprise buried storage tanks and open water features to treat the attenuated water through Sustainable Drainage Systems (SuDS). This includes an open ditch connecting the attenuation tanks to the proposed discharge point at the Mill Pond. Given the constrained nature of the Order limits, the ditch will pass through the eastern side of T358's RPA. Please refer to Figure 1 which illustrates the potential locations of the drainage apparatus.

Footbridge

2.7 The existing footbridge (refer to Figure 1) will be impacted by the proposed alignment of the Scheme necessitating its demolition and replacement.

2.8 The demolition activities to remove the existing Markeaton footbridge will have an impact on T358's RPA, namely heavy plant and excavation activities will need to be undertaken within the northern section of the RPA.

2.9 The western ramp of the proposed replacement footbridge (refer to Figure 1) is likely to be in the same position as that of the existing footbridge with a similar loop radius to that of the existing footbridge. The new bridge ramps have been designed to current accessibility requirements, which provide an improvement over the steeper gradients of the existing bridge. However, retaining the existing loop radii will mean that the approach ramps for the new footbridge will be longer than those of the existing bridge.

2.10 The eastern ramp position of the new footbridge will need to be moved further east due to the proposed carriageway alignment. This will result in the footbridge conflicting with the canopy of T358 and the support foundations and the approach ramp impacting on the tree's RPA. Please refer to Figure 1 which illustrates the interactions between T358 and its RPA with the existing and proposed replacement footbridge. In addition, in order to install the replacement footbridge, heavy plant and excavation activities will need to be undertaken within the northern section of the RPA.

Statutory Undertakers

2.11 Markeaton junction is a key location that has a significant number of Statutory Undertakers' plant crossings at the junction. As such, the construction of the underpass through the junction requires all services to be diverted around the proposed works.

2.12 The creation of a Statutory Undertakers corridor along the outer edge of Markeaton Park has enabled the diversion of key services. The main east/ west crossing point of the A38 for the Statutory Undertakers plant is to the north of the underpass close to the existing/ replacement footbridge. The excavations required to install the plant and equipment will impact on the southern side of T358's RPA. Refer to Figure 1 which illustrates the interactions between T358 and its RPA with proposed utilities diversions.

3 Result of Combined Impacts

3.1 The urban surroundings of the A38 as it passes through Derby constrains the space available to make the required improvements to the highway. The limited space and land available has been carefully assessed so that the land used is optimised to enable the improvements to the A38 and its associated engineering infrastructure and that impacts from the Scheme (from an environmental perspective and from a compulsory acquisition perspective) are minimised.

3.2 The combination of all the required works, as listed above, affect all sides of the RPA of T358 with excavation works. This is particularly true of the carriageway of the realigned A38 itself. In addition to the various works requiring excavations, the replacement footbridge also conflicts with the canopy of the tree. The processes of undertaking all the work in this area of the site means that there will be a significant number of construction vehicle movements across the tree's RPA.

3.3 With the large number of intrusions to the RPA of T358 means that the tree would be unavoidably lost to allow the Scheme works to be constructed.

4 Possible Alternatives to reduce impact on T358

4.1 Following concerns raised during the Examination relating to the loss of the veteran tree T358, options have been investigated to potentially avoid or reduce the impact on the tree and its RPA.

4.2 The Limits of Deviation (LoD) included within the application for the Scheme were set based on the preliminary design information available at the time of the application and have been set to optimise land use within the Order limits and to minimise impacts from the Scheme. These LoD form the basis of the environmental impacts of the Scheme as assessed in the Environmental Statement. Whilst the LoD offers a small degree of flexibility in terms of the location of the final works items (particularly those noted above) even within these confines the works cannot avoid impacts on the tree itself and its RPA. This is particularly the case in respect of the realigned carriageway which will still impact the tree and/or its RPA even if the proposed 1m LoD is utilised and the proposed location of the new footbridge.

4.3 The A38 main carriageway LoD is restricted to 1m. In order to reduce the Scheme impact on the RPA of T358 the carriageway would require need to be relocated to the shifting west (an option which is not proposed by Highways England or included as part of the Scheme and is outside of what has been assessed as part of the DCO application). This shift to the west would, however, have a resultant impact of taking more land from Markeaton Park and risk taking further mature trees from the perimeter of the park. The options explored for the alignment of the A38 are provided in Environmental Statement Chapter 3 - Scheme History and Assessment of Alternatives [**APP-041**] and this note does not explore these alternative options any further as the justification for the alignment of this proposal has been made out in those documents. In addition, the location of the new footbridge is proposed to be as close as possible to the footprint of the existing footbridge and this location necessitates encroaching the tree and/or the RPA.

4.4 It should be noted that whilst the individual engineering infrastructure items can be repositioned to potentially reduce the impact on the RPA of T358, access for construction vehicles carrying out demolition and construction works would still need to cross the RPA, whilst the main carriageway works would still have a significant impact on the western side of T358's RPA. In order to reduce the impacts of construction traffic on the RPA, access restriction can be put in place, although this would not prevent some parts of the RPA being impacted.

5 Conclusion

5.1 The Scheme as submitted to the Examination would, as a result of the combined impacts on the veteran tree T358 and its associated RPA, result in the unavoidable loss of the veteran tree due to the proposed works and construction traffic within the vicinity of the tree. As such, the Environmental Statement reports the loss of this veteran tree and explains and assesses this as a worst case scenario.

5.2 It is important to note that whilst a number of infrastructure items (listed in this note) can be repositioned within the relevant LoD, even where the A38 main carriageway is moved to its maximum LoD of 1m it cannot be moved further and this limit will still impact the tree and/or its RPA. In addition, the new footbridge is proposed to be of a similar design and in a similar location to the existing footbridge and this will impact the tree and its RPA. Given the constrained nature of the site these work items (even if moved within its LoD) will still impact on the tree and/or its RPA. Finally, the associated construction traffic movements within close proximity to the tree's RPA in order to deliver the works would also remain, although some construction plant access restrictions could be put in place.

5.3 However, during the Scheme detailed design stage, Highways England will examine further options that may increase the potential to retain tree T358 and reduce the Scheme impacts upon its RPA. This will include examining the potential for moving construction works further outside of the RPA if possible and within the confines of the existing constraints including the LoD.

5.4 As such, whilst it may be possible to retain the tree itself and measures taken to reduce the Scheme impacts upon the tree's RPA, the Scheme works would still inevitably have a significant effect on the tree's RPA. It thus remains the most likely scenario (despite best endeavours) that the veteran tree will be unavoidably lost due to the Scheme. As noted above, given the loss of this veteran tree it is proposed that the felled tree with its potential bat roost features will be made into a totem pole feature and installed at the edge of Markeaton Park as part of the bat mitigation strategy.

5.5 In terms of the policy tests within the NPS NN, the loss of the veteran tree should be weighed in the balance against the clear national and local need for the Scheme coupled with the significant benefits of that the Scheme will bring, including unlocking future investment in the City of Derby and the time savings a less congested route will bring.

Appendix 8: 8.50 – Hedgerows within the Order Limits – 19.12.19 [REP3-021]

A38 Derby Junctions

TR010022

8.50 Hedgerows within the Order Limits

Planning Act 2008

Rule 8 (1)(c)(ii)

The Infrastructure Planning (Examination Procedure) Rules 2010

Volume 8

December 2019

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010

A38 Derby Junctions
Development Consent Order 202[ ]

Hedgerows within the Order Limits

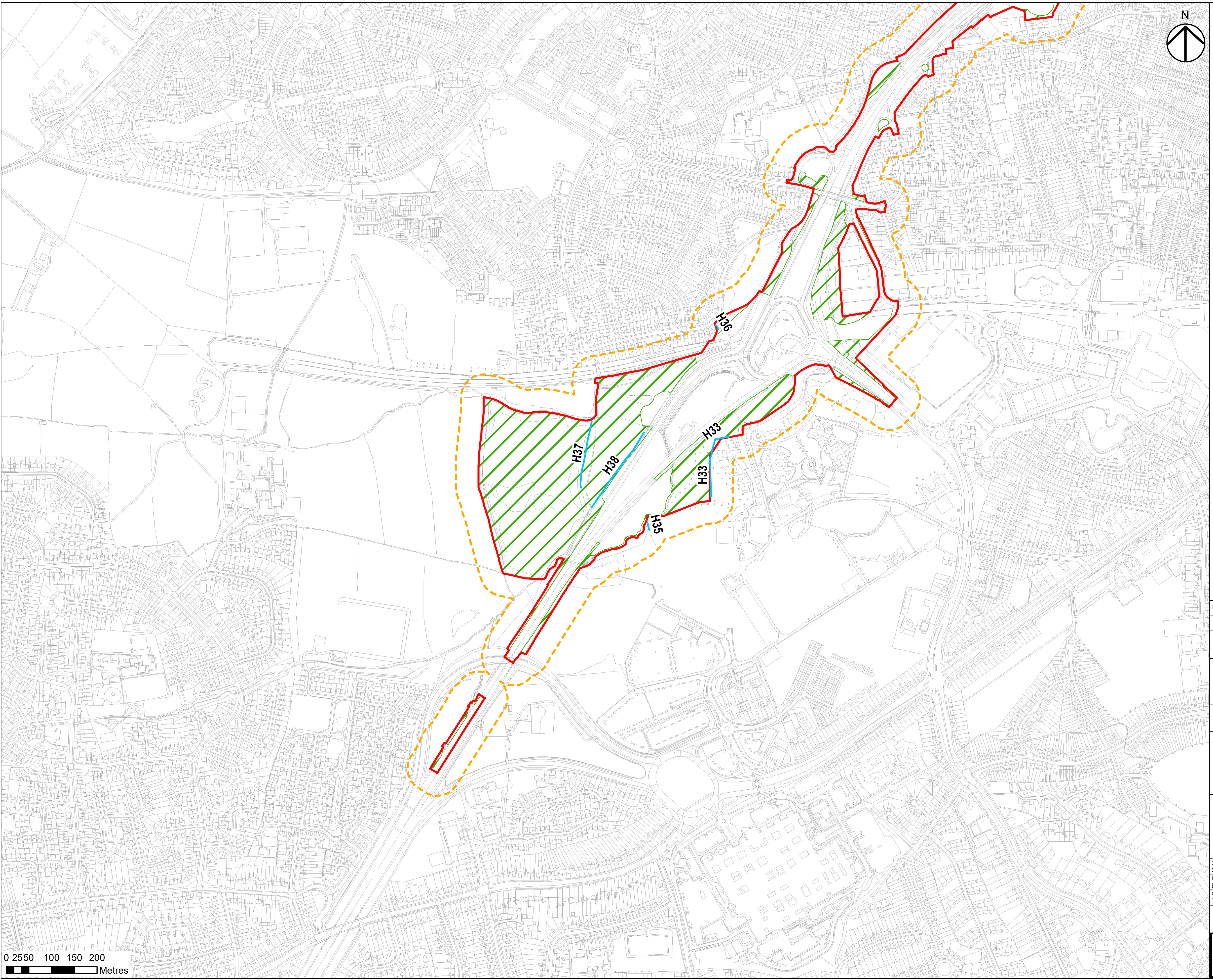
Regulation Number	Rule 8(1)(c)(ii)
Planning Inspectorate Scheme Reference	TR010022
Application Document Reference	8.50
Author	A38 Derby Junctions Project Team, Highways England

Version	Date	Status of Version
1	19 December 2019	Deadline 3 Submission

1 Hedgerows within the Order Limits

1.1 The ExA has asked Highways England to identify any hedgerows within the Order Limits that are subject to protection under the Hedgerows Regulations 1997 (question 56b of the ISH2). The figures in Appendix A provide details of hedgerows within the Order Limits, including the identification of which hedgerows would be retained and lost due to the Scheme (plus details of hedgerow ecological and cultural heritage interest).

Appendix A – Hedgerows Lost and Retained in the Order Limits



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NOTES

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3.ALL DIMENSIONS IN METRES, ALL CHAINAGES, LEVELS AND COORDINATES ARE IN METRES UNLESS DEFINED OTHERWISE.

LEGEND

- 🟥 SCHEME BOUNDARY
- ⬚ 50M SURVEY BOUNDARY
- ▨ INDICATIVE AREA OF HABITAT RETENTION
- ━ SPECIES POOR HEDGEROW LOST
- ━ SPECIES POOR HEDGEROW RETAINED

HEDGEROWS H37 & H35 OF HISTORIC INTEREST

Revision Details	By / Check	Date	Suffix
FIRST ISSUE	AG / HP	17/12/19	P01

Purpose of Issue

DCO APPLICATION

Client

Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
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Development Consent Order Number

TR010022

Project Title

A38
DERBY JUNCTIONS

Drawing Title

KINGSWAY JUNCTION
HEDGES LOST AND RETAINED

Designed	Drawn	Checked	Approved	Date
SW	AG	LC	HP	17/12/19

Internal Project No
60533462

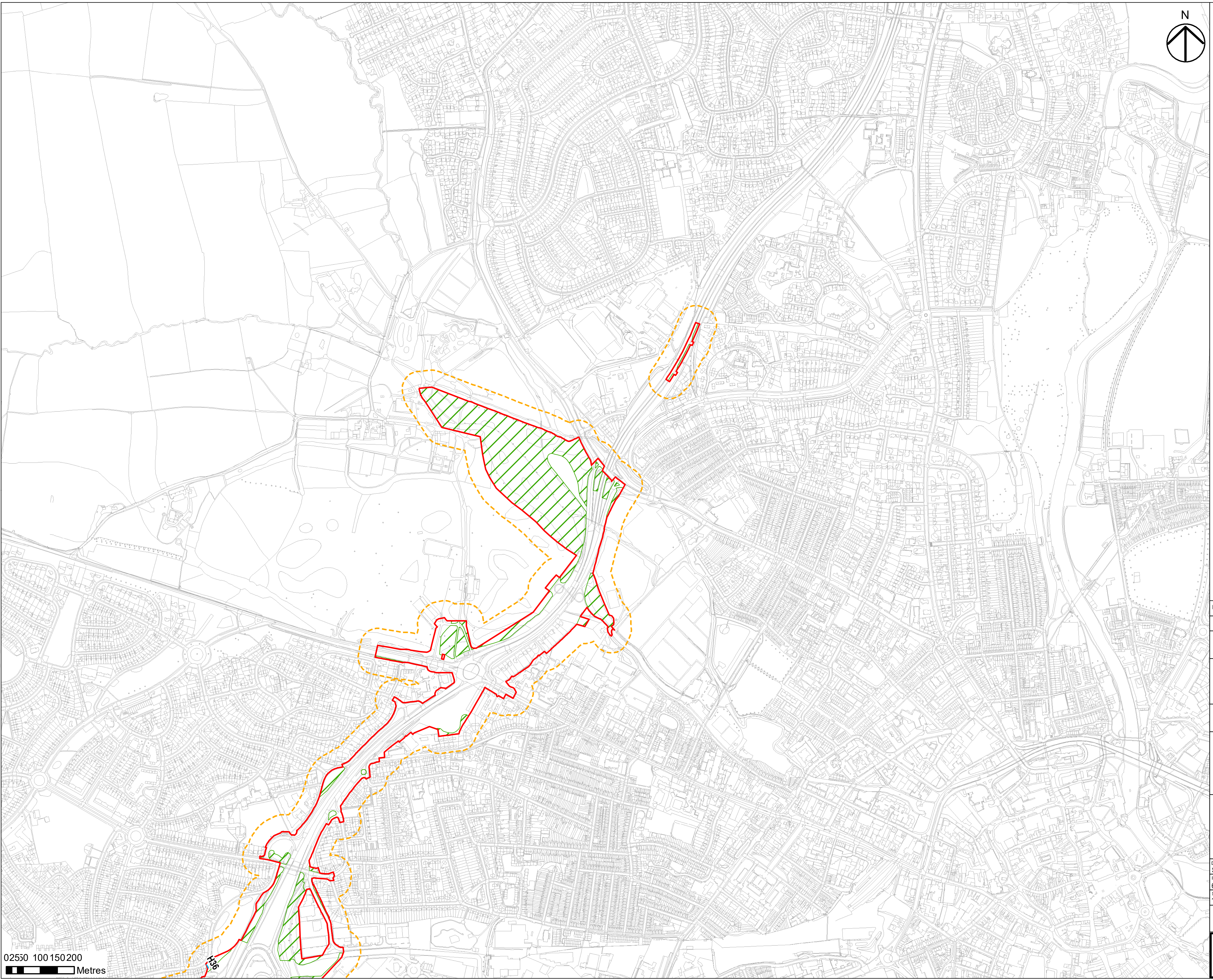
Suitability
S2

Scale @ A3
1:7,500

Zone
A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EBD-
A38_SW_PR_ZZ -DR-EG-0001
Location | Type | Role | Number

Rev
P01



NOTES

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LEGEND

- ☐ SCHEME BOUNDARY
- ☐ 50M SURVEY BOUNDARY
- ▨ INDICATIVE AREA OF HABITAT RETENTION
- — SPECIES POOR HEDGEROW LOST
- — SPECIES POOR HEDGEROW RETAINED

Revision Details	By / Check	Date	Suffix
FIRST ISSUE	AG / HP	17/12/19	P01

Purpose of Issue

DCO APPLICATION

Client

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Development Consent Order Number

TR010022

Project Title

A38
DERBY JUNCTIONS

Drawing Title

MARKEATON JUNCTION
HEDGES LOST AND RETAINED

Designed	Drawn	Checked	Approved	Date
SW	AG	LC	HP	17/12/19

Internal Project No	Suitability
60533462	S2

Scale @ A3	Zone
1:10,000	A38

Drawing Number

Highways England Pin	Originator	Volume	Location	Type	Role	Number	Rev
HE514503	-ACM	-EBD-	A38_SW_PR_ZZ	-DR	-EG	-0002	P01

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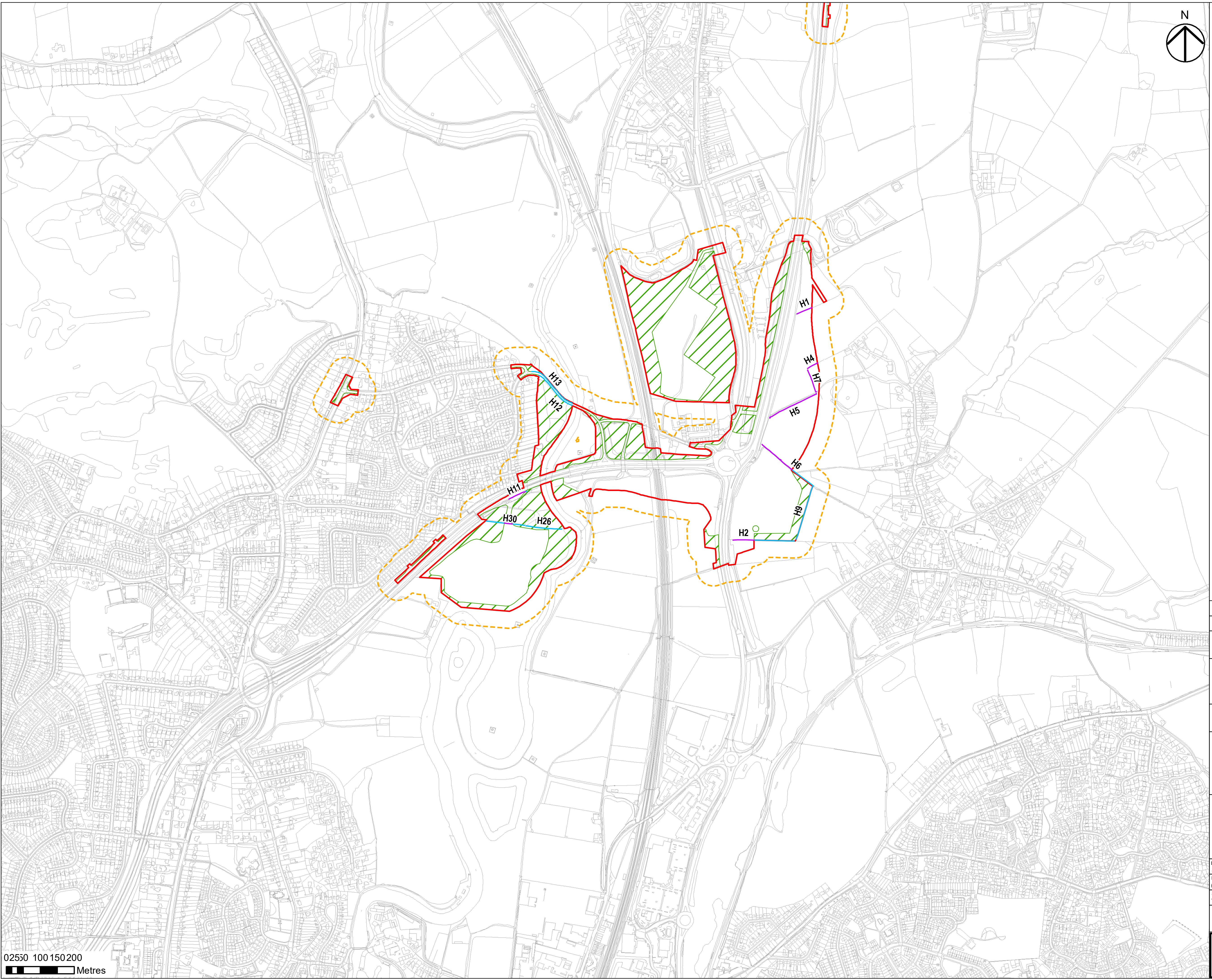

NOTES

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2.DO NOT SCALE FROM THIS DRAWING, USE ONLY PRINTED DIMENSIONS.

3.ALL DIMENSIONS IN METRES, ALL CHAINAGES, LEVELS AND COORDINATES ARE IN METRES UNLESS DEFINED OTHERWISE.

LEGEND

- ▭ SCHEME BOUNDARY
- ▭ 50M SURVEY BOUNDARY
- ▨ INDICATIVE AREA OF HABITAT RETENTION
- — SPECIES POOR HEDGEROW LOST
- — SPECIES POOR HEDGEROW RETAINED

HEDGEROWS H5, H30 & H26 OF HISTORIC INTEREST

FIRST ISSUE	AG / HP	17/12/19	P01
Revision Details	By / Check	Date	Suffix

Purpose of Issue

DCO APPLICATION

Client

Highways England
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Two Colmore Square
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Development Consent Order Number

TR010022

Project Title

A38
DERBY JUNCTIONS

Drawing Title

LITTLE EATON JUNCTION
HEDGES LOST AND RETAINED

Designed	Drawn	Checked	Approved	Date
SW	AG	LC	HP	17/12/19

Internal Project No	Suitability
60533462	S2
Scale @ A3	Zone
1:10,000	A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EBD-
A38_SW_PR_ZZ -DR-EG-0003
Location | Type | Role | Number

Rev
P01

Filename: K:\Newproje\60533462 - A38 GIS\GIS\02_Maps\00 Environmental Statement\DCO Template\TR010022_A38_Hedgerows Lost and Retained.mxd

Appendix 9: 8.61 – Ecological Impact Assessment of Alfreton Road Local Wildlife Site (LWS) – 3.2.20 [REP4-023]

A38 Derby Junctions

TR010022

8.61 Ecological Impact Assessment of Alfreton Road LWS

Planning Act 2008

Rule 8 (1)(k)

Infrastructure Planning (Examination Procedure) Rules 2010

Volume 8

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Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010

A38 Derby Junctions

Development Consent Order 202[ ]

Ecological Impact Assessment of Alfreton Road LWS

Regulation Number	Rule 8 (1)(k)
Planning Inspectorate Scheme Reference	TR010022
Application Document Reference	TR010022/APP/8.61
Author	A38 Derby Junctions Project Team, Highways England

Version	**Date**	**Status of Version**
1	03 February 2020	Deadline 4 submission

A38 Derby Junctions – Ecological Impact Assessment of Alfreton Road Rough Grassland Local Wildlife Site (LWS)

As requested by Derbyshire Wildlife Trust (DWT) and Erewash Borough Council (EBC) during a site visit to Alfreton Road Rough Grassland Local Wildlife Site (LWS) on the 22nd January 2020, below is a summary of the biodiversity assessment based on significance of effects as presented in the **Environmental Statement (ES) Chapter 8: Biodiversity [APP-046]** as related to the A38 Derby junctions scheme (referred to as “the Scheme” herein) and the proposed mitigation and monitoring measures for the LWS set out in the **Outline Environmental Management Plan [REP3-003]**.

Summary of Biodiversity Assessment

Alfreton Road Rough Grassland LWS is approximately 4.08ha[1] in size and is located partially within the Scheme boundary at Little Eaton junction. The LWS is designated for its floodplain grassland. Refer to **Table 8.10: Summary of designated and non-designated sites scoped into the assessment – Little Eaton Junction, ES Chapter 8: Biodiversity [APP-046]** for details.

Approximately 1.64ha (40%) of Alfreton Road Rough Grassland LWS falls within the Scheme boundary. Of this 1.64ha within the Scheme boundary, approximately 0.13ha would be retained; approximately 0.87ha would be temporarily lost to construction activities and reinstated (landscaping primarily species-rich grassland and broad-leaved plantation woodland); whilst approximately 0.64ha would be permanently lost (to build the Scheme new slip road). In summary, approximately 16% of the LWS would be permanently lost due to the Scheme.

Table 1 provides a summary of the Scheme effects upon the Alfreton Road Rough Grassland LWS in terms of area retained, area reinstated, and area permanently lost.

Table 1: Summary of Approximate Areas Retained, Created and Lost at Alfreton Road Rough Grassland LWS

Alfreton Road Rough Grassland LWS	Area	Percentage of Total Area of LWS (approx.)
Total area of the LWS within the Scheme boundary	**1.64 ha**	**40%**
Area retained within Scheme boundary	0.13 ha	3%
Area reinstated (temporarily lost and landscaped)	0.87 ha	21%
Area lost (permanently lost[2])	0.64 ha	16%
Total area of the LWS outside of Scheme boundary (retained)	**2.44 ha**	**60%**
Total area of LWS	**4.08 ha**	**100%**

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[1] The LWS area measurement provided is approximate based on digital mapping information provided by DWT.

[2] This 0.64 ha permanently lost includes the new slip road and landscaped area within the central reservation as this area would not *function* as part of the LWS.

Section 8.10 Assessment of likely significant effects, paragraph 8.10.15 of the ES Chapter 8: Biodiversity **[APP-046]** states the following:

"*The Scheme would result in the permanent loss of approximately 30% (approximately 1.23ha) of Alfreton Road Rough Grassland LWS at Little Eaton junction. In addition, approximately 20% (approximately 0.86ha) of Alfreton Road Rough Grassland LWS would be temporarily impacted during the Scheme construction phase but would be reinstated through suitable landscape planting post-construction. The LWS is designated for its floodplain semi-improved grassland habitat; however, it is dominated by New Zealand pigmyweed (invasive plant under Schedule 9 of the Wildlife and Countryside Act 1981) which is currently affecting its intrinsic biodiversity value. The functional integrity of this site is not considered to be affected due to the relatively small area to be permanently lost due to the Scheme. The area of most biodiversity interest (botanically and for ornithology) is the inundation area/drawdown zone which would remain unaffected by the construction works. Therefore, it is considered that there would be a non-significant (neutral) effect on Alfreton Road Rough Grassland LWS from habitat loss. The confidence in this prediction is certain/near-certain. The timing of habitat loss would consider impacts upon other ecological species, particularly nesting-birds and wintering birds (as detailed further in this section).*"

Given the evaluation as detailed above, it is apparent that ES paragraph 8.10.15 needs to be corrected and should read:

'*The Scheme would result in the permanent loss of approximately 16% (0.64ha) of Alfreton Road Rough Grassland LWS at Little Eaton junction. In addition, approximately 21% (0.87ha) of Alfreton Road Rough Grassland LWS would be temporarily impacted during the Scheme construction phase but reinstated through suitable landscape planting post-construction. The LWS is designated for its floodplain semi-improved grassland habitat; however, it is dominated by New Zealand pigmyweed (invasive plant under Schedule 9 of the Wildlife and Countryside Act 1981) which is currently affecting its intrinsic biodiversity value. The functional integrity of this site is not considered to be affected due to the relatively small area to be permanently lost due to the Scheme. The area of most biodiversity interest (botanically and for ornithology) is the inundation area/drawdown zone which would remain unaffected by the construction works. Therefore, it is considered that there would be a non-significant (neutral) effect on Alfreton Road Rough Grassland LWS from habitat loss. The confidence in this prediction is certain/near-certain. The timing of habitat loss would consider impacts upon other ecological species, particularly nesting-birds and wintering birds (as detailed further in this section).*"

Thus, whilst the figures relating to the permanent and temporary losses at the Alfreton Road Rough Grassland LWS have been amended from those reported in the ES, this does not change the ES assessment results or effect significance assigned.

The Ecological Impact Assessment (EcIA) reported in the ES is an assessment based on the significance of effects. The conclusion that there will be a non-significant (neutral) effect on the Alfreton Road Rough Grassland LWS is based on the reduced value of much of the area to be lost to the Scheme through the presence of New Zealand pigmyweed *Crassula helmsii* and that the core biodiversity value of the LWS area is in the area to be retained, namely the floodplain semi-improved grassland of botanical and ornithological interest. The area to be lost temporarily and then reinstated will in time be of higher biodiversity value than the current areas; with new planting comprising semi-improved species-rich grassland and broad-leaved woodland with non-native invasive plant species controlled (see below).

Also refer to the following ES figures for details of the LWS ecological features:

- **Figure 8.5 [APP-099]** Non-Statutory Designated and Notable Nature Conservation Sites Little Eaton Junction – shows the boundary of Alfreton Road Rough Grassland LWS and the Scheme
- **Figure 8.6 [APP-100]** Phase 1 Habitat Survey Legend
- **Figure 8.8 [APP-102]** Little Eaton Junction Phase 1 Habitat Survey

- **Figure 2.12F [APP-068]** Environmental Masterplan (Little Eaton Junction) – shows the areas of habitat to be retained and landscaped

Proposed Mitigation and Monitoring Measures

As outlined in the **OEMP Ref. D-B4 [REP3-003],** an area of Alfreton Road Rough Grassland LWS temporarily lost during construction will be reinstated with species-rich grassland planting and the non-native invasive species New Zealand pigmyweed will be controlled in the works area, whilst the retained and reinstated habitat will be monitored for up to 5 years post construction to inform management which will be an improvement on the current situation. The LWS is privately owned and the site visit on 22nd January 2020 identified recently established patches of tall ruderal and scrub habitat, along with fly tipping and evidence of poaching by horses damaging the grassland and so impacting upon the condition of the habitats within the LWS (see Photos 3, 4 and 5 attached).

PW-BIO4 of the OEMP [REP3-003] outlines the potential for nesting little ringed plover (Schedule 1) at Little Eaton junction, in the northern part of Alfreton Road Rough Grassland LWS. Preconstruction surveys are scheduled between March to June 2020 to inform the mitigation requirements. The OEMP states: '*Should construction works in the northern part of Alfreton Road Rough Grassland LWS need to be undertaken during the nesting season, bird deterrents (such as shiny tape attached to canes fixed into the ground) should be implemented prior to the onset of (and during) the nesting season, in order to deter little ringed plover from nesting on the site. Temporary screen fencing shall also be provided prior to construction works to minimise visual disturbance*.' Regarding monitoring, the OEMP states: '*An appropriate specialist shall undertake monitoring of the potential little ringed plover nesting sites within the retained habitat, as associated with the mitigation defined in the ES Chapter 8: Biodiversity. Monitoring also to be conducted on the effectiveness of temporary barriers during Scheme construction and assess the success of habitat establishment. Alternative measures may need to be implemented if barriers are found to be ineffective.*'

Conclusion

The information as presented above indicates that the ES reported that the area of the Alfreton Road Rough Grassland LWS to be permanently lost due to the Scheme would be approximately 30% (approximately 1.23ha), with approximately 20% (approximately 0.86ha) being temporarily impacted and subject to reinstatement. However, herein it is corrected that the Scheme will result in the permanent loss of approximately 16% (0.64ha) of the LWS, with approximately 21% (0.87ha) being temporarily impacted during the Scheme construction phase and subject to reinstatement with habitat of higher biodiversity value than that currently present. It is assessed that such impacts, with the defined mitigation measures and landscape proposals, that the Scheme will have a non-significant (neutral) effect upon the LWS and that the functional integrity of this site will not be affected.

Regardless of the above, Highways England are exploring opportunities for enhancing local ecology in the vicinity of the Alfreton Road Rough Grassland LWS via a Designated Fund project being investigated outside of the Development Order Consent (DCO) (as referenced in ES Chapter 8: Biodiversity **[APP-046]**). Highways England will liaise with DWT and EBC regarding such ecological enhancement opportunities separately.

Photos – Alfreton Road Rough Grassland LWS 22.01.19

Photo 1: Facing North (area to be lost) – patches of tall ruderal habitat and scrub

Photo 2: Facing south (area to be retained)

Photo 3: Evidence of fly tipping around the eastern perimeter of the LWS

Photo 4: Evidence of fly tipping around the eastern perimeter of the LWS

Photo 5: Evidence of fly tipping and poaching around the eastern perimeter of the LWS

Appendix 10: 8.77 – Technical Note on Noise Assessment – The Averaging Time (T) and the Duration of Impact – 3.3.20 [REP6-021]

A38 Derby Junctions

TR010022

8.77 Noise Assessment – The Averaging Time (T) and the Duration of Impact

Planning Act 2008

Rule 8 (1)(c)(ii)

The Infrastructure Planning (Examination Procedure) Rules 2010

Volume 8

March 2020

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010

A38 Derby Junctions
Development Consent Order 202[ ]

Noise Assessment – The Averaging Time (T) and the Duration of Impact

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Regulation Number	Rule 8(1)(c)(ii)
Planning Inspectorate Scheme Reference	TR010022
Application Document Reference	8.77
Author	A38 Derby Junctions Project Team, Highways England

Version	**Date**	**Status of Version**
1	03 March 2020	Deadline 6 Submission

Noise Assessment - The Averaging Time (T) and the Duration of Impact

BS 5228-1:2009+A1:2014 (the Noise Standard) gives two methods for determining significance of noise effects for environmental impact assessment (EIA) purposes (i.e. at the Environmental Statement (ES) preparation stage) based on noise changes due to construction activities, namely: the ABC method and the 5 dB change method. The Noise Standard gives guidance on a range of other situations, for example the provision of noise insulation and temporary re-housing, and the impact of long term substantial earth moving.

Both methods (i.e. ABC and 5 dB change) require the noise levels from construction site activity to be compared with a threshold (i.e. the Significant Observed Adverse Effect Level (SOAEL)) which is determined from the existing ambient noise level for the averaging period, *T. T* is equal to the duration of the period (e.g. eight hours for night-time (23:00 to 07:00)). This averaging period (e.g. over the whole night) is appropriate to the level of detail available at ES stage on the nature and timing of the works.

The guidance in relation to noise insulation and temporary re-housing defines *T* for various time periods, which are shorter than those used in the ABC and 5 dB change methods. However, this guidance does not relate to the identification of significant effects at the ES stage, but instead relates to determining the need for noise insulation/ re-housing *after* Best Practicable Means (BPM) have been applied. Such an assessment, if carried out, would be done immediately prior to or during the construction works when more construction detail is available (though given the highly variable nature of construction activities, the detail to predict individual 1-hour construction noise levels is rarely available).

It is, therefore, not appropriate to apply the more granular *T* values from the noise insulation and temporary re-housing guidance to the identification of significant adverse effects at the ES stage.

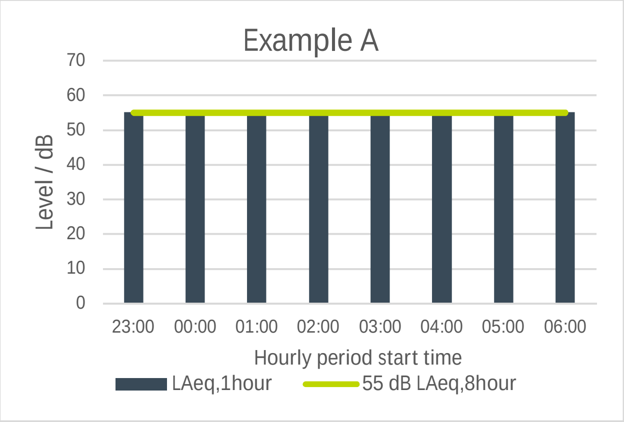
However, to address the concern that using a longer averaging period could be ‘more favourable’ to Highways England and reduce the number of significant effects, examples based on the eight-hour night time period are provided below to illustrate the potential effect of the averaging period, *T*.

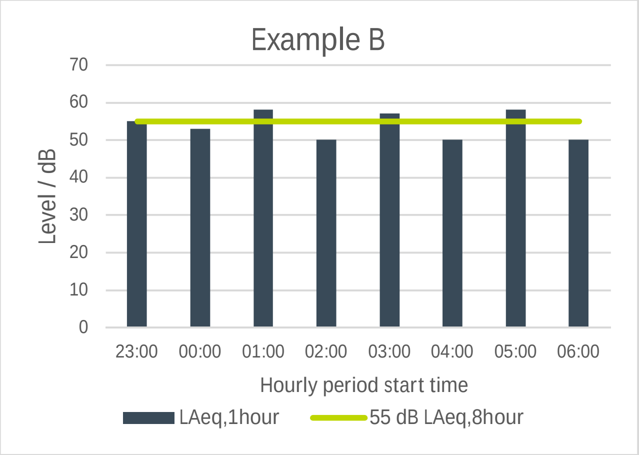
Both ambient and construction noise levels, by their nature, vary over time. Taking the eight-hour night-time as an example, due to the way in which noise levels in decibels are averaged over time, in order to achieve a given level (e.g. 55 dB $L_{\mathrm{Aeq,8hour}}$), there is a limit to the amount by which the individual $L_{\mathrm{Aeq,1hour}}$ can exceed this level. A construction noise level of 64 dB occurring for one hour (i.e. $L_{\mathrm{Aeq,1hour}}$ 64 dB) which then stops (or is considerably reduced to e.g. the mid to low 40 dB range) for seven hours, would equate to 55 dB $L_{\mathrm{Aeq,8hours}}$ (i.e. taking the average over the eight-hour period).

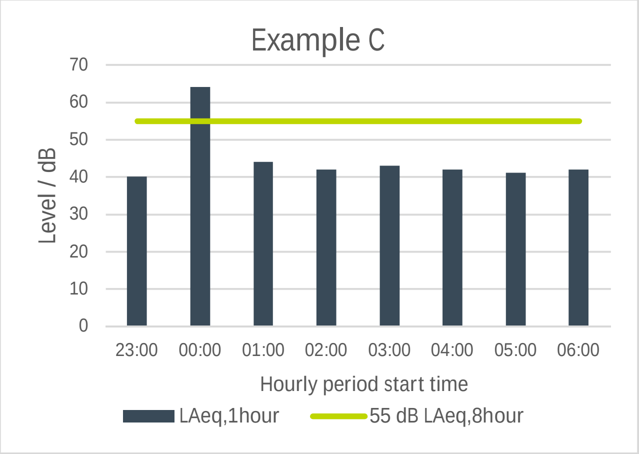
The examples below illustrate three hypothetical examples of individual hourly construction noise level data over an eight-hour night, each of which have a $L_{\mathrm{Aeq,8hour}}$ of 55 dB.

- In Example A, the level in each hour is 55 dB $L_{\mathrm{Aeq,1hour,}}$ and the overall average is therefore also 55 dB $L_{\mathrm{Aeq,8hour.}}$
- In Example B some hours are slightly above and slightly below 55 dB $L_{\mathrm{Aeq,1hour}}$ with the overall average still being 55 dB $L_{\mathrm{Aeq,8hour}}$.
- In Example C, one hour is considerably above 55 dB (64 dB), therefore, to maintain the overall $L_{\mathrm{Aeq,8hour}}$ at 55 dB, the remaining hours must be considerably lower.

Thus, whilst Example C appears to ‘allow’ a single large exceedance, it is compensated for by seven hours of relative quiet, whereas Examples A and B consist of more continuous moderate levels throughout. A person's perception of Examples A and B are likely to be comparable, though not necessarily "more favourable" than Example C. Some people may prefer the situation illustrated in Example C, where the noisy activity takes place over a short period and then stops.







Exceedance of SOAEL, and Duration of Exceedance

Of the two methods based on the change in noise level presented in BS 5228 for determining significance of noise effects at the ES stage, the ABC Method is the most commonly applied, and is the method specified in the current version of DMRB (LA 111), issued in November 2019.

Using this method, for each period (night-time, evening/ weekend, daytime), a threshold for potentially significant effects (i.e. the SOAEL) is set in terms of $L_{Aeq,T}$ based on the existing ambient noise levels.

In simple terms, if the existing ambient levels are low (Category A), the daytime SOAEL is 65 dB $L_{Aeq,12hours}$. Therefore, if the daytime construction noise level averaged over 12 hours exceeds 65 dB $L_{Aeq,12hours}$ (the SOAEL) there is a potential significant effect. This allows for variation in noise levels throughout the day (as discussed above), as is expected given the nature of construction activities, with noisier periods of activity being balanced out by quieter periods.

However, the standard goes on to say that other factors, including the duration of the impact, should be considered, to determine if there is a significant effect.

As the ABC method itself gives no further guidance on duration, the options are therefore:

i. Develop criteria from scratch; or
ii. Apply appropriate guidance from within the standard itself.

As developing criteria from scratch would not be backed up by published guidance, it makes sense to first seek guidance from within the standard itself.

The only other two references to duration within the standard fall within the 5 dB change method, and the noise insulation and temporary rehousing guidance.

- The ‘5 dB change’ method is comparable to the ABC method, as it relates to identification of significant adverse effects at ES stage. Is suggests that an exceedance of up to one month would not normally be considered significant (unless works of a shorter duration are likely to result in a significant effect, but gives no further guidance on how this might be applied).
- The noise insulation and temporary rehousing guidance is less comparable as it does not relate to the identification of significant adverse effects, but the criteria are more stringent in that exceedances of 10 or more days of working in any 15 consecutive days (or 40 days in 6 consecutive months) would be considered significant.

Whilst the 5 dB change method may be more comparable (as it relates to the ES stage), in the interests of robustness the more stringent criteria from the temporary rehousing guidance have been adopted. If exceedances of a given threshold can occur for up to 9 days without the need for noise insulation or temporary re-housing, it follows that exceedances of a given threshold for up to 9 days could also occur without the effect being significant.

The duration criteria are therefore:

- Exceedances of the SOAEL for less than 10 days in any 15 consecutive days (or 40 days in any consecutive 6 month) would not normally be considered significant.
- Exceedances of the SOAEL for 10 or more days in any 15 consecutive days (or 40 days in any 6 month period) would normally be considered significant.

These criteria are adopted in the current version of DMRB (LA 111), issued in November 2019.

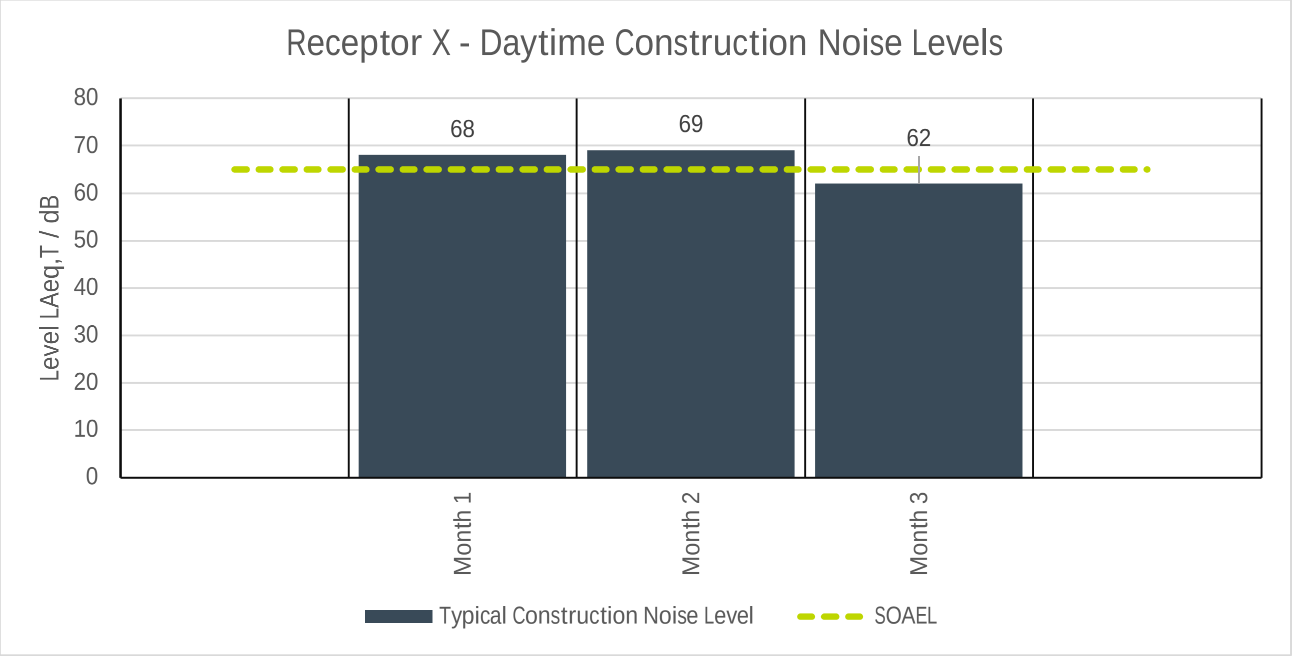
Together the SOAEL and duration criteria are not intended to be ‘design criteria’, as the overriding principle of BPM applies throughout the design and construction, they are intended to be used to assess the potential for significant adverse effects at the ES stage. Whether or not a significant adverse effect is predicted at the ES stage has no bearing on the requirement to adopt BPM.

The detail required to apply the duration criteria is not normally available at the ES stage. The Highways England contractor has provided details of the Scheme activities taking place within each month, however, precise details regarding durations and timings on individual days within each month, as required to apply the duration criteria, would not be expected to be available at this stage. Therefore, within the assessment, within each month all activities are assumed to take place simultaneously for the entire month, giving a ‘typical worst case’ construction noise level for that month. To be conservative, if this level exceeds the SOAEL, a significant adverse effect is identified in the ES, even if consideration of duration, which is not known at this stage, would have led to it being considered not significant.

A hypothetical example using a three-month period is illustrated below.

Example 1 – no detailed information on timings and durations:

- Activities in each month **known**
- Timings and durations **not known**
- All activities therefore assumed to take place simultaneously for the entire month (i.e. worst case)
- Any exceedance of SOAEL considered significant (i.e. duration criteria not applied)

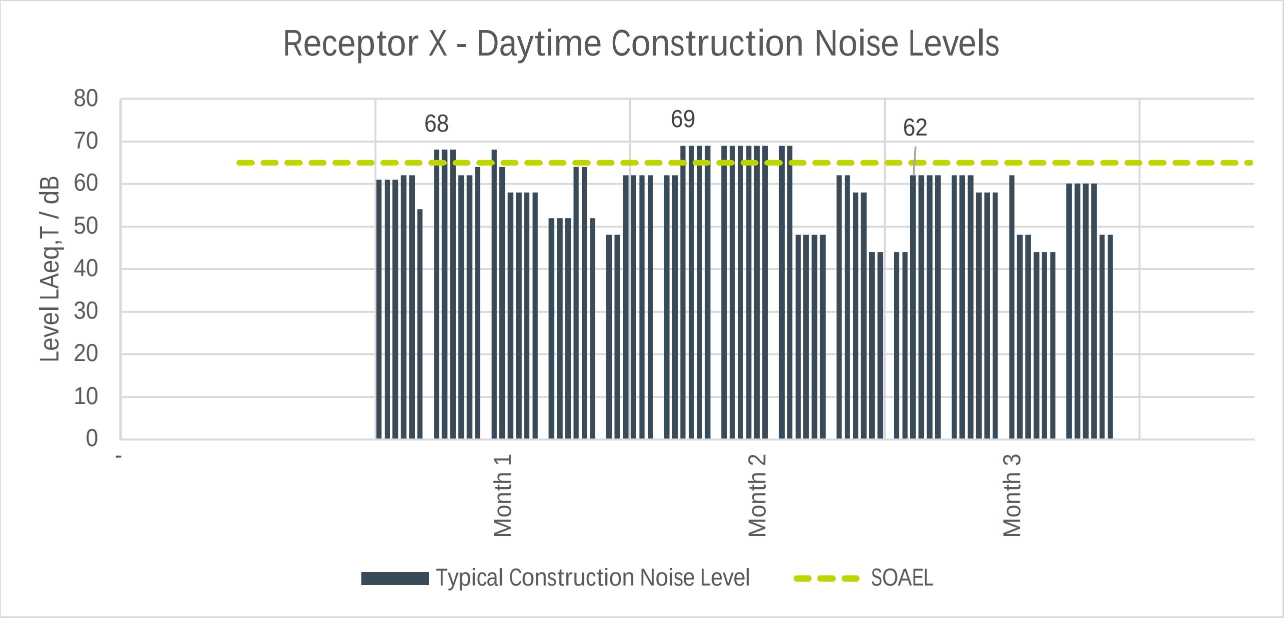


- *Month 1: SOAEL* ***exceeded****; duration of exceedance* ***not known****, to be conservative* ***a significant adverse effect is identified***
- *Month 2: SOAEL* ***exceeded****; duration of exceedance* ***not known****, to be conservative* ***a significant adverse effect is identified***
- *Month 3: SOAEL* **not exceeded***; (and therefore there is no duration of exceedance) therefore* **a significant adverse effect is NOT identified**

Conclusion: significant adverse effects identified in TWO MONTHS at Receptor X.

Example 2 – detailed information on timings and durations available:

- Activities in each month **known**
- Timings and durations within each month **known**
- Daily construction noise levels can be predicted
- Significant effect only identified if SOAEL exceeded AND duration criteria met



- *Month 1: SOAEL **exceeded**; duration of exceedance **4 days in a 15 consecutive day period**, therefore **a significant adverse effect is NOT identified***
- *Month 2: SOAEL **exceeded**; duration of exceedance **11 days in a 15 consecutive day period**, therefore **a significant adverse effect is identified***
- *Month 3: SOAEL **not exceeded**; (and therefore there is no duration of exceedance) therefore **a significant adverse effect is NOT identified***

Conclusion: significant adverse effect identified in ONE MONTH at Receptor X

OVERALL CONCLUSION: More detailed assessment including consideration of duration of exceedance of the SOAEL would have led to fewer significant adverse effects being identified. Therefore, the approach in the ES is conservative and robust.

Noted that in this hypothetical example, the highest levels have been kept consistent between the two examples (68 in month 1, 69 in month 2, 62 in month 3), to help illustrate the effect of additionally considering duration of the exceedance of SOAEL.

Appendix 11: 8.49 – Additional Soil and Groundwater Contamination Information submitted to the Environment Agency (EA) – 19.12.19 [REP3-020]

A38 Derby Junctions

TR010022

8.49 Additional Soil and Groundwater Contamination Information Submitted to the EA

Planning Act 2008

Rule 8 (1)(c)(ii)

The Infrastructure Planning (Examination Procedure) Rules 2010

Volume 8

December 2019

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010

A38 Derby Junctions

Development Consent Order 202[ ]

Additional Soil and Groundwater Contamination Information Submitted to the EA

Regulation Number	Rule 8(1)(c)(ii)
Planning Inspectorate Scheme Reference	TR010022
Application Document Reference	8.49
Author	A38 Derby Junctions Project Team, Highways England

Version	Date	Status of Version
1	19 December 2019	Deadline 3 Submission

1 Additional Soil and Groundwater Contamination Information Submitted to the EA

1.1.1 In the Environment Agency (EA) relevant representation [**RR-005**] regarding the Scheme, a number of points relating to soil and groundwater contamination were raised (comments 4 to 6). Highways England responded to these various questions in [**RR1-003**]. In addition, on the 9.10.19 Highways England provided additional information to the EA regarding groundwater quality in the areas of the A38 junctions, namely tables of chemical data and figures presenting borehole locations where exceedances of the Tier 1 groundwater risk assessment were recorded.

1.1.2 The EA reviewed the information supplied by Highways England and responded in their Written Representation [**REP1-020**] that: "*The applicant provided figures showing groundwater exceedances in each area, but still believe the use of UCL95 for groundwater quality data is not appropriate. This is because the UCL95 value is used to represent a concentration of a contaminant in groundwater across the whole of each area of investigation, which is conceptually incorrect*".

1.2 In response to this comment, Highways England prepared a Technical Note containing a revised Quantitative Risk Assessment (QRA) for Controlled Waters for the Scheme at Kingsway, Markeaton and Little Eaton junctions. The Generic Quantitative Risk Assessment (GQRA) and Detailed Quantitative Risk Assessment (DQRA) included in the Technical Note did not use UCL95 (95% Upper Confidence Limits) values in the assessments. The Technical Note was issued to the EA on 26.11.19 (refer to Appendix A) noting that this also contains the information supplied to the EA on the 9.10.19.

Appendix A – Technical Note

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Project name:
A38 Derby Junctions

Project ref:
60533462

From:
David Evans

Date:
25 November 2019

To:
Mr T. Lowden
Environment Agency

CC:
Simon Wild

Technical Note: A38 Derby Junctions

Subject: Geology and Soils (Controlled Waters Quantitative Risk Assessment)

In October 2019 AECOM provided clarification to assist in addressing queries from the Environment Agency regarding groundwater quality in the areas associated with the A38 Derby junctions (referred to as the Scheme herein), namely Kingsway junction, Markeaton junction and Little Eaton junction. This information comprised tables of chemical data and figures presenting borehole locations where exceedances of the Tier 1[1] groundwater generic quantitative risk (GQRA) assessment were recorded. These tables supplied to the Environment Agency are replicated in Appendix A and are as follows:

- A38 Groundwater Tier 1 Screen Little Eaton junction
- A38 Groundwater Tier 1 Screen Markeaton junction
- A38 Groundwater Tier 1 Screen Kingsway junction

The tables present the groundwater chemical analysis data from the monitoring wells sampled during the post investigation works monitoring (3 rounds). Where there are fewer than 3 rounds of data, it indicates that the monitoring well was dry, inaccessible or damaged for that round(s). The data has been split between the various lithologies within which the monitoring wells were screened; either within Made Ground, superficial deposits or bedrock deposits.

The figures supplied to the Environment Agency are replicated in Appendix B and are as follows:

- Figure 1 – Tier 1 Assessment Groundwater Exceedances (Little Eaton) GW monitoring wells
- Figure 2 – Tier 1 Assessment Groundwater Exceedances (Markeaton) GW monitoring wells
- Figure 3 – Tier 1 Assessment Groundwater Exceedance (Kingsway - North) GW monitoring wells
- Figure 4 – Tier 1 Assessment Groundwater Exceedance (Kingsway - East) GW monitoring wells
- Figure 5 – Tier 1 Assessment Groundwater Exceedance (Kingsway - South) GW monitoring wells

The figures present the distribution of monitoring wells from which groundwater samples were collected for chemical analysis at each junction.

Following the Environment Agency's review of the additional data it was clear that the Environment Agency did not agree with the use of UCL95 values within the quantitative risk assessments for controlled waters. As such, the following provides a revised Quantitative Risk Assessment (QRA) for Controlled Waters for the Scheme at Kingsway, Markeaton and Little Eaton junctions. The revision is undertaken following Environment Agency comments regarding the use of

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[1] Tier 1 GQRA is terminology from CLR11 (EA, 2004); the terminology has been changed in the Contaminated Land: Risk Management (EA, 2019) guidance which refers to GQRA as Tier 2. For consistency with the earlier reports the GQRA will continue to be referred to as Tier 1.

statistical analysis of the datasets in the 2018 Ground Investigation Report which determined a 95th percentile upper confidence limit (UCL95) for the groundwater data for each determinand for comparison with the Generic Assessment Criteria. The Environment Agency disagreed with this approach due to the underlying assumptions in the use of UCL95 values. The GQRA and DQRA in this Technical Note do not use UCL95 values in the assessments. The following quantitative risk assessment (QRA) is based on groundwater data only. The GQRA and DQRA in the Ground Investigation Report (2018) were based on the maximum concentrations recorded in either soil leachate or groundwater which was a highly conservative approach.

Generic Quantitative Risk Assessment

Basis of Tier 1 Assessment

The main critical receptors present at each of the three junctions are discussed in Section 6.7.1.3 of the A38 Derby Junctions Ground Investigation Factual Report (AECOM, 2018) [DCO Document APP-222].

The groundwater monitoring datasets have been evaluated against the following hierarchy of criteria for the groundwater receptor in order to assess potential risks to controlled waters:

- Water, England & Wales - Water Supply (Water Quality) Regulations, 2016 No. 614
- Guidelines for Drinking-water Quality (4th Edition inc. the First Addendum). World Health Organisation. 2017
- WHO, Petroleum Products in Drinking-water. Background document for development of WHO Guidelines for Drinking-water Quality WHO/SDE/WSH/05.08/123, 2008
- Drinking Water Guidelines Calculated using WHO Methodology
- US Environmental Protection Agency, Regional Screening Levels, May 2019. Tapwater
- Draft health protective concentration from California Environmental Protection Agency (1999) Ethanol in Gasoline

Minimum from:

- (Taste/Odour) Guidelines for Drinking-water Quality (4th Edition inc. the First Addendum). World Health Organisation. 2017 (except phenol - 1st edition 1984) - Taste
- (Taste/Odour) Guidelines for Drinking-water Quality (4th Edition inc. the First Addendum). World Health Organisation. 2017 (except phenol - 1st edition 1984) - Odour

The groundwater monitoring datasets have also been evaluated against the following hierarchy of criteria for the surface watercourse receptor in order to assess potential risks to controlled waters:

- The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 - AA-EQS Inland; MAC-EQS Inland and Freshwater Standards
- The Water Environment (River Basin Management Planning etc.) (Miscellaneous Amendments) (Scotland) Regulations 2015. Scottish SI 2015 No. 211. AA-EQS Inland and MAC-EQS Inland
- SEPA - Supporting Guidance (WAT-SG-53) Environmental Quality Standards for Discharges to Surface Waters. v6. Dec 2015. Fresh EQS – AA and Fresh EQS – MAC
- The Water Framework Directive (Classification, Priority Substances and Shellfish Waters) Regulations (Northern Ireland) 2015. AA-EQS Inland; MAC-EQS Inland and Freshwater Standards
- European Union Environmental Objectives (Surface Waters) (Amendment) Regulations 2015. S.I. No. 386 of 2015. Ireland - AA-EQS Inland and MAC-EQS Inland
- PNEC derived for EU REACH registration dossiers - Freshwater

An Initial Tier 1 Risk Assessment has been undertaken to compare the groundwater monitoring datasets to the criteria detailed above to identify whether any of the samples had recorded elevated concentrations of metals, inorganic or organic determinands compared to the above hierarchy of criteria.

Laboratory chemical analysis data from the ground investigation have been used in the analysis of risk to controlled waters. It should be noted that for a risk to be present, then a viable pollutant linkage should be identified between the source and receptor. The chemical analysis data has been split into tables for natural ground and made ground where monitoring wells were screened in different materials. The results of the Tier 1 Screen for controlled waters are presented in Appendix A. Where concentrations for PAHs have been detected in several laboratory tests (PAHs, VOCs and/or SVOCs), AECOM has combined the results to provide the recorded range for that determinand.

Kingsway Junction

The groundwater monitoring wells at Kingsway junction were either screened in Made Ground [BK12, BK13 and BK14] and natural ground [BK02, BK04, BK09, BK11 and BK15] depending on the ground materials encountered. The dates of sampling are noted on the Kingsway junction screening table.

Made Ground

Three groundwater monitoring wells [BK12, BK13 and BK14] were sampled on 3 occasions each. Table 1 provides a summary of the determinands in groundwater (perched water) in the Made Ground that exhibited exceedances of the Tier 1 Assessment Criteria. Although groundwater and potable water supplies are not considered a critical receptor at this location, the assessment of the data against Drinking Water Standards has been provided as greyed text in Table 1.

Table 1. Summary of Exceedances Recorded in Made Ground Groundwater at Kingsway Junction

Determinand	Units	DWS	EQS	No. of Samples	Recorded Concentrations	No. of Exceedances DWS	No. of Exceedances EQS
Metals							
Arsenic (filtered)	µg/L	10	50	9	<0.5 – 35.3	2	-
Boron (filtered)	µg/L	1000	2000	9	69.4 – 3,030	4	1
Chromium (III + VI)	µg/L	50	-	9	7.04 – 872	6	-
Iron	µg/L	200	1000	9	<24 – 429,000	8	8
Iron (filtered)	µg/L	200	1000	9	<19 – 32,100	5	5
Nickel (filtered)	µg/L	20	4	9	2.03 – 50.3	3	8
Zinc	µg/L	6000	10.9	9	2.91 – 11.2	-	1
Organics							
Naphthalene	µg/L	6	2	9	<1 – 10.7	-	6
Phenanthrene	µg/L	4	-	9	<1 – 74.1	2	-
Anthracene	µg/L	90	0.1	9	<1 – 21.8	-	4
Fluoranthene	µg/L	4	0.0063	9	<1 – 65.2	4	4
Benzo(a)anthracene	µg/L	3.5	-	9	<1 – 25.3	3	-
Benzo(a)pyrene	µg/L	0.01	0.00017	9	<0.009 – 78.9	7	7
Indeno(1,2,3 c-d)pyrene	µg/L	0.1	-	9	<0.014 – 43.5	6	-
Dibenzo(a,h)anthracene	µg/L	0.07	-	9	<0.016 – 3.63	6	-
Benzo(g,h,i)perylene	µg/L	0.016	0.0082	9	<0.016 – 45.8	6	7
Benzo(b)fluoranthene	µg/L	0.1	0.017	9	<0.023 – 89.3	6	7
Benzo(k)fluoranthene	µg/L	0.1	0.017	9	<0.027 – 35.7	6	7
PAHS (Sum of 4)	µg/L	0.1	-	3	0.2284 – 214	3	-
Phenol	µg/L	5800	7.7	9	<2 – 30	-	1
>C10-C12 Aliphatics	µg/L	300	-	9	<10 – 331	1	-
>C12-C16 Aliphatics	µg/L	300	-	9	<10 – 324	2	-
>C16-C21 Aliphatics	µg/L	300	-	9	<10 – 542	5	-
>C21-C35 Aliphatics	µg/L	300	-	9	<10 - 5760	6	-
>EC5-EC7 Aromatics	µg/L	1	10	9	<10 – 17	3	2
>EC8-EC10 Aromatics	µg/L	300	-	6	<10 – 391	1	-

Determinand	Units	DWS	EQS	No. of Samples	Recorded Concentrations	No. of Exceedances DWS	No. of Exceedances EQS
>EC10-EC12 Aromatics	µg/L	90	-	9	<10 – 221	3	-
>EC12-EC16 Aromatics	µg/L	90	-	9	<10 – 352	6	-
>EC16-EC21 Aromatics	µg/L	90	-	9	<10 – 484	6	-
>EC21-EC35 Aromatics	µg/L	90	-	9	<10 – 1,850	6	-
2,4 -dichlorophenol	µg/L	46	4.2	9	<1 – 4.76	-	1
Bis(2-ethylhexyl) phthalate	µg/L	8	1.3	9	<2 – 37.4	5	5
Dibenzofuran	µg/L	7.9	-	9	<1 – 13.8	2	-
Benzene	µg/L	1	10	9	<1 – 24.2	6	3
Xylene Total	µg/L	500	30	9	<11 – 380	-	1

The groundwater chemical data for Made Ground were from groundwater samples taken from BK12, BK13 and BK14 which were located within the area of the Rowditch Tip former landfill site - see Figure 4 (refer to Appendix B). BK12, BK13 and BK14 were screened within the landfilled materials. The following determinands exceeded their corresponding EQS GAC values:

- No inorganic compounds were recorded at concentrations at or above their corresponding EQS value;
- Four metal determinands Boron, Iron, Nickel and Zinc were recorded at concentrations above their corresponding EQS values; and
- Fourteen organic determinands (seven PAHs, two phenol compounds, benzene, xylene, dibenzofuran, EC5 to EC7 aromatic petroleum hydrocarbon fraction and a phthalate compound) were recorded at concentrations above their corresponding EQS values.

Natural Ground (Mercia Mudstone Group strata)

Four groundwater monitoring wells [BK04, BK09, BK11 and BK15] were sampled on three occasions each and one well [BK02] was sampled on one occasion. Table 2 provides a summary of the determinands in groundwater in natural ground (Mercia Mudstone) that exhibited exceedances of the Tier 1 Assessment Criteria. Although groundwater and potable water supplies are not considered a critical receptor at this location, the assessment of the chemical results against Drinking Water Standards has been provided as greyed text in Table 2.

Table 2. Summary of Exceedances Recorded in Mercia Mudstone at Kingsway Junction

Determinand	Units	DWS	EQS	No. of Samples	Recorded Concentrations	No. of Exceedances DWS	No. of Exceedances EQS
Metals							
Cadmium (Filtered)	µg/L	5	0.08	13	<0.08 – 0.274	-	1
Chromium (III +VI)	µg/L	50	-	13	<3 – 258	1	-
Copper (filtered)	µg/L	2000	1	13	<3 – 1.81	-	2
Iron	µg/L	200	1000	13	1,280 – 274,000	13	13
Iron (filtered)	µg/L	200	1000	13	<19 – 2,030	1	1
Nickel (filtered)	µg/L	20	4	13	0.454 – 7	-	1
Organics							
Fluoranthene	µg/L	4	0.0063	13	<0.017 – 0.198	-	5
Benzo(a)pyrene	µg/L	0.01	0.00017	13	<0.009 – 0.166	6	6
Indeno(1,2,3 c-d)pyrene	µg/L	0.1	-	13	<0.014 – 0.105	1	-
Benzo(g,h,i)perylene	µg/L	0.1	0.0082	13	<0.016 – 0.168	1	5
Benzo(b)fluoranthene	µg/L	0.1	0.017	13	<0.023 – 0.274	2	4
Benzo(k)fluoranthene	µg/L	0.1	0.017	13	<0.027 – 0.115	1	3

Determinand	Units	DWS	EQS	No. of Samples	Recorded Concentrations	No. of Exceedances DWS	No. of Exceedances EQS
PAHS (Sum of 4)	µg/L	0.1	-	4	<0.08 – 0.662	3	-
Bis(2-ethylhexyl) phthalate	µg/L	8	1.3	13	<2 – 8.26	1	1

The groundwater chemical data for natural ground were from groundwater samples taken from BK02, BK04, BK09, BK11 and BK15 which were located along the length of the proposed improvements to Kingsway Junction - see Figures 3, 4 and 5 (refer to Appendix B). BK15 is located within the Rowditch Tip former landfill site, but the BK15 monitoring well was screened within the underlying Mercia Mudstone bedrock material. Only iron (unfiltered) (all samples) and benzo(a)pyrene (1 out of samples) exceeded the corresponding EQS concentration in groundwater samples from BK15. The landfilled materials are underlain by clay materials which appear to be containing the perched water within the confines of the former landfill [the location is part of an infilled clay pit].

PAHs were recorded at elevated concentrations in comparison to their respective EQS value in groundwater samples from BK02 [4 PAH compounds] (1 out of 1 samples), BK09 [6 PAH compounds] (3 out of 3 samples) and BK11 [4 PAH compounds] (1 out of 3 samples).

Cadmium and nickel were recorded at elevated concentrations in comparison to their respective EQS value in 1 out 1 sample in BK02. Copper was recorded at elevated concentrations in comparison to its EQS value in 2 out of 3 samples in BK04. Bis(2-ethylhexyl) phthalate was recorded at elevated concentrations in comparison to its EQS value in 1 out of 3 samples in BK04. No other exceedances of EQS values were recorded.

BK02 is located within the existing Kingsway junction. BK04 is located to the west of the existing Kingsway junction and adjacent to the former landfill ‘Disused Railway Cutting and Tunnel off Station Road’. BK09 is located on Lyttleton Street underpass beneath the A38. BK11 is located within Mackworth Park, to the west of the A38 south west of the existing Kingsway junction and south of the former landfill adjacent to BK04.

Markeaton Junction

The four groundwater monitoring wells at Markeaton junction [BM05, BM06A, BM10 and BM11] were screened in the natural strata (alluvium/mudstone). Initially, BM05 and B06A were monitored and sampled. However, BM05 became dry and BM10 and BM11 were added to subsequent monitoring rounds. BM10 and BM11 were not ideal monitoring wells as they were screened through all of the ground materials encountered. The dates of monitoring are noted on the Markeaton Junction Screening Table. Additional monitoring was undertaken in the vicinity of Markeaton junction due to:

- The presence of a working ‘petrol station’
- The Scheme requires a cutting to be constructed adjacent to the location of the petrol station
- Dewatering of the cutting may be required

One groundwater monitoring well [BM06A] was sampled on 7 occasions, two wells [BM10 and BM11] were sampled on four occasions and one well [BM05] was sampled on two occasions. The locations of BM05, BM06A, BM10 and BM11 are shown on Figure 2 (refer to Appendix B).

Table 3 details the summary of the determinands in groundwater in the Natural Ground (alluvium/mudstone) that exhibited exceedances of the Tier 1 Assessment Criteria. Although groundwater and potable water supplies are not considered a critical receptor at this location, the assessment of the data against Drinking Water Standards has been provided as greyed text in Table 3.

Table 3. Summary of Exceedances Recorded at Markeaton Junction

Determinand	Units	DWS	EQS	No. of Samples	Recorded Concentrations	No. of Exceedances DWS	No. of Exceedances EQS
Herbicides							
Metazachlor	µg/L	0.1	-	4	<0.01 - 0.486	1	-
Metals							
Chromium (III+VI)	µg/L	50	-	17	1 – 255	6	-
Copper	µg/L	2000	1	2	<0.85 - 17	-	1

Determinand	Units	DWS	EQS	No. of Samples	Recorded Concentrations	No. of Exceedances DWS	No. of Exceedances EQS
Copper (Filtered)	µg/L	2000	1	15	<0.3 – 1.68	-	2
Iron	µg/L	200	1000	17	990 – 211,000	17	16
Iron (Filtered)	µg/L	200	1000	15	<19 - 317	1	-
Zinc (Filtered)	µg/L	6000	10.9	15	<1 – 11.2	-	1
Organics							
>C21-C35 Aliphatics	µg/L	300	-	16	<10 – 1,250	4	-
>EC21-EC35 Aromatics	µg/L	90	-	16	<10 – 591	4	-
Benzene	µg/L	1	10	17	<1 - 11	1	1
Anthracene	µg/L	90	0.1	17	<0.005 - 0.215	-	3
Fluoranthene	µg/L	4	0.0063	17	<0.017 – 0.712	-	15
Benzo(a) pyrene	µg/L	0.01	0.00017	17	<0.009 – 1.55	7	8
Indeno(1,2,3-c,d)pyrene	µg/L	0.1	-	17	<0.005 – 2.55	4	-
Dibenzo(a,h)anthracene	µg/L	0.075	-	17	<0.005 – 0.238	4	-
Benzo(g,h,i)perylene	µg/L	0.1	0.0082	17	<0.005 – 2.04	4	8
Benzo(b)fluoranthene	µg/L	0.1	0.017	17	<0.005 – 2.99	5	6
Benzo(k)fluoranthene	µg/L	0.1	0.017	17	<0.027 – 1.2	4	6
Chloroform	µg/L	100	2.5	17	<1 - 15	-	1
Phenol	µg/L	5800	7.7	17	<1 – 15.3	-	1

Very few metal determinands exceeded their corresponding EQS values in groundwater samples from Markeaton junction: copper in one sample from BM05; iron in all four wells and zinc in one sample from BM06A. PAHs [6 PAH compounds] exceeded their corresponding EQS values in samples tested in all four monitoring wells: BM05 in one sample; BM06A in five samples; BM10 in all four samples and BM11 in all four samples. Benzene [BM05], chloroform [BM05] and phenol [BM10] were detected in one sample each.

BM05A is located to the south of the existing petrol station adjacent to the northbound carriageway of the A38. BM06A is located within the Territorial Army land to the east of the existing petrol station and adjacent to the southbound carriageway of the A38. BM10 is located to the east of the existing Markeaton junction, adjacent to Ashbourne Road. BM11 is located to the north west of the existing Markeaton junction adjacent to the northbound A38 carriageway.

Little Eaton Junction

Three groundwater monitoring wells were located at Little Eaton junction [BL02, BL08 and BL10]. These wells were all screened within natural ground (alluvium). The dates of monitoring are noted on the Little Eaton Junction Screening Table.

Two groundwater monitoring wells [BL08 and BL10] were sampled on three occasions and one well [BL02] was sampled on two occasions. The locations of monitoring wells BL02, BL08 and BL10 are shown in Figure 1 (refer to Appendix B). Table 4 details the summary of the determinands in groundwater in the Alluvium that exhibited exceedances of the Tier 1 Assessment Criteria.

Table 4. Summary of Exceedances Recorded in Alluvium at Little Eaton Junction

Determinand	Units	DWS	EQS	No. of Samples	Recorded Concentrations	No. of Exceedances DWS	No. of Exceedances EQS
Metals							
Cadmium (Filtered)	µg/L	5	0.08	8	<0.08 – 5.24	1	2
Chromium (III+VI)	µg/L	50	-	8	9.87 – 136	2	-
Copper (Filtered)	µg/L	2000	1	8	<0.85 – 1.62	-	1

Determinand	Units	DWS	EQS	No. of Samples	Recorded Concentrations	No. of Exceedances DWS	No. of Exceedances EQS
Iron	µg/L	200	1000	8	17,200 – 115,000	8	8
Iron (Filtered)	µg/L	200	1000	8	<19 – 3,250	6	3
Nickel (Filtered)	µg/L	20	4	8	2.68 – 37.9	1	6
Organics							
Anthracene	µg/L	90	0.1	8	<0.015 - 0.115	-	1
Fluoranthene	µg/L	4	0.0063	8	<0.017 – 0.712	-	5
Benzo(a) pyrene	µg/L	0.01	0.00017	8	<0.009 – 1.55	5	5
Indeno(1,2,3-c,d)pyrene	µg/L	0.1	-	8	<0.014 – 0.951	3	-
Dibenzo(a,h)anthracene	µg/L	0.075	-	8	<0.016 – 0.189	1	-
Benzo(g,h,i)perylene	µg/L	0.1	0.0082	8	<0.016 – 1.06	4	5
Benzo(b)fluoranthene	µg/L	0.1	0.017	8	<0.023 – 2.46	4	5
Benzo(k)fluoranthene	µg/L	0.1	0.017	8	<0.027 – 1.2	2	4
PAHs (sum of 4)	µg/L	0.1	-	3	<0.08 – 5.671	2	-
Bis(2-ethylhexyl) phthalate	µg/L	8	1.3	8	<2 – 3.38	-	1

Elevated nickel and iron concentrations in comparison to their respective GAC EQS or DWS values were recorded at all three locations. Chromium was recorded at elevated concentration in comparison to its GAC DWS value in BL02 and BL08. Cadmium and copper were recorded at concentrations elevated in comparison to their respective GAC values in BL02. PAHs were recorded at concentrations elevated in comparison to their respective GAC EQS or DWS at all three locations.

BL10 is located within a crop field to the east of the A38; BL08 is located within the verge to the north of the existing Little Eaton junction, and BL02 is located to the north of the A38 and adjacent to the western side of the railway line. It is noted that all three of the monitoring wells are located within 250m to 300m of the former landfill at Ford Lane.

The recorded exceedances of the GAC EQS and DWS indicate a potential risk to existing groundwater (Zone 3 Source Protection Zone - Groundwater) and surface water (River Derwent) resources.

Detailed Quantitative Risk Assessment

Following the Tier 1 risk assessment as detailed in the section above, elevated concentrations of some metals, PAHs, VOCs and SVOCs which were detected in groundwater samples warrant further detailed assessment. The detailed quantitative risk assessment (DQRA) has been undertaken in accordance with current guidance to assess the potential risk posed to the receptors by the elevated contaminants identified in groundwater.

The risk assessment is based on the guidance contained within the Environment Agency (2006) Remedial Target Methodology - Hydrogeological Risk Assessment for Land Contamination' (RTM) and the associated Remedial Targets Worksheet (Release 3.2). The RTM document provides guidance on the method to derive remedial targets from soil, leachate and groundwater data.

A Level 3 groundwater assessment was undertaken for each of the three junctions. The Level 3 assessment simulates the migration of contaminants that have already reached the underlying groundwater, taking into account the potential attenuation as the contaminated groundwater moves to the receptor(s) as follows:

- Kingsway junction – Bramble Brook
- Markeaton junction – Markeaton Lake/ Pond
- Little Eaton junction – River Derwent and SPZ Zone III Total Catchment

The assessment does not take into consideration dilution at the receptor.

Remedial Target Methodology

The site-specific remedial target concentrations with respect to the elevated contaminants in groundwater were computed in accordance with the Environment Agency's Risk Assessment Methodology (RTM). The Remedial Target Worksheet (Release 3.2) for the hydrogeological risk assessment for land contamination was utilised. The input parameters were derived from data from the ground investigation at the site and the various databases for related soil types and geochemical inputs.

Risk Assessment Simulation Overview

The risk assessment simulations assume a continuous groundwater body present beneath the site. It is assumed that the underlying groundwater flows towards each of the receptors. There was no on-site measurement of redox potential and dissolved oxygen during the groundwater monitoring at the sites. As such, anaerobic biodegradation rates for the organic contaminants have been used where available. This is a conservative approach.

The specific input parameters for each simulation in RTM worksheet and the physical properties of the various contaminants are included in Appendices C, D, E and F.

Results of the Detailed Quantitative Risk Assessment (DQRA)

Kingsway Junction

Made Ground

Table 5 details the results of the DQRA (full results are included in Appendix C), the simulated remedial target values and the predicted maximum concentrations of the various contaminants at the compliance point (Bramble Brook). The results summarise the predicted concentrations of the contaminant after the contaminant reaches the receptor. A Remedial Target Value (RTV) is given in Red or Green. Red corresponds to an RTV value less than the maximum concentration recorded in groundwater which indicates that mitigation measures may be required, and Green corresponds to an RTV value more than the maximum concentration recorded in groundwater which indicates that mitigation measures are not required.

Table 5. Results of Detailed Quantitative Risk Assessment in Made Ground at Kingsway Junction

Determinand	**Target Concentration (EQS) (µg/L)**	**Maximum Concentration in Groundwater (µg/L)**	**Predicted Concentration at Receptor (µg/L)**	**Remedial Target Value (µg/L)**
Nickel	4	50.3	13.3	**15.1**
Zinc	10.9	11.2	3	**40.6**
Naphthalene	2	10.7	<0.00001	**>10000**
Anthracene	0.1	21.8	<0.00001	**>10000**
Fluoranthene	0.0063	65.2	<0.00001	**>10000**
Benzo(a)pyrene	0.00017	78.9	<0.00001	**>10000**
Benzo(g,h,i)perylene	0.0082	45.8	<0.00001	**>10000**
Benzo(b)fluoranthene	0.017	89.3	<0.00001	**>10000**
Benzo(k)fluoranthene	0.017	0.357	<0.00001	**>10000**
>EC5-EC7 Aromatics	10	17	<0.00001	**>10000**
Benzene	10	24.2	<0.00001	**>10000**
Xylene Total	30	380	<0.00001	**>10000**
2,4 Dichlorophenol	4.2	4.76	1.27	**15.7**
Bis(2-ethylhexyl) phthalate	1.3	37.6	<0.00001	**>10000**

XX RTV less than maximum concentration in groundwater
XX RTV greater than maximum concentration in groundwater

The results of the DQRA for groundwater sampled from made ground materials at Kingsway junction suggest that there will be negligible risks from organic determinands present in groundwater to the identified critical receptor (Bramble Brook). There remain potential risks to the brook from the presence of dissolved concentrations of nickel identified. However, in the case of nickel it is noted that according to BGS Baseline reports on potable aquifers, trace element concentrations in associated potable aquifers such as the underlying Sherwood Sandstone Group strata can naturally approach and exceed 50 µg/L.

However, it should be noted that no exceedance of nickel was recorded in the groundwater samples taken from BK15 which was screened in natural materials beneath the landfilled materials in the former Rowditch Tip. This indicates that the groundwater within the landfill materials is likely to be contained within the former landfill.

Natural Ground

Table 6 details the results of the DQRA (full results are included in Appendix D), the simulated remedial target values and the predicted maximum concentrations of the various contaminants at the compliance point (Bramble Brook). The results summarise the predicted concentrations of the contaminant after the contaminant reaches the receptor. A Remedial Target Value (RTV) is given in Red or Green. Red corresponds to an RTV value less than the maximum concentration recorded in groundwater which indicates that mitigation measures may be required, and Green corresponds to an RTV value more than the maximum concentration recorded in groundwater which indicates that mitigation measures are not required.

Table 6. Results of Detailed Quantitative Risk Assessment in Mercia Mudstone (Bedrock) at Kingsway Junction

Determinand	Target Concentration (EQS) (µg/L)	Maximum Concentration in Groundwater (µg/L)	Predicted Concentration at Receptor (µg/L)	Remedial Target Value (µg/L)
Cadmium	0.08	0.274	0.251	**0.0879**
Copper	1	1.81	1.65	**1.09**
Nickel	4	7	6.38	**4.39**
Fluoranthene	0.0063	0.198	<0.00001	**>10000**
Benzo(a)pyrene	0.00017	0.166	<0.00001	**>10000**
Benzo(g,h,i)perylene	0.0082	0.168	<0.00001	**>10000**
Benzo(b)fluoranthene	0.017	0.274	<0.00001	**>10000**
Benzo(k)fluoranthene	0.017	0.115	<0.00001	**>10000**
Bis(2-ethylhexyl) phthalate	1.3	8.26	<0.00001	**>10000**

XX RTV less than maximum concentration in groundwater
XX RTV greater than maximum concentration in groundwater

The results of the DQRA for natural ground materials at Kingsway junction suggest that there will be negligible risks from organic determinands present in groundwater to the identified critical receptor (Bramble Brook). There remain potential risks to the brook from the presence of dissolved concentrations of the metal determinands identified. However, the predicted receptor concentrations and the derived remedial target values are of the order of a few µg/L and are very close to the respective EQS. Trace element concentrations in associated potable aquifers such as the underlying Sherwood Sandstone Group strata can naturally approach and exceed the measured max concentrations and the EQS.

Markeaton Junction

Table 7 details the results of the DQRA (full results are included in Appendix E), the simulated remedial target values and the predicted maximum concentrations of the various contaminants at the compliance point (Markeaton Lake). The results summarise the predicted concentrations of the contaminant after the contaminant reaches the receptor. A Remedial Target Value (RTV) is given in Red or Green. Red corresponds to an RTV value less than the maximum concentration recorded in groundwater which indicates that mitigation measures may be required, and Green corresponds to an RTV value more than the maximum concentration recorded in groundwater which indicates that mitigation measures are not required.

Table 7. Results of Detailed Quantitative Risk Assessment at in Mercia Mudstone (Bedrock) at Markeaton Junction

Determinand	Target Concentration (EQS) (µg/L)	Maximum Concentration in Groundwater (µg/L)	Predicted Concentration at Receptor (µg/L)	Remedial Target Value (µg/L)
Copper	1	17	15.7	**1.08**
Zinc	10.9	11.2	10.4	**11.8**
Benzene	10	11	<0.00001	**>10000**
Anthracene	0.1	0.215	<0.00001	**>10000**
Fluoranthene	0.0063	0.712	<0.00001	**>10000**
Benzo(a)pyrene	0.00017	1.55	<0.00001	**>10000**
Benzo(ghi)perylene	0.0082	2.04	<0.00001	**>10000**
Benzo(b)fluoranthene	0.017	2.99	<0.00001	**>10000**
Benzo(k)fluoranthene	0.017	1.2	<0.00001	**>10000**
Chloroform	2.5	15	<0.00001	**>10000**
Phenol	7.7	15.3	<0.00001	**>10000**

XX RTV less than maximum concentration in groundwater
XX RTV greater than maximum concentration in groundwater

The results of the DQRA for natural ground materials at Kingsway junction suggest that there will be negligible risks from organic determinands present in groundwater to the identified critical receptor (Bramble Brook). There remain potential risks to the brook from the presence of dissolved concentrations of copper identified. However, trace element concentrations in associated potable aquifers such as the underlying Sherwood Sandstone Group strata can naturally approach and exceed the measured maximum concentration and the related EQS. In the case of copper the naturally occurring maximum concentration can exceed 100 µg/L.

Little Eaton Junction

Table 8 details the results of the DQRA (full results are included in Appendix F), the simulated remedial target values and the predicted maximum concentrations of the various contaminants at the compliance point (River Derwent).

Table 8. Results of Detailed Quantitative Risk Assessment in Superficial Deposits at Little Eaton Junction

Determinand	Target Concentration (EQS/DWS*)(µg/L)	Maximum Concentration in Groundwater (µg/L)	Predicted Concentration at Receptor (µg/L)	Remedial Target Value (µg/L)
Cadmium	0.08	5.24	0.302	**1.39**
Chromium (III+VI)	50*	136	1.26	**5410**
Copper	1	1.62	1.54	**1.05**
Nickel	4	37.9	3.7	**40.9**
Anthracene	0.1	0.115	<0.00001	**>10000**
Fluoranthene	0.0063	0.712	0	**No Impact**
Benzo(a) pyrene	0.00017	1.55	0	**No Impact**
Indeno(1,2,3-c,d)pyrene	0.1*	0.951	<0.00001	**>10000**
Dibenzo(a,h)anthracene	0.075*	0.189	0	**No Impact**
Benzo(g,h,i)perylene	0.0082	1.06	0	**No Impact**
Benzo(b)fluoranthene	0.017	2.46	<0.00001	**>10000**
Benzo(k)fluoranthene	0.017	1.2	0	**No Impact**
Bis(2-ethylhexyl) phthalate	1.3	3.38	0	**No Impact**

Determinand	Target Concentration (EQS/DWS*)(µg/L)	Maximum Concentration in Groundwater (µg/L)	Predicted Concentration at Receptor (µg/L)	Remedial Target Value (µg/L)

XX RTV less than maximum concentration in groundwater

XX RTV greater than maximum concentration in groundwater

The results of the DQRA for natural ground materials at Little Eaton junction suggest that there will be negligible risks from organic determinands present in groundwater to the identified critical receptor (Groundwater SPZ Zone III and to the River Derwent). There remain potential risks to the SPZ Zone III and to the River Derwent from the presence of dissolved concentrations of cadmium and copper identified. However, trace element concentrations in associated potable aquifers such as the underlying Sherwood Sandstone Group strata can naturally approach and exceed the measured maximum concentration and the related EQS.

Summary of Controlled Water Risk Assessment

The Tier 1 screening results revealed elevated concentrations of some metals and organic compounds in groundwater within the Made Ground at Kingsway (former Rowditch Tip) and Natural Ground at Kingsway, Markeaton and Little Eaton junctions.

A Detailed Quantitative Risk Assessment (DQRA) was carried out using the Environment Agency's Remedial Targets Worksheet for the contaminants identified in groundwater within the Made Ground at Kingsway junction and Natural Ground at Kingsway, Markeaton and Little Eaton junctions. The results of the DQRA indicates that there is negligible risk to identified receptors from organic contaminants. The theoretical risk from dissolved metals is likely to be influenced by naturally occurring low-level concentrations derived from the strata mineralogy. Therefore, it is considered that there is a very low risk to the identified receptors from the presence of cadmium, copper and/or nickel concentrations recorded in a very small number of samples at each of the three junctions.

No remedial works are considered necessary regarding the concentrations of potential contaminants encountered within groundwater at the three junctions.

Where dewatering of excavations is required during the Scheme construction works, water should be collected, stored, tested and then shall either be:

- Discharged to foul sewer under a trade effluent consent agreed with the local sewerage undertaker; and/or
- Discharged to surface water under a water discharge activity environmental permit (WDA-EP) from the Environment Agency.

Appendix A – Tier 1 Screening Tables

Tier 1 Screen (Groundwater - Kingsway)
A38 Derby Junctions
Highways England

				Monitoring Zone	Kingsway Junction												
				Location	BK02	BK04			BK09			BK11			BK15		
				Date	06/07/2017	15/12/2016	20/03/2017	06/07/2017	14/12/2016	21/03/2017	04/07/2017	15/12/2016	20/03/2017	06/07/2017	15/12/2016	21/03/2017	05/07/2017
				Monitoring Unit	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone
				Monitoring Round	3	1	2	3	1	2	3	1	2	3	1	2	3
Parameter	**Units**	**Method Detection Limit**	**TIER 1 GAC (DWS)**	**TIER 1 GAC (EQS-Fresh)**													
ACID_HERB_GCMS_SUB																	
2,4-Dichlorprop	µg/L	0.04	$100^{\#3}$		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Mecoprop	µg/L	0.04	$10^{\#3}$	$18^{\#7}$	<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04
CARBON																	
TOC	mg/L	3			5.05	4.18	<3	<3	3.48	<3	<3	3.15	<3	<3	3.14	4.04	<3
COD																	
COD	mg/L	7			-	-	-	-	-	-	20.5	-	-	-	-	-	-
EPHCWG																	
>C12-C16 Aliphatics	µg/L	10	$300^{\#2}$		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	12	<10	<10
>C16-C21 Aliphatics	µg/L	10	$300^{\#2}$		<10	<10	<10	<10	<10	<10	<10	13	<10	<10	16	<10	<10
>C21-C35 Aliphatics	µg/L	10	$300^{\#2}$		<10	23	<10	<10	<10	<10	17	102	<10	28	45	<10	<10
>C12-C35 Aliphatics	µg/L	10			<10	23	<10	<10	<10	<10	17	115	<10	28	73	<10	<10
>C16-C35 Aliphatics	µg/L				-	33	-	-	<20	-	-	115	-	-	61	-	-
>EC12-EC16 Aromatics	µg/L	10	$90^{\#2}$		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC16-EC21 Aromatics	µg/L	10	$90^{\#2}$		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC21-EC35 Aromatics	µg/L	10	$90^{\#2}$		<10	18	<10	<10	<10	<10	<10	<10	<10	28	<10	<10	<10
>EC12-EC35 Aromatics	µg/L	10			<10	18	<10	<10	<10	<10	<10	<10	<10	28	<10	<10	<10
>C5-C35 Aliphatics & Aromatics	µg/L	10			<10	41	-	<10	<10	-	17	115	-	56	73	-	<10
ESDAT Combined Compounds																	
Benzo(b)&(k)fluoranthene	µg/L				-	<0.05	-	-	0.389	-	-	0.0623	-	-	<0.05	-	-
PAHs (sum of 4)	µg/L		$0.1^{\#1}$		-	<0.08	-	-	0.662	-	-	0.1005	-	-	<0.08	-	-
benzo(g,h,i)perylene + indeno(1,2,3-cd)pyrene	µg/L				-	<0.03	-	-	0.273	-	-	0.0382	-	-	<0.03	-	-
Benzo(a)pyrene (surrogate marker for PAH mixture)	µg/L				-	<0.009	-	-	0.166	-	-	0.0261	-	-	<0.009	-	-
Sum of PCE and TCE	µg/L		$10^{\#1}$		-	<2	-	-	<2	-	-	<2	-	-	<2	-	-
TCE+DCE+VC	µg/L				-	<5	-	-	<5	-	-	<5	-	-	10.94	-	-
PCE+TCE+DCE+VC	µg/L				-	<6	-	-	<6	-	-	<6	-	-	11.94	-	-
1,2-Dichloroethene	µg/L		$50^{\#3}$		-	<2	-	-	<2	-	-	<2	-	-	7.94	-	-
Trihalomethanes	µg/L		$100^{\#1}$		-	<4	-	-	<4	-	-	<4	-	-	<4	-	-
Aldrin + Dieldrin	µg/L		$0.03^{\#3}$		-	<0.02	-	-	<0.02	-	-	<0.02	-	-	<0.02	-	-
DDT+DDE+DDD	µg/L				-	<0.02	-	-	<0.02	-	-	<0.02	-	-	<0.02	-	-
Aldrin+Dieldrin+Endrin+Isodrin	µg/L			$0.01^{\#8}$	-	<0.03	-	-	<0.03	-	-	<0.03	-	-	<0.03	-	-
GRO																	
GRO >C5-C12	µg/L	50			<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50	<50
>C5-C6 Aliphatics	µg/L	10	$15{,}000^{\#2}$		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>C6-C8 Aliphatics	µg/L	10	$15{,}000^{\#2}$		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>C8-C10 Aliphatics	µg/L	10	$300^{\#2}$		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>C10-C12 Aliphatics	µg/L	10	$300^{\#2}$		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC5-EC7 Aromatics	µg/L	10	$1^{\#1}$	$10^{\#8}$	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
>EC7-EC8 Aromatics	µg/L	10	$700^{\#2}$	$74^{\#7}$	<10	-	<10	<10	-	<10	<10	-	<10	<10	-	<10	<10
>EC8-EC10 Aromatics	µg/L	10	$300^{\#2}$		<10	-	<10	<10	-	<10	<10	-	<10	<10	-	<10	<10
>EC10-EC12 Aromatics	µg/L	10	$90^{\#2}$		<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10
MTBE	µg/L	3	$1{,}800^{\#15}$	$5{,}100^{\#13}$	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Benzene	µg/L	7	$1^{\#1}$	$10^{\#8}$	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7	<7
Toluene	µg/L	4	$700^{\#3}$	$74^{\#7}$	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4
Ethylbenzene	µg/L	5	$300^{\#3}$	$20^{\#12}$	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5
Xylene (m & p)	µg/L	8			<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8	<8
Xylene Total	µg/L	11	$500^{\#3}$	$30^{\#12}$	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11	<11
Xylene (o)	µg/L	3	$190^{\#10}$		<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
Total BTEX	µg/L	28			<28	<28	<28	<28	<28	<28	<28	<28	<28	<28	<28	<28	<28
Aromatics >EC8-EC10	µg/L				-	<10	-	-	<10	-	-	<10	-	-	<10	-	-
Aromatics >EC7-EC8	µg/L				-	<10	-	-	<10	-	-	<10	-	-	<10	-	-
GRO Surrogate	%				-	87	-	-	87	-	-	86	-	-	84	-	-

Tier 1 Screen (Groundwater - Kingsway)
A38 Derby Junctions
Highways England

Monitoring Zone					**Kingsway Junction**												
Location					**BK02**	**BK04**			**BK09**			**BK11**			**BK15**		
Date					06/07/2017	15/12/2016	20/03/2017	06/07/2017	14/12/2016	21/03/2017	04/07/2017	15/12/2016	20/03/2017	06/07/2017	15/12/2016	21/03/2017	05/07/2017
Monitoring Unit					Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone
Monitoring Round					3	1	2	3	1	2	3	1	2	3	1	2	3
Parameter	**Units**	**Method Detection Limit**	**TIER 1 GAC (DWS)**	**TIER 1 GAC (EQS-Fresh)**													
HERBPEST																	
a-BHC	µg/L	0.01	0.0072[#10]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
b-BHC	µg/L	0.01	0.025[#10]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan I	µg/L	0.01	0.1[#1]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan II	µg/L	0.01	0.1[#1]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan sulphate	µg/L	0.01	0.1[#1]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
g-BHC (Lindane)	µg/L	0.01	2[#3]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor epoxide	µg/L	0.01	0.03[#1]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o,p''-DDE	µg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2,4-DDT	µg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o,p''-Methoxychlor	µg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o,p-DDD	µg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4,4-DDE	µg/L	0.01	0.1[#1]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
DDT	µg/L	0.01	0.1[#1]	**0.01[#8]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methoxychlor	µg/L	0.01	0.1[#1]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
DDD	µg/L	0.01	0.1[#1]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Azinophos methyl	µg/L	0.01	0.1[#1]	**0.01[#12]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methyl parathion	µg/L	0.01	0.1[#1]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mevinphos (Phosdrin)	µg/L	0.01	0.1[#1]	**0.02[#11]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
INORGANICS																	
Cyanide (Free)	mg/L	0.05	0.05[#1]	**0.001[#12]**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cyanide Total	mg/L	0.05	0.05[#1]	**0.001[#7]**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrogen (Total)	µg/L				-	<200	-	-	<200	-	-	<200	-	-	<200	-	-
Ammoniacal Nitrogen as N	mg/L	0.2		**300[#7]**	1.36	-	<0.2	<0.2	-	<0.2	<0.2	-	<0.2	<0.2	-	<0.2	<0.2
TSS	mg/L	2			-	-	-	-	-	-	77.1	-	-	-	-	-	-
Total Hardness	mg/l	0.35			-	-	584	-	-	675	-	-	2,460	-	-	721	-
pH (Lab)	pH_Units	1			7.23	7.49	7.48	7.57	7.73	7.43	7.47	7.59	7.46	7.33	7.39	7.49	7.38
METALS_ICP																	
Arsenic (Filtered)	µg/L	0.5	10[#1]	**50[#7]**	1.1	1.26	1.4	1.32	4.78	2.55	2.04	<0.51	1.24	1.29	0.668	0.82	0.685
Boron (Filtered)	µg/L	5	1,000[#1]	**2,000[#12]**	260	138	139	106	63	50.2	48	24.4	102	117	119	218	123
Cadmium (Filtered)	µg/L	0.08	5[#1]	**0.08[#8]**	**0.274**	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Chromium (hexavalent)	µg/L	30	50[#1]	**3.4[#7]**	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30	<30
Chromium (III+VI)	µg/L	3	50[#1]		16.7	21.8	11.8	8.59	36.7	14.7	<3	258	49.3	46.2	18.9	11.8	14.6
Copper (Filtered)	µg/L	0.3	2,000[#1]	**1[#7]**	<0.3	**1.79**	**1.81**	0.693	<0.85	<0.85	<0.3	<0.85	<0.85	<0.3	<0.85	<0.85	<0.3
Iron	µg/L	24	200[#1]	**1,000[#7]**	**36,800**	**14,000**	**4,550**	**6,270**	**21,300**	**6,490**	**1,280**	**274,000**	**66,400**	**37,200**	**8,080**	**5,230**	**6,780**
Iron (Filtered)	µg/L	19	200[#1]	**1,000[#7]**	**2,030**	<19	<19	<19	32.3	92.6	<19	<19	<19	<19	<19	22.4	<19
Lead (Filtered)	µg/L	0.1	10[#1]	**1.2[#8]**	0.209	<0.1	<0.1	<0.2	<0.1	<0.1	<0.2	<0.1	<0.1	<0.2	<0.1	<0.1	<0.2
Mercury (Filtered)	µg/L	0.01	1[#1]	**0.07[#6]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel (Filtered)	µg/L	0.4	20[#1]	**4[#8]**	**7**	1.08	1.27	0.454	1.26	1.63	0.853	1.13	1.54	1.69	1.17	1.75	0.492
Selenium (Filtered)	µg/L	0.5	10[#1]		<0.5	<0.81	<0.81	<0.5	1.01	<0.81	0.687	<0.81	1.36	<0.5	1.06	<0.81	<0.5
Zinc (Filtered)	µg/L	1	6,000[#10]	**10.9[#7]**	1.64	2.3	3.23	1.09	<1.3	2.13	2.72	2.54	2.57	<1	3.94	3.53	1.14
OCP_GCMS																	
Aldrin	µg/L	0.01	0.03[#1]	**0.01[#8]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dieldrin	µg/L	0.01	0.03[#1]	**0.01[#8]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	µg/L	0.01	0.1[#1]	**0.01[#8]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor	µg/L	0.01	0.03[#1]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
OPP_GCMS																	
Diazinon	µg/L	0.01	0.1[#1]	**0.01[#7]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dichlorvos	µg/L	0.01	0.1[#1]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ethion	µg/L	0.01	0.1[#1]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Parathion	µg/L	0.01	0.1[#1]		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fenitrothion	µg/L	0.01	0.1[#1]	**0.01[#12]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Malathion	µg/L	0.01	0.1[#1]	**0.01[#12]**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Tier 1 Screen (Groundwater - Kingsway)
A38 Derby Junctions
Highways England

				Monitoring Zone	Kingsway Junction												
				Location	BK02	BK04			BK09			BK11			BK15		
				Date	06/07/2017	15/12/2016	20/03/2017	06/07/2017	14/12/2016	21/03/2017	04/07/2017	15/12/2016	20/03/2017	06/07/2017	15/12/2016	21/03/2017	05/07/2017
				Monitoring Unit	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone
				Monitoring Round	3	1	2	3	1	2	3	1	2	3	1	2	3
Parameter	Units	Method Detection Limit	TIER 1 GAC (DWS)	TIER 1 GAC (EQS-Fresh)													
PAH																	
Naphthalene	µg/L	0.1	$6^{\#15}$	**$2^{\#8}$**	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Acenaphthylene	µg/L	0.011	$18^{\#15}$		<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011	<0.011
Acenaphthene	µg/L	0.015	$18^{\#15}$		<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Fluorene	µg/L	0.014	$12^{\#15}$		<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014	<0.014
Phenanthrene	µg/L	0.022	$4^{\#15}$		<0.022	<0.022	<0.022	<0.022	0.0469	0.0222	0.0321	<0.022	<0.022	<0.022	<0.022	<0.022	<0.022
Anthracene	µg/L	0.015	$90^{\#15}$	**$0.1^{\#8}$**	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015	<0.015
Fluoranthene	µg/L	0.017	$4^{\#3}$	**$0.0063^{\#8}$**	**0.0245**	<0.017	<0.017	<0.017	**0.198**	**0.0686**	**0.15**	**0.031**	<0.017	<0.017	<0.017	<0.017	<0.017
Pyrene	µg/L	0.015	$9^{\#15}$		0.0328	0.0153	<0.015	0.0164	0.195	0.0756	0.135	0.0341	<0.015	<0.015	<0.015	0.0191	<0.015
Benz(a)anthracene	µg/L	0.017	$3.5^{\#15}$		0.0199	<0.017	<0.017	<0.017	0.122	0.0495	0.076	0.0186	<0.017	<0.017	<0.017	<0.017	<0.017
Chrysene	µg/L	0.013	$7^{\#15}$		0.0136	<0.013	<0.013	<0.013	0.12	0.0295	0.0718	0.0168	<0.013	<0.013	<0.013	<0.013	<0.013
Benzo(a) pyrene	µg/L	0.009	$0.01^{\#1}$	**$0.00017^{\#8}$**	**0.0178**	<0.009	<0.009	<0.009	**0.166**	**0.0494**	**0.0919**	**0.0261**	<0.009	<0.009	<0.009	**0.0102**	<0.009
Indeno(1,2,3-c,d)pyrene	µg/L	0.014	$0.1^{\#1}$		0.0198	<0.014	<0.014	<0.014	0.105	0.0476	0.0747	0.016	<0.014	<0.014	<0.014	<0.014	<0.014
Dibenz(a,h)anthracene	µg/L	0.016	$0.07^{\#15}$		<0.016	<0.016	<0.016	<0.016	0.0238	<0.016	0.0163	<0.016	<0.016	<0.016	<0.016	<0.016	<0.016
Benzo(g,h,i)perylene	µg/L	0.016	$0.1^{\#1}$	**$0.0082^{\#6}$**	**0.024**	<0.016	<0.016	<0.016	**0.168**	**0.0524**	**0.0739**	**0.0222**	<0.016	<0.016	<0.016	<0.016	<0.016
Benzo(b)fluoranthene	µg/L	0.023	$0.1^{\#1}$	**$0.017^{\#6}$**	**0.0332**	<0.023	<0.023	<0.023	**0.274**	**0.0719**	**0.178**	**0.0353**	<0.023	<0.023	<0.023	<0.023	<0.023
Benzo(k)fluoranthene	µg/L	0.027	$0.1^{\#1}$	**$0.017^{\#6}$**	<0.027	<0.027	<0.027	<0.027	**0.115**	**0.029**	**0.0568**	<0.027	<0.027	<0.027	<0.027	<0.027	<0.027
PAH 16 Total	µg/L	0.344			<0.344	<0.344	<0.344	<0.344	1.54	0.496	0.956	<0.344	<0.344	<0.344	<0.344	<0.344	<0.344
PHENOL																	
2,3,5,6-Tetrachlorophenol	µg/L	0.5			<1	<0.5	<0.5	<0.5	<0.5	<0.5	<4	<0.5	<0.5	<0.5	<0.5	<1	<0.5
2-chlorophenol	µg/L	0.5	$91^{\#10}$	**$50^{\#12}$**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-methylphenol	µg/L	0.5	$930^{\#10}$		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-nitrophenol	µg/L	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-dichlorophenol	µg/L	0.5	$46^{\#10}$	**$4.2^{\#7}$**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-dimethylphenol	µg/L	0.5	$360^{\#10}$		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,5-trichlorophenol	µg/L	0.5	$1,200^{\#10}$		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,6-trichlorophenol	µg/L	0.5	$200^{\#3}$		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-chloro-3-methylphenol	µg/L	0.5	$1,400^{\#10}$	**$40^{\#12}$**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-methylphenol	µg/L	0.5	$1,900^{\#10}$		0.6	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-nitrophenol	µg/L	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Pentachlorophenol	µg/L	2	$9^{\#3}$	**$0.4^{\#8}$**	<4	<2	<2	<2	<2	<2	<14	<2	<2	<2	<2	<2	<2
Phenol	µg/L	0.5	$5,800^{\#10}$	**$7.7^{\#7}$**	<5.5	<5	<5	<4	<5	<4.5	<4	<5	<5	<4	<5	<4.5	<3.5
2,4-dinitrophenol	µg/L	2.5	$39^{\#10}$		<12.5	<2.5	<5	<12.5	<2.5	<2.5	<12.5	<2.5	<5	<12.5	<2.5	<2.5	<12.5
3-Methylphenol	µg/L	0.5	$930^{\#10}$		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4,6-Dinitro-2-methylphenol	µg/L	3	$1.5^{\#10}$		<12	-	<6	<9	-	<3	<9	-	<6	<9	-	<3	<9
4-chlorophenol	µg/L	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dinoseb	µg/L	4	$15^{\#10}$		<16	<4	<8	<12	<4	<4	<12	<4	<8	<12	<4	<4	<12
DNOC :- {4,6-dinitro-o-cresol}	µg/L				-	<3	-	-	<3	-	-	<3	-	-	<3	-	-
PHENOLS_HPLC																	
Phenol	µg/L	2	$5,800^{\#10}$	**$7.7^{\#7}$**	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2	<2
Phenols	µg/L				-	<16	-	-	<16	-	-	<16	-	-	<16	-	-
Cresols by HPLC (W)	µg/L	6			<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6	<6
Total Monohydric Phenols (S) Corrected	µg/L	16			<16	-	<16	<16	-	<16	<16	-	<16	<16	-	<16	<16
Xylenols	µg/L	8			<8	<8	-	<8	<8	-	<8	<8	-	<8	<8	-	<8

Tier 1 Screen (Groundwater - Kingsway)
A38 Derby Junctions
Highways England

				Monitoring Zone	Kingsway Junction												
				Location	BK02	BK04			BK09			BK11			BK15		
				Date	06/07/2017	15/12/2016	20/03/2017	06/07/2017	14/12/2016	21/03/2017	04/07/2017	15/12/2016	20/03/2017	06/07/2017	15/12/2016	21/03/2017	05/07/2017
				Monitoring Unit	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone
				Monitoring Round	3	1	2	3	1	2	3	1	2	3	1	2	3
Parameter	Units	Method Detection Limit	TIER 1 GAC (DWS)	TIER 1 GAC (EQS-Fresh)													
SVOC																	
Naphthalene	µg/L	1	$6^{\#15}$	$2^{\#8}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Acenaphthylene	µg/L	1	$18^{\#15}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Acenaphthene	µg/L	1	$18^{\#15}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Fluorene	µg/L	1	$12^{\#15}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Phenanthrene	µg/L	1	$4^{\#15}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Anthracene	µg/L	1	$90^{\#15}$	$0.1^{\#8}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Fluoranthene	µg/L	1	$4^{\#3}$	$0.0063^{\#8}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Pyrene	µg/L	1	$9^{\#15}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Benz(a)anthracene	µg/L	1	$3.5^{\#15}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Chrysene	µg/L	1	$7^{\#15}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Benzo(a) pyrene	µg/L	1	$0.01^{\#1}$	$0.00017^{\#8}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	1	$0.1^{\#1}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Dibenz(a,h)anthracene	µg/L	1	$0.07^{\#15}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	1	$0.1^{\#1}$	$0.0082^{\#6}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Benzo(b)fluoranthene	µg/L	1	$0.1^{\#1}$	$0.017^{\#6}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Benzo(k)fluoranthene	µg/L	1	$0.1^{\#1}$	$0.017^{\#6}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
1,3-dichlorobenzene	µg/L	1			<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
1,4-dichlorobenzene	µg/L	1	$300^{\#3}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
1,2-dichlorobenzene	µg/L	1	$1,000^{\#3}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
1,2,4-trichlorobenzene	µg/L	1	$0.1^{\#1}$	$0.4^{\#9}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	µg/L	1	$0.1^{\#1}$	$0.6^{\#6}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
2-chlorophenol	µg/L	1	$91^{\#10}$	$50^{\#12}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
2-methylphenol	µg/L	1	$930^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
2-nitrophenol	µg/L	1			<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
2,4-dichlorophenol	µg/L	1	$46^{\#10}$	$4.2^{\#7}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
2,4-dimethylphenol	µg/L	1	$360^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
2,4,5-trichlorophenol	µg/L	1	$1,200^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
2,4,6-trichlorophenol	µg/L	1	$200^{\#3}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
4-chloro-3-methylphenol	µg/L	1	$1,400^{\#10}$	$40^{\#12}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
4-methylphenol	µg/L	1	$1,900^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
4-nitrophenol	µg/L	1			<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Pentachlorophenol	µg/L	1	$9^{\#3}$	$0.4^{\#8}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Phenol	µg/L	1	$5,800^{\#10}$	$7.7^{\#7}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
2-chloronaphthalene	µg/L	1	$750^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
2-methylnaphthalene	µg/L	1	$36^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Bis(2-ethylhexyl) phthalate	µg/L	2	$8^{\#3}$	$1.3^{\#8}$	<2	<2	<2	**8.26**	<4	<4	<2	<2	<2	<2	<2	<2	<2
Butyl benzyl phthalate	µg/L	1	$16^{\#10}$	$7.5^{\#7}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Di-n-butyl phthalate	µg/L	1	$900^{\#10}$	$8^{\#12}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Di-n-octyl phthalate	µg/L	5	$200^{\#10}$	$20^{\#12}$	<5	<5	<5	<5	<10	<10	<5	<5	<5	<5	<5	<5	<5
Diethylphthalate	µg/L	1	$15,000^{\#10}$	$200^{\#12}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Dimethyl phthalate	µg/L	1		$800^{\#12}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
2-nitroaniline	µg/L	1	$190^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
2,4-Dinitrotoluene	µg/L	1	$0.24^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
2,6-dinitrotoluene	µg/L	1	$0.049^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
3-nitroaniline	µg/L	1			<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
4-bromophenyl phenyl ether	µg/L	1			<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
4-chloroaniline	µg/L	1	$0.37^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
4-chlorophenyl phenyl ether	µg/L	1			<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
4-nitroaniline	µg/L	1	$3.8^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Azobenzene	µg/L	1	$0.12^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Bis(2-chloroethoxy) methane	µg/L	1	$59^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Bis(2-chloroethyl)ether	µg/L	1	$0.014^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Carbazole	µg/L	1			<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Dibenzofuran	µg/L	1	$7.9^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Hexachlorobenzene	µg/L	1	$0.1^{\#1}$	$0.05^{\#6}$	<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Hexachlorocyclopentadiene	µg/L	1	$0.41^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Hexachloroethane	µg/L	1	$0.33^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Isophorone	µg/L	1	$78^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
N-nitrosodi-n-propylamine	µg/L	1	$0.011^{\#10}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1
Nitrobenzene	µg/L	1	$8.0^{\#3}$		<1	<1	<1	<1	<2	<2	<1	<1	<1	<1	<1	<1	<1

Tier 1 Screen (Groundwater - Kingsway)
A38 Derby Junctions
Highways England

				Monitoring Zone	**Kingsway Junction**												
				Location	**BK02**	**BK04**			**BK09**			**BK11**			**BK15**		
				Date	**06/07/2017**	**15/12/2016**	**20/03/2017**	**06/07/2017**	**14/12/2016**	**21/03/2017**	**04/07/2017**	**15/12/2016**	**20/03/2017**	**06/07/2017**	**15/12/2016**	**21/03/2017**	**05/07/2017**
				Monitoring Unit	**Mercia Mudstone**	**Mercia Mudstone**	**Mercia Mudstone**	**Mercia Mudstone**	**Mercia Mudstone**	**Mercia Mudstone**	**Mercia Mudstone**	**Mercia Mudstone**	**Mercia Mudstone**	**Mercia Mudstone**	**Mercia Mudstone**	**Mercia Mudstone**	**Mercia Mudstone**
				Monitoring Round	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**	**1**	**2**	**3**
Parameter	**Units**	**Method Detection Limit**	**TIER 1 GAC (DWS)**	**TIER 1 GAC (EQS-Fresh)**													
UNK																	
Pentachlorophenol	µg/L	0.04	$9^{\#3}$	**$0.4^{\#8}$**	<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04
Dichloroacetic acid	µg/L		$1.5^{\#10}$		-	<0.04	-	-	<0.04	-	-	<0.04	-	-	<0.04	-	-
Benazolin	µg/L				-	<0.04	-	-	<0.04	-	-	<0.04	-	-	<0.04	-	-
Bentazone	µg/L	0.04	$500^{\#3}$	**$500^{\#12}$**	<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04
Bromoxynil	µg/L	0.04	$0.61^{\#10}$	**$100^{\#12}$**	<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04
Clopyralid	µg/L	0.04			<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04
Hedonal	µg/L	0.04	$30^{\#3}$	**$0.3^{\#7}$**	<0.04	-	-	<0.04	-	-	<0.04	-	-	<0.04	-	-	<0.04
2,4-DB	µg/L				-	<0.04	-	-	<0.04	-	-	<0.04	-	-	<0.04	-	-
Dicamba	µg/L	0.04	$570^{\#10}$		<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04
2,4,5-TP (Silvex)	µg/L	0.04	$110^{\#10}$		-	-	-	-	-	-	<0.04	-	-	-	-	-	<0.04
Actril (Ioxynil)	mg/L	0.00004		**$0.01^{\#12}$**	<0.00004	<0.00004	-	<0.00004	<0.00004	-	<0.00004	<0.00004	-	<0.00004	<0.00004	-	<0.00004
2-Methyl-4-chlorophenoxyacetic acid	µg/L	0.04	$700^{\#3}$	**$12^{\#12}$**	<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04
2-Methyl-4-Chlorophenoxy Butanoic Acid	µg/L	0.04	$65^{\#10}$		<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04
2,4,5-Trichlorophenoxy Acetic Acid	µg/L	0.04	$9^{\#3}$		<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04	<0.04	-	<0.04
Triclopyr	µg/L	0.04			<0.04	<0.04	-	-	<0.04	-	<0.04	<0.04	-	-	<0.04	-	<0.04
2,3,6-Trichlorobenzoic acid	µg/L				-	<0.04	-	-	<0.06	-	-	<0.04	-	-	<0.04	-	-
4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)	µg/L	0.04	$450^{\#10}$		<0.04	-	-	<0.04	-	-	<0.04	-	-	<0.04	-	-	<0.04
Fluroxypyr	µg/L	0.04			-	<0.04	-	-	<0.04	-	<0.04	<0.04	-	-	<0.04	-	<0.04
Fenoprop	µg/L		$9^{\#3}$		-	<0.04	-	-	<0.04	-	-	<0.04	-	-	<0.04	-	-
VOC																	
1,3,5-Trichlorobenzene	µg/L	1	$0.1^{\#1}$	**$0.4^{\#9}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Naphthalene	µg/L	1	$6^{\#15}$	**$2^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Dichlorodifluoromethane	µg/L	1	$200^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
MTBE	µg/L	1	$1,800^{\#15}$	**$5,100^{\#13}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloromethane	µg/L	1	$190^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Vinyl chloride	µg/L	1	$0.5^{\#1}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromomethane	µg/L	1	$7.5^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloroethane	µg/L	1	$21,000^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Trichlorofluoromethane	µg/L	1	$5,200^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethene	µg/L	1	$140^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Dichloromethane	µg/L	3	$20^{\#3}$	**$20^{\#8}$**	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3	<3
trans-1,2-dichloroethene	µg/L	1	$50^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethane	µg/L	1	$2.8^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
cis-1,2-dichloroethene	µg/L	1	$50^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	6.94	13	5.37
2,2-dichloropropane	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromochloromethane	µg/L	1	$83^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloroform	µg/L	1	$100^{\#1}$	**$2.5^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1-trichloroethane	µg/L	1	$2,000^{\#3}$	**$100^{\#12}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloropropene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	µg/L	1	$3^{\#1}$	**$12^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloroethane	µg/L	1	$3^{\#1}$	**$10^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Benzene	µg/L	1	$1^{\#1}$	**$10^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Trichloroethene	µg/L	1	$10^{\#1}$	**$10^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloropropane	µg/L	1	$40^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Dibromomethane	µg/L	1	$8.3^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromodichloromethane	µg/L	1	$100^{\#1}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
cis-1,3-dichloropropene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/L	1	$700^{\#3}$	**$74^{\#7}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,3-dichloropropene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-trichloroethane	µg/L	1	$0.28^{\#10}$	**$400^{\#12}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloroethene	µg/L	1	$10^{\#1}$	**$10^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichloropropane	µg/L	1	$370^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlorodibromomethane	µg/L	1	$100^{\#1}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromoethane	µg/L	1	$0.4^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlorobenzene	µg/L	1	$300^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1,2-tetrachloroethane	µg/L	1	$0.57^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	µg/L	1	$300^{\#3}$	**$20^{\#12}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Xylene (m & p)	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Xylene (o)	µg/L	1	$190^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Styrene	µg/L	1	$20^{\#3}$	**$50^{\#12}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromoform	µg/L	1	$100^{\#1}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Isopropylbenzene	µg/L	1	$450^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2,2-tetrachloroethane	µg/L	1	$0.076^{\#10}$	**$140^{\#7}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Tier 1 Screen (Groundwater - Kingsway)
A38 Derby Junctions
Highways England

Parameter	Units	Method Detection Limit	TIER 1 GAC (DWS)	TIER 1 GAC (EQS-Fresh)													
				Monitoring Zone	Kingsway Junction												
				Location	BK02	BK04			BK09			BK11			BK15		
				Date	06/07/2017	15/12/2016	20/03/2017	06/07/2017	14/12/2016	21/03/2017	04/07/2017	15/12/2016	20/03/2017	06/07/2017	15/12/2016	21/03/2017	05/07/2017
				Monitoring Unit	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone	Mercia Mudstone
				Monitoring Round	3	1	2	3	1	2	3	1	2	3	1	2	3
Bromobenzene	µg/L	1	$62^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichloropropane	µg/L	1	$0.00075^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
n-propylbenzene	µg/L	1	$660^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
2-chlorotoluene	µg/L	1	$240^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3,5-trimethylbenzene	µg/L	1	$60^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
4-chlorotoluene	µg/L	1	$250^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
tert-butylbenzene	µg/L	1	$690^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trimethylbenzene	µg/L	1	$56^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
sec-butylbenzene	µg/L	1	$2,000^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
p-isopropyltoluene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichlorobenzene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,4-dichlorobenzene	µg/L	1	$300^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
n-butylbenzene	µg/L	1	$1,000^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichlorobenzene	µg/L	1	$1000^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromo-3-chloropropane	µg/L	1	$1^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trichlorobenzene	µg/L	1	$0.1^{\#1}$	$0.4^{\#9}$	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	µg/L	1	$0.1^{\#1}$	$0.6^{\#6}$	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichlorobenzene	µg/L	1	$0.1^{\#1}$	$0.4^{\#9}$	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon disulfide	µg/L	1	$810^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tert Amyl Methyl Ether	µg/L	1		$510^{\#13}$	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Comments

#1 WS Regs 2016 (Eng/Wal)
#2 WHO Petroleum DWG 2008
#3 WHO DWG 2017
#4 WHO 2017 - Taste
#5 WHO 2017 - Odour
#6 WFD England/Wales. 2015 - MAC-EQS Inland
#7 WFD England/Wales. 2015 - Freshwater Standards
#8 WFD England/Wales. 2015 - AA-EQS Inland
#9 Water Env't Regs (Scotland) 2015. AA-EQS Inland
#10 USEPA RSL (tapwater) [May 2019]
#11 SEPA WAT-SG-53 Fresh EQS - MAC - 2015
#12 SEPA WAT-SG-53 Fresh EQS - AA - 2015
#13 PNEC (EU REACH) - Freshwater
#14 California Draft health protective concentration
#15 AECOM DWG (WHO method)
GAC: Generic Assessment Criteria
(blank): No assessment criteria available
- : Not analysed

Key

XXX	Exceedance of CW/WE Water. DWS - England/Wales
XXX	Exceedance of CW/WE Water. Aquatic Toxicity - England/Wales - Freshwater

Tier 1 Screen (Groundwater - Kingsway)
A38 Derby Junctions
Highways England

				Monitoring Zone	Kingsway Junction								
				Location	BK12			BK13			BK14		
				Date	15/12/2016	23/03/2017	05/07/2017	15/12/2016	23/03/2017	05/07/2017	15/12/2016	21/03/2017	05/07/2017
				Monitoring Unit	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground
				Monitoring Round	1	2	3	1	2	3	1	2	3
Parameter	**Units**	**Method Detection Limit**	**TIER 1 GAC (DWS)**	**TIER 1 GAC (EQS-Fresh)**									
ACID_HERB_GCMS_SUB													
2,4-Dichlorprop	µg/L	0.04	100[#3]		<0.08	<0.08	0.05	<0.04	<0.04	<0.04	<0.08	<0.0571	0.062
Mecoprop	µg/L	0.04	10[#3]	**18[#7]**	0.619	-	0.547	<0.04	-	<0.04	0.369	-	0.649
CARBON													
TOC	mg/L	3			63.4	24.6	54.8	4.78	27.3	<3	42.5	41.1	52.3
COD													
COD	mg/L	7			-	-	-	-	-	-	-	-	-
EPHCWG													
>C12-C16 Aliphatics	µg/L	10	300[#2]		91	24	70	<10	<10	<10	297	324	323
>C16-C21 Aliphatics	µg/L	10	300[#2]		485	290	476	<10	<10	<10	542	514	525
>C21-C35 Aliphatics	µg/L	10	300[#2]		3,680	2,610	3,850	27	<10	<10	5,760	5,360	5,370
>C12-C35 Aliphatics	µg/L	10			4,250	2,930	4,400	27	<10	<10	6,600	6,200	6,220
>C16-C35 Aliphatics	µg/L				4,165	-	-	37	-	-	6,302	-	-
>EC12-EC16 Aromatics	µg/L	10	90[#2]		112	99	230	<10	<10	<10	183	258	352
>EC16-EC21 Aromatics	µg/L	10	90[#2]		464	258	446	<10	<10	<10	440	484	448
>EC21-EC35 Aromatics	µg/L	10	90[#2]		1,380	994	1,180	<10	<10	<10	1,850	1,790	1,160
>EC12-EC35 Aromatics	µg/L	10			1,960	1,350	1,860	<10	<10	<10	2,470	2,530	1,960
>C5-C35 Aliphatics & Aromatics	µg/L	10			7,790	-	7,180	27	-	<10	9,440	-	8,310
ESDAT Combined Compounds													
Benzo(b)&(k)fluoranthene	µg/L				10.76	-	-	0.1264	-	-	124.7	-	-
PAHs (sum of 4)	µg/L		0.1[#1]		19.14	-	-	0.2284	-	-	214	-	-
benzo(g,h,i)perylene + indeno(1,2,3-cd)pyrene	µg/L				8.38	-	-	0.102	-	-	89.3	-	-
Benzo(a)pyrene (surrogate marker for PAH mixture)	µg/L				7.12	-	-	0.0496	-	-	78.9	-	-
Sum of PCE and TCE	µg/L		10[#1]		<2	-	-	<2	-	-	<2	-	-
TCE+DCE+VC	µg/L				5.59	-	-	<5	-	-	<5	-	-
PCE+TCE+DCE+VC	µg/L				6.59	-	-	<6	-	-	<6	-	-
1,2-Dichloroethene	µg/L		50[#3]		2.59	-	-	<2	-	-	<2	-	-
Trihalomethanes	µg/L		100[#1]		<4	-	-	<4	-	-	<4	-	-
Aldrin + Dieldrin	µg/L		0.03[#3]		<0.02	-	-	<0.02	-	-	<0.02	-	-
DDT+DDE+DDD	µg/L				<0.02	-	-	<0.02	-	-	<0.02	-	-
Aldrin+Dieldrin+Endrin+Isodrin	µg/L			**0.01[#8]**	<0.03	-	-	<0.03	-	-	<0.03	-	-
GRO													
GRO >C5-C12	µg/L	50			1,580	683	928	<50	<50	<50	359	276	131
>C5-C6 Aliphatics	µg/L	10	15,000[#2]		10	<10	<10	<10	<10	<10	20	21	23
>C6-C8 Aliphatics	µg/L	10	15,000[#2]		90	27	49	<10	<10	<10	30	27	15
>C8-C10 Aliphatics	µg/L	10	300[#2]		277	121	143	<10	<10	<10	64	44	15
>C10-C12 Aliphatics	µg/L	10	300[#2]		331	173	186	<10	<10	<10	119	89	39
>EC5-EC7 Aromatics	µg/L	10	1[#1]	**10[#8]**	**17**	10	**16**	<10	<10	<10	<10	<10	<10
>EC7-EC8 Aromatics	µg/L	10	700[#2]	**74[#7]**	-	12	10	-	<10	<10	-	<10	<10
>EC8-EC10 Aromatics	µg/L	10	300[#2]		-	220	391	-	<10	<10	-	33	12
>EC10-EC12 Aromatics	µg/L	10	90[#2]		221	115	124	<10	<10	<10	79	59	26
MTBE	µg/L	3	1,800[#15]	**5,100[#13]**	<3	<3	<3	<3	<3	<3	<3	<3	<3
Benzene	µg/L	7	1[#1]	**10[#8]**	**17**	10	**16**	<7	<7	<7	<7	<7	<7
Toluene	µg/L	4	700[#3]	**74[#7]**	32	12	10	<4	<4	<4	<4	<4	<4
Ethylbenzene	µg/L	5	300[#3]	**20[#12]**	**34**	9	**25**	<5	<5	<5	<5	<5	<5
Xylene (m & p)	µg/L	8			356	122	258	<8	<8	<8	<8	<8	<8
Xylene Total	µg/L	11	500[#3]	**30[#12]**	**380**	**130**	**271**	<11	<11	<11	<11	<11	<11
Xylene (o)	µg/L	3	190[#10]		24	8	13	<3	<3	<3	<3	<3	<3
Total BTEX	µg/L	28			463	161	322	<28	<28	<28	<28	<28	<28
Aromatics >EC8-EC10	µg/L				599	-	-	<10	-	-	45	-	-
Aromatics >EC7-EC8	µg/L				32	-	-	<10	-	-	<10	-	-
GRO Surrogate	%				79	-	-	87	-	-	82	-	-

Tier 1 Screen (Groundwater - Kingsway)
A38 Derby Junctions
Highways England

				Monitoring Zone	Kingsway Junction								
				Location	BK12			BK13			BK14		
				Date	15/12/2016	23/03/2017	05/07/2017	15/12/2016	23/03/2017	05/07/2017	15/12/2016	21/03/2017	05/07/2017
				Monitoring Unit	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground
				Monitoring Round	1	2	3	1	2	3	1	2	3
Parameter	**Units**	**Method Detection Limit**	**TIER 1 GAC (DWS)**	**TIER 1 GAC (EQS-Fresh)**									
HERBPEST													
a-BHC	µg/L	0.01	0.0072$^{\#10}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
b-BHC	µg/L	0.01	0.025$^{\#10}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan I	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan II	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan sulphate	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
g-BHC (Lindane)	µg/L	0.01	2$^{\#3}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor epoxide	µg/L	0.01	0.03$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o,p''-DDE	µg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2,4-DDT	µg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o,p''-Methoxychlor	µg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o,p-DDD	µg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4,4-DDE	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
DDT	µg/L	0.01	0.1$^{\#1}$	**0.01$^{\#8}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methoxychlor	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
DDD	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Azinophos methyl	µg/L	0.01	0.1$^{\#1}$	**0.01$^{\#12}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methyl parathion	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mevinphos (Phosdrin)	µg/L	0.01	0.1$^{\#1}$	**0.02$^{\#11}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
INORGANICS													
Cyanide (Free)	mg/L	0.05	0.05$^{\#1}$	**0.001$^{\#12}$**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cyanide Total	mg/L	0.05	0.05$^{\#1}$	**0.001$^{\#7}$**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrogen (Total)	µg/L				56,400	-	-	517	-	-	12,700	-	-
Ammoniacal Nitrogen as N	mg/L	0.2		**300$^{\#7}$**	-	27.3	56.3	-	13.3	0.478	-	13.8	16.5
TSS	mg/L	2			-	-	-	-	-	-	-	-	-
Total Hardness	mg/l	0.35			-	1,570	-	-	651	-	-	1,870	-
pH (Lab)	pH_Units	1			7.24	7.24	7.21	7.63	7.5	7.57	7.39	7.8	7.62
METALS_ICP													
Arsenic (Filtered)	µg/L	0.5	10$^{\#1}$	**50$^{\#7}$**	4.72	3.43	5.74	0.525	1.22	<0.5	35.3	9.32	13.1
Boron (Filtered)	µg/L	5	1,000$^{\#1}$	**2,000$^{\#12}$**	**3,030**	1,240	**2,850**	102	965	69.4	808	829	1,190
Cadmium (Filtered)	µg/L	0.08	5$^{\#1}$	**0.08$^{\#8}$**	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Chromium (hexavalent)	µg/L	30	50$^{\#1}$	**3.4$^{\#7}$**	<30	<30	<30	<30	<30	<30	<30	<30	<30
Chromium (III+VI)	µg/L	3	50$^{\#1}$		791	192	411	21.8	11.9	7.04	872	377	278
Copper (Filtered)	µg/L	0.3	2,000$^{\#1}$	**1$^{\#7}$**	<0.85	<0.85	<0.3	<0.85	<0.85	<0.3	<0.85	<0.85	<0.3
Iron	µg/L	24	200$^{\#1}$	**1,000$^{\#7}$**	<24	**92,400**	**428,000**	**5,580**	**10,700**	**6,750**	**429,000**	**300,000**	**169,000**
Iron (Filtered)	µg/L	19	200$^{\#1}$	**1,000$^{\#7}$**	**23,700**	**13,700**	**32,100**	27.4	52.4	76.3	**16,300**	**8,280**	<19
Lead (Filtered)	µg/L	0.1	10$^{\#1}$	**1.2$^{\#8}$**	1.13	0.927	0.483	<0.1	0.52	<0.2	<0.1	<0.1	0.506
Mercury (Filtered)	µg/L	0.01	1$^{\#1}$	**0.07$^{\#6}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel (Filtered)	µg/L	0.4	20$^{\#1}$	**4$^{\#8}$**	**50.3**	**39.6**	**30.5**	**10.8**	**16.7**	2.03	**5.46**	**8.1**	**8.62**
Selenium (Filtered)	µg/L	0.5	10$^{\#1}$		1.1	<0.81	<0.5	1.11	<0.81	0.549	<0.81	<0.81	<0.5
Zinc (Filtered)	µg/L	1	6,000$^{\#10}$	**10.9$^{\#7}$**	4.87	3.61	**11.2**	5.84	5.66	4.75	3.51	3.21	2.91
OCP_GCMS													
Aldrin	µg/L	0.01	0.03$^{\#1}$	**0.01$^{\#8}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dieldrin	µg/L	0.01	0.03$^{\#1}$	**0.01$^{\#8}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	µg/L	0.01	0.1$^{\#1}$	**0.01$^{\#8}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor	µg/L	0.01	0.03$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
OPP_GCMS													
Diazinon	µg/L	0.01	0.1$^{\#1}$	**0.01$^{\#7}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dichlorvos	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ethion	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Parathion	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fenitrothion	µg/L	0.01	0.1$^{\#1}$	**0.01$^{\#12}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Malathion	µg/L	0.01	0.1$^{\#1}$	**0.01$^{\#12}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Tier 1 Screen (Groundwater - Kingsway)
A38 Derby Junctions
Highways England

Monitoring Zone					Kingsway Junction								
Location					BK12			BK13			BK14		
Date					15/12/2016	23/03/2017	05/07/2017	15/12/2016	23/03/2017	05/07/2017	15/12/2016	21/03/2017	05/07/2017
Monitoring Unit					Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground
Monitoring Round					1	2	3	1	2	3	1	2	3
Parameter	**Units**	**Method Detection Limit**	**TIER 1 GAC (DWS)**	**TIER 1 GAC (EQS-Fresh)**									
PAH													
Naphthalene	µg/L	0.1	6$^{\#15}$	**2$^{\#8}$**	**8.14**	1.96	**7.44**	<0.1	<0.1	<0.1	**5.99**	**6.4**	0.912
Acenaphthylene	µg/L	0.011	18$^{\#15}$		0.279	0.0966	0.251	<0.011	0.0126	<0.011	1.02	0.549	0.646
Acenaphthene	µg/L	0.015	18$^{\#15}$		5.1	2.26	6.37	<0.015	0.768	0.0775	25.2	15.8	9.55
Fluorene	µg/L	0.014	12$^{\#15}$		5.36	1.72	6.02	<0.014	0.356	0.0344	17.2	11.2	7.68
Phenanthrene	µg/L	0.022	4$^{\#15}$		19.7	3.79	23.4	0.0542	0.26	0.0313	60.1	38.3	21.9
Anthracene	µg/L	0.015	90$^{\#15}$	**0.1$^{\#8}$**	**3.9**	**0.813**	**3.52**	<0.015	0.0485	<0.015	**15.4**	**8.44**	**6.08**
Fluoranthene	µg/L	0.017	4$^{\#3}$	**0.0063$^{\#8}$**	**17.9**	**3.16**	**20.2**	**0.124**	**0.0662**	**0.0254**	**59.2**	**28.8**	**21.7**
Pyrene	µg/L	0.015	9$^{\#15}$		13.3	2.61	13.9	0.133	0.0547	0.0262	41.5	23.1	18.3
Benz(a)anthracene	µg/L	0.017	3.5$^{\#15}$		6.75	1.11	5.52	0.0957	<0.017	<0.017	39.7	16.9	7.62
Chrysene	µg/L	0.013	7$^{\#15}$		5.95	0.951	4.7	0.0753	<0.013	<0.013	35.4	12.5	7.39
Benzo(a) pyrene	µg/L	0.009	0.01$^{\#1}$	**0.00017$^{\#8}$**	**7.12**	**1.12**	**5.65**	**0.0496**	<0.009	<0.009	**78.9**	**31.2**	**14.3**
Indeno(1,2,3-c,d)pyrene	µg/L	0.014	0.1$^{\#1}$		3.81	0.707	2.48	0.0377	<0.014	<0.014	43.5	16.8	8.32
Dibenz(a,h)anthracene	µg/L	0.016	0.07$^{\#15}$		1.03	0.153	0.619	<0.016	<0.016	<0.016	11.2	3.63	1.73
Benzo(g,h,i)perylene	µg/L	0.016	0.1$^{\#1}$	**0.0082$^{\#6}$**	**4.57**	**0.72**	**2.42**	**0.0643**	<0.016	<0.016	**45.8**	**16.7**	**8.45**
Benzo(b)fluoranthene	µg/L	0.023	0.1$^{\#1}$	**0.017$^{\#6}$**	**7.81**	**1.2**	**6.8**	**0.0884**	<0.023	<0.023	**89.3**	**18.9**	**16.9**
Benzo(k)fluoranthene	µg/L	0.027	0.1$^{\#1}$	**0.017$^{\#6}$**	**2.95**	**0.531**	**2.6**	**0.038**	<0.027	<0.027	**35.4**	**11.5**	**7.13**
PAH 16 Total	µg/L	0.344			114	22.9	112	0.76	1.57	<0.344	605	261	159
PHENOL													
2,3,5,6-Tetrachlorophenol	µg/L	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<3.5	<0.5
2-chlorophenol	µg/L	0.5	91$^{\#10}$	**50$^{\#12}$**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.584	<0.5
2-methylphenol	µg/L	0.5	930$^{\#10}$		1.64	1.07	0.67	<0.5	<0.5	<0.5	1.28	1.1	<0.5
2-nitrophenol	µg/L	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-dichlorophenol	µg/L	0.5	46$^{\#10}$	**4.2$^{\#7}$**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	0.706	<0.5
2,4-dimethylphenol	µg/L	0.5	360$^{\#10}$		26.3	10.7	23.8	<0.5	<0.5	<0.5	4.38	10.8	3.08
2,4,5-trichlorophenol	µg/L	0.5	1,200$^{\#10}$		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.07	<0.5
2,4,6-trichlorophenol	µg/L	0.5	200$^{\#3}$		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.07	<0.5
4-chloro-3-methylphenol	µg/L	0.5	1,400$^{\#10}$	**40$^{\#12}$**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-methylphenol	µg/L	0.5	1,900$^{\#10}$		<0.5	2	0.62	<0.5	<0.5	<0.5	5.01	2.29	<0.5
4-nitrophenol	µg/L	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Pentachlorophenol	µg/L	2	9$^{\#3}$	**0.4$^{\#8}$**	<2	<2	<2	<2	<2	<2	<2	<7	<2
Phenol	µg/L	0.5	5,800$^{\#10}$	**7.7$^{\#7}$**	<5	6.04	<4.5	6.29	<5	<3.5	6.22	<6.5	<4
2,4-dinitrophenol	µg/L	2.5	39$^{\#10}$		<2.5	<2.5	<12.5	<2.5	<2.5	<12.5	<2.5	<2.5	<12.5
3-Methylphenol	µg/L	0.5	930$^{\#10}$		<0.5	0.64	<0.5	<0.5	<0.5	<0.5	<0.5	0.563	<0.5
4,6-Dinitro-2-methylphenol	µg/L	3	1.5$^{\#10}$		-	<3	<9	-	<3	<9	-	<3	<9
4-chlorophenol	µg/L	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	1.42	<0.5	<0.5
Dinoseb	µg/L	4	15$^{\#10}$		<4	<4	<12	<4	<4	<12	<4	<4	<12
DNOC :- {4,6-dinitro-o-cresol}	µg/L				<3	-	-	<3	-	-	<3	-	-
PHENOLS_HPLC													
Phenol	µg/L	2	5,800$^{\#10}$	**7.7$^{\#7}$**	<2	<2	**30**	<2	<2	<2	<2	<2	<2
Phenols	µg/L				150	-	-	<16	-	-	<16	-	-
Cresols by HPLC (W)	µg/L	6			50	<6	10	<6	<6	<6	<6	<6	<6
Total Monohydric Phenols (S) Corrected	µg/L	16			-	<16	70	-	<16	<16	-	<16	20
Xylenols	µg/L	8			100	-	30	<8	-	<8	<8	-	20

Tier 1 Screen (Groundwater - Kingsway)
A38 Derby Junctions
Highways England

				Monitoring Zone	Kingsway Junction								
				Location	BK12			BK13			BK14		
				Date	15/12/2016	23/03/2017	05/07/2017	15/12/2016	23/03/2017	05/07/2017	15/12/2016	21/03/2017	05/07/2017
				Monitoring Unit	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground
				Monitoring Round	1	2	3	1	2	3	1	2	3
Parameter	**Units**	**Method Detection Limit**	**TIER 1 GAC (DWS)**	**TIER 1 GAC (EQS-Fresh)**									
SVOC													
Naphthalene	µg/L	1	$6^{\#15}$	**$2^{\#8}$**	**2.62**	**3.68**	<8	<1	<1	<1	**15.3**	**12.8**	<4
Acenaphthylene	µg/L	1	$18^{\#15}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
Acenaphthene	µg/L	1	$18^{\#15}$		1.06	2.85	<8	<1	<1	<1	28.3	20.6	9.69
Fluorene	µg/L	1	$12^{\#15}$		<1	2.79	<8	<1	<1	<1	20.3	16.8	7.47
Phenanthrene	µg/L	1	$4^{\#15}$		<1	9.47	25.5	<1	<1	<1	74.1	61.4	22.8
Anthracene	µg/L	1	$90^{\#15}$	**$0.1^{\#8}$**	<1	**2.48**	<8	<1	<1	<1	**21.8**	**19.8**	**6.22**
Fluoranthene	µg/L	1	$4^{\#3}$	**$0.0063^{\#8}$**	<1	<1	**33.5**	<1	<1	<1	**65.2**	**52.4**	**20.1**
Pyrene	µg/L	1	$9^{\#15}$		<1	8.74	25.2	<1	<1	<1	55.3	43.3	17.3
Benz(a)anthracene	µg/L	1	$3.5^{\#15}$		<1	2.9	<8	<1	<1	<1	25.3	19.2	7.41
Chrysene	µg/L	1	$7^{\#15}$		<1	2.79	<8	<1	<1	<1	26.3	17.4	6.98
Benzo(a) pyrene	µg/L	1	$0.01^{\#1}$	**$0.00017^{\#8}$**	<1	**2.25**	<8	<1	<1	<1	**22.4**	**16**	**6**
Indeno(1,2,3-c,d)pyrene	µg/L	1	$0.1^{\#1}$		<1	<1	<8	<1	<1	<1	11.6	7.65	<4
Dibenz(a,h)anthracene	µg/L	1	$0.07^{\#15}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
Benzo(g,h,i)perylene	µg/L	1	$0.1^{\#1}$	**$0.0082^{\#6}$**	<1	**1.28**	<8	<1	<1	<1	**12.3**	**9.29**	<4
Benzo(b)fluoranthene	µg/L	1	$0.1^{\#1}$	**$0.017^{\#6}$**	<1	**2.92**	<8	<1	<1	<1	**25.1**	**19.5**	**7.21**
Benzo(k)fluoranthene	µg/L	1	$0.1^{\#1}$	**$0.017^{\#6}$**	<1	**1.08**	<8	<1	<1	<1	**10.8**	**7.64**	<4
1,3-dichlorobenzene	µg/L	1			<1	<1	<8	<1	<1	<1	<8	<4	<4
1,4-dichlorobenzene	µg/L	1	$300^{\#3}$		<1	1.42	<8	<1	<1	<1	<8	<4	<4
1,2-dichlorobenzene	µg/L	1	$1,000^{\#3}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
1,2,4-trichlorobenzene	µg/L	1	$0.1^{\#1}$	**$0.4^{\#9}$**	<1	<1	<8	<1	<1	<1	<8	<4	<4
Hexachlorobutadiene	µg/L	1	$0.1^{\#1}$	**$0.6^{\#6}$**	<1	<1	<8	<1	<1	<1	<8	<4	<4
2-chlorophenol	µg/L	1	$91^{\#10}$	**$50^{\#12}$**	<1	<1	<8	<1	<1	<1	<8	<4	<4
2-methylphenol	µg/L	1	$930^{\#10}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
2-nitrophenol	µg/L	1			<1	<1	<8	<1	<1	<1	<8	<4	<4
2,4-dichlorophenol	µg/L	1	$46^{\#10}$	**$4.2^{\#7}$**	<1	<1	<8	<1	<1	<1	<8	**4.76**	<4
2,4-dimethylphenol	µg/L	1	$360^{\#10}$		33.2	12.1	21.7	<1	<1	<1	<8	8.88	<4
2,4,5-trichlorophenol	µg/L	1	$1,200^{\#10}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
2,4,6-trichlorophenol	µg/L	1	$200^{\#3}$		<1	<1	<8	<1	<1	<1	<8	5.98	<4
4-chloro-3-methylphenol	µg/L	1	$1,400^{\#10}$	**$40^{\#12}$**	<1	<1	<8	<1	<1	<1	<8	<4	<4
4-methylphenol	µg/L	1	$1,900^{\#10}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
4-nitrophenol	µg/L	1			<1	<1	<8	<1	<1	<1	<8	<4	<4
Pentachlorophenol	µg/L	1	$9^{\#3}$	**$0.4^{\#8}$**	<1	<1	<8	<1	<1	<1	<8	<4	<4
Phenol	µg/L	1	$5,800^{\#10}$	**$7.7^{\#7}$**	<1	<1	<8	<1	<1	<1	<8	<4	<4
2-chloronaphthalene	µg/L	1	$750^{\#10}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
2-methylnaphthalene	µg/L	1	$36^{\#10}$		1.15	4.07	<8	<1	<1	<1	<8	5.75	<4
Bis(2-ethylhexyl) phthalate	µg/L	2	$8^{\#3}$	**$1.3^{\#8}$**	<2	**18.1**	**22.2**	<2	<2	<2	**27.6**	**37.4**	**17.2**
Butyl benzyl phthalate	µg/L	1	$16^{\#10}$	**$7.5^{\#7}$**	<1	<1	<8	<1	<1	<1	<8	<4	<4
Di-n-butyl phthalate	µg/L	1	$900^{\#10}$	**$8^{\#12}$**	<1	1.75	<8	<1	<1	<1	<8	<4	<4
Di-n-octyl phthalate	µg/L	5	$200^{\#10}$	**$20^{\#12}$**	<5	<5	<40	<5	<5	<5	<40	<20	<20
Diethylphthalate	µg/L	1	$15,000^{\#10}$	**$200^{\#12}$**	1.58	1.32	<8	<1	<1	<1	<8	<4	<4
Dimethyl phthalate	µg/L	1		**$800^{\#12}$**	<1	<1	<8	<1	<1	<1	31.1	26	12.9
2-nitroaniline	µg/L	1	$190^{\#10}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
2,4-Dinitrotoluene	µg/L	1	$0.24^{\#10}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
2,6-dinitrotoluene	µg/L	1	$0.049^{\#10}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
3-nitroaniline	µg/L	1			<1	<1	<8	<1	<1	<1	<8	<4	<4
4-bromophenyl phenyl ether	µg/L	1			<1	<1	<8	<1	<1	<1	<8	<4	<4
4-chloroaniline	µg/L	1	$0.37^{\#10}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
4-chlorophenyl phenyl ether	µg/L	1			<1	<1	<8	<1	<1	<1	<8	<4	<4
4-nitroaniline	µg/L	1	$3.8^{\#10}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
Azobenzene	µg/L	1	$0.12^{\#10}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
Bis(2-chloroethoxy) methane	µg/L	1	$59^{\#10}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
Bis(2-chloroethyl)ether	µg/L	1	$0.014^{\#10}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
Carbazole	µg/L	1			<1	1.82	<8	<1	<1	<1	26.7	20.4	11.1
Dibenzofuran	µg/L	1	$7.9^{\#10}$		<1	1.88	<8	<1	<1	<1	13.8	11.5	5.47
Hexachlorobenzene	µg/L	1	$0.1^{\#1}$	**$0.05^{\#6}$**	<1	<1	<8	<1	<1	<1	<8	<4	<4
Hexachlorocyclopentadiene	µg/L	1	$0.41^{\#10}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
Hexachloroethane	µg/L	1	$0.33^{\#10}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
Isophorone	µg/L	1	$78^{\#10}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
N-nitrosodi-n-propylamine	µg/L	1	$0.011^{\#10}$		<1	<1	<8	<1	<1	<1	<8	<4	<4
Nitrobenzene	µg/L	1	$8.0^{\#3}$		<1	<1	<8	<1	<1	<1	<8	<4	<4

Tier 1 Screen (Groundwater - Kingsway)
A38 Derby Junctions
Highways England

			Monitoring Zone		Kingsway Junction								
			Location		BK12			BK13			BK14		
			Date		15/12/2016	23/03/2017	05/07/2017	15/12/2016	23/03/2017	05/07/2017	15/12/2016	21/03/2017	05/07/2017
			Monitoring Unit		Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground
			Monitoring Round		1	2	3	1	2	3	1	2	3
Parameter	Units	Method Detection Limit	TIER 1 GAC (DWS)	TIER 1 GAC (EQS-Fresh)									
UNK													
Pentachlorophenol	µg/L	0.04	9[#3]	**0.4[#8]**	<3	-	0.089	<0.04	-	<0.04	<0.8	-	<0.1
Dichloroacetic acid	µg/L		1.5[#10]		<0.08	-	-	<0.04	-	-	<0.08	-	-
Benazolin	µg/L				<0.08	-	-	<0.04	-	-	<0.08	-	-
Bentazone	µg/L	0.04	500[#3]	**500[#12]**	<0.08	-	<0.3	<0.04	-	<0.04	<0.1	-	<0.15
Bromoxynil	µg/L	0.04	0.61[#10]	**100[#12]**	<0.08	-	<0.04	<0.04	-	<0.04	<0.08	-	<0.04
Clopyralid	µg/L	0.04			<0.5	-	<0.5	<0.04	-	<0.04	<0.4	-	<1
Hedonal	µg/L	0.04	30[#3]	**0.3[#7]**	-	-	<0.04	-	-	<0.04	-	-	<0.04
2,4-DB	µg/L				<0.08	-	-	<0.04	-	-	<0.08	-	-
Dicamba	µg/L	0.04	570[#10]		<1	-	<5	<0.12	-	<0.045	<1	-	<7
2,4,5-TP (Silvex)	µg/L	0.04	110[#10]		-	-	<0.04	-	-	<0.04	-	-	<0.15
Actril (Ioxynil)	mg/L	0.00004		**0.01[#12]**	<0.00008	-	<0.00004	<0.00004	-	<0.00004	<0.00008	-	<0.00004
2-Methyl-4-chlorophenoxyacetic acid	µg/L	0.04	700[#3]	**12[#12]**	<0.08	-	<0.04	<0.04	-	<0.04	<0.08	-	<0.04
2-Methyl-4-Chlorophenoxy Butanoic Acid	µg/L	0.04	65[#10]		<0.08	-	<0.04	<0.04	-	<0.04	<0.08	-	<0.04
2,4,5-Trichlorophenoxy Acetic Acid	µg/L	0.04	9[#3]		<0.08	-	<0.08	<0.04	-	<0.04	<0.08	-	<0.08
Triclopyr	µg/L	0.04			<0.08	-	<0.04	<0.04	-	<0.04	<0.08	-	<0.04
2,3,6-Trichlorobenzoic acid	µg/L				<0.7	-	-	<0.065	-	-	<0.9	-	-
4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)	µg/L	0.04	450[#10]		-	-	<0.14	-	-	<0.04	-	-	<0.04
Fluroxypyr	µg/L	0.04			<0.08	-	<0.04	<0.04	-	<0.04	<0.18	-	<1.2
Fenoprop	µg/L		9[#3]		<0.08	-	-	<0.04	-	-	<0.08	-	-
VOC													
1,3,5-Trichlorobenzene	µg/L	1	0.1[#1]	**0.4[#9]**	<1	<1	<1	<1	<1	<1	<1	<1	<1
Naphthalene	µg/L	1	6[#15]	**2[#8]**	**9.97**	**3.9**	**5.03**	<1	<1	<1	**10.7**	**4.16**	**2.35**
Dichlorodifluoromethane	µg/L	1	200[#10]		<1	<1	<1	<1	<1	<1	<1	<1	<1
MTBE	µg/L	1	1,800[#15]	**5,100[#13]**	<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloromethane	µg/L	1	190[#10]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Vinyl chloride	µg/L	1	0.5[#1]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromomethane	µg/L	1	7.5[#10]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloroethane	µg/L	1	21,000[#10]		<1	<1	<1	<1	<1	<1	2.56	4.83	6.27
Trichlorofluoromethane	µg/L	1	5,200[#10]		<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethene	µg/L	1	140[#3]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Dichloromethane	µg/L	3	20[#3]	**20[#8]**	<3	<3	<3	<3	<3	<3	<3	<3	<3
trans-1,2-dichloroethene	µg/L	1	50[#3]		<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethane	µg/L	1	2.8[#10]		<1	<1	<1	<1	2.8	<1	<1	<1	<1
cis-1,2-dichloroethene	µg/L	1	50[#3]		1.59	<1	<1	<1	<1	<1	<1	<1	<1
2,2-dichloropropane	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromochloromethane	µg/L	1	83[#10]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloroform	µg/L	1	100[#1]	**2.5[#8]**	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1-trichloroethane	µg/L	1	2,000[#3]	**100[#12]**	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloropropene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	µg/L	1	3[#1]	**12[#8]**	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloroethane	µg/L	1	3[#1]	**10[#8]**	<1	<1	<1	<1	<1	<1	<1	<1	<1
Benzene	µg/L	1	1[#1]	**10[#8]**	**24.2**	**13.4**	**20.6**	<1	<1	<1	2.57	2.2	2.79
Trichloroethene	µg/L	1	10[#1]	**10[#8]**	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloropropane	µg/L	1	40[#3]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Dibromomethane	µg/L	1	8.3[#10]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromodichloromethane	µg/L	1	100[#1]		<1	<1	<1	<1	<1	<1	<1	<1	<1
cis-1,3-dichloropropene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/L	1	700[#3]	**74[#7]**	28.9	15.3	11.7	<1	<1	<1	<1	<1	<1
trans-1,3-dichloropropene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-trichloroethane	µg/L	1	0.28[#10]	**400[#12]**	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloroethene	µg/L	1	10[#1]	**10[#8]**	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichloropropane	µg/L	1	370[#10]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlorodibromomethane	µg/L	1	100[#1]		<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromoethane	µg/L	1	0.4[#3]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlorobenzene	µg/L	1	300[#3]		1.28	2.88	<1	<1	<1	<1	2.64	<1	<1
1,1,1,2-tetrachloroethane	µg/L	1	0.57[#10]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	µg/L	1	300[#3]	**20[#12]**	**34**	9.29	**26.4**	<1	<1	<1	<1	<1	<1
Xylene (m & p)	µg/L	1			383	141	324	<1	<1	<1	1.17	1.8	<1
Xylene (o)	µg/L	1	190[#10]		24.9	6.81	11.2	<1	<1	<1	<1	<1	<1
Styrene	µg/L	1	20[#3]	**50[#12]**	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromoform	µg/L	1	100[#1]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Isopropylbenzene	µg/L	1	450[#10]		3.29	1.56	3.24	<1	<1	<1	1.27	<1	<1
1,1,2,2-tetrachloroethane	µg/L	1	0.076[#10]	**140[#7]**	<1	<1	<1	<1	<1	<1	<1	<1	<1

Tier 1 Screen (Groundwater - Kingsway)
A38 Derby Junctions
Highways England

			Monitoring Zone		Kingsway Junction								
			Location		BK12			BK13			BK14		
			Date		15/12/2016	23/03/2017	05/07/2017	15/12/2016	23/03/2017	05/07/2017	15/12/2016	21/03/2017	05/07/2017
			Monitoring Unit		Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground	Made Ground
			Monitoring Round		1	2	3	1	2	3	1	2	3
Parameter	**Units**	**Method Detection Limit**	**TIER 1 GAC (DWS)**	**TIER 1 GAC (EQS-Fresh)**									
Bromobenzene	µg/L	1	$62^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichloropropane	µg/L	1	$0.00075^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
n-propylbenzene	µg/L	1	$660^{\#10}$		4.23	1.47	4.54	<1	<1	<1	1.02	<1	<1
2-chlorotoluene	µg/L	1	$240^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3,5-trimethylbenzene	µg/L	1	$60^{\#10}$		16.2	8.48	6.24	<1	<1	<1	<1	<1	<1
4-chlorotoluene	µg/L	1	$250^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
tert-butylbenzene	µg/L	1	$690^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trimethylbenzene	µg/L	1	$56^{\#10}$		71.8	48.2	57.4	<1	<1	<1	2.39	1.5	1.04
sec-butylbenzene	µg/L	1	$2,000^{\#10}$		1.69	<1	1.66	<1	<1	<1	<1	<1	<1
p-isopropyltoluene	µg/L	1			4.08	1.46	1.76	<1	<1	<1	5.19	3.36	<1
1,3-dichlorobenzene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1
1,4-dichlorobenzene	µg/L	1	$300^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
n-butylbenzene	µg/L	1	$1,000^{\#10}$		<1	<1	1.76	<1	<1	<1	<1	<1	<1
1,2-dichlorobenzene	µg/L	1	$1000^{\#3}$		<1	<1	<1	<1	<1	<1	1.19	<1	1.23
1,2-dibromo-3-chloropropane	µg/L	1	$1^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trichlorobenzene	µg/L	1	$0.1^{\#1}$	$0.4^{\#9}$	<1	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	µg/L	1	$0.1^{\#1}$	$0.6^{\#6}$	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichlorobenzene	µg/L	1	$0.1^{\#1}$	$0.4^{\#9}$	<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon disulfide	µg/L	1	$810^{\#10}$		<1	<1	<1	<1	<1	<1	1.57	1.78	<1
Tert Amyl Methyl Ether	µg/L	1		$510^{\#13}$	<1	<1	<1	<1	<1	<1	<1	<1	<1

Comments

#1 WS Regs 2016 (Eng/Wal)
#2 WHO Petroleum DWG 2008
#3 WHO DWG 2017
#4 WHO 2017 - Taste
#5 WHO 2017 - Odour
#6 WFD England/Wales. 2015 - MAC-EQS Inland
#7 WFD England/Wales. 2015 - Freshwater Standards
#8 WFD England/Wales. 2015 - AA-EQS Inland
#9 Water Env't Regs (Scotland) 2015. AA-EQS Inland
#10 USEPA RSL (tapwater) [May 2019]
#11 SEPA WAT-SG-53 Fresh EQS - MAC - 2015
#12 SEPA WAT-SG-53 Fresh EQS - AA - 2015
#13 PNEC (EU REACH) - Freshwater
#14 California Draft health protective concentration
#15 AECOM DWG (WHO method)
GAC: Generic Assessment Criteria
(blank): No assessment criteria available
- : Not analysed

Key

XXX	Exceedance of CW/WE Water. DWS - England/Wales
XXX	Exceedance of CW/WE Water. Aquatic Toxicity - England/Wales - Freshwater

Tier 1 Screen (Groundwater - Little Eaton)
A38 Derby Junctions
Highways England

				Monitoring Zone	Little Eaton Junction							
				Location	BL02		BL08			BL10		
				Date	12/12/2016	23/03/2017	12/12/2016	23/03/2017	06/07/2017	13/12/2016	22/03/2017	03/07/2017
				Monitoring Unit	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium
				Monitoring Round	1	2	1	2	3	1	2	3
Parameter	**Units**	**Method Detection Limit**	**GAC_WTV_EN/WA_DWS**	**GAC_WTV_EN/WA_EQS-Fresh**								
ACID_HERB_GCMS_SUB												
2,4-Dichlorprop	µg/L	0.04	100[#3]		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04
Mecoprop	µg/L	0.04	10[#3]	**18[#7]**	<0.04	-	<0.04	-	<0.04	<0.04	-	<0.04
CARBON												
TOC	mg/L	3			6.99	7.03	15.6	11.1	9.8	10.6	6.62	6.01
COD												
COD	mg/L	7			-	-	-	-	-	-	-	76.1
EPHCWG												
>C12-C16 Aliphatics	µg/L	10	300[#2]		10	<10	<10	<10	<10	<10	<10	<10
>C16-C21 Aliphatics	µg/L	10	300[#2]		13	<10	13	<10	<10	<10	<10	<10
>C21-C35 Aliphatics	µg/L	10	300[#2]		57	<10	16	<10	<10	<10	<10	70
>C12-C35 Aliphatics	µg/L	10			80	<10	29	<10	<10	<10	<10	70
>EC12-EC16 Aromatics	µg/L	10	90[#2]		<10	<10	<10	<10	<10	<10	<10	<10
>EC16-EC21 Aromatics	µg/L	10	90[#2]		<10	<10	<10	<10	<10	<10	<10	<10
>EC21-EC35 Aromatics	µg/L	10	90[#2]		<10	<10	<10	<10	<10	<10	<10	28
>EC12-EC35 Aromatics	µg/L	10			<10	<10	<10	<10	<10	<10	<10	28
>C5-C35 Aliphatics & Aromatics	µg/L	10			80	-	41	-	<10	<10	-	107
ESDAT Combined Compounds												
>C16-C35 Aliphatics	µg/L				70	-	29	-	-	<20	-	-
Benzo(b)&(k)fluoranthene	µg/L				0.709	-	3.66	-	-	<0.05	-	-
PAHs (sum of 4)	µg/L		0.1[#1]		1.267	-	5.671	-	-	<0.08	-	-
benzo(g,h,i)perylene + indeno(1,2,3-cd)pyrene	µg/L				0.558	-	2.011	-	-	<0.03	-	-
Benzo(a)pyrene (surrogate marker for PAH mixture)	µg/L				0.283	-	1.55	-	-	<0.009	-	-
Sum of PCE and TCE	µg/L		10[#1]		<2	-	<2	-	-	<2	-	-
TCE+DCE+VC	µg/L				<5	-	<5	-	-	<5	-	-
PCE+TCE+DCE+VC	µg/L				<6	-	<6	-	-	<6	-	-
1,2-Dichloroethene	µg/L		50[#3]		<2	-	<2	-	-	<2	-	-
Trihalomethanes	µg/L		100[#1]		<4	-	<4	-	-	<4	-	-
Aldrin + Dieldrin	µg/L		0.03[#3]		<0.02	-	<0.02	-	-	<0.02	-	-
DDT+DDE+DDD	µg/L				<0.02	-	<0.02	-	-	<0.02	-	-
Aldrin+Dieldrin+Endrin+Isodrin	µg/L			**0.01[#8]**	<0.03	-	<0.03	-	-	<0.03	-	-
GRO												
GRO >C5-C12	µg/L	50			<50	<50	<50	<50	<50	<50	<50	<50
>C5-C6 Aliphatics	µg/L	10	15.000[#2]		<10	<10	<10	<10	<10	<10	<10	<10
>C6-C8 Aliphatics	µg/L	10	15.000[#2]		<10	<10	<10	<10	<10	<10	<10	<10
>C8-C10 Aliphatics	µg/L	10	300[#2]		<10	<10	<10	<10	<10	<10	<10	<10
>C10-C12 Aliphatics	µg/L	10	300[#2]		<10	<10	<10	<10	<10	<10	<10	<10
>EC5-EC7 Aromatics	µg/L	10	1[#1]	**10[#8]**	<10	<10	<10	<10	<10	<10	<10	<10
>EC7-EC8 Aromatics	µg/L	10	700[#2]	**74[#7]**	-	<10	-	<10	<10	-	<10	<10
>EC8-EC10 Aromatics	µg/L	10	300[#2]		-	<10	-	<10	<10	-	<10	<10
>EC10-EC12 Aromatics	µg/L	10	90[#2]		<10	<10	<10	<10	<10	<10	<10	<10
MTBE	µg/L	3	1.800[#15]	**5.100[#13]**	<3	<3	<3	<3	<3	<3	<3	<3
Benzene	µg/L	7	1[#1]	**10[#8]**	<7	<7	<7	<7	<7	<7	<7	<7
Toluene	µg/L	4	700[#3]	**74[#7]**	<4	<4	<4	<4	<4	<4	<4	<4
Ethylbenzene	µg/L	5	300[#3]	**20[#12]**	<5	<5	<5	<5	<5	<5	<5	<5
Xylene (m & p)	µg/L	8			<8	<8	<8	<8	<8	<8	<8	<8
Xylene Total	µg/L	11	500[#3]	**30[#12]**	<11	<11	<11	<11	<11	<11	<11	<11
Xylene (o)	µg/L	3	190[#10]		<3	<3	<3	<3	<3	<3	<3	<3
Total BTEX	µg/L	28			<28	<28	<28	<28	<28	<28	<28	<28
Aromatics >EC8-EC10	µg/L				<10	-	<10	-	-	<10	-	-
Aromatics >EC7-EC8	µg/L				<10	-	<10	-	-	<10	-	-
GRO Surrogate	%				89	-	100	-	-	90	-	-

Tier 1 Screen (Groundwater - Little Eaton)
A38 Derby Junctions
Highways England

				Monitoring Zone	**Little Eaton Junction**							
				Location	BL02		BL08			BL10		
				Date	12/12/2016	23/03/2017	12/12/2016	23/03/2017	06/07/2017	13/12/2016	22/03/2017	03/07/2017
				Monitoring Unit	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium
				Monitoring Round	1	2	1	2	3	1	2	3
Parameter	**Units**	**Method Detection Limit**	**GAC_WTV_EN/WA_DWS**	**GAC_WTV_EN/WA_EQS-Fresh**								
HERBPEST												
a-BHC	µg/L	0.01	0.0072$^{\#10}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
b-BHC	µg/L	0.01	0.025$^{\#10}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan I	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan II	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endosulfan sulphate	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
g-BHC (Lindane)	µg/L	0.01	2$^{\#3}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor epoxide	µg/L	0.01	0.03$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o,p''-DDE	µg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
2,4-DDT	µg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o,p''-Methoxychlor	µg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
o,p-DDD	µg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
4,4-DDE	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
DDT	µg/L	0.01	0.1$^{\#1}$	**0.01$^{\#8}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methoxychlor	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
DDD	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Azinophos methyl	µg/L	0.01	0.1$^{\#1}$	**0.01$^{\#12}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Methyl parathion	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Mevinphos (Phosdrin)	µg/L	0.01	0.1$^{\#1}$	**0.02$^{\#11}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
INORGANICS												
Cyanide (Free)	mg/L	0.05	0.05$^{\#1}$	**0.001$^{\#12}$**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cyanide Total	mg/L	0.05	0.05$^{\#1}$	**0.001$^{\#7}$**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrogen (Total)	µg/L				1,190	-	<200	-	-	<200	-	-
Ammoniacal Nitrogen as N	mg/L	0.2		**300$^{\#7}$**	-	1.43	-	0.245	0.307	-	<0.2	<0.2
TSS	mg/L	2			-	-	-	-	-	-	-	704
Total Hardness	mg/l	0.35			-	618	-	1,060	-	-	402	-
pH (Lab)	pH_Units	1			7.26	7.67	7.51	7.86	7.48	7.56	7.76	7.54
METALS_ICP												
Arsenic (Filtered)	µg/L	0.5	10$^{\#1}$	**50$^{\#7}$**	0.56	0.692	8.02	9.46	5.87	1.02	0.624	1.36
Boron (Filtered)	µg/L	5	1,000$^{\#1}$	**2,000$^{\#12}$**	215	259	64.1	87.4	92.5	83.6	68.2	79.2
Cadmium (Filtered)	µg/L	0.08	5$^{\#1}$	**0.08$^{\#8}$**	**5.24**	**0.475**	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Chromium (hexavalent)	µg/L	30	50$^{\#1}$	**3.4$^{\#7}$**	<30	<30	<30	<30	<30	<30	<30	<30
Chromium (III+VI)	µg/L	3	50$^{\#1}$		136	22.3	62.9	25.6	17.1	13	9.87	15.9
Copper (Filtered)	µg/L	0.3	2,000$^{\#1}$	**1$^{\#7}$**	**1.62**	<0.85	<0.85	<0.85	<0.3	<0.85	<0.85	<0.3
Iron	µg/L	24	200$^{\#1}$	**1,000$^{\#7}$**	**440,000**	**38,700**	**115,000**	**104,000**	**27,200**	**17,200**	**21,200**	**35,000**
Iron (Filtered)	µg/L	19	200$^{\#1}$	**1,000$^{\#7}$**	<19	258	**1,030**	471	**3,250**	67.9	327	**2,010**
Lead (Filtered)	µg/L	0.1	10$^{\#1}$	**1.2$^{\#8}$**	0.193	<0.1	<0.1	<0.1	<0.2	<0.1	<0.1	<0.2
Mercury (Filtered)	µg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel (Filtered)	µg/L	0.4	20$^{\#1}$	**4$^{\#8}$**	**37.9**	**7.91**	**4.69**	**5.01**	2.68	3.2	**5.34**	**4.57**
Selenium (Filtered)	µg/L	0.5	10$^{\#1}$		1.29	<0.81	1.05	1.12	<0.5	<0.81	<0.81	<0.5
Zinc (Filtered)	µg/L	1	6,000$^{\#10}$	**10.9$^{\#7}$**	9.89	4.4	<1.3	<1.3	<1	1.34	1.7	<1
OCP_GCMS												
Aldrin	µg/L	0.01	0.03$^{\#1}$	**0.01$^{\#8}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dieldrin	µg/L	0.01	0.03$^{\#1}$	**0.01$^{\#8}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Endrin	µg/L	0.01	0.1$^{\#1}$	**0.01$^{\#8}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Heptachlor	µg/L	0.01	0.03$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
OPP_GCMS												
Diazinon	µg/L	0.01	0.1$^{\#1}$	**0.01$^{\#7}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Dichlorvos	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Ethion	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Parathion	µg/L	0.01	0.1$^{\#1}$		<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Fenitrothion	µg/L	0.01	0.1$^{\#1}$	**0.01$^{\#12}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Malathion	µg/L	0.01	0.1$^{\#1}$	**0.01$^{\#12}$**	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01

Tier 1 Screen (Groundwater - Little Eaton)
A38 Derby Junctions
Highways England

				Monitoring Zone	**Little Eaton Junction**							
				Location	BL02		BL08			BL10		
				Date	12/12/2016	23/03/2017	12/12/2016	23/03/2017	06/07/2017	13/12/2016	22/03/2017	03/07/2017
				Monitoring Unit	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium
				Monitoring Round	1	2	1	2	3	1	2	3
Parameter	**Units**	**Method Detection Limit**	**GAC_WTV_EN/WA_DWS**	**GAC_WTV_EN/WA_EQS-Fresh**								
PAH												
Naphthalene	µg/L	0.1	$6^{\#15}$	**$2^{\#8}$**	<0.1	<0.1	0.182	<0.1	0.1	<0.1	<0.1	<0.1
Acenaphthylene	µg/L	0.011	$18^{\#15}$		0.0125	<0.011	0.0217	<0.011	<0.011	<0.011	<0.011	<0.011
Acenaphthene	µg/L	0.015	$18^{\#15}$		0.0225	<0.015	0.097	0.0264	0.0304	<0.015	<0.015	<0.015
Fluorene	µg/L	0.014	$12^{\#15}$		0.0224	<0.014	0.0948	0.0341	0.0339	<0.014	<0.014	<0.014
Phenanthrene	µg/L	0.022	$4^{\#15}$		0.135	<0.022	0.427	0.14	0.136	<0.022	0.0221	0.0233
Anthracene	µg/L	0.015	$90^{\#15}$	**$0.1^{\#8}$**	0.0253	<0.015	**0.115**	0.0328	0.0284	<0.015	<0.015	<0.015
Fluoranthene	µg/L	0.017	$4^{\#3}$	**$0.0063^{\#8}$**	**0.203**	<0.017	**0.712**	**0.177**	**0.172**	<0.017	<0.017	**0.0198**
Pyrene	µg/L	0.015	$9^{\#15}$		0.239	0.0182	0.613	0.164	0.175	<0.015	<0.015	0.0224
Benz(a)anthracene	µg/L	0.017	$3.5^{\#15}$		0.184	<0.017	0.425	0.0933	<0.017	<0.017	0.0278	<0.017
Chrysene	µg/L	0.013	$7^{\#15}$		0.214	<0.013	0.451	0.105	0.0843	<0.013	<0.013	<0.013
Benzo(a) pyrene	µg/L	0.009	$0.01^{\#1}$	**$0.00017^{\#8}$**	**0.283**	<0.009	**1.55**	**0.142**	**0.147**	<0.009	<0.009	**0.0115**
Indeno(1,2,3-c,d)pyrene	µg/L	0.014	$0.1^{\#1}$		0.241	<0.014	0.951	0.101	0.0872	<0.014	<0.014	<0.014
Dibenz(a,h)anthracene	µg/L	0.016	$0.07^{\#15}$		0.0523	<0.016	0.189	0.0181	0.0165	<0.016	<0.016	<0.016
Benzo(g,h,i)perylene	µg/L	0.016	$0.1^{\#1}$	**$0.0082^{\#6}$**	**0.317**	<0.016	**1.06**	**0.128**	**0.115**	<0.016	**0.017**	<0.016
Benzo(b)fluoranthene	µg/L	0.023	$0.1^{\#1}$	**$0.017^{\#6}$**	**0.486**	<0.023	**2.46**	**0.201**	**0.227**	<0.023	<0.023	**0.0234**
Benzo(k)fluoranthene	µg/L	0.027	$0.1^{\#1}$	**$0.017^{\#6}$**	**0.223**	<0.027	**1.2**	**0.0881**	**0.0916**	<0.027	<0.027	<0.027
PAH 16 Total	µg/L	0.344			2.66	<0.344	10.5	1.45	1.44	<0.344	<0.344	<0.344
PHENOL												
2,3,5,6-Tetrachlorophenol	µg/L	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<1	<0.5
2-chlorophenol	µg/L	0.5	$91^{\#10}$	**$50^{\#12}$**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-methylphenol	µg/L	0.5	$930^{\#10}$		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-nitrophenol	µg/L	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-dichlorophenol	µg/L	0.5	$46^{\#10}$	**$4.2^{\#7}$**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4-dimethylphenol	µg/L	0.5	$360^{\#10}$		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,5-trichlorophenol	µg/L	0.5	$1,200^{\#10}$		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,6-trichlorophenol	µg/L	0.5	$200^{\#3}$		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-chloro-3-methylphenol	µg/L	0.5	$1,400^{\#10}$	**$40^{\#12}$**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-methylphenol	µg/L	0.5	$1,900^{\#10}$		<0.5	<0.5	1.97	<0.5	<0.5	<0.5	<0.5	<0.5
4-nitrophenol	µg/L	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Pentachlorophenol	µg/L	2	$9^{\#3}$	**$0.4^{\#8}$**	<2	<2	<2	<2	<2	<2	<2	<2
Phenol	µg/L	0.5	$5,800^{\#10}$	**$7.7^{\#7}$**	<5	<5	<5	<5	<4.5	<5	<5	<6.5
2,4-dinitrophenol	µg/L	2.5	$39^{\#10}$		<2.5	<2.5	<2.5	<2.5	<12.5	<2.5	<2.5	<5
3-Methylphenol	µg/L	0.5	$930^{\#10}$		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4,6-Dinitro-2-methylphenol	µg/L	3	$1.5^{\#10}$		-	<3	-	<3	<9	-	<3	<6
4-chlorophenol	µg/L	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dinoseb	µg/L	4	$15^{\#10}$		<4	<4	<4	<4	<12	<4	<4	<8
DNOC :- {4,6-dinitro-o-cresol}	µg/L				<3	-	<3	-	-	<3	-	-
PHENOLS_HPLC												
Phenol	µg/L	2	$5,800^{\#10}$	**$7.7^{\#7}$**	<2	<2	<2	<2	<2	<2	<2	<2
Phenols	µg/L				<16	-	<16	-	-	<16	-	-
Cresols by HPLC (W)	µg/L	6			<6	<6	<6	<6	<6	<6	<6	<6
Total Monohydric Phenols (S) Corrected	µg/L	16			-	<16	-	<16	<16	-	<16	<16
Xylenols	µg/L	8			<8	-	<8	-	<8	<8	-	<8

Tier 1 Screen (Groundwater - Little Eaton)
A38 Derby Junctions
Highways England

				Monitoring Zone	Little Eaton Junction							
				Location	BL02		BL08			BL10		
				Date	12/12/2016	23/03/2017	12/12/2016	23/03/2017	06/07/2017	13/12/2016	22/03/2017	03/07/2017
				Monitoring Unit	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium
				Monitoring Round	1	2	1	2	3	1	2	3
Parameter	Units	Method Detection Limit	GAC_WTV_EN/WA_DWS	GAC_WTV_EN/WA_EQS-Fresh								
SVOC												
Naphthalene	µg/L	1	6[#15]	**2[#8]**	<1	<1	<1	<1	<1	<1	<1	<1
Acenaphthylene	µg/L	1	18[#15]		<1	<1	<1	<1	<1	<1	<1	<1
Acenaphthene	µg/L	1	18[#15]		<1	<1	<1	<1	<1	<1	<1	<1
Fluorene	µg/L	1	12[#15]		<1	<1	<1	<1	<1	<1	<1	<1
Phenanthrene	µg/L	1	4[#15]		<1	<1	<1	<1	<1	<1	<1	<1
Anthracene	µg/L	1	90[#15]	**0.1[#8]**	<1	<1	<1	<1	<1	<1	<1	<1
Fluoranthene	µg/L	1	4[#3]	**0.0063[#8]**	<1	<1	<1	<1	<1	<1	<1	<1
Pyrene	µg/L	1	9[#15]		<1	<1	<1	<1	<1	<1	<1	<1
Benz(a)anthracene	µg/L	1	3.5[#15]		<1	<1	<1	<1	<1	<1	<1	<1
Chrysene	µg/L	1	7[#15]		<1	<1	<1	<1	<1	<1	<1	<1
Benzo(a) pyrene	µg/L	1	0.01[#1]	**0.00017[#8]**	<1	<1	<1	<1	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	1	0.1[#1]		<1	<1	<1	<1	<1	<1	<1	<1
Dibenz(a,h)anthracene	µg/L	1	0.07[#15]		<1	<1	<1	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	1	0.1[#1]	**0.0082[#6]**	<1	<1	<1	<1	<1	<1	<1	<1
Benzo(b)fluoranthene	µg/L	1	0.1[#1]	**0.017[#6]**	<1	<1	<1	<1	<1	<1	<1	<1
Benzo(k)fluoranthene	µg/L	1	0.1[#1]	**0.017[#6]**	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichlorobenzene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
1,4-dichlorobenzene	µg/L	1	300[#3]		<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichlorobenzene	µg/L	1	1,000[#3]		<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trichlorobenzene	µg/L	1	0.1[#1]	**0.4[#9]**	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	µg/L	1	0.1[#1]	**0.6[#6]**	<1	<1	<1	<1	<1	<1	<1	<1
2-chlorophenol	µg/L	1	91[#10]	**50[#12]**	<1	<1	<1	<1	<1	<1	<1	<1
2-methylphenol	µg/L	1	930[#10]		<1	<1	<1	<1	<1	<1	<1	<1
2-nitrophenol	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
2,4-dichlorophenol	µg/L	1	46[#10]	**4.2[#7]**	<1	<1	<1	<1	<1	<1	<1	<1
2,4-dimethylphenol	µg/L	1	360[#10]		<1	<1	<1	<1	<1	<1	<1	<1
2,4,5-trichlorophenol	µg/L	1	1,200[#10]		<1	<1	<1	<1	<1	<1	<1	<1
2,4,6-trichlorophenol	µg/L	1	200[#3]		<1	<1	<1	<1	<1	<1	<1	<1
4-chloro-3-methylphenol	µg/L	1	1,400[#10]	**40[#12]**	<1	<1	<1	<1	<1	<1	<1	<1
4-methylphenol	µg/L	1	1,900[#10]		<1	<1	<1	<1	<1	<1	<1	<1
4-nitrophenol	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
Pentachlorophenol	µg/L	1	9[#3]	**0.4[#8]**	<1	<1	<1	<1	<1	<1	<1	<1
Phenol	µg/L	1	5,800[#10]	**7.7[#7]**	<1	<1	<1	<1	<1	1.71	<1	<1
2-chloronaphthalene	µg/L	1	750[#10]		<1	<1	<1	<1	<1	<1	<1	<1
2-methylnaphthalene	µg/L	1	36[#10]		<1	<1	<1	<1	<1	<1	<1	<1
Bis(2-ethylhexyl) phthalate	µg/L	2	8[#3]	**1.3[#8]**	<2	<2	**3.38**	<2	<2	<2	<2	<2
Butyl benzyl phthalate	µg/L	1	16[#10]	**7.5[#7]**	<1	<1	<1	<1	<1	<1	<1	<1
Di-n-butyl phthalate	µg/L	1	900[#10]	**8[#12]**	<1	<1	<1	<1	<1	<1	<1	<1
Di-n-octyl phthalate	µg/L	5	200[#10]	**20[#12]**	<5	<5	<5	<5	<5	<5	<5	<5
Diethylphthalate	µg/L	1	15,000[#10]	**200[#12]**	<1	<1	<1	<1	<1	<1	<1	<1
Dimethyl phthalate	µg/L	1		**800[#12]**	<1	<1	<1	<1	<1	<1	<1	<1
2-nitroaniline	µg/L	1	190[#10]		<1	<1	<1	<1	<1	<1	<1	<1
2,4-Dinitrotoluene	µg/L	1	0.24[#10]		<1	<1	<1	<1	<1	<1	<1	<1
2,6-dinitrotoluene	µg/L	1	0.049[#10]		<1	<1	<1	<1	<1	<1	<1	<1
3-nitroaniline	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
4-bromophenyl phenyl ether	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
4-chloroaniline	µg/L	1	0.37[#10]		<1	<1	<1	<1	<1	<1	<1	<1
4-chlorophenyl phenyl ether	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
4-nitroaniline	µg/L	1	3.8[#10]		<1	<1	<1	<1	<1	<1	<1	<1
Azobenzene	µg/L	1	0.12[#10]		<1	<1	<1	<1	<1	<1	<1	<1
Bis(2-chloroethoxy) methane	µg/L	1	59[#10]		<1	<1	<1	<1	<1	<1	<1	<1
Bis(2-chloroethyl)ether	µg/L	1	0.014[#10]		<1	<1	<1	<1	<1	<1	<1	<1
Carbazole	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
Dibenzofuran	µg/L	1	7.9[#10]		<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobenzene	µg/L	1	0.1[#1]	**0.05[#6]**	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorocyclopentadiene	µg/L	1	0.41[#10]		<1	<1	<1	<1	<1	<1	<1	<1
Hexachloroethane	µg/L	1	0.33[#10]		<1	<1	<1	<1	<1	<1	<1	<1
Isophorone	µg/L	1	78[#10]		<1	<1	<1	<1	<1	<1	<1	<1
N-nitrosodi-n-propylamine	µg/L	1	0.011[#10]		<1	<1	<1	<1	<1	<1	<1	<1
Nitrobenzene	µg/L	1	8[#3]		<1	<1	<1	<1	<1	<1	<1	<1

Tier 1 Screen (Groundwater - Little Eaton)
A38 Derby Junctions
Highways England

				Monitoring Zone	**Little Eaton Junction**							
				Location	BL02		BL08			BL10		
				Date	12/12/2016	23/03/2017	12/12/2016	23/03/2017	06/07/2017	13/12/2016	22/03/2017	03/07/2017
				Monitoring Unit	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium
				Monitoring Round	1	2	1	2	3	1	2	3
Parameter	**Units**	**Method Detection Limit**	**GAC_WTV_EN/WA_DWS**	**GAC_WTV_EN/WA_EQS-Fresh**								
UNK												
Pentachlorophenol	µg/L	0.04	$9^{\#3}$	**$0.4^{\#8}$**	<0.04	-	<0.04	-	<0.04	<0.04	-	-
Dichloroacetic acid	µg/L		$1.5^{\#10}$		<0.04	-	<0.04	-	-	<0.04	-	-
Benazolin	µg/L				<0.04	-	<0.04	-	-	<0.04	-	-
Bentazone	µg/L	0.04	$500^{\#3}$	**$500^{\#12}$**	<0.04	-	<0.04	-	<0.04	<0.04	-	-
Bromoxynil	µg/L	0.04	$0.61^{\#10}$	**$100^{\#12}$**	<0.08	-	<0.08	-	<0.04	<0.04	-	-
Clopyralid	µg/L	0.04			<0.08	-	<0.2	-	<0.05	<0.04	-	-
Hedonal	µg/L	0.04	$30^{\#3}$	**$0.3^{\#7}$**	-	-	-	-	<0.04	-	-	<0.04
2,4-DB	µg/L				<0.04	-	<0.04	-	-	<0.04	-	-
Dicamba	µg/L	0.04	$570^{\#10}$		<0.08	-	<0.08	-	<0.05	<0.04	-	-
Actril (loxynil)	mg/L	0.00004		**$0.01^{\#12}$**	<0.00004	-	<0.00004	-	<0.00004	<0.00004	-	-
2-Methyl-4-chlorophenoxyacetic acid	µg/L	0.04	$700^{\#3}$	**$12^{\#12}$**	<0.08	-	<0.08	-	<0.04	<0.04	-	<0.04
2-Methyl-4-Chlorophenoxy Butanoic Acid	µg/L	0.04	$65^{\#10}$		<0.04	-	<0.04	-	<0.04	<0.04	-	-
2,4,5-Trichlorophenoxy Acetic Acid	µg/L	0.04	$9^{\#3}$		<0.04	-	<0.04	-	<0.04	<0.04	-	<0.04
Triclopyr	µg/L				<0.04	-	<0.04	-	-	<0.04	-	-
2,3,6-Trichlorobenzoic acid	µg/L				<0.08	-	<0.145	-	-	<0.07	-	-
4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)	µg/L	0.04	$450^{\#10}$		-	-	-	-	<0.04	-	-	<0.04
Fluroxypyr	µg/L				<0.08	-	<0.08	-	-	<0.04	-	-
Fenoprop	µg/L		$9^{\#3}$		<0.04	-	<0.04	-	-	<0.04	-	-
VOC												
1,3,5-Trichlorobenzene	µg/L	1	$0.1^{\#1}$	**$0.4^{\#9}$**	<1	<1	<1	<1	<1	<1	<1	<1
Naphthalene	µg/L	1	$6^{\#15}$	**$2^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1
Dichlorodifluoromethane	µg/L	1	$200^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
MTBE	µg/L	1	$1,800^{\#15}$	**$5,100^{\#13}$**	<1	<1	<1	<1	<1	<1	<1	<1
Chloromethane	µg/L	1	$190^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Vinyl chloride	µg/L	1	$0.5^{\#1}$		<1	<1	<1	<1	<1	<1	<1	<1
Bromomethane	µg/L	1	$7.5^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Chloroethane	µg/L	1	$21,000^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Trichlorofluoromethane	µg/L	1	$5,200^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethene	µg/L	1	$140^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
Dichloromethane	µg/L	3	$20^{\#3}$	**$20^{\#8}$**	<3	<3	<3	<3	<3	<3	<3	<3
trans-1,2-dichloroethene	µg/L	1	$50^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethane	µg/L	1	$2.8^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
cis-1,2-dichloroethene	µg/L	1	$50^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
2,2-dichloropropane	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
Bromochloromethane	µg/L	1	$83^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Chloroform	µg/L	1	$100^{\#1}$	**$2.5^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1-trichloroethane	µg/L	1	$2,000^{\#3}$	**$100^{\#12}$**	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloropropene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	µg/L	1	$3^{\#1}$	**$12^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloroethane	µg/L	1	$3^{\#1}$	**$10^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1
Benzene	µg/L	1	$1^{\#1}$	**$10^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1
Trichloroethene	µg/L	1	$10^{\#1}$	**$10^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloropropane	µg/L	1	$40^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
Dibromomethane	µg/L	1	$8.3^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Bromodichloromethane	µg/L	1	$100^{\#1}$		<1	<1	<1	<1	<1	<1	<1	<1
cis-1,3-dichloropropene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/L	1	$700^{\#3}$	**$74^{\#7}$**	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,3-dichloropropene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-trichloroethane	µg/L	1	$0.28^{\#10}$	**$400^{\#12}$**	<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloroethene	µg/L	1	$10^{\#1}$	**$10^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichloropropane	µg/L	1	$370^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Chlorodibromomethane	µg/L	1	$100^{\#1}$		<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromoethane	µg/L	1	$0.4^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
Chlorobenzene	µg/L	1	$300^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
1,1,1,2-tetrachloroethane	µg/L	1	$0.57^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	µg/L	1	$300^{\#3}$	**$20^{\#12}$**	<1	<1	<1	<1	<1	<1	<1	<1
Xylene (m & p)	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
Xylene (o)	µg/L	1	$190^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Styrene	µg/L	1	$20^{\#3}$	**$50^{\#12}$**	<1	<1	<1	<1	<1	<1	<1	<1
Bromoform	µg/L	1	$100^{\#1}$		<1	<1	<1	<1	<1	<1	<1	<1
Isopropylbenzene	µg/L	1	$450^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1

Tier 1 Screen (Groundwater - Little Eaton)
A38 Derby Junctions
Highways England

				Monitoring Zone	**Little Eaton Junction**							
				Location	BL02		BL08			BL10		
				Date	12/12/2016	23/03/2017	12/12/2016	23/03/2017	06/07/2017	13/12/2016	22/03/2017	03/07/2017
				Monitoring Unit	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium	Alluvium
				Monitoring Round	1	2	1	2	3	1	2	3
Parameter	**Units**	**Method Detection Limit**	**GAC_WTV_EN/WA_DWS**	**GAC_WTV_EN/WA_EQS-Fresh**								
1,1,2,2-tetrachloroethane	µg/L	1	0.076$^{\#10}$	**140$^{\#7}$**	<1	<1	<1	<1	<1	<1	<1	<1
Bromobenzene	µg/L	1	62$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichloropropane	µg/L	1	0.00075$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
n-propylbenzene	µg/L	1	660$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
2-chlorotoluene	µg/L	1	240$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
1,3,5-trimethylbenzene	µg/L	1	60$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
4-chlorotoluene	µg/L	1	250$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
tert-butylbenzene	µg/L	1	690$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trimethylbenzene	µg/L	1	56$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
sec-butylbenzene	µg/L	1	2,000$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
p-isopropyltoluene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichlorobenzene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
1,4-dichlorobenzene	µg/L	1	300$^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
n-butylbenzene	µg/L	1	1,000$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichlorobenzene	µg/L	1	1000$^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromo-3-chloropropane	µg/L	1	1$^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trichlorobenzene	µg/L	1	0.1$^{\#1}$	**0.4$^{\#9}$**	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	µg/L	1	0.1$^{\#1}$	**0.6$^{\#6}$**	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichlorobenzene	µg/L	1	0.1$^{\#1}$	**0.4$^{\#9}$**	<1	<1	<1	<1	<1	<1	<1	<1
Carbon disulfide	µg/L	1	810$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Tert Amyl Methyl Ether	µg/L	1		**510$^{\#13}$**	<1	<1	<1	<1	<1	<1	<1	<1

Comments
#1 WS Regs 2016 (Eng/Wal)
#2 WHO Petroleum DWG 2008
#3 WHO DWG 2017
#4 WHO 2017 - Taste
#5 WHO 2017 - Odour
#6 WFD England/Wales. 2015 - MAC-EQS Inland
#7 WFD England/Wales. 2015 - Freshwater Standards
#8 WFD England/Wales. 2015 - AA-EQS Inland
#9 Water Env't Regs (Scotland) 2015. AA-EQS Inland
#10 USEPA RSL (tapwater) [May 2019]
#11 SEPA WAT-SG-53 Fresh EQS - MAC - 2015
#12 SEPA WAT-SG-53 Fresh EQS - AA - 2015
#13 PNEC (EU REACH) - Freshwater
#14 California Draft health protective concentration
#15 AECOM DWG (WHO method)
GAC: Generic Assessment Criteria
(blank): No assessment criteria available
- : Not analysed

Key

XXX	Exceedance of CW/WE Water. DWS - England/Wales
XXX	Exceedance of CW/WE Water. Aquatic Toxicity - England/Wales - Freshwater

				Location	BM05		BM06A						
				Monitoring_Unit	Alluvium / Mercia Mudstone		Alluvium / Mercia Mudstone						
				Date	04/08/2016	23/03/2017	14/12/2016	21/03/2017	04/07/2017	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Parameter	**Units**	**Method Detection Limit**	**GAC (DWS)**	**GAC (EQS-Fresh)**									
ACID_HERB_GCMS_SUB													
2,4-Dichlorprop	µg/L	0.04	100$^{\#3}$		-	<0.04	<0.04	<0.04	<0.04	-	-	-	-
Mecoprop	µg/L	0.04	10$^{\#3}$	**18$^{\#7}$**	-	-	<0.04	-	<0.04	-	-	-	-
CARBON													
TOC	mg/L	3			5.5	5.54	<3	<3	<3	<3	<3	<3	<3
COD													
COD	mg/L	7			-	-	-	-	119	44.4	70.9	73.5	19.8
EPHCWG													
>C12-C16 Aliphatics	µg/L	10	300$^{\#2}$		-	<20	<10	<10	<10	<10	<10	<10	<10
>C16-C21 Aliphatics	µg/L	10	300$^{\#2}$		-	25	<10	<10	<10	<10	<10	<10	<10
>C16-C35 Aliphatics	µg/L	10			-	-	<20	-	-	<10	<10	<10	<10
>C21-C35 Aliphatics	µg/L	10	300$^{\#2}$		-	1,250	<10	<10	<10	<10	<10	<10	<10
>C12-C35 Aliphatics	µg/L	10			-	1,270	<10	<10	<10	<10	<10	<10	<10
>EC12-EC16 Aromatics	µg/L	10	90$^{\#2}$		-	<20	<10	<10	<10	<10	<10	<10	<10
>EC16-EC21 Aromatics	µg/L	10	90$^{\#2}$		-	26	<10	<10	<10	<10	<10	<10	<10
>EC21-EC35 Aromatics	µg/L	10	90$^{\#2}$		-	591	<10	<10	<10	<10	<10	<10	<10
>EC12-EC35 Aromatics	µg/L	10			-	617	<10	<10	<10	<10	<10	<10	<10
>C5-C35 Aliphatics & Aromatics	µg/L	10			-	-	<10	-	<10	<10	<10	<10	<10
ESDAT Combined Compounds													
Benzo(b)&(k)fluoranthene	µg/L				-	-	<0.05	-	-	-	-	-	-
PAHs (sum of 4)	µg/L		0.1$^{\#1}$		-	-	<0.08	-	-	-	-	-	-
benzo(g,h,i)perylene + indeno(1,2,3-cd)pyrene	µg/L				-	-	<0.03	-	-	-	-	-	-
Benzo(a)pyrene (surrogate marker for PAH mixture)	µg/L				-	-	<0.009	-	-	-	-	-	-
Sum of PCE and TCE	µg/L		10$^{\#1}$		-	-	<2	-	-	-	-	-	-
TCE+DCE+VC	µg/L				-	-	<5	-	-	-	-	-	-
PCE+TCE+DCE+VC	µg/L				-	-	<6	-	-	-	-	-	-
1,2-Dichloroethene	µg/L		50$^{\#3}$		-	-	<2	-	-	-	-	-	-
Trihalomethanes	µg/L		100$^{\#1}$		-	-	<4	-	-	-	-	-	-
Aldrin + Dieldrin	µg/L		0.03$^{\#3}$		-	-	<0.02	-	-	-	-	-	-
DDT+DDE+DDD	µg/L				-	-	<0.02	-	-	-	-	-	-
Aldrin+Dieldrin+Endrin+Isodrin	µg/L			**0.01$^{\#8}$**	-	-	<0.03	-	-	-	-	-	-
GRO													
GRO >C5-C12	µg/L	50			-	<50	<50	<50	<50	<50	<50	<50	<50
>C5-C6 Aliphatics	µg/L	10	15,000$^{\#2}$		-	<10	<10	<10	<10	<10	<10	<10	<10
>C6-C8 Aliphatics	µg/L	10	15,000$^{\#2}$		-	<10	<10	<10	<10	<10	<10	<10	<10
>C8-C10 Aliphatics	µg/L	10	300$^{\#2}$		-	<10	<10	<10	<10	<10	<10	<10	<10
>C10-C12 Aliphatics	µg/L	10	300$^{\#2}$		-	<10	<10	<10	<10	<10	<10	<10	<10
>EC5-EC7 Aromatics	µg/L	10	1$^{\#1}$	**10$^{\#8}$**	-	<10	<10	<10	<10	<10	<10	<10	<10
>EC7-EC8 Aromatics	µg/L	10	700$^{\#2}$	**74$^{\#7}$**	-	<10	-	<10	<10	<10	<10	<10	<10
>EC8-EC10 Aromatics	µg/L	10	300$^{\#2}$		-	<10	-	<10	<10	<10	<10	<10	<10
>EC10-EC12 Aromatics	µg/L	10	90$^{\#2}$		-	<10	<10	<10	<10	<10	<10	<10	<10
MTBE	µg/L	3	1,800$^{\#15}$	**5,100$^{\#13}$**	-	<3	<3	<3	<3	<3	<3	<3	<3
Benzene	µg/L	7	1$^{\#1}$	**10$^{\#8}$**	10	<7	<7	<7	<7	<7	<7	<7	<7
Toluene	µg/L	4	700$^{\#3}$	**74$^{\#7}$**	10	<4	<4	<4	<4	<4	<4	<4	<4
Ethylbenzene	µg/L	5	300$^{\#3}$	**20$^{\#12}$**	<5	<5	<5	<5	<5	<5	<5	<5	<5
Xylene (m & p)	µg/L	8			<10	<8	<8	<8	<8	<8	<8	<8	<8
Xylene Total	µg/L	11	500$^{\#3}$	**30$^{\#12}$**	-	<11	<11	<11	<11	<11	<11	<11	<11
Xylene (o)	µg/L	3	190$^{\#10}$		-	<3	<3	<3	<3	<3	<3	<3	<3
Total BTEX	µg/L	28			-	<28	<28	<28	<28	<28	<28	<28	<28
Aromatics >EC8-EC10	µg/L				-	-	<10	-	-	-	-	-	-
Aromatics >EC7-EC8	µg/L				-	-	<10	-	-	-	-	-	-
GRO Surrogate	%				-	-	85	-	-	-	-	-	-
GRO_HSA_UK													
>C5-C7	µg/L				10	-	-	-	-	-	-	-	-
GRO >C5-C6	µg/L				<100	-	-	-	-	-	-	-	-
GRO >C5-C10	µg/L				<100	-	-	-	-	-	-	-	-
GRO >C6-C8	µg/L				<100	-	-	-	-	-	-	-	-
GRO >C7-C8	µg/L				10	-	-	-	-	-	-	-	-

GQRA (Groundwater Markeaton)
A38 Derby Junctions
Highways England

				Location	BM05		BM06A						
				Monitoring_Unit	Alluvium / Mercia Mudstone		Alluvium / Mercia Mudstone						
				Date	04/08/2016	23/03/2017	14/12/2016	21/03/2017	04/07/2017	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Parameter	**Units**	**Method Detection Limit**	**GAC (DWS)**	**GAC (EQS-Fresh)**									
HERBPEST													
a-BHC	µg/L	0.01	$0.0072^{\#10}$		-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
b-BHC	µg/L	0.01	$0.025^{\#10}$		-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Chlordane (cis)	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Endosulfan I	µg/L	0.01	$0.1^{\#1}$		-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Endosulfan II	µg/L	0.01	$0.1^{\#1}$		-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	-
Endosulfan sulphate	µg/L	0.01	$0.1^{\#1}$		-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.04	-
g-BHC (Lindane)	µg/L	0.01	$2^{\#3}$		-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
Heptachlor epoxide	µg/L	0.01	$0.03^{\#1}$		-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
o,p''-DDE	µg/L	0.01			-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
2,4-DDT	µg/L	0.01			-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	-
o,p''-Methoxychlor	µg/L	0.01			-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	-
o,p-DDD	µg/L	0.01			-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
4,4-DDE	µg/L	0.01	$0.1^{\#1}$		-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
DDT	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#8}$**	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	-
Methoxychlor	µg/L	0.01	$0.1^{\#1}$		-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.02	-
DDD	µg/L	0.01	$0.1^{\#1}$		-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
Permethrin II	µg/L	0.01			-	-	-	-	-	-	-	<0.01	-
Chlordane (trans)	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Azinophos methyl	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#12}$**	-	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	-	-
Methyl parathion	µg/L	0.01	$0.1^{\#1}$		-	<0.01	<0.01	<0.01	<0.01	<0.03	<0.01	-	-
Mevinphos (Phosdrin)	µg/L	0.01	$0.1^{\#1}$	**$0.02^{\#11}$**	-	<0.01	<0.01	<0.01	<0.01	<0.03	<0.01	-	-
INORGANICS													
Cyanide (Free)	mg/L	0.05	$0.05^{\#1}$	**$0.001^{\#12}$**	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cyanide Total	mg/L	0.05	$0.05^{\#1}$	**$0.001^{\#7}$**	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrogen (Total)	µg/L				-	-	<200	-	-	-	-	-	-
Ammoniacal Nitrogen as N	mg/L	0.2		**$0.3^{\#7}$**	-	<0.2	-	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
TSS	mg/L	2			-	-	-	-	1,110	730	-	-	499
Total Hardness	mg/l	0.35			-	6,650	-	1,120	-	841	1,240	750	-
pH (Lab)	pH_Units	1			7.6	7.51	7.61	7.81	7.25	7.34	7.66	7.25	7.43
METALS_ICP													
Arsenic (Filtered)	µg/L	0.5	$10^{\#1}$	**$50^{\#7}$**	3	0.677	2.38	1.97	1.85	1.65	2.56	1.88	2.2
Boron (Filtered)	µg/L	5	$1,000^{\#1}$	**$2,000^{\#12}$**	140	107	33.5	38.9	26.2	30.3	33	49.6	42.7
Cadmium (Filtered)	µg/L	0.08	$5^{\#1}$	**$0.08^{\#8}$**	<0.1	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Chromium (hexavalent)	µg/L	30	$50^{\#1}$	**$3.4^{\#7}$**	-	<30	<30	<30	<30	<30	<30	<30	<30
Chromium (III+VI)	µg/L	3	$50^{\#1}$		1	76.4	60.7	27.6	17.6	19.3	37.5	33.5	17.4
Copper (Filtered)	µg/L	0.3	$2,000^{\#1}$	**$1^{\#7}$**	**17**	**1.68**	<0.85	<0.85	0.312	<0.3	<0.3	0.456	<0.3
Iron (Filtered)	µg/L	19	$200^{\#1}$	**$1,000^{\#7}$**	990	<19	<19	19.1	<19	<19	<19	<19	<19
Iron (Total)	µg/L	24	$200^{\#1}$	**$1,000^{\#7}$**	-	**70,400**	**27,800**	**13,100**	**9,280**	**8,440**	**15,800**	**12,000**	**6,070**
Lead (Filtered)	µg/L	0.1	$10^{\#1}$	**$1.2^{\#8}$**	<1	<0.1	<0.1	<0.1	<0.2	<0.2	<0.2	<0.2	<0.2
Mercury (Filtered)	µg/L	0.01			0.4	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel (Filtered)	µg/L	0.4	$20^{\#1}$	**$4^{\#8}$**	3	1.39	<0.44	<0.44	0.451	<0.4	<0.4	<0.4	<0.4
Selenium (Filtered)	µg/L	0.5	$10^{\#1}$		<1	4.51	<0.81	<0.81	<0.5	<0.5	0.576	<1	<1
Zinc (Filtered)	µg/L	1	$6,000^{\#10}$	**$10.9^{\#7}$**	<2	1.92	3.57	4.53	1.08	<1	1.62	7.68	**11.2**
MISC													
BOD	mg/L	1			-	-	-	-	-	<1	-	<1	-
OCP_GCMS													
Aldrin	µg/L	0.01	$0.03^{\#1}$	**$0.01^{\#8}$**	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
Dieldrin	µg/L	0.01	$0.03^{\#1}$	**$0.01^{\#8}$**	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
Endrin	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#8}$**	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
Heptachlor	µg/L	0.01	$0.03^{\#1}$		-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-
OPP_GCMS													
Diazinon	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#7}$**	-	<0.01	<0.01	<0.01	<0.01	<0.03	<0.01	-	-
Dichlorvos	µg/L	0.01	$0.1^{\#1}$		-	<0.01	<0.01	<0.01	<0.01	<0.03	<0.01	-	-
Ethion	µg/L	0.01	$0.1^{\#1}$		-	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	-	-
Parathion	µg/L	0.01	$0.1^{\#1}$		-	<0.01	<0.01	<0.01	<0.01	<0.03	<0.01	-	-
Fenitrothion	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#12}$**	-	<0.01	<0.01	<0.01	<0.01	<0.03	<0.01	-	-
Malathion	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#12}$**	-	<0.01	<0.01	<0.01	<0.01	<0.02	<0.01	-	-

GQRA (Groundwater Markeaton)
A38 Derby Junctions
Highways England

				Location	BM05		BM06A						
				Monitoring_Unit	Alluvium / Mercia Mudstone		Alluvium / Mercia Mudstone						
				Date	04/08/2016	23/03/2017	14/12/2016	21/03/2017	04/07/2017	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Parameter	**Units**	**Method Detection Limit**	**GAC (DWS)**	**GAC (EQS-Fresh)**									
PAH													
Naphthalene	µg/L	0.01	$6^{\#15}$	**$2^{\#8}$**	0.486	<0.2	<0.1	<0.1	<0.1	<0.01	0.0579	<0.01	<0.01
Acenaphthylene	µg/L	0.005	$18^{\#15}$		<0.2	0.0473	<0.011	<0.011	0.0578	<0.005	<0.005	<0.005	<0.005
Acenaphthene	µg/L	0.005	$18^{\#15}$		<0.2	<0.03	0.04	<0.015	0.059	<0.005	<0.005	0.0155	0.0252
Fluorene	µg/L	0.005	$12^{\#15}$		<0.2	<0.028	0.0313	<0.014	0.0569	<0.005	<0.005	<0.005	0.0152
Phenanthrene	µg/L	0.005	$4^{\#15}$		0.978	0.358	0.0994	<0.022	0.0617	<0.005	<0.005	0.00785	0.0185
Anthracene	µg/L	0.005	$90^{\#15}$	**$0.1^{\#8}$**	<0.2	0.0665	<0.015	<0.015	0.0545	<0.005	<0.005	<0.005	<0.005
Fluoranthene	µg/L	0.005	$4^{\#3}$	**$0.0063^{\#8}$**	**0.77**	**0.839**	**0.0302**	<0.017	**0.0533**	**0.0102**	<0.005	**0.00813**	**0.00797**
Pyrene	µg/L	0.005	$9^{\#15}$		2.42	0.812	0.0306	<0.015	0.0507	0.0102	<0.005	0.00859	0.00595
Benz(a)anthracene	µg/L	0.005	$3.5^{\#15}$		0.29	0.562	<0.017	<0.017	0.0632	<0.005	<0.005	0.0148	<0.005
Chrysene	µg/L	0.005	$7^{\#15}$		<0.2	0.496	<0.013	<0.013	0.0572	<0.005	<0.005	<0.005	<0.005
Benzo(a) pyrene	µg/L	0.002	$0.01^{\#1}$	**$0.00017^{\#8}$**	<0.2	**1.05**	<0.009	<0.009	**0.0869**	<0.002	<0.002	<0.002	<0.002
Indeno(1,2,3-c,d)pyrene	µg/L	0.005	$0.1^{\#1}$		<0.2	0.76	<0.014	<0.014	0.075	<0.005	<0.005	<0.005	<0.005
Dibenz(a,h)anthracene	µg/L	0.005	$0.07^{\#15}$		<0.2	0.12	<0.016	<0.016	0.0618	<0.005	<0.005	<0.005	<0.005
Benzo(g,h,i)perylene	µg/L	0.005	$0.1^{\#1}$	**$0.0082^{\#6}$**	<0.2	**0.73**	<0.016	<0.016	**0.0703**	<0.005	<0.005	**0.0219**	<0.005
Benzo(b)fluoranthene	µg/L	0.005	$0.1^{\#1}$	**$0.017^{\#6}$**	<0.2	**1.26**	<0.023	<0.023	**0.103**	<0.005	<0.005	<0.005	<0.005
Benzo(k)fluoranthene	µg/L	0.005	$0.1^{\#1}$	**$0.017^{\#6}$**	<0.2	**0.532**	<0.027	<0.027	**0.0961**	<0.005	<0.005	<0.005	<0.005
PAH 16 Total	µg/L	0.082			<7.144	7.68	<0.344	<0.344	1.01	<0.082	<0.082	<0.082	<0.082
PHENOL													
2,3,5,6-Tetrachlorophenol	µg/L	0.5			-	<0.5	<0.5	<0.5	<2	<3.5	<0.5	<0.5	<0.5
2-chlorophenol	µg/L	0.5	$91^{\#10}$	**$50^{\#12}$**	-	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
2-methylphenol	µg/L	0.5	$930^{\#10}$		-	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
2-nitrophenol	µg/L	0.5			-	<0.5	<0.5	<0.5	<0.5	<3	<0.5	<0.5	<0.5
2,4-dichlorophenol	µg/L	0.5	$46^{\#10}$	**$4.2^{\#7}$**	-	<0.5	<0.5	<0.5	<0.5	<2	<0.5	<0.5	<0.5
2,4-dimethylphenol	µg/L	0.5	$360^{\#10}$		-	<0.5	<0.5	<0.5	<0.5	<1.25	<0.5	<0.5	<0.5
2,4,5-trichlorophenol	µg/L	0.5	$1,200^{\#10}$		-	<0.5	<0.5	<0.5	<0.5	<3	<0.5	<0.5	<0.5
2,4,6-trichlorophenol	µg/L	0.5	$200^{\#3}$		-	<0.5	<0.5	<0.5	<0.5	<2.5	<0.5	<0.5	<0.5
4-chloro-3-methylphenol	µg/L	0.5	$1,400^{\#10}$	**$40^{\#12}$**	-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-methylphenol	µg/L	0.5	$1,900^{\#10}$		-	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
4-nitrophenol	µg/L	0.5			-	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Pentachlorophenol	µg/L	2	$9^{\#3}$	**$0.4^{\#8}$**	-	<2	<2	<2	<7	<5	<2	<2	<2
Phenol	µg/L	0.5	$5,800^{\#10}$	**$7.7^{\#7}$**	-	<5	<5	<4.5	<5	<7	<6.5	<6	<6
2,4-dinitrophenol	µg/L	2.5	$39^{\#10}$		-	<2.5	<2.5	<2.5	<5	<7.5	<5	<5	<2.5
3-Methylphenol	µg/L	0.5	$930^{\#10}$		-	<0.5	<0.5	<0.5	<0.5	-	-	-	-
4,6-Dinitro-2-methylphenol	µg/L	3	$1.5^{\#10}$		-	<3	-	<3	<6	<9	<3	<6	<3
4-chlorophenol	µg/L	0.5			-	<0.5	<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5
Dinoseb	µg/L	4	$15^{\#10}$		-	<4	<4	<4	<8	<8	<8	<8	<4
DNOC :- {4,6-dinitro-o-cresol}	µg/L				-	-	<3	-	-	-	-	-	-
PHENOLS_HPLC													
Phenol	µg/L	2	$5,800^{\#10}$	**$7.7^{\#7}$**	-	<2	<2	<2	<2	<2	<2	<2	<2
Cresol Total	µg/L	6	$1,500^{\#10}$		-	<6	<6	<6	<6	<6	<6	<6	<6
Total Monohydric Phenols (S) Corrected	µg/L	16			-	<16	<16	<16	<16	<16	<16	<16	<16
Xylenols	µg/L	8			-	-	<8	-	<8	<8	<8	<8	<8

GQRA (Groundwater Markeaton)
A38 Derby Junctions
Highways England

				Location	BM05		BM06A						
				Monitoring_Unit	Alluvium / Mercia Mudstone		Alluvium / Mercia Mudstone						
				Date	04/08/2016	23/03/2017	14/12/2016	21/03/2017	04/07/2017	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Parameter	**Units**	**Method Detection Limit**	**GAC (DWS)**	**GAC (EQS-Fresh)**									
SVOC													
Naphthalene	µg/L	1	6[#15]	**2**[#8]	-	<1	<2	<2	<1	<1	<1	<1	<1
Acenaphthylene	µg/L	1	18[#15]		-	<1	<2	<2	<1	<1	<1	<1	<1
Acenaphthene	µg/L	1	18[#15]		-	<1	<2	<2	<1	<1	<1	<1	<1
Fluorene	µg/L	1	12[#15]		-	<1	<2	<2	<1	<1	<1	<1	<1
Phenanthrene	µg/L	1	4[#15]		-	<1	<2	<2	<1	<1	<1	<1	<1
Anthracene	µg/L	1	90[#15]	**0.1**[#8]	-	<1	<2	<2	<1	<1	<1	<1	<1
Fluoranthene	µg/L	1	4[#3]	**0.0063**[#8]	-	<1	<2	<2	<1	<1	<1	<1	<1
Pyrene	µg/L	1	9[#15]		-	<1	<2	<2	<1	<1	<1	<1	<1
Benz(a)anthracene	µg/L	1	3.5[#15]		-	<1	<2	<2	<1	<1	<1	<1	<1
Chrysene	µg/L	1	7[#15]		-	<1	<2	<2	<1	<1	<1	<1	<1
Benzo(a) pyrene	µg/L	1	0.01[#1]	**0.00017**[#8]	-	<1	<2	<2	<1	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	1	0.1[#1]		-	<1	<2	<2	<1	<1	<1	<1	<1
Dibenz(a,h)anthracene	µg/L	1	0.07[#15]		-	<1	<2	<2	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	1	0.1[#1]	**0.0082**[#6]	-	<1	<2	<2	<1	<1	<1	<1	<1
Benzo(b)fluoranthene	µg/L	1	0.1[#1]	**0.017**[#6]	-	<1	<2	<2	<1	<1	<1	<1	<1
Benzo(k)fluoranthene	µg/L	1	0.1[#1]	**0.017**[#6]	-	<1	<2	<2	<1	<1	<1	<1	<1
1,3-dichlorobenzene	µg/L	1			-	<1	<2	<2	<1	<1	<1	<1	<1
1,4-dichlorobenzene	µg/L	1	300[#3]		-	<1	<2	<2	<1	<1	<1	<1	<1
1,2-dichlorobenzene	µg/L	1	1,000[#3]		-	<1	<2	<2	<1	<1	<1	<1	<1
1,2,4-trichlorobenzene	µg/L	1	0.1[#1]	**0.4**[#9]	-	<1	<2	<2	<1	<1	<1	<1	<1
Hexachlorobutadiene	µg/L	1	0.1[#1]	**0.6**[#6]	-	<1	<2	<2	<1	<1	<1	<1	<1
2-chlorophenol	µg/L	1	91[#10]	**50**[#12]	-	<1	<2	<2	<1	<1	<1	<1	<1
2-methylphenol	µg/L	1	930[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
2-nitrophenol	µg/L	1			-	<1	<2	<2	<1	<1	<1	<1	<1
2,4-dichlorophenol	µg/L	1	46[#10]	**4.2**[#7]	-	<1	<2	<2	<1	<1	<1	<1	<1
2,4-dimethylphenol	µg/L	1	360[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
2,4,5-trichlorophenol	µg/L	1	1,200[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
2,4,6-trichlorophenol	µg/L	1	200[#3]		-	<1	<2	<2	<1	<1	<1	<1	<1
4-chloro-3-methylphenol	µg/L	1	1,400[#10]	**40**[#12]	-	<1	<2	<2	<1	<1	<1	<1	<1
4-methylphenol	µg/L	1	1,900[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
4-nitrophenol	µg/L	1			-	<1	<2	<2	<1	<1	<1	<1	<1
Pentachlorophenol	µg/L	1	9[#3]	**0.4**[#8]	-	<1	<2	<2	<1	<1	<1	<1	<1
Phenol	µg/L	1	5,800[#10]	**7.7**[#7]	-	<1	<2	<2	<1	<1	<1	<1	<1
2-chloronaphthalene	µg/L	1	750[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
2-methylnaphthalene	µg/L	1	36[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
Bis(2-ethylhexyl) phthalate	µg/L	2	8[#3]	**1.3**[#8]	-	<2	<4	<4	<2	<2	<2	<2	<2
Butyl benzyl phthalate	µg/L	1	16[#10]	**7.5**[#7]	-	<1	<2	<2	<1	<1	<1	<1	<1
Di-n-butyl phthalate	µg/L	1	900[#10]	**8**[#12]	-	<1	<2	<2	<1	<1	<1	<1	<1
Di-n-octyl phthalate	µg/L	5	200[#10]	**20**[#12]	-	<5	<10	<10	<5	<5	<5	<5	<5
Diethylphthalate	µg/L	1	15,000[#10]	**200**[#12]	-	<1	<2	<2	<1	<1	<1	<1	<1
Dimethyl phthalate	µg/L	1		**800**[#12]	-	<1	<2	<2	<1	<1	<1	<1	<1
2-nitroaniline	µg/L	1	190[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
2,4-Dinitrotoluene	µg/L	1	0.24[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
2,6-dinitrotoluene	µg/L	1	0.049[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
3-nitroaniline	µg/L	1			-	<1	<2	<2	<1	<1	<1	<1	<1
4-bromophenyl phenyl ether	µg/L	1			-	<1	<2	<2	<1	<1	<1	<1	<1
4-chloroaniline	µg/L	1	0.37[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
4-chlorophenyl phenyl ether	µg/L	1			-	<1	<2	<2	<1	<1	<1	<1	<1
4-nitroaniline	µg/L	1	3.8[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
Azobenzene	µg/L	1	0.12[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
Bis(2-chloroethoxy) methane	µg/L	1	59[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
Bis(2-chloroethyl)ether	µg/L	1	0.014[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
Carbazole	µg/L	1			-	<1	<2	<2	<1	<1	<1	<1	<1
Dibenzofuran	µg/L	1	7.9[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
Hexachlorobenzene	µg/L	1	0.1[#1]	**0.05**[#6]	-	<1	<2	<2	<1	<1	<1	<1	<1
Hexachlorocyclopentadiene	µg/L	1	0.41[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
Hexachloroethane	µg/L	1	0.33[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
Isophorone	µg/L	1	78[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
N-nitrosodi-n-propylamine	µg/L	1	0.011[#10]		-	<1	<2	<2	<1	<1	<1	<1	<1
Nitrobenzene	µg/L	1	8[#3]		-	<1	<2	<2	<1	<1	<1	<1	<1

				Location	BM05		BM06A						
				Monitoring_Unit	Alluvium / Mercia Mudstone		Alluvium / Mercia Mudstone						
				Date	04/08/2016	23/03/2017	14/12/2016	21/03/2017	04/07/2017	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Parameter	**Units**	**Method Detection Limit**	**GAC (DWS)**	**GAC (EQS-Fresh)**									
SVOCSW													
Biphenylene	µg/L				<40	-	-	-	-	-	-	-	-
Diphenyl ether	mg/L		0.00083[#10]		<0.04	-	-	-	-	-	-	-	-
Coronene	µg/L				<1,000	-	-	-	-	-	-	-	-
Naphthalene	µg/L		6[#15]	**2[#8]**	<40	-	-	-	-	-	-	-	-
Acenaphthylene	µg/L		18[#15]		<40	-	-	-	-	-	-	-	-
Acenaphthene	µg/L		18[#15]		<40	-	-	-	-	-	-	-	-
Fluorene	µg/L		12[#15]		<40	-	-	-	-	-	-	-	-
Phenanthrene	µg/L		4[#15]		<40	-	-	-	-	-	-	-	-
Anthracene	µg/L		90[#15]	**0.1[#8]**	<40	-	-	-	-	-	-	-	-
Fluoranthene	µg/L		4[#3]	**0.0063[#8]**	<40	-	-	-	-	-	-	-	-
Pyrene	µg/L		9[#15]		<40	-	-	-	-	-	-	-	-
Benz(a)anthracene	µg/L		3.5[#15]		<40	-	-	-	-	-	-	-	-
Chrysene	µg/L		7[#15]		<40	-	-	-	-	-	-	-	-
Benzo(a) pyrene	µg/L		0.01[#1]	**0.00017[#8]**	<40	-	-	-	-	-	-	-	-
Indeno(1,2,3-c,d)pyrene	µg/L		0.1[#1]		<40	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	µg/L		0.07[#15]		<40	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	µg/L		0.1[#1]	**0.0082[#6]**	<40	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	µg/L		0.1[#1]	**0.017[#6]**	<40	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	µg/L		0.1[#1]	**0.017[#6]**	<40	-	-	-	-	-	-	-	-
1,3-dichlorobenzene	µg/L				<100	-	-	-	-	-	-	-	-
1,4-dichlorobenzene	µg/L		300[#3]		<100	-	-	-	-	-	-	-	-
1,2-dichlorobenzene	µg/L		1,000[#3]		<100	-	-	-	-	-	-	-	-
1,2,4-trichlorobenzene	µg/L		0.1[#1]	**0.4[#9]**	<100	-	-	-	-	-	-	-	-
Hexachlorobutadiene	µg/L		0.1[#1]	**0.6[#6]**	<100	-	-	-	-	-	-	-	-
2-chlorophenol	µg/L		91[#10]	**50[#12]**	<400	-	-	-	-	-	-	-	-
2-methylphenol	µg/L		930[#10]		<100	-	-	-	-	-	-	-	-
2-nitrophenol	µg/L				<400	-	-	-	-	-	-	-	-
2,4-dichlorophenol	µg/L		46[#10]	**4.2[#7]**	<400	-	-	-	-	-	-	-	-
2,4-dimethylphenol	µg/L		360[#10]		<400	-	-	-	-	-	-	-	-
2,4,5-trichlorophenol	µg/L		1,200[#10]		<400	-	-	-	-	-	-	-	-
2,4,6-trichlorophenol	µg/L		200[#3]		<400	-	-	-	-	-	-	-	-
4-chloro-3-methylphenol	µg/L		1,400[#10]	**40[#12]**	<100	-	-	-	-	-	-	-	-
4-nitrophenol	µg/L				<1,000	-	-	-	-	-	-	-	-
Pentachlorophenol	µg/L		9[#3]	**0.4[#8]**	<1,000	-	-	-	-	-	-	-	-
Phenol	µg/L		5,800[#10]	**7.7[#7]**	<400	-	-	-	-	-	-	-	-
2-chloronaphthalene	µg/L		750[#10]		<40	-	-	-	-	-	-	-	-
2-methylnaphthalene	µg/L		36[#10]		<40	-	-	-	-	-	-	-	-
Bis(2-ethylhexyl) phthalate	µg/L		8[#3]	**1.3[#8]**	<100	-	-	-	-	-	-	-	-
Butyl benzyl phthalate	µg/L		16[#10]	**7.5[#7]**	<100	-	-	-	-	-	-	-	-
Di-n-butyl phthalate	µg/L		900[#10]	**8[#12]**	<100	-	-	-	-	-	-	-	-
Di-n-octyl phthalate	µg/L		200[#10]	**20[#12]**	<40	-	-	-	-	-	-	-	-
Diethylphthalate	µg/L		15,000[#10]	**200[#12]**	<100	-	-	-	-	-	-	-	-
Dimethyl phthalate	µg/L			**800[#12]**	<100	-	-	-	-	-	-	-	-
2-nitroaniline	µg/L		190[#10]		<100	-	-	-	-	-	-	-	-
2,4-Dinitrotoluene	µg/L		0.24[#10]		<100	-	-	-	-	-	-	-	-
2,6-dinitrotoluene	µg/L		0.049[#10]		<100	-	-	-	-	-	-	-	-
3-nitroaniline	µg/L				<100	-	-	-	-	-	-	-	-
4-bromophenyl phenyl ether	µg/L				<100	-	-	-	-	-	-	-	-
4-chloroaniline	µg/L		0.37[#10]		<100	-	-	-	-	-	-	-	-
4-chlorophenyl phenyl ether	µg/L				<100	-	-	-	-	-	-	-	-
4-nitroaniline	µg/L		3.8[#10]		<100	-	-	-	-	-	-	-	-
Bis(2-chloroethoxy) methane	µg/L		59[#10]		<100	-	-	-	-	-	-	-	-
Bis(2-chloroethyl)ether	µg/L		0.014[#10]		<100	-	-	-	-	-	-	-	-
Dibenzofuran	µg/L		7.9[#10]		<100	-	-	-	-	-	-	-	-
Hexachlorobenzene	µg/L		0.1[#1]	**0.05[#6]**	<100	-	-	-	-	-	-	-	-
Hexachlorocyclopentadiene	µg/L		0.41[#10]		<100	-	-	-	-	-	-	-	-
Hexachloroethane	µg/L		0.33[#10]		<100	-	-	-	-	-	-	-	-
Isophorone	µg/L		78[#10]		<100	-	-	-	-	-	-	-	-
N-nitrosodi-n-propylamine	µg/L		0.011[#10]		<100	-	-	-	-	-	-	-	-
Nitrobenzene	µg/L		8[#3]		<100	-	-	-	-	-	-	-	-
1-Methylnaphthalene	µg/L		1.1[#10]		<40	-	-	-	-	-	-	-	-
3,3-Dichlorobenzidine	µg/L		0.13[#10]		<400	-	-	-	-	-	-	-	-
Benzoic Acid	µg/L		75,000[#10]		<2,000	-	-	-	-	-	-	-	-
Benzyl alcohol	µg/L		2,000[#10]		<100	-	-	-	-	-	-	-	-
2,4-dinitrophenol	µg/L		39[#10]		<200	-	-	-	-	-	-	-	-

GQRA (Groundwater Markeaton)
A38 Derby Junctions
Highways England

				Location	BM05		BM06A						
				Monitoring_Unit	Alluvium / Mercia Mudstone		Alluvium / Mercia Mudstone						
				Date	04/08/2016	23/03/2017	14/12/2016	21/03/2017	04/07/2017	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Parameter	**Units**	**Method Detection Limit**	**GAC (DWS)**	**GAC (EQS-Fresh)**									
3-&4-methylphenol	µg/L				<400	-	-	-	-	-	-	-	-
4,6-Dinitro-2-methylphenol	µg/L		$1.5^{\#10}$		<1,000	-	-	-	-	-	-	-	-
4-chlorophenol	µg/L				<400	-	-	-	-	-	-	-	-
n-Nitrosodiphenylamine	µg/L		$12^{\#10}$		<100	-	-	-	-	-	-	-	-
UNK													
2,4-D (ester) (Dichlorophenoxyacetic acid)	µg/L				-	-	-	-	-	<0.02	<0.02	-	-
Permethrin I	µg/L	0.01			-	-	-	-	-	-	-	<0.01	-
Trietazine	mg/L	0.00001	$0.0001^{\#1}$		-	-	-	-	-	-	-	<0.00001	-
1,3,5-Trichlorobenzene	µg/L	0.01	$0.1^{\#1}$	**$0.4^{\#9}$**	-	-	-	-	-	-	-	<0.01	-
1,2,4-trichlorobenzene	µg/L	0.01	$0.1^{\#1}$	**$0.4^{\#9}$**	-	-	-	-	-	-	-	<0.01	-
Hexachlorobutadiene	µg/L	0.01	$0.1^{\#1}$	**$0.6^{\#6}$**	-	-	-	-	-	-	-	<0.01	-
1,2,3-trichlorobenzene	µg/L	0.01	$0.1^{\#1}$	**$0.4^{\#9}$**	-	-	-	-	-	-	-	<0.01	-
Pentachlorophenol	µg/L	0.04	$9^{\#3}$	**$0.4^{\#8}$**	-	-	<0.04	-	<0.04	<0.02	<0.02	-	-
Hexachlorobenzene	µg/L	0.01	$0.1^{\#1}$	**$0.05^{\#6}$**	-	-	-	-	-	-	-	<0.01	-
Dichloroacetic acid	µg/L		$1.5^{\#10}$		-	-	<0.04	-	-	-	-	-	-
Aldrin	µg/L	0.01	$0.03^{\#1}$	**$0.01^{\#8}$**	-	-	-	-	-	-	-	<0.01	-
Chlorothalonil	µg/L	0.01	$0.1^{\#1}$	**$0.035^{\#7}$**	-	-	-	-	-	-	-	<0.01	-
Chlordane (cis)	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Dieldrin	µg/L	0.01	$0.03^{\#1}$	**$0.01^{\#8}$**	-	-	-	-	-	-	-	<0.01	-
Endrin	µg/L	0.02	$0.1^{\#1}$	**$0.01^{\#8}$**	-	-	-	-	-	-	-	<0.02	-
Heptachlor	µg/L	0.01	$0.03^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Isodrin	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#8}$**	-	-	-	-	-	-	-	<0.01	-
o,p-DDD	µg/L	0.01			-	-	-	-	-	-	-	<0.01	-
DDD	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Pendimethalin	µg/L	0.01	$0.1^{\#1}$	**$0.3^{\#7}$**	-	-	-	-	-	-	-	<0.01	-
Pentachloronitrobenzene	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Tecnazene	mg/L	0.00001	$0.0001^{\#1}$	**$0.001^{\#12}$**	-	-	-	-	-	-	-	<0.00001	-
Telodrin	mg/L	0.00001	$0.0001^{\#1}$		-	-	-	-	-	-	-	<0.00001	-
Chlordane (trans)	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Triadimefon	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Triallate	µg/L	0.01	$0.1^{\#1}$	**$0.25^{\#12}$**	-	-	-	-	-	-	-	<0.01	-
Trifluralin	µg/L	0.01	$0.1^{\#1}$	**$0.03^{\#8}$**	-	-	-	-	-	-	-	<0.01	-
d-BHC	µg/L	0.05			-	-	-	-	-	-	-	<0.05	-
Azinphos Ethyl	µg/L	0.02	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.02	-
Azinophos methyl	µg/L	0.02	$0.1^{\#1}$	**$0.01^{\#12}$**	-	-	-	-	-	-	-	<0.02	-
Carbophenothion	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Chlorfenvinphos	µg/L	0.01	$0.1^{\#1}$	**$0.1^{\#8}$**	-	-	-	-	-	-	-	<0.01	-
Chlorpyrifos	µg/L	0.01	$0.1^{\#1}$	**$0.03^{\#8}$**	-	-	-	-	-	-	-	<0.01	-
Chlorpyrifos-methyl	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Diazinon	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#7}$**	-	-	-	-	-	-	-	<0.01	-
Dichlorvos	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Dimethoate	µg/L	0.01	$0.1^{\#1}$	**$0.48^{\#7}$**	-	-	-	-	-	-	-	<0.01	-
Ethion	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Parathion	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Etrimphos	mg/L	0.00001	$0.0001^{\#1}$		-	-	-	-	-	-	-	<0.00001	-
Fenitrothion	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#12}$**	-	-	-	-	-	-	-	<0.01	-
Fenthion	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Malathion	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#12}$**	-	-	-	-	-	-	-	<0.01	-
Methyl parathion	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Mevinphos (Phosdrin)	µg/L	0.01	$0.1^{\#1}$	**$0.02^{\#11}$**	-	-	-	-	-	-	-	<0.01	-
Phosalone	mg/L	0.00001	$0.0001^{\#1}$		-	-	-	-	-	-	-	<0.00001	-
Pirimiphos-methyl	µg/L	0.01	$0.1^{\#1}$	**$0.015^{\#12}$**	-	-	-	-	-	-	-	<0.01	-
Propetamphos	mg/L	0.00001	$0.0001^{\#1}$	**$0.00003^{\#12}$**	-	-	-	-	-	-	-	<0.00001	-
Triazophos	mg/L	0.00001	$0.0001^{\#1}$	**$0.000005^{\#12}$**	-	-	-	-	-	-	-	<0.00001	-
Coumaphos	µg/L	0.01	$0.1^{\#1}$	**$0.03^{\#12}$**	-	-	-	-	-	-	-	<0.01	-
Disulfoton	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Omethoate	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#12}$**	-	-	-	-	-	-	-	<0.01	-
Phorate	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Demeton-S-methyl	µg/L	0.01	$0.1^{\#1}$		-	-	-	-	-	-	-	<0.01	-
Benazolin	µg/L				-	-	<0.04	-	-	<0.02	<0.02	-	-
Bentazone	µg/L	0.04	$500^{\#3}$	**$500^{\#12}$**	-	-	<0.04	-	<0.04	<0.02	<0.02	-	-
Bromoxynil	µg/L	0.04	$0.61^{\#10}$	**$100^{\#12}$**	-	-	<0.04	-	<0.04	<0.02	<0.02	-	-
Clopyralid	µg/L	0.04			-	-	<0.04	-	<0.04	<0.02	<0.02	-	-
Hedonal	µg/L	0.04	$30^{\#3}$	**$0.3^{\#7}$**	-	-	-	-	<0.04	-	-	-	-
2,4-DB	µg/L				-	-	<0.04	-	-	-	-	-	-
Dicamba	µg/L	0.04	$570^{\#10}$		-	-	<0.04	-	<0.04	<0.02	<0.02	-	-

				Location	BM05		BM06A						
				Monitoring_Unit	Alluvium / Mercia Mudstone		Alluvium / Mercia Mudstone						
				Date	04/08/2016	23/03/2017	14/12/2016	21/03/2017	04/07/2017	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Parameter	**Units**	**Method Detection Limit**	**GAC (DWS)**	**GAC (EQS-Fresh)**									
2,4-Dichlorprop	µg/L		100[#3]		-	-	-	-	-	<0.02	<0.02	-	-
2,4,5-TP (Silvex)	µg/L	0.04	110[#10]		-	-	-	-	<0.04	-	-	-	-
Actril (Ioxynil)	mg/L	0.00004		**0.01[#12]**	-	-	<0.00004	-	<0.00004	<0.00002	<0.00002	-	-
2-Methyl-4-chlorophenoxyacetic acid	µg/L	0.04	700[#3]	**12[#12]**	-	-	<0.04	-	<0.04	<0.02	<0.02	-	-
2-Methyl-4-Chlorophenoxy Butanoic Acid	µg/L	0.04	65[#10]		-	-	<0.04	-	<0.04	<0.02	<0.02	-	-
2,4,5-Trichlorophenoxy Acetic Acid	µg/L	0.04	9[#3]		-	-	<0.04	-	<0.04	<0.02	<0.02	-	-
Triclopyr	µg/L	0.04			-	-	<0.04	-	<0.04	<0.02	<0.02	-	-
Atrazine	µg/L	0.01	0.1[#1]	**0.6[#8]**	-	-	-	-	-	-	-	<0.01	-
Simazine	µg/L	0.01	0.1[#1]	**1[#8]**	-	-	-	-	-	-	-	<0.01	-
2,3,6-Trichlorobenzoic acid	µg/L				-	-	<0.04	-	-	-	<0.02	-	-
2,3,6-Trichlorophenol	µg/L				-	-	-	-	-	<0.02	-	-	-
4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)	µg/L	0.04	450[#10]		-	-	-	-	<0.04	<0.02	<0.02	-	-
Cyanazine	µg/L	0.01	0.1[#1]		-	-	-	-	-	-	-	<0.01	-
Dichlobenil	µg/L	0.01	0.1[#1]		-	-	-	-	-	-	-	<0.01	-
Fluroxypyr	µg/L	0.04			-	-	<0.04	-	<0.04	<0.02	<0.02	-	-
Mecoprop	µg/L		10[#3]	**18[#7]**	-	-	-	-	-	<0.02	<0.02	-	-
Metachlor	µg/L	0.01	0.1[#1]	**0.3[#8]**	-	-	-	-	-	-	-	<0.01	-
Prometryn	µg/L	0.01	0.1[#1]		-	-	-	-	-	-	-	<0.01	-
Pronamide	µg/L	0.01	0.1[#1]	**100[#12]**	-	-	-	-	-	-	-	<0.01	-
Propazine	µg/L	0.01	0.1[#1]		-	-	-	-	-	-	-	<0.01	-
Terbutryn	µg/L	0.01	0.1[#1]		-	-	-	-	-	-	-	<0.01	-
Fenoprop	µg/L		9[#3]		-	-	<0.04	-	-	<0.02	<0.02	-	-
Etridiazole	µg/L	0.01	0.1[#1]		-	-	-	-	-	-	-	<0.01	-
Metazachlor	µg/L	0.01	0.1[#1]		-	-	-	-	-	-	-	<0.01	-
Pentachlorobenzene	µg/L	0.01	0.1[#1]	**0.007[#8]**	-	-	-	-	-	-	-	<0.01	-
Propachlor	µg/L	0.01	0.1[#1]		-	-	-	-	-	-	-	<0.01	-
Phosphamidon I	µg/L	0.01	0.1[#1]		-	-	-	-	-	-	-	<0.01	-
Phosphamidon II	µg/L	0.01	0.1[#1]		-	-	-	-	-	-	-	<0.01	-
VOC													
1,3,5-Trichlorobenzene	µg/L	1	0.1[#1]	**0.4[#9]**	-	<1	<1	<1	<1	<1	<1	<1	<1
Naphthalene	µg/L	1	6[#15]	**2[#8]**	<5	<1	<1	<1	<1	<1	<1	<1	<1
Dichlorodifluoromethane	µg/L	1	200[#10]		<1	<1	<1	<1	<1	<1	<1	<1	<1
MTBE	µg/L	1	1,800[#15]	**5,100[#13]**	-	<1	<1	<1	<1	<1	<1	<1	<1
Chloromethane	µg/L	1	190[#10]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Vinyl chloride	µg/L	1	0.5[#1]	**77[#13]**	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromomethane	µg/L	1	7.5[#10]		<5	<1	<1	<1	<1	<1	<1	<1	<1
Chloroethane	µg/L	1	21,000[#10]		<5	<1	<1	<1	<1	<1	<1	<1	<1
Trichlorofluoromethane	µg/L	1	5,200[#10]		<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethene	µg/L	1	140[#3]	**9[#13]**	<1	<1	<1	<1	<1	<1	<1	<1	<1
Dichloromethane	µg/L	3	20[#3]	**20[#8]**	-	<3	<3	<3	<3	<3	<3	<3	<3
trans-1,2-dichloroethene	µg/L	1	50[#3]		<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethane	µg/L	1	2.8[#10]		<1	<1	<1	<1	<1	<1	<1	<1	<1
cis-1,2-dichloroethene	µg/L	1	50[#3]		<1	<1	<1	<1	<1	<1	<1	<1	<1
2,2-dichloropropane	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromochloromethane	µg/L	1	83[#10]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Chloroform	µg/L	1	100[#1]	**2.5[#8]**	**15**	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1-trichloroethane	µg/L	1	2,000[#3]	**100[#12]**	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloropropene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	µg/L	1	3[#1]	**12[#8]**	<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloroethane	µg/L	1	3[#1]	**10[#8]**	<1	<1	<1	<1	<1	<1	<1	<1	<1
Benzene	µg/L	1	1[#1]	**10[#8]**	**11**	<1	<1	<1	<1	<1	<1	<1	<1
Trichloroethene	µg/L	1	10[#1]	**10[#8]**	<5	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloropropane	µg/L	1	40[#3]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Dibromomethane	µg/L	1	8.3[#10]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromodichloromethane	µg/L	1	100[#1]		6	<1	<1	<1	<1	<1	<1	<1	<1
cis-1,3-dichloropropene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/L	1	700[#3]	**74[#7]**	4	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,3-dichloropropene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-trichloroethane	µg/L	1	0.28[#10]	**400[#12]**	<1	<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloroethene	µg/L	1	10[#1]	**10[#8]**	<5	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichloropropane	µg/L	1	370[#10]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlorodibromomethane	µg/L	1	100[#1]		6	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromoethane	µg/L	1	0.4[#3]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Chlorobenzene	µg/L	1	300[#3]		<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1,2-tetrachloroethane	µg/L	1	0.57[#10]		<1	<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	µg/L	1	300[#3]	**20[#12]**	<1	<1	<1	<1	<1	<1	<1	<1	<1

GQRA (Groundwater Markeaton)
A38 Derby Junctions
Highways England

				Location	BM05		BM06A						
				Monitoring_Unit	Alluvium / Mercia Mudstone		Alluvium / Mercia Mudstone						
				Date	04/08/2016	23/03/2017	14/12/2016	21/03/2017	04/07/2017	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Parameter	**Units**	**Method Detection Limit**	**GAC (DWS)**	**GAC (EQS-Fresh)**									
Xylene (m & p)	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1
Xylene (o)	µg/L	1	$190^{\#10}$		2	<1	<1	<1	<1	<1	<1	<1	<1
Styrene	µg/L	1	$20^{\#3}$	**$50^{\#12}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromoform	µg/L	1	$100^{\#1}$		3	<1	<1	<1	<1	<1	<1	<1	<1
Isopropylbenzene	µg/L	1	$450^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
1,1,2,2-tetrachloroethane	µg/L	1	$0.076^{\#10}$	**$140^{\#7}$**	<1	<1	<1	<1	<1	<1	<1	<1	<1
Bromobenzene	µg/L	1	$62^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichloropropane	µg/L	1	$0.00075^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
n-propylbenzene	µg/L	1	$660^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
2-chlorotoluene	µg/L	1	$240^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3,5-trimethylbenzene	µg/L	1	$60^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
4-chlorotoluene	µg/L	1	$250^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
tert-butylbenzene	µg/L	1	$690^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trimethylbenzene	µg/L	1	$56^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
sec-butylbenzene	µg/L	1	$2,000^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
p-isopropyltoluene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichlorobenzene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1	<1
1,4-dichlorobenzene	µg/L	1	$300^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
n-butylbenzene	µg/L	1	$1,000^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichlorobenzene	µg/L	1	$1000^{\#3}$		<5	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromo-3-chloropropane	µg/L	1	$1^{\#3}$		<5	<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trichlorobenzene	µg/L	1	$0.1^{\#1}$	**$0.4^{\#9}$**	<5	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	µg/L	1	$0.1^{\#1}$	**$0.6^{\#6}$**	<5	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichlorobenzene	µg/L	1	$0.1^{\#1}$	**$0.4^{\#9}$**	<5	<1	<1	<1	<1	<1	<1	<1	<1
Carbon disulfide	µg/L	1	$810^{\#10}$		-	<1	<1	<1	<1	<1	<1	<1	<1
Tert Amyl Methyl Ether	µg/L	1		**$510^{\#13}$**	-	<1	<1	<1	<1	<1	<1	<1	<1

Comments
#1 WS Regs 2016 (Eng/Wal)
#2 WHO Petroleum DWG 2008
#3 WHO DWG 2017
#4 WHO 2017 - Taste
#5 WHO 2017 - Odour
#6 WFD England/Wales. 2015 - MAC-EQS Inland
#7 WFD England/Wales. 2015 - Freshwater Standards
#8 WFD England/Wales. 2015 - AA-EQS Inland
#9 Water Env't Regs (Scotland) 2015. AA-EQS Inland
#10 USEPA RSL (tapwater) [May 2019]
#11 SEPA WAT-SG-53 Fresh EQS - MAC - 2015
#12 SEPA WAT-SG-53 Fresh EQS - AA - 2015
#13 PNEC (EU REACH) - Freshwater
#14 California Draft health protective concentration
#15 AECOM DWG (WHO method)
GAC: Generic Assessment Criteria
(blank): No assessment criteria available
- : Not analysed

Key

XXX	Exceedance of GAC_WTV_EN/WA_DWS
XXX	Exceedance of GAC_WTV_EN/WA_EQS-Fresh

GQRA (Groundwater Markeaton)
A38 Derby Junctions
Highways England

				Location	BM10				BM11			
				Monitoring_Unit	Made Ground / Alluvium / Mercia Mudstone				Made Ground / Alluvium / Mercia Mudstone			
				Date	18/01/2018	14/02/2018	14/03/2018	19/04/2018	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Parameter	**Units**	**Method Detection Limit**	**GAC (DWS)**	**GAC (EQS-Fresh)**								
ACID_HERB_GCMS_SUB												
2,4-Dichlorprop	µg/L	0.04	100$^{\#3}$		-	-	-	-	-	-	-	-
Mecoprop	µg/L	0.04	10$^{\#3}$	**18$^{\#7}$**	-	-	-	-	-	-	-	-
CARBON												
TOC	mg/L	3			<3	<3	<3	<3	15.3	8.71	6.15	11.2
COD												
COD	mg/L	7			64.3	70.8	87.7	23.8	303	560	526	582
EPHCWG												
>C12-C16 Aliphatics	µg/L	10	300$^{\#2}$		<10	<10	<10	<10	20	<20	<10	<10
>C16-C21 Aliphatics	µg/L	10	300$^{\#2}$		<10	<10	<10	<10	114	56	23	<10
>C16-C35 Aliphatics	µg/L	10			<10	<10	<10	<10	1,040	660	337	<10
>C21-C35 Aliphatics	µg/L	10	300$^{\#2}$		<10	<10	<10	<10	923	604	314	<10
>C12-C35 Aliphatics	µg/L	10			<10	<10	<10	<10	1,060	660	337	<10
>EC12-EC16 Aromatics	µg/L	10	90$^{\#2}$		<10	<10	<10	<10	<10	<20	<10	<10
>EC16-EC21 Aromatics	µg/L	10	90$^{\#2}$		<10	<10	<10	<10	26	32	16	16
>EC21-EC35 Aromatics	µg/L	10	90$^{\#2}$		<10	<10	<10	<10	234	231	125	29
>EC12-EC35 Aromatics	µg/L	10			<10	<10	<10	<10	260	263	141	45
>C5-C35 Aliphatics & Aromatics	µg/L	10			<10	<10	<10	<10	1,320	923	478	45
ESDAT Combined Compounds												
Benzo(b)&(k)fluoranthene	µg/L				-	-	-	-	-	-	-	-
PAHs (sum of 4)	µg/L		0.1$^{\#1}$		-	-	-	-	-	-	-	-
benzo(g,h,i)perylene + indeno(1,2,3-cd)pyrene	µg/L				-	-	-	-	-	-	-	-
Benzo(a)pyrene (surrogate marker for PAH mixture)	µg/L				-	-	-	-	-	-	-	-
Sum of PCE and TCE	µg/L		10$^{\#1}$		-	-	-	-	-	-	-	-
TCE+DCE+VC	µg/L				-	-	-	-	-	-	-	-
PCE+TCE+DCE+VC	µg/L				-	-	-	-	-	-	-	-
1,2-Dichloroethene	µg/L		50$^{\#3}$		-	-	-	-	-	-	-	-
Trihalomethanes	µg/L		100$^{\#1}$		-	-	-	-	-	-	-	-
Aldrin + Dieldrin	µg/L		0.03$^{\#3}$		-	-	-	-	-	-	-	-
DDT+DDE+DDD	µg/L				-	-	-	-	-	-	-	-
Aldrin+Dieldrin+Endrin+Isodrin	µg/L			**0.01$^{\#8}$**	-	-	-	-	-	-	-	-
GRO												
GRO >C5-C12	µg/L	50			<50	54	<50	56	<50	<50	<50	<50
>C5-C6 Aliphatics	µg/L	10	15,000$^{\#2}$		<10	<10	<10	<10	<10	<10	<10	<10
>C6-C8 Aliphatics	µg/L	10	15,000$^{\#2}$		<10	<10	<10	<10	<10	<10	<10	<10
>C8-C10 Aliphatics	µg/L	10	300$^{\#2}$		<10	<10	<10	<10	<10	<10	<10	<10
>C10-C12 Aliphatics	µg/L	10	300$^{\#2}$		<10	<10	<10	<10	<10	<10	<10	<10
>EC5-EC7 Aromatics	µg/L	10	1$^{\#1}$	**10$^{\#8}$**	<10	<10	<10	<10	<10	<10	<10	<10
>EC7-EC8 Aromatics	µg/L	10	700$^{\#2}$	**74$^{\#7}$**	<10	<10	<10	<10	<10	<10	<10	<10
>EC8-EC10 Aromatics	µg/L	10	300$^{\#2}$		<10	<10	<10	<10	<10	<10	<10	<10
>EC10-EC12 Aromatics	µg/L	10	90$^{\#2}$		<10	<10	<10	<10	<10	<10	<10	<10
MTBE	µg/L	3	1,800$^{\#15}$	**5,100$^{\#13}$**	44	54	49	56	<3	<3	<3	3
Benzene	µg/L	7	1$^{\#1}$	**10$^{\#8}$**	<7	<7	<7	<7	<7	<7	<7	<7
Toluene	µg/L	4	700$^{\#3}$	**74$^{\#7}$**	<4	<4	<4	<4	<4	<4	<4	<4
Ethylbenzene	µg/L	5	300$^{\#3}$	**20$^{\#12}$**	<5	<5	<5	<5	<5	<5	<5	<5
Xylene (m & p)	µg/L	8			<8	<8	<8	<8	<8	<8	<8	<8
Xylene Total	µg/L	11	500$^{\#3}$	**30$^{\#12}$**	<11	<11	<11	<11	<11	<11	<11	<11
Xylene (o)	µg/L	3	190$^{\#10}$		<3	<3	<3	<3	<3	<3	<3	<3
Total BTEX	µg/L	28			<28	<28	<28	<28	<28	<28	<28	<28
Aromatics >EC8-EC10	µg/L				-	-	-	-	-	-	-	-
Aromatics >EC7-EC8	µg/L				-	-	-	-	-	-	-	-
GRO Surrogate	%				-	-	-	-	-	-	-	-
GRO_HSA_UK												
>C5-C7	µg/L				-	-	-	-	-	-	-	-
GRO >C5-C6	µg/L				-	-	-	-	-	-	-	-
GRO >C5-C10	µg/L				-	-	-	-	-	-	-	-
GRO >C6-C8	µg/L				-	-	-	-	-	-	-	-
GRO >C7-C8	µg/L				-	-	-	-	-	-	-	-

				Location	BM10				BM11			
				Monitoring_Unit	Made Ground / Alluvium / Mercia Mudstone				Made Ground / Alluvium / Mercia Mudstone			
				Date	18/01/2018	14/02/2018	14/03/2018	19/04/2018	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Parameter	**Units**	**Method Detection Limit**	**GAC (DWS)**	**GAC (EQS-Fresh)**								
HERBPEST												
a-BHC	µg/L	0.01	$0.0072^{\#10}$		<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.02	-
b-BHC	µg/L	0.01	$0.025^{\#10}$		<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.02	-
Chlordane (cis)	µg/L	0.01	$0.1^{\#1}$		-	-	<0.01	-	-	-	<0.02	-
Endosulfan I	µg/L	0.01	$0.1^{\#1}$		<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.02	-
Endosulfan II	µg/L	0.01	$0.1^{\#1}$		<0.01	<0.01	<0.02	-	<0.01	<0.01	<0.04	-
Endosulfan sulphate	µg/L	0.01	$0.1^{\#1}$		<0.01	<0.01	<0.04	-	<0.01	<0.01	<0.08	-
g-BHC (Lindane)	µg/L	0.01	$2^{\#3}$		<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.02	-
Heptachlor epoxide	µg/L	0.01	$0.03^{\#1}$		<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.02	-
o,p''-DDE	µg/L	0.01			<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.02	-
2,4-DDT	µg/L	0.01			<0.01	<0.01	<0.02	-	<0.01	<0.01	<0.04	-
o,p''-Methoxychlor	µg/L	0.01			<0.01	<0.01	<0.02	-	<0.01	<0.01	<0.04	-
o,p-DDD	µg/L	0.01			<0.01	<0.01	-	-	<0.01	<0.01	-	-
4,4-DDE	µg/L	0.01	$0.1^{\#1}$		<0.01	<0.01	<0.01	-	<0.01	<0.01	<0.02	-
DDT	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#8}$**	<0.01	<0.01	<0.02	-	<0.01	<0.01	<0.04	-
Methoxychlor	µg/L	0.01	$0.1^{\#1}$		<0.01	<0.01	<0.02	-	<0.01	<0.01	<0.04	-
DDD	µg/L	0.01	$0.1^{\#1}$		<0.01	<0.01	-	-	<0.01	<0.01	-	-
Permethrin II	µg/L	0.01			-	-	<0.01	-	-	-	<0.02	-
Chlordane (trans)	µg/L	0.01	$0.1^{\#1}$		-	-	<0.01	-	-	-	<0.02	-
Azinophos methyl	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#12}$**	<0.02	<0.01	-	-	<0.02	<0.01	-	-
Methyl parathion	µg/L	0.01	$0.1^{\#1}$		<0.03	<0.01	-	-	<0.03	<0.01	-	-
Mevinphos (Phosdrin)	µg/L	0.01	$0.1^{\#1}$	**$0.02^{\#11}$**	<0.03	<0.01	-	-	<0.03	<0.01	-	-
INORGANICS												
Cyanide (Free)	mg/L	0.05	$0.05^{\#1}$	**$0.001^{\#12}$**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Cyanide Total	mg/L	0.05	$0.05^{\#1}$	**$0.001^{\#7}$**	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Nitrogen (Total)	µg/L				-	-	-	-	-	-	-	-
Ammoniacal Nitrogen as N	mg/L	0.2		**$0.3^{\#7}$**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
TSS	mg/L	2			906	-	-	71.8	-	-	-	-
Total Hardness	mg/l	0.35			1,020	1,110	1,320	-	2,790	6,710	1,690	-
pH (Lab)	pH_Units	1			7.29	7.56	7.17	7.41	7.25	7.46	7.13	7.3
METALS_ICP												
Arsenic (Filtered)	µg/L	0.5	$10^{\#1}$	**$50^{\#7}$**	1.73	2.71	1.84	1.85	3.83	9.07	9.81	6.97
Boron (Filtered)	µg/L	5	$1,000^{\#1}$	**$2,000^{\#12}$**	86.7	83.3	94.1	90.4	136	118	112	115
Cadmium (Filtered)	µg/L	0.08	$5^{\#1}$	**$0.08^{\#8}$**	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08	<0.08
Chromium (hexavalent)	µg/L	30	$50^{\#1}$	**$3.4^{\#7}$**	<30	<30	<30	<30	<30	<30	<30	<30
Chromium (III+VI)	µg/L	3	$50^{\#1}$		26.2	31.7	33.9	14.8	255	186	180	212
Copper (Filtered)	µg/L	0.3	$2,000^{\#1}$	**$1^{\#7}$**	<0.3	<0.3	<0.3	<0.3	0.554	0.687	**1.19**	0.921
Iron (Filtered)	µg/L	19	$200^{\#1}$	**$1,000^{\#7}$**	<19	<19	<19	55.6	107	163	218	317
Iron (Total)	µg/L	24	$200^{\#1}$	**$1,000^{\#7}$**	**16,100**	**10,600**	**16,400**	**4,890**	**211,000**	**190,000**	**107,000**	**128,000**
Lead (Filtered)	µg/L	0.1	$10^{\#1}$	**$1.2^{\#8}$**	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2
Mercury (Filtered)	µg/L	0.01			<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01
Nickel (Filtered)	µg/L	0.4	$20^{\#1}$	**$4^{\#8}$**	<0.4	0.529	<0.4	0.513	2.58	3.73	3.88	2.95
Selenium (Filtered)	µg/L	0.5	$10^{\#1}$		<0.5	0.6	<1	<1	0.977	0.924	1.14	<1
Zinc (Filtered)	µg/L	1	$6,000^{\#10}$	**$10.9^{\#7}$**	1.69	1.11	<1	<1	8.04	2.07	1.07	4.25
MISC												
BOD	mg/L	1			<1	-	<1	-	11.1	-	5.05	-
OCP_GCMS												
Aldrin	µg/L	0.01	$0.03^{\#1}$	**$0.01^{\#8}$**	<0.01	<0.01	-	-	<0.01	<0.01	-	-
Dieldrin	µg/L	0.01	$0.03^{\#1}$	**$0.01^{\#8}$**	<0.01	<0.01	-	-	<0.01	<0.01	-	-
Endrin	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#8}$**	<0.01	<0.01	-	-	<0.01	<0.01	-	-
Heptachlor	µg/L	0.01	$0.03^{\#1}$		<0.01	<0.01	-	-	<0.01	<0.01	-	-
OPP_GCMS												
Diazinon	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#7}$**	<0.03	<0.01	-	-	<0.03	<0.01	-	-
Dichlorvos	µg/L	0.01	$0.1^{\#1}$		<0.03	<0.01	-	-	<0.03	<0.01	-	-
Ethion	µg/L	0.01	$0.1^{\#1}$		<0.02	<0.01	-	-	<0.02	<0.01	-	-
Parathion	µg/L	0.01	$0.1^{\#1}$		<0.03	<0.01	-	-	<0.03	<0.01	-	-
Fenitrothion	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#12}$**	<0.03	<0.01	-	-	<0.03	<0.01	-	-
Malathion	µg/L	0.01	$0.1^{\#1}$	**$0.01^{\#12}$**	<0.02	<0.01	-	-	<0.02	<0.01	-	-

GQRA (Groundwater Markeaton)
A38 Derby Junctions
Highways England

				Location	BM10				BM11			
				Monitoring_Unit	Made Ground / Alluvium / Mercia Mudstone				Made Ground / Alluvium / Mercia Mudstone			
				Date	18/01/2018	14/02/2018	14/03/2018	19/04/2018	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Parameter	**Units**	**Method Detection Limit**	**GAC (DWS)**	**GAC (EQS-Fresh)**								
PAH												
Naphthalene	µg/L	0.01	6$^{\#15}$	**2$^{\#8}$**	<0.01	<0.01	<0.01	0.0205	0.0235	0.0667	0.0101	<0.01
Acenaphthylene	µg/L	0.005	18$^{\#15}$		<0.005	<0.005	<0.005	0.00696	0.11	0.0693	0.0351	<0.005
Acenaphthene	µg/L	0.005	18$^{\#15}$		<0.005	<0.005	<0.005	0.00576	0.105	0.0891	0.0368	0.0439
Fluorene	µg/L	0.005	12$^{\#15}$		<0.005	<0.005	<0.005	0.0113	0.0843	0.0806	0.0377	0.0281
Phenanthrene	µg/L	0.005	4$^{\#15}$		<0.005	0.0057	0.00574	0.0601	0.893	0.974	0.395	0.0409
Anthracene	µg/L	0.005	90$^{\#15}$	**0.1$^{\#8}$**	<0.005	<0.005	<0.005	0.0184	**0.196**	**0.215**	**0.147**	<0.005
Fluoranthene	µg/L	0.005	4$^{\#3}$	**0.0063$^{\#8}$**	**0.0114**	**0.0145**	**0.0128**	**0.139**	**3.05**	**3.37**	**1.34**	**0.0172**
Pyrene	µg/L	0.005	9$^{\#15}$		0.0129	0.014	0.0118	0.13	2.79	3.15	1.32	<0.005
Benz(a)anthracene	µg/L	0.005	3.5$^{\#15}$		<0.005	<0.005	<0.005	0.0636	1.42	1.66	0.76	<0.005
Chrysene	µg/L	0.005	7$^{\#15}$		<0.005	0.00968	0.00513	0.0603	1.76	1.8	0.754	<0.005
Benzo(a) pyrene	µg/L	0.002	0.01$^{\#1}$	**0.00017$^{\#8}$**	<0.002	**0.0138**	**0.0057**	**0.0589**	**2.16**	**2.27**	**1.15**	<0.002
Indeno(1,2,3-c,d)pyrene	µg/L	0.005	0.1$^{\#1}$		<0.005	0.0121	<0.005	0.0343	2.55	1.36	1.04	<0.005
Dibenz(a,h)anthracene	µg/L	0.005	0.07$^{\#15}$		<0.005	0.00731	<0.005	0.00766	0.213	0.238	0.161	<0.005
Benzo(g,h,i)perylene	µg/L	0.005	0.1$^{\#1}$	**0.0082$^{\#6}$**	<0.005	**0.0122**	<0.005	**0.0503**	**2.04**	**1.71**	**1.18**	<0.005
Benzo(b)fluoranthene	µg/L	0.005	0.1$^{\#1}$	**0.017$^{\#6}$**	<0.005	0.0161	0.0051	**0.08**	**2.69**	**2.99**	**1.56**	<0.005
Benzo(k)fluoranthene	µg/L	0.005	0.1$^{\#1}$	**0.017$^{\#6}$**	<0.005	0.0113	0.00516	**0.0477**	**1.24**	**1.29**	**0.813**	<0.005
PAH 16 Total	µg/L	0.082			<0.082	0.117	<0.082	0.795	21.3	21.3	10.8	0.13
PHENOL												
2,3,5,6-Tetrachlorophenol	µg/L	0.5			<1.5	<0.5	<0.5	<2	<0.5	<0.5	<0.5	<0.5
2-chlorophenol	µg/L	0.5	91$^{\#10}$	**50$^{\#12}$**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-methylphenol	µg/L	0.5	930$^{\#10}$		<1	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2-nitrophenol	µg/L	0.5			<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
2,4-dichlorophenol	µg/L	0.5	46$^{\#10}$	**4.2$^{\#7}$**	<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
2,4-dimethylphenol	µg/L	0.5	360$^{\#10}$		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
2,4,5-trichlorophenol	µg/L	0.5	1,200$^{\#10}$		<1.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
2,4,6-trichlorophenol	µg/L	0.5	200$^{\#3}$		<1	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
4-chloro-3-methylphenol	µg/L	0.5	1,400$^{\#10}$	**40$^{\#12}$**	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-methylphenol	µg/L	0.5	1,900$^{\#10}$		<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
4-nitrophenol	µg/L	0.5			<0.5	<0.5	<0.5	<1	<0.5	<0.5	<0.5	<0.5
Pentachlorophenol	µg/L	2	9$^{\#3}$	**0.4$^{\#8}$**	<4	<2	<2	<4	<2	<2	<2	<2
Phenol	µg/L	0.5	5,800$^{\#10}$	**7.7$^{\#7}$**	**15.3**	<6.5	<6	<6	<7	<7	<6	<6
2,4-dinitrophenol	µg/L	2.5	39$^{\#10}$		<2.5	<5	<5	<6.25	<2.5	<5	<5	<2.5
3-Methylphenol	µg/L	0.5	930$^{\#10}$		-	-	-	-	-	-	-	-
4,6-Dinitro-2-methylphenol	µg/L	3	1.5$^{\#10}$		<3	<3	<6	<3	<3	<3	<6	<3
4-chlorophenol	µg/L	0.5			<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5	<0.5
Dinoseb	µg/L	4	15$^{\#10}$		<8	<8	<8	<4	<8	<8	<8	<4
DNOC :- {4,6-dinitro-o-cresol}	µg/L				-	-	-	-	-	-	-	-
PHENOLS_HPLC												
Phenol	µg/L	2	5,800$^{\#10}$	**7.7$^{\#7}$**	<2	<2	<2	<2	<2	<2	<2	<2
Cresol Total	µg/L	6	1,500$^{\#10}$		<6	<6	<6	<6	<6	<6	<6	<6
Total Monohydric Phenols (S) Corrected	µg/L	16			<16	<16	<16	<16	<16	<16	<16	<16
Xylenols	µg/L	8			<8	<8	<8	<8	<8	<8	<8	<8

GQRA (Groundwater Markeaton)
A38 Derby Junctions
Highways England

				Location	BM10				BM11			
				Monitoring_Unit	Made Ground / Alluvium / Mercia Mudstone				Made Ground / Alluvium / Mercia Mudstone			
				Date	18/01/2018	14/02/2018	14/03/2018	19/04/2018	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Parameter	**Units**	**Method Detection Limit**	**GAC (DWS)**	**GAC (EQS-Fresh)**								
SVOC												
Naphthalene	µg/L	1	$6^{\#15}$	**$2^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1
Acenaphthylene	µg/L	1	$18^{\#15}$		<1	<1	<1	<1	<1	<1	<1	<1
Acenaphthene	µg/L	1	$18^{\#15}$		<1	<1	<1	<1	<1	<1	<1	<1
Fluorene	µg/L	1	$12^{\#15}$		<1	<1	<1	<1	<1	<1	<1	<1
Phenanthrene	µg/L	1	$4^{\#15}$		<1	<1	<1	<1	<1	<1	<1	<1
Anthracene	µg/L	1	$90^{\#15}$	**$0.1^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1
Fluoranthene	µg/L	1	$4^{\#3}$	**$0.0063^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1
Pyrene	µg/L	1	$9^{\#15}$		<1	<1	<1	<1	<1	<1	<1	<1
Benz(a)anthracene	µg/L	1	$3.5^{\#15}$		<1	<1	<1	<1	<1	<1	<1	<1
Chrysene	µg/L	1	$7^{\#15}$		<1	<1	<1	<1	<1	<1	<1	<1
Benzo(a) pyrene	µg/L	1	$0.01^{\#1}$	**$0.00017^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1
Indeno(1,2,3-c,d)pyrene	µg/L	1	$0.1^{\#1}$		<1	<1	<1	<1	<1	<1	<1	<1
Dibenz(a,h)anthracene	µg/L	1	$0.07^{\#15}$		<1	<1	<1	<1	<1	<1	<1	<1
Benzo(g,h,i)perylene	µg/L	1	$0.1^{\#1}$	**$0.0082^{\#6}$**	<1	<1	<1	<1	<1	<1	<1	<1
Benzo(b)fluoranthene	µg/L	1	$0.1^{\#1}$	**$0.017^{\#6}$**	<1	<1	<1	<1	<1	<1	<1	<1
Benzo(k)fluoranthene	µg/L	1	$0.1^{\#1}$	**$0.017^{\#6}$**	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichlorobenzene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
1,4-dichlorobenzene	µg/L	1	$300^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichlorobenzene	µg/L	1	$1,000^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trichlorobenzene	µg/L	1	$0.1^{\#1}$	**$0.4^{\#9}$**	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	µg/L	1	$0.1^{\#1}$	**$0.6^{\#6}$**	<1	<1	<1	<1	<1	<1	<1	<1
2-chlorophenol	µg/L	1	$91^{\#10}$	**$50^{\#12}$**	<1	<1	<1	<1	<1	<1	<1	<1
2-methylphenol	µg/L	1	$930^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
2-nitrophenol	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
2,4-dichlorophenol	µg/L	1	$46^{\#10}$	**$4.2^{\#7}$**	<1	<1	<1	<1	<1	<1	<1	<1
2,4-dimethylphenol	µg/L	1	$360^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
2,4,5-trichlorophenol	µg/L	1	$1,200^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
2,4,6-trichlorophenol	µg/L	1	$200^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
4-chloro-3-methylphenol	µg/L	1	$1,400^{\#10}$	**$40^{\#12}$**	<1	<1	<1	<1	<1	<1	<1	<1
4-methylphenol	µg/L	1	$1,900^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
4-nitrophenol	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
Pentachlorophenol	µg/L	1	$9^{\#3}$	**$0.4^{\#8}$**	<1	<1	<1	<1	<1	<1	<1	<1
Phenol	µg/L	1	$5,800^{\#10}$	**$7.7^{\#7}$**	<1	<1	<1	<1	<1	<1	<1	<1
2-chloronaphthalene	µg/L	1	$750^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
2-methylnaphthalene	µg/L	1	$36^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Bis(2-ethylhexyl) phthalate	µg/L	2	$8^{\#3}$	**$1.3^{\#8}$**	<2	<2	<2	<2	<2	<2	<2	<2
Butyl benzyl phthalate	µg/L	1	$16^{\#10}$	**$7.5^{\#7}$**	<1	<1	<1	<1	<1	<1	<1	<1
Di-n-butyl phthalate	µg/L	1	$900^{\#10}$	**$8^{\#12}$**	<1	<1	<1	<1	<1	<1	<1	<1
Di-n-octyl phthalate	µg/L	5	$200^{\#10}$	**$20^{\#12}$**	<5	<5	<5	<5	<5	<5	<5	<5
Diethylphthalate	µg/L	1	$15,000^{\#10}$	**$200^{\#12}$**	<1	<1	<1	<1	<1	<1	<1	<1
Dimethyl phthalate	µg/L	1		**$800^{\#12}$**	<1	<1	<1	<1	<1	<1	<1	<1
2-nitroaniline	µg/L	1	$190^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
2,4-Dinitrotoluene	µg/L	1	$0.24^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
2,6-dinitrotoluene	µg/L	1	$0.049^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
3-nitroaniline	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
4-bromophenyl phenyl ether	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
4-chloroaniline	µg/L	1	$0.37^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
4-chlorophenyl phenyl ether	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
4-nitroaniline	µg/L	1	$3.8^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Azobenzene	µg/L	1	$0.12^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Bis(2-chloroethoxy) methane	µg/L	1	$59^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Bis(2-chloroethyl)ether	µg/L	1	$0.014^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Carbazole	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
Dibenzofuran	µg/L	1	$7.9^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobenzene	µg/L	1	$0.1^{\#1}$	**$0.05^{\#6}$**	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorocyclopentadiene	µg/L	1	$0.41^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Hexachloroethane	µg/L	1	$0.33^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Isophorone	µg/L	1	$78^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
N-nitrosodi-n-propylamine	µg/L	1	$0.011^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Nitrobenzene	µg/L	1	$8^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1

				Location	BM10				BM11			
				Monitoring_Unit	Made Ground / Alluvium / Mercia Mudstone				Made Ground / Alluvium / Mercia Mudstone			
				Date	18/01/2018	14/02/2018	14/03/2018	19/04/2018	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Parameter	**Units**	**Method Detection Limit**	**GAC (DWS)**	**GAC (EQS-Fresh)**								
SVOCSW												
Biphenylene	µg/L				-	-	-	-	-	-	-	-
Diphenyl ether	mg/L		$0.00083^{\#10}$		-	-	-	-	-	-	-	-
Coronene	µg/L				-	-	-	-	-	-	-	-
Naphthalene	µg/L		$6^{\#15}$	$2^{\#8}$	-	-	-	-	-	-	-	-
Acenaphthylene	µg/L		$18^{\#15}$		-	-	-	-	-	-	-	-
Acenaphthene	µg/L		$18^{\#15}$		-	-	-	-	-	-	-	-
Fluorene	µg/L		$12^{\#15}$		-	-	-	-	-	-	-	-
Phenanthrene	µg/L		$4^{\#15}$		-	-	-	-	-	-	-	-
Anthracene	µg/L		$90^{\#15}$	$0.1^{\#8}$	-	-	-	-	-	-	-	-
Fluoranthene	µg/L		$4^{\#3}$	$0.0063^{\#8}$	-	-	-	-	-	-	-	-
Pyrene	µg/L		$9^{\#15}$		-	-	-	-	-	-	-	-
Benz(a)anthracene	µg/L		$3.5^{\#15}$		-	-	-	-	-	-	-	-
Chrysene	µg/L		$7^{\#15}$		-	-	-	-	-	-	-	-
Benzo(a) pyrene	µg/L		$0.01^{\#1}$	$0.00017^{\#8}$	-	-	-	-	-	-	-	-
Indeno(1,2,3-c,d)pyrene	µg/L		$0.1^{\#1}$		-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	µg/L		$0.07^{\#15}$		-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	µg/L		$0.1^{\#1}$	$0.0082^{\#6}$	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	µg/L		$0.1^{\#1}$	$0.017^{\#6}$	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	µg/L		$0.1^{\#1}$	$0.017^{\#6}$	-	-	-	-	-	-	-	-
1,3-dichlorobenzene	µg/L				-	-	-	-	-	-	-	-
1,4-dichlorobenzene	µg/L		$300^{\#3}$		-	-	-	-	-	-	-	-
1,2-dichlorobenzene	µg/L		$1,000^{\#3}$		-	-	-	-	-	-	-	-
1,2,4-trichlorobenzene	µg/L		$0.1^{\#1}$	$0.4^{\#9}$	-	-	-	-	-	-	-	-
Hexachlorobutadiene	µg/L		$0.1^{\#1}$	$0.6^{\#6}$	-	-	-	-	-	-	-	-
2-chlorophenol	µg/L		$91^{\#10}$	$50^{\#12}$	-	-	-	-	-	-	-	-
2-methylphenol	µg/L		$930^{\#10}$		-	-	-	-	-	-	-	-
2-nitrophenol	µg/L				-	-	-	-	-	-	-	-
2,4-dichlorophenol	µg/L		$46^{\#10}$	$4.2^{\#7}$	-	-	-	-	-	-	-	-
2,4-dimethylphenol	µg/L		$360^{\#10}$		-	-	-	-	-	-	-	-
2,4,5-trichlorophenol	µg/L		$1,200^{\#10}$		-	-	-	-	-	-	-	-
2,4,6-trichlorophenol	µg/L		$200^{\#3}$		-	-	-	-	-	-	-	-
4-chloro-3-methylphenol	µg/L		$1,400^{\#10}$	$40^{\#12}$	-	-	-	-	-	-	-	-
4-nitrophenol	µg/L				-	-	-	-	-	-	-	-
Pentachlorophenol	µg/L		$9^{\#3}$	$0.4^{\#8}$	-	-	-	-	-	-	-	-
Phenol	µg/L		$5,800^{\#10}$	$7.7^{\#7}$	-	-	-	-	-	-	-	-
2-chloronaphthalene	µg/L		$750^{\#10}$		-	-	-	-	-	-	-	-
2-methylnaphthalene	µg/L		$36^{\#10}$		-	-	-	-	-	-	-	-
Bis(2-ethylhexyl) phthalate	µg/L		$8^{\#3}$	$1.3^{\#8}$	-	-	-	-	-	-	-	-
Butyl benzyl phthalate	µg/L		$16^{\#10}$	$7.5^{\#7}$	-	-	-	-	-	-	-	-
Di-n-butyl phthalate	µg/L		$900^{\#10}$	$8^{\#12}$	-	-	-	-	-	-	-	-
Di-n-octyl phthalate	µg/L		$200^{\#10}$	$20^{\#12}$	-	-	-	-	-	-	-	-
Diethylphthalate	µg/L		$15,000^{\#10}$	$200^{\#12}$	-	-	-	-	-	-	-	-
Dimethyl phthalate	µg/L			$800^{\#12}$	-	-	-	-	-	-	-	-
2-nitroaniline	µg/L		$190^{\#10}$		-	-	-	-	-	-	-	-
2,4-Dinitrotoluene	µg/L		$0.24^{\#10}$		-	-	-	-	-	-	-	-
2,6-dinitrotoluene	µg/L		$0.049^{\#10}$		-	-	-	-	-	-	-	-
3-nitroaniline	µg/L				-	-	-	-	-	-	-	-
4-bromophenyl phenyl ether	µg/L				-	-	-	-	-	-	-	-
4-chloroaniline	µg/L		$0.37^{\#10}$		-	-	-	-	-	-	-	-
4-chlorophenyl phenyl ether	µg/L				-	-	-	-	-	-	-	-
4-nitroaniline	µg/L		$3.8^{\#10}$		-	-	-	-	-	-	-	-
Bis(2-chloroethoxy) methane	µg/L		$59^{\#10}$		-	-	-	-	-	-	-	-
Bis(2-chloroethyl)ether	µg/L		$0.014^{\#10}$		-	-	-	-	-	-	-	-
Dibenzofuran	µg/L		$7.9^{\#10}$		-	-	-	-	-	-	-	-
Hexachlorobenzene	µg/L		$0.1^{\#1}$	$0.05^{\#6}$	-	-	-	-	-	-	-	-
Hexachlorocyclopentadiene	µg/L		$0.41^{\#10}$		-	-	-	-	-	-	-	-
Hexachloroethane	µg/L		$0.33^{\#10}$		-	-	-	-	-	-	-	-
Isophorone	µg/L		$78^{\#10}$		-	-	-	-	-	-	-	-
N-nitrosodi-n-propylamine	µg/L		$0.011^{\#10}$		-	-	-	-	-	-	-	-
Nitrobenzene	µg/L		$8^{\#3}$		-	-	-	-	-	-	-	-
1-Methylnaphthalene	µg/L		$1.1^{\#10}$		-	-	-	-	-	-	-	-
3,3-Dichlorobenzidine	µg/L		$0.13^{\#10}$		-	-	-	-	-	-	-	-
Benzoic Acid	µg/L		$75,000^{\#10}$		-	-	-	-	-	-	-	-
Benzyl alcohol	µg/L		$2,000^{\#10}$		-	-	-	-	-	-	-	-
2,4-dinitrophenol	µg/L		$39^{\#10}$		-	-	-	-	-	-	-	-

GQRA (Groundwater Markeaton)
A38 Derby Junctions
Highways England

				Location	BM10				BM11			
				Monitoring_Unit	Made Ground / Alluvium / Mercia Mudstone				Made Ground / Alluvium / Mercia Mudstone			
				Date	18/01/2018	14/02/2018	14/03/2018	19/04/2018	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Parameter	**Units**	**Method Detection Limit**	**GAC (DWS)**	**GAC (EQS-Fresh)**								
3-&4-methylphenol	µg/L				-	-	-	-	-	-	-	-
4,6-Dinitro-2-methylphenol	µg/L		1.5[#10]		-	-	-	-	-	-	-	-
4-chlorophenol	µg/L				-	-	-	-	-	-	-	-
n-Nitrosodiphenylamine	µg/L		12[#10]		-	-	-	-	-	-	-	-
UNK												
2,4-D (ester) (Dichlorophenoxyacetic acid)	µg/L				<0.02	<0.02	-	-	<0.02	<0.02	-	-
Permethrin I	µg/L	0.01			-	-	<0.01	-	-	-	<0.02	-
Trietazine	mg/L	0.00001	0.0001[#1]		-	-	<0.00001	-	-	-	<0.00001	-
1,3,5-Trichlorobenzene	µg/L	0.01	0.1[#1]	0.4[#9]	-	-	<0.01	-	-	-	<0.01	-
1,2,4-trichlorobenzene	µg/L	0.01	0.1[#1]	0.4[#9]	-	-	<0.01	-	-	-	<0.01	-
Hexachlorobutadiene	µg/L	0.01	0.1[#1]	0.6[#6]	-	-	<0.01	-	-	-	<0.01	-
1,2,3-trichlorobenzene	µg/L	0.01	0.1[#1]	0.4[#9]	-	-	<0.01	-	-	-	<0.01	-
Pentachlorophenol	µg/L	0.04	9[#3]	0.4[#8]	<0.02	<0.02	-	-	<0.02	<0.02	-	-
Hexachlorobenzene	µg/L	0.01	0.1[#1]	0.05[#6]	-	-	<0.01	-	-	-	<0.01	-
Dichloroacetic acid	µg/L		1.5[#10]		-	-	-	-	-	-	-	-
Aldrin	µg/L	0.01	0.03[#1]	0.01[#8]	-	-	<0.01	-	-	-	<0.02	-
Chlorothalonil	µg/L	0.01	0.1[#1]	0.035[#7]	-	-	<0.01	-	-	-	<0.01	-
Chlordane (cis)	µg/L	0.01	0.1[#1]		-	-	<0.01	-	-	-	<0.01	-
Dieldrin	µg/L	0.01	0.03[#1]	0.01[#8]	-	-	<0.01	-	-	-	<0.02	-
Endrin	µg/L	0.02	0.1[#1]	0.01[#8]	-	-	<0.02	-	-	-	<0.04	-
Heptachlor	µg/L	0.01	0.03[#1]		-	-	<0.01	-	-	-	<0.02	-
Isodrin	µg/L	0.01	0.1[#1]	0.01[#8]	-	-	<0.01	-	-	-	<0.02	-
o,p-DDD	µg/L	0.01			-	-	<0.01	-	-	-	<0.02	-
DDD	µg/L	0.01	0.1[#1]		-	-	<0.01	-	-	-	<0.02	-
Pendimethalin	µg/L	0.01	0.1[#1]	0.3[#7]	-	-	<0.01	-	-	-	<0.01	-
Pentachloronitrobenzene	µg/L	0.01	0.1[#1]		-	-	<0.01	-	-	-	<0.01	-
Tecnazene	mg/L	0.00001	0.0001[#1]	0.001[#12]	-	-	<0.00001	-	-	-	<0.00001	-
Telodrin	mg/L	0.00001	0.0001[#1]		-	-	<0.00001	-	-	-	<0.00001	-
Chlordane (trans)	µg/L	0.01	0.1[#1]		-	-	<0.01	-	-	-	<0.01	-
Triadimefon	µg/L	0.01	0.1[#1]		-	-	<0.01	-	-	-	<0.01	-
Triallate	µg/L	0.01	0.1[#1]	0.25[#12]	-	-	<0.01	-	-	-	<0.01	-
Trifluralin	µg/L	0.01	0.1[#1]	0.03[#8]	-	-	<0.01	-	-	-	<0.02	-
d-BHC	µg/L	0.05			-	-	<0.05	-	-	-	<0.1	-
Azinphos Ethyl	µg/L	0.02	0.1[#1]		-	-	<0.02	-	-	-	<0.02	-
Azinophos methyl	µg/L	0.02	0.1[#1]	0.01[#12]	-	-	<0.02	-	-	-	<0.02	-
Carbophenothion	µg/L	0.01	0.1[#1]		-	-	<0.01	-	-	-	<0.01	-
Chlorfenvinphos	µg/L	0.01	0.1[#1]	0.1[#8]	-	-	<0.01	-	-	-	<0.01	-
Chlorpyrifos	µg/L	0.01	0.1[#1]	0.03[#8]	-	-	<0.01	-	-	-	<0.01	-
Chlorpyrifos-methyl	µg/L	0.01	0.1[#1]		-	-	<0.01	-	-	-	<0.01	-
Diazinon	µg/L	0.01	0.1[#1]	0.01[#7]	-	-	<0.01	-	-	-	<0.01	-
Dichlorvos	µg/L	0.01	0.1[#1]		-	-	<0.01	-	-	-	<0.01	-
Dimethoate	µg/L	0.01	0.1[#1]	0.48[#7]	-	-	<0.01	-	-	-	<0.01	-
Ethion	µg/L	0.01	0.1[#1]		-	-	<0.01	-	-	-	<0.01	-
Parathion	µg/L	0.01	0.1[#1]		-	-	<0.01	-	-	-	<0.01	-
Etrimphos	mg/L	0.00001	0.0001[#1]		-	-	<0.00001	-	-	-	<0.00001	-
Fenitrothion	µg/L	0.01	0.1[#1]	0.01[#12]	-	-	<0.01	-	-	-	<0.01	-
Fenthion	µg/L	0.01	0.1[#1]		-	-	<0.01	-	-	-	<0.01	-
Malathion	µg/L	0.01	0.1[#1]	0.01[#12]	-	-	<0.01	-	-	-	<0.01	-
Methyl parathion	µg/L	0.01	0.1[#1]		-	-	<0.01	-	-	-	<0.01	-
Mevinphos (Phosdrin)	µg/L	0.01	0.1[#1]	0.02[#11]	-	-	<0.01	-	-	-	<0.01	-
Phosalone	mg/L	0.00001	0.0001[#1]		-	-	<0.00001	-	-	-	<0.00001	-
Pirimiphos-methyl	µg/L	0.01	0.1[#1]	0.015[#12]	-	-	<0.01	-	-	-	<0.01	-
Propetamphos	mg/L	0.00001	0.0001[#1]	0.00003[#12]	-	-	<0.00001	-	-	-	<0.00001	-
Triazophos	mg/L	0.00001	0.0001[#1]	0.000005[#12]	-	-	<0.00001	-	-	-	<0.00001	-
Coumaphos	µg/L	0.01	0.1[#1]	0.03[#12]	-	-	<0.01	-	-	-	<0.01	-
Disulfoton	µg/L	0.01	0.1[#1]		-	-	<0.01	-	-	-	<0.01	-
Omethoate	µg/L	0.01	0.1[#1]	0.01[#12]	-	-	<0.01	-	-	-	<0.01	-
Phorate	µg/L	0.01	0.1[#1]		-	-	<0.01	-	-	-	<0.01	-
Demeton-S-methyl	µg/L	0.01	0.1[#1]		-	-	<0.01	-	-	-	<0.01	-
Benazolin	µg/L				<0.02	<0.02	-	-	<0.02	<0.02	-	-
Bentazone	µg/L	0.04	500[#3]	500[#12]	<0.02	<0.02	-	-	<0.02	<0.02	-	-
Bromoxynil	µg/L	0.04	0.61[#10]	100[#12]	<0.02	<0.02	-	-	<0.02	<0.02	-	-
Clopyralid	µg/L	0.04			<0.02	<0.02	-	-	<0.02	<0.02	-	-
Hedonal	µg/L	0.04	30[#3]	0.3[#7]	-	-	-	-	-	-	-	-
2,4-DB	µg/L				-	-	-	-	-	-	-	-
Dicamba	µg/L	0.04	570[#10]		<0.02	<0.02	-	-	<0.02	<0.02	-	-

GQRA (Groundwater Markeaton)
A38 Derby Junctions
Highways England

				Location	BM10				BM11			
				Monitoring_Unit	Made Ground / Alluvium / Mercia Mudstone				Made Ground / Alluvium / Mercia Mudstone			
				Date	18/01/2018	14/02/2018	14/03/2018	19/04/2018	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Parameter	**Units**	**Method Detection Limit**	**GAC (DWS)**	**GAC (EQS-Fresh)**								
2,4-Dichlorprop	µg/L		$100^{\#3}$		<0.02	<0.02	-	-	<0.02	<0.02	-	-
2,4,5-TP (Silvex)	µg/L	0.04	$110^{\#10}$		-	-	-	-	-	-	-	-
Actril (Ioxynil)	mg/L	0.00004		$0.01^{\#12}$	<0.00002	<0.00002	-	-	<0.00002	<0.00002	-	-
2-Methyl-4-chlorophenoxyacetic acid	µg/L	0.04	$700^{\#3}$	$12^{\#12}$	<0.02	<0.02	-	-	<0.02	<0.02	-	-
2-Methyl-4-Chlorophenoxy Butanoic Acid	µg/L	0.04	$65^{\#10}$		<0.02	<0.02	-	-	<0.02	<0.02	-	-
2,4,5-Trichlorophenoxy Acetic Acid	µg/L	0.04	$9^{\#3}$		<0.02	<0.02	-	-	<0.02	<0.02	-	-
Triclopyr	µg/L	0.04			<0.02	<0.02	-	-	<0.02	<0.02	-	-
Atrazine	µg/L	0.01	$0.1^{\#1}$	$0.6^{\#8}$	-	-	<0.01	-	-	-	<0.01	-
Simazine	µg/L	0.01	$0.1^{\#1}$	$1^{\#8}$	-	-	<0.01	-	-	-	<0.01	-
2,3,6-Trichlorobenzoic acid	µg/L				-	<0.02	-	-	-	<0.02	-	-
2,3,6-Trichlorophenol	µg/L				<0.02	-	-	-	<0.02	-	-	-
4-(2,4-Dichlorophenoxy)butyric Acid (2,4-DB)	µg/L	0.04	$450^{\#10}$		<0.02	<0.02	-	-	<0.02	<0.02	-	-
Cyanazine	µg/L	0.01	$0.1^{\#1}$		-	-	<0.01	-	-	-	<0.01	-
Dichlobenil	µg/L	0.01	$0.1^{\#1}$		-	-	<0.01	-	-	-	<0.01	-
Fluroxypyr	µg/L	0.04			<0.02	<0.02	-	-	<0.02	<0.02	-	-
Mecoprop	µg/L		$10^{\#3}$	$18^{\#7}$	<0.02	<0.02	-	-	<0.02	<0.02	-	-
Metachlor	µg/L	0.01	$0.1^{\#1}$	$0.3^{\#8}$	-	-	<0.01	-	-	-	<0.01	-
Prometryn	µg/L	0.01	$0.1^{\#1}$		-	-	<0.01	-	-	-	<0.01	-
Pronamide	µg/L	0.01	$0.1^{\#1}$	$100^{\#12}$	-	-	<0.01	-	-	-	<0.01	-
Propazine	µg/L	0.01	$0.1^{\#1}$		-	-	<0.01	-	-	-	<0.01	-
Terbutryn	µg/L	0.01	$0.1^{\#1}$		-	-	<0.01	-	-	-	<0.01	-
Fenoprop	µg/L		$9^{\#3}$		<0.02	<0.02	-	-	<0.02	<0.02	-	-
Etridiazole	µg/L	0.01	$0.1^{\#1}$		-	-	<0.01	-	-	-	<0.01	-
Metazachlor	µg/L	0.01	$0.1^{\#1}$		-	-	<0.01	-	-	-	<0.01	-
Pentachlorobenzene	µg/L	0.01	$0.1^{\#1}$	$0.007^{\#8}$	-	-	<0.01	-	-	-	<0.01	-
Propachlor	µg/L	0.01	$0.1^{\#1}$		-	-	<0.01	-	-	-	<0.01	-
Phosphamidon I	µg/L	0.01	$0.1^{\#1}$		-	-	<0.01	-	-	-	<0.01	-
Phosphamidon II	µg/L	0.01	$0.1^{\#1}$		-	-	<0.01	-	-	-	<0.01	-
VOC												
1,3,5-Trichlorobenzene	µg/L	1	$0.1^{\#1}$	$0.4^{\#9}$	<1	<1	<1	<1	<1	<1	<1	<1
Naphthalene	µg/L	1	$6^{\#15}$	$2^{\#8}$	<1	<1	<1	<1	<1	<1	<1	<1
Dichlorodifluoromethane	µg/L	1	$200^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
MTBE	µg/L	1	$1,800^{\#15}$	$5,100^{\#13}$	33.5	48.7	55.3	50.8	<1	<1	<1	<1
Chloromethane	µg/L	1	$190^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Vinyl chloride	µg/L	1	$0.5^{\#1}$	$77^{\#13}$	<1	<1	<1	<1	<1	<1	<1	<1
Bromomethane	µg/L	1	$7.5^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Chloroethane	µg/L	1	$21,000^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Trichlorofluoromethane	µg/L	1	$5,200^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethene	µg/L	1	$140^{\#3}$	$9^{\#13}$	<1	<1	<1	<1	<1	<1	<1	<1
Dichloromethane	µg/L	3	$20^{\#3}$	$20^{\#8}$	<3	<3	<3	<3	<3	<3	<3	<3
trans-1,2-dichloroethene	µg/L	1	$50^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloroethane	µg/L	1	$2.8^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
cis-1,2-dichloroethene	µg/L	1	$50^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
2,2-dichloropropane	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
Bromochloromethane	µg/L	1	$83^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Chloroform	µg/L	1	$100^{\#1}$	$2.5^{\#8}$	<1	<1	<1	<1	<1	<1	<1	<1
1,1,1-trichloroethane	µg/L	1	$2,000^{\#3}$	$100^{\#12}$	<1	<1	<1	<1	<1	<1	<1	<1
1,1-dichloropropene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
Carbon tetrachloride	µg/L	1	$3^{\#1}$	$12^{\#8}$	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloroethane	µg/L	1	$3^{\#1}$	$10^{\#8}$	<1	<1	<1	<1	<1	<1	<1	<1
Benzene	µg/L	1	$1^{\#1}$	$10^{\#8}$	<1	<1	<1	<1	<1	<1	<1	<1
Trichloroethene	µg/L	1	$10^{\#1}$	$10^{\#8}$	<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichloropropane	µg/L	1	$40^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
Dibromomethane	µg/L	1	$8.3^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Bromodichloromethane	µg/L	1	$100^{\#1}$		<1	<1	<1	<1	<1	<1	<1	<1
cis-1,3-dichloropropene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
Toluene	µg/L	1	$700^{\#3}$	$74^{\#7}$	<1	<1	<1	<1	<1	<1	<1	<1
trans-1,3-dichloropropene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
1,1,2-trichloroethane	µg/L	1	$0.28^{\#10}$	$400^{\#12}$	<1	<1	<1	<1	<1	<1	<1	<1
Tetrachloroethene	µg/L	1	$10^{\#1}$	$10^{\#8}$	<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichloropropane	µg/L	1	$370^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Chlorodibromomethane	µg/L	1	$100^{\#1}$		<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromoethane	µg/L	1	$0.4^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
Chlorobenzene	µg/L	1	$300^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
1,1,1,2-tetrachloroethane	µg/L	1	$0.57^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Ethylbenzene	µg/L	1	$300^{\#3}$	$20^{\#12}$	<1	<1	<1	<1	<1	<1	<1	<1

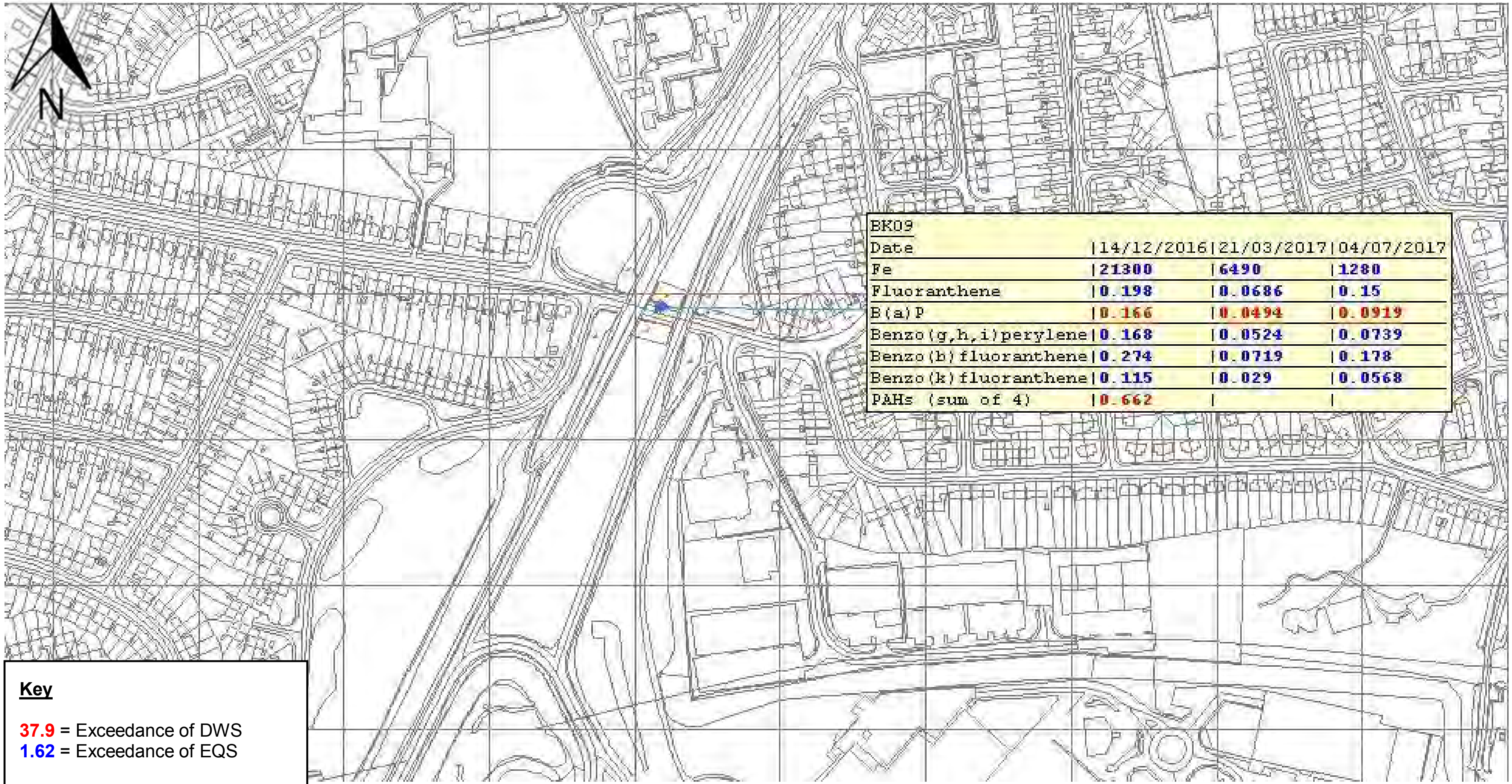
				Location	BM10				BM11			
				Monitoring_Unit	Made Ground / Alluvium / Mercia Mudstone				Made Ground / Alluvium / Mercia Mudstone			
				Date	18/01/2018	14/02/2018	14/03/2018	19/04/2018	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Parameter	**Units**	**Method Detection Limit**	**GAC (DWS)**	**GAC (EQS-Fresh)**								
Xylene (m & p)	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
Xylene (o)	µg/L	1	190$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Styrene	µg/L	1	20$^{\#3}$	**50$^{\#12}$**	<1	<1	<1	<1	<1	<1	<1	<1
Bromoform	µg/L	1	100$^{\#1}$		<1	<1	<1	<1	<1	<1	<1	<1
Isopropylbenzene	µg/L	1	450$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
1,1,2,2-tetrachloroethane	µg/L	1	0.076$^{\#10}$	**140$^{\#7}$**	<1	<1	<1	<1	<1	<1	<1	<1
Bromobenzene	µg/L	1	62$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichloropropane	µg/L	1	0.00075$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
n-propylbenzene	µg/L	1	660$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
2-chlorotoluene	µg/L	1	240$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
1,3,5-trimethylbenzene	µg/L	1	60$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
4-chlorotoluene	µg/L	1	250$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
tert-butylbenzene	µg/L	1	690$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trimethylbenzene	µg/L	1	56$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
sec-butylbenzene	µg/L	1	2,000$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
p-isopropyltoluene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
1,3-dichlorobenzene	µg/L	1			<1	<1	<1	<1	<1	<1	<1	<1
1,4-dichlorobenzene	µg/L	1	300$^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
n-butylbenzene	µg/L	1	1,000$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
1,2-dichlorobenzene	µg/L	1	1000$^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
1,2-dibromo-3-chloropropane	µg/L	1	1$^{\#3}$		<1	<1	<1	<1	<1	<1	<1	<1
1,2,4-trichlorobenzene	µg/L	1	0.1$^{\#1}$	**0.4$^{\#9}$**	<1	<1	<1	<1	<1	<1	<1	<1
Hexachlorobutadiene	µg/L	1	0.1$^{\#1}$	**0.6$^{\#6}$**	<1	<1	<1	<1	<1	<1	<1	<1
1,2,3-trichlorobenzene	µg/L	1	0.1$^{\#1}$	**0.4$^{\#9}$**	<1	<1	<1	<1	<1	<1	<1	<1
Carbon disulfide	µg/L	1	810$^{\#10}$		<1	<1	<1	<1	<1	<1	<1	<1
Tert Amyl Methyl Ether	µg/L	1		**510$^{\#13}$**	<1	<1	<1	<1	<1	<1	<1	<1

Comments
#1 WS Regs 2016 (Eng/Wal)
#2 WHO Petroleum DWG 2008
#3 WHO DWG 2017
#4 WHO 2017 - Taste
#5 WHO 2017 - Odour
#6 WFD England/Wales. 2015 - MAC-EQS Inland
#7 WFD England/Wales. 2015 - Freshwater Standards
#8 WFD England/Wales. 2015 - AA-EQS Inland
#9 Water Env't Regs (Scotland) 2015. AA-EQS Inland
#10 USEPA RSL (tapwater) [May 2019]
#11 SEPA WAT-SG-53 Fresh EQS - MAC - 2015
#12 SEPA WAT-SG-53 Fresh EQS - AA - 2015
#13 PNEC (EU REACH) - Freshwater
#14 California Draft health protective concentration
#15 AECOM DWG (WHO method)
GAC: Generic Assessment Criteria
(blank): No assessment criteria available
- : Not analysed

Key

XXX	Exceedance of GAC_WTV_EN/WA_DWS
XXX	Exceedance of GAC_WTV_EN/WA_EQS-Fresh

Appendix B – Exploratory Hole Locations Figures



BK09

Date	14/12/2016	21/03/2017	04/07/2017
Fe	21300	6490	1280
Fluoranthene	0.198	0.0686	0.15
B(a)P	0.166	0.0494	0.0919
Benzo(g,h,i)perylene	0.168	0.0524	0.0739
Benzo(b)fluoranthene	0.274	0.0719	0.178
Benzo(k)fluoranthene	0.115	0.029	0.0568
PAHs (sum of 4)	0.662		

Key

37.9 = Exceedance of DWS
1.62 = Exceedance of EQS

All concentrations are in µg/l

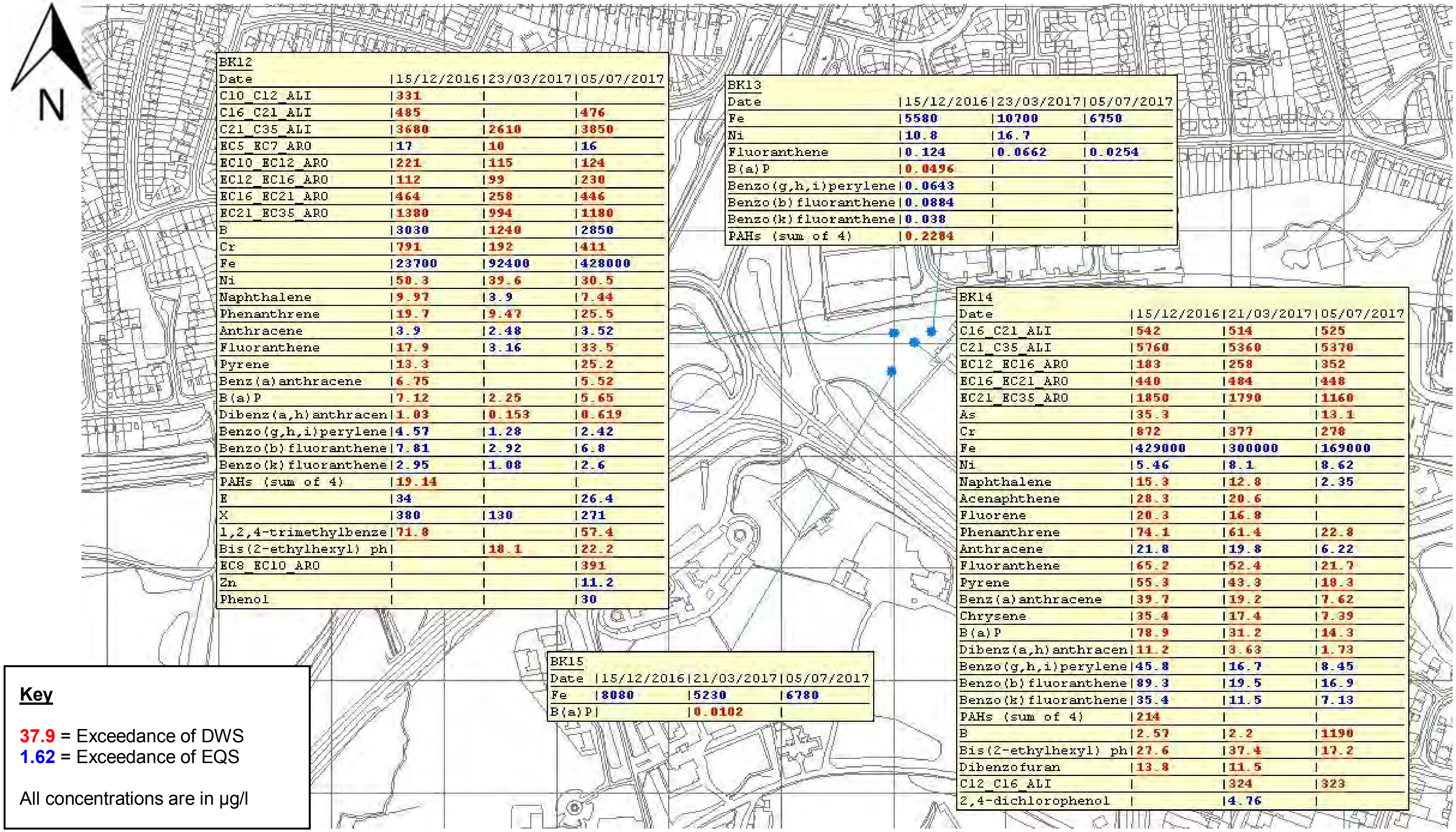
Figure 3 : Groundwater Exceedances (Kingsway North)

Project : A38 Derby Junctions

Project Number : 60533462

Date : 04/10/2019

AECOM



BK12

Date	15/12/2016	23/03/2017	05/07/2017
C10_C12_ALI	331		
C16_C21_ALI	485		476
C21_C35_ALI	3680	2610	3850
EC5_EC7_ARO	17	10	16
EC10_EC12_ARO	221	115	124
EC12_EC16_ARO	112	99	230
EC16_EC21_ARO	464	258	446
EC21_EC35_ARO	1380	994	1180
B	3030	1240	2850
Cr	791	192	411
Fe	23700	92400	428000
Ni	50.3	39.6	30.5
Naphthalene	9.97	3.9	7.44
Phenanthrene	19.7	9.47	25.5
Anthracene	3.9	2.48	3.52
Fluoranthene	17.9	3.16	33.5
Pyrene	13.3		25.2
Benz(a)anthracene	6.75		5.52
B(a)P	7.12	2.25	5.65
Dibenz(a,h)anthracen	1.03	0.153	0.619
Benzo(g,h,i)perylene	4.57	1.28	2.42
Benzo(b)fluoranthene	7.81	2.92	6.8
Benzo(k)fluoranthene	2.95	1.08	2.6
PAHs (sum of 4)	19.14		
E	34		26.4
X	380	130	271
1,2,4-trimethylbenze	71.8		57.4
Bis(2-ethylhexyl) ph		18.1	22.2
EC8_EC10_ARO			391
Zn			11.2
Phenol			30

BK13

Date	15/12/2016	23/03/2017	05/07/2017
Fe	5580	10700	6750
Ni	10.8	16.7	
Fluoranthene	0.124	0.0662	0.0254
B(a)P	0.0496		
Benzo(g,h,i)perylene	0.0643		
Benzo(b)fluoranthene	0.0884		
Benzo(k)fluoranthene	0.038		
PAHs (sum of 4)	0.2284		

BK14

Date	15/12/2016	21/03/2017	05/07/2017
C16_C21_ALI	542	514	525
C21_C35_ALI	5760	5360	5370
EC12_EC16_ARO	183	258	352
EC16_EC21_ARO	440	484	448
EC21_EC35_ARO	1850	1790	1160
As	35.3		13.1
Cr	872	377	278
Fe	429000	300000	169000
Ni	5.46	8.1	8.62
Naphthalene	15.3	12.8	2.35
Acenaphthene	28.3	20.6	
Fluorene	20.3	16.8	
Phenanthrene	74.1	61.4	22.8
Anthracene	21.8	19.8	6.22
Fluoranthene	65.2	52.4	21.7
Pyrene	55.3	43.3	18.3
Benz(a)anthracene	39.7	19.2	7.62
Chrysene	35.4	17.4	7.39
B(a)P	78.9	31.2	14.3
Dibenz(a,h)anthracen	11.2	3.63	1.73
Benzo(g,h,i)perylene	45.8	16.7	8.45
Benzo(b)fluoranthene	89.3	19.5	16.9
Benzo(k)fluoranthene	35.4	11.5	7.13
PAHs (sum of 4)	214		
B	2.57	2.2	1190
Bis(2-ethylhexyl) ph	27.6	37.4	17.2
Dibenzofuran	13.8	11.5	
C12_C16_ALI		324	323
2,4-dichlorophenol		4.76	

BK15

Date	15/12/2016	21/03/2017	05/07/2017
Fe	8080	5230	6780
B(a)P		0.0102	

Key

37.9 = Exceedance of DWS
1.62 = Exceedance of EQS

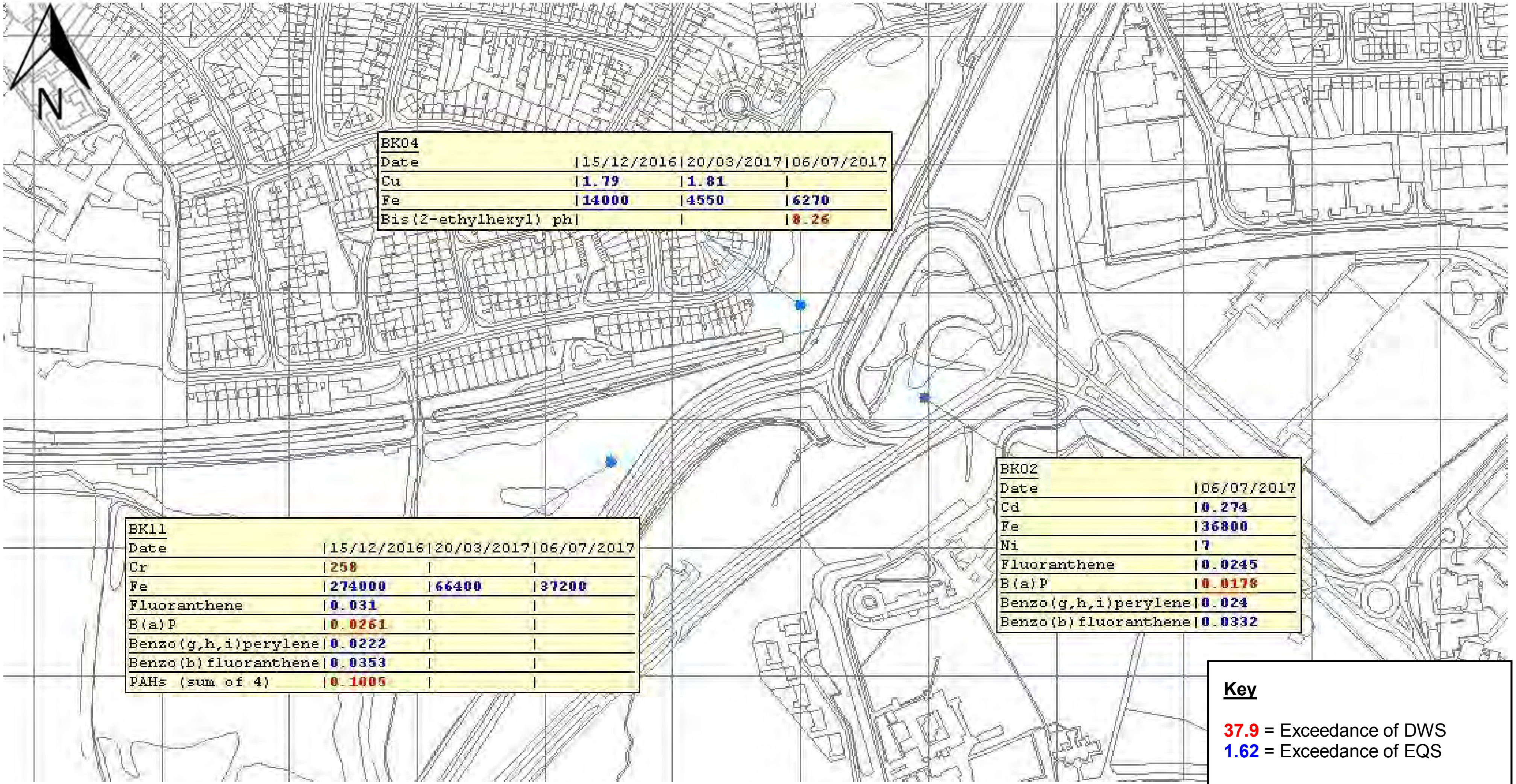
All concentrations are in µg/l

Figure 4 : Groundwater Exceedances (Kingsway East)

Project : A38 Derby Junctions

Project Number : 60533462

Date : 04/10/2019



BK04

Date	15/12/2016	20/03/2017	06/07/2017
Cu	1.79	1.81	
Fe	14000	4550	6270
Bis(2-ethylhexyl) ph			8.26

BK11

Date	15/12/2016	20/03/2017	06/07/2017
Cr	258		
Fe	274000	66400	37200
Fluoranthene	0.031		
B(a)P	0.0261		
Benzo(g,h,i)perylene	0.0222		
Benzo(b)fluoranthene	0.0353		
PAHs (sum of 4)	0.1005		

BK02

Date	06/07/2017
Cd	0.274
Fe	36800
Ni	7
Fluoranthene	0.0245
B(a)P	0.0178
Benzo(g,h,i)perylene	0.024
Benzo(b)fluoranthene	0.0332

Key

37.9 = Exceedance of DWS

1.62 = Exceedance of EQS

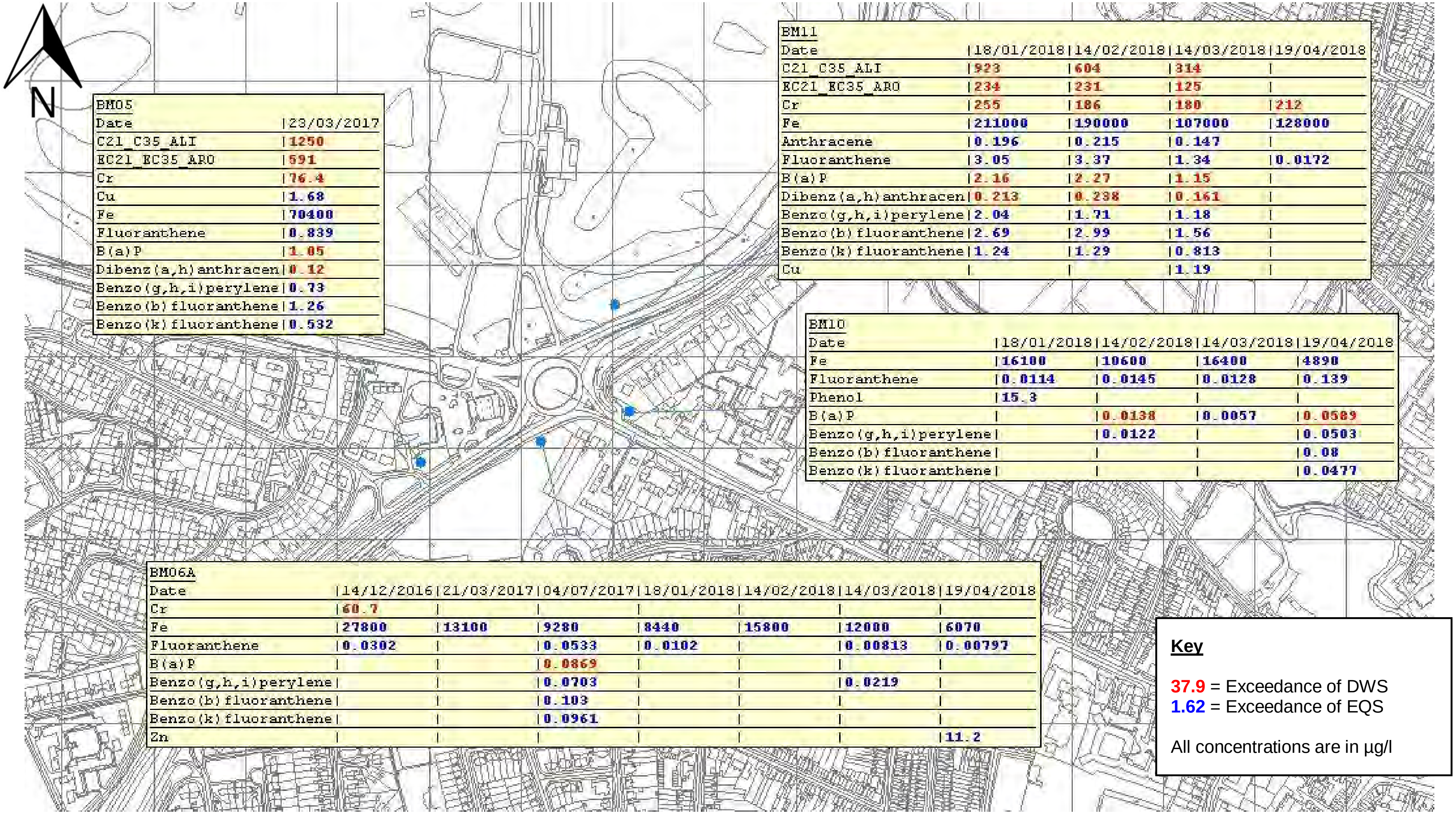
All concentrations are in µg/l

Figure 5 : Groundwater Exceedances (Kingsway South)

Project : A38 Derby Junctions

Project Number : 60533462

Date : 04/10/2019



BM05

Date	23/03/2017
C21_C35_ALI	1250
EC21_EC35_ARO	591
Cr	76.4
Cu	1.68
Fe	70400
Fluoranthene	0.839
B(a)P	1.05
Dibenz(a,h)anthracen	0.12
Benzo(g,h,i)perylene	0.73
Benzo(b)fluoranthene	1.26
Benzo(k)fluoranthene	0.532

BM11

Date	18/01/2018	14/02/2018	14/03/2018	19/04/2018
C21_C35_ALI	923	604	314	
EC21_EC35_ARO	234	231	125	
Cr	255	186	180	212
Fe	211000	190000	107000	128000
Anthracene	0.196	0.215	0.147	
Fluoranthene	3.05	3.37	1.34	0.0172
B(a)P	2.16	2.27	1.15	
Dibenz(a,h)anthracen	0.213	0.238	0.161	
Benzo(g,h,i)perylene	2.04	1.71	1.18	
Benzo(b)fluoranthene	2.69	2.99	1.56	
Benzo(k)fluoranthene	1.24	1.29	0.813	
Cu			1.19	

BM10

Date	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Fe	16100	10600	16400	4890
Fluoranthene	0.0114	0.0145	0.0128	0.139
Phenol	15.3			
B(a)P		0.0138	0.0057	0.0589
Benzo(g,h,i)perylene		0.0122		0.0503
Benzo(b)fluoranthene				0.08
Benzo(k)fluoranthene				0.0477

BM06A

Date	14/12/2016	21/03/2017	04/07/2017	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Cr	60.7						
Fe	27800	13100	9280	8440	15800	12000	6070
Fluoranthene	0.0302		0.0533	0.0102		0.00813	0.00797
B(a)P			0.0869				
Benzo(g,h,i)perylene			0.0703			0.0219	
Benzo(b)fluoranthene			0.103				
Benzo(k)fluoranthene			0.0961				
Zn							11.2

Key

37.9 = Exceedance of DWS
1.62 = Exceedance of EQS

All concentrations are in µg/l

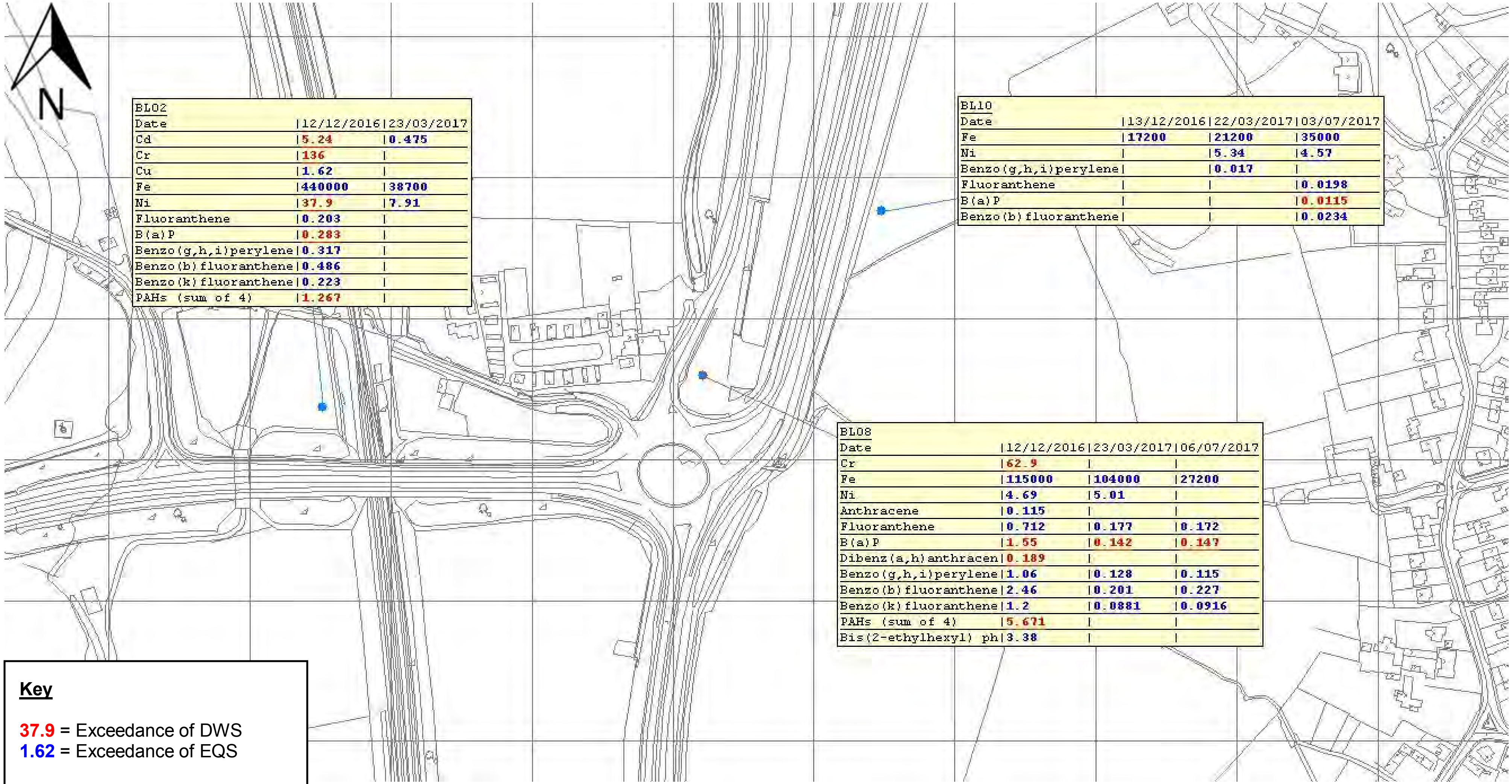
Figure 2 : Groundwater Exceedances (Markeaton)

Project : A38 Derby Junctions

Project Number : 60533462

Date : 13/11/2019

AECOM



BL02

Date	12/12/2016	23/03/2017
Cd	5.24	0.475
Cr	136	
Cu	1.62	
Fe	440000	38700
Ni	37.9	7.91
Fluoranthene	0.203	
B(a)P	0.283	
Benzo(g,h,i)perylene	0.317	
Benzo(b)fluoranthene	0.486	
Benzo(k)fluoranthene	0.223	
PAHs (sum of 4)	1.267	

BL10

Date	13/12/2016	22/03/2017	03/07/2017
Fe	17200	21200	35000
Ni		5.34	4.57
Benzo(g,h,i)perylene		0.017	
Fluoranthene			0.0198
B(a)P			0.0115
Benzo(b)fluoranthene			0.0234

BL08

Date	12/12/2016	23/03/2017	06/07/2017
Cr	62.9		
Fe	115000	104000	27200
Ni	4.69	5.01	
Anthracene	0.115		
Fluoranthene	0.712	0.177	0.172
B(a)P	1.55	0.142	0.147
Dibenz(a,h)anthracen	0.189		
Benzo(g,h,i)perylene	1.06	0.128	0.115
Benzo(b)fluoranthene	2.46	0.201	0.227
Benzo(k)fluoranthene	1.2	0.0881	0.0916
PAHs (sum of 4)	5.671		
Bis(2-ethylhexyl) ph	3.38		

Key

37.9 = Exceedance of DWS
1.62 = Exceedance of EQS

All concentrations are in µg/l

Figure 1 : Groundwater Exceedances (Little Eaton)

Project : A38 Derby Junctions

Project Number : 60533462

Date : 04/10/2019

AECOM

Appendix C – Kingsway Junction RTM DQRA Made Ground

RTM - Hydrogeological Risk Assessment

Project Number	60533462
Project Title	A38 Derby Kingsway Junction
Date	18-Nov-19

Simulation Details	Analysis of potential migration of Contaminants in Made Ground Groundwater to Bramble Brook.

RTM - Hydrogeological Risk Assessment

LEVEL 3 (GROUNDWATER) ASSESSMENT - INPUTS & JUSTIFICATION

Project Number	60533462	
Project Title	A38 Derby Kingsway Junction	
Date	18-Nov-19	

Simulation Details	Analysis of potential migration of Contaminants in Made Ground Groundwater to Bramble Brook.

Source	Contaminants in the groundwater onsite		
Parameter	**Units**	**Input Value(s)**	**Source / Justification**
Saturated aquifer thickness	m	2.5	Assuming average Made Ground groundwater level of 6.62m bgl together with average proven base of Made Ground (9.12m)
Width of plume in aquifer	m	360	Length of the landfill perpendicular to the groundwater flow
Plume thickness at source	m	2.3	Average thickness of Made Ground
Bulk density of aquifer materials	g/cm^3	1.79	No site data available majority of strata is Clay, bulk density based on Brady, N.C., 1984. The nature and properties of soils.
Effective porosity of aquifer	fraction	0.1	Effective Porosity for Clay from Domenico & Schwartz, 1989
Hydraulic gradient	fraction	0.14	Calculated from the Groundwater levels in BH14 and BH15 in Made Ground
Hydraulic conductivity of aquifer	m/d	0.1944	Hydraulic conductivity value for Clay (Fetter 1986), most conservative value used
Fraction of Organic Carbon	fraction	25	Mean value from site data of TOC from landfill boreholes from ESG chemical data
Distance to compliance point	m	150	Distance between the former Landfill (Rowditch Tip) and Bramble Brook
Time since pollutant entered groundwater	days	9.90E+99	EA RTM recommended value
Longitudinal dispersivity	m	1.5	10% of pathway length
Transverse dispersivity	m	0.15	1% of pathway length

CONTAMINANT SPECIFIC INPUTS

Project Number	60533462
Project Title	A38 Derby Kingsway Junction
Date	17-Nov-19

Simulation Details	Analysis of potential migration of Contaminants in Made Ground Groundwater to Bramble Brook.

Determinand	Henry's Law Constant	Source	Soil-Water Partition Coefficient	Source	Organic carbon partition coefficient	Source	Half-Life of Contaminant in Groundwater	Source	Initial Contaminant Concentration in Groundwater Plume	Source
	dimensionless		l/kg		l/kg		days		µg/l	
Nickel	-	-	2000	CLEA UK	-	-	1.00E+09	No degradation	5.03E+01	Maximum concentration recorded during groundwater monitoring
Zinc	-	-	36	cc calc	-	-	1.00E+09	No degradation	1.12E+01	Maximum concentration recorded during groundwater monitoring
>EC5-7 Aromatics	2.30E-01	CC	-	-	6.76E+01	LQ	5.00E+01	(2) URS/EA	17	Maximum concentration recorded during groundwater monitoring
Benzene	1.16E-01	SR7	-	-	6.76E+01	SR7	5.00E+01	(1) EA	2.42E+01	Maximum concentration recorded during groundwater monitoring
Xylene	1.04E+01	SR7	-	-	4.54E+02	SR7	5.00E+02	(1) EA	3.80E+02	Maximum concentration recorded during groundwater monitoring
Bis(2-ethylhexyl)phthalate	5.33E-05	CC	-	-	8.74E+04	cb	5.00E+03	(4)A&H/URS	37.6	Maximum concentration recorded during groundwater monitoring
Naphthalene	6.62E-03	SR7	-	-	6.46E+02	LQ	2.00E+02	(1) EA; (3) URS/PAHs	1.07E+01	Maximum concentration recorded during groundwater monitoring
Anthracene	1.81E-04	LQ	-	-	5.62E+03	LQ	6.00E+03	(3) URS/PAHs	2.18E+01	Maximum concentration recorded during groundwater monitoring
Fluoranthene	6.29E-05	SR7	-	-	1.82E+04	LQ	10,000	(3) URS/PAHs	6.52E+01	Maximum concentration recorded during groundwater monitoring
Benzo(a)pyrene	1.76E-06	SR7	-	-	1.29E+05	LQ	50,000	(3) URS/PAHs	78.90	Maximum concentration recorded during groundwater monitoring
Benzo(g,h,i)perylene	2.86E-06	LQ	-	-	4.17E+05	LQ	50,000	(3) URS/PAHs	45.80	Maximum concentration recorded during groundwater monitoring
Benzo(b) fluoranthene	2.05E-06	SR7	-	-	1.05E+05	LQ	50,000	(3) URS/PAHs	89.30	Maximum concentration recorded during groundwater monitoring
Benzo(k) fluoranthene	1.74E-06	SR7	-	-	1.48E+05	LQ	50,000	(3) URS/PAHs	0.36	Maximum concentration recorded during groundwater monitoring
2,4-Dichlorophenol	5.51E-06				1.57E+03		1,000,000,000	No degradation	4.76	Maximum concentration recorded during groundwater monitoring

Key to sources	
a	Buss et al (2004), A Review of Ammonium Attenuation in Soil and Groundwater
c	US EPA 2003 User's Guide for Evaluating Subsurface Vapour Intrusion into Buildings
cb	www.toxnet.nlm.nih.gov
CC	h calc, compensated to 10C using Clausius-Claeyron relationship
cc	2001, USEPA, Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, Peer Review Draft.
calc	US EPA 2001, Factsheet: Correcting the Henry's Law Constant for Soil Temperature, June 2001
ce	Baes.C.F., Sharp R.D., Sjoreen A.L., Shor R.W., (1984) A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture,
	Oak Ridge National laboratory for the US DoE
k	Review of the Fate and Transport of Selected Contaminants in the Soil Environment, Draft R&D Technical Report P5-079/TR1
LQ	LQM/CIEH 2009, Tremperature corrected to 10oC
SR7	Science Report – SC050021/SR7

EPI The EPI (**Estimation Programs Interface**) Suite^{TM} is a Windows-based suite of physical/chemical property and environmental fate estimation programs developed by the EPA\'s Office of Pollution Prevention Toxics and Syracuse Research Corporation (SRC).

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**13-Nov-19**		**Version:**	**3.2**
Contaminant	**2,4 Dichlorophenol**			
Target Concentration (C_T)	**0.0042**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**2,4 Dicholorophenol**		from Level 1
Target Concentration	C_T	**4.20E-03**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	4.76E-03	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+09	days	*See Justification Table*
Calculated decay rate	λ	6.93E-10	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.93E+02	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	7.03E+03	fraction
Decay rate used	λ	6.93E-10	d^{-1}
Rate of contaminant flow due to retardation	u	3.87E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.27E-03	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.74E+00**	

Remedial Targets

Remedial Target		**1.57E-02**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**1.27E-03**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	1.57E+03	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc.n}$		l/kg
Sorption coefficient for ionised species	$K_{oc.i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.93E+02	l/kg

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

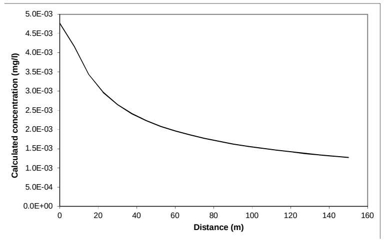
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	1.50E+01	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	1.50E+00	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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:	Kingsway Junction
Completed by:	Lucy Full
Date:	13/11/2019
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**4.8E-03**
7.5	**4.16E-03**
15.0	**3.43E-03**
22.5	**2.97E-03**
30.0	**2.65E-03**
37.5	**2.41E-03**
45.0	**2.23E-03**
52.5	**2.08E-03**
60.0	**1.96E-03**
67.5	**1.86E-03**
75.0	**1.77E-03**
82.5	**1.69E-03**
90.0	**1.63E-03**
97.5	**1.57E-03**
105.0	**1.51E-03**
112.5	**1.46E-03**
120.0	**1.42E-03**
127.5	**1.38E-03**
135.0	**1.34E-03**
142.5	**1.31E-03**
150.0	**1.27E-03**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**01-Mar-17**		**Version:**	**3.2**
Contaminant	**Anthracene**			
Target Concentration (C_T)	**0.0001**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Anthracene**		from Level 1
Target Concentration	C_T	**1.00E-04**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	2.18E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	6.00E+03	days	*See Justification Table*
Calculated decay rate	λ	1.16E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.41E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	2.52E+04	fraction
Decay rate used	λ	1.16E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.08E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	8.65E-56	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**2.52E+53**	

Remedial Targets

Remedial Target		**2.52E+49**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**8.65E-56**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	5.62E+03	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	1.41E+03	l/kg

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

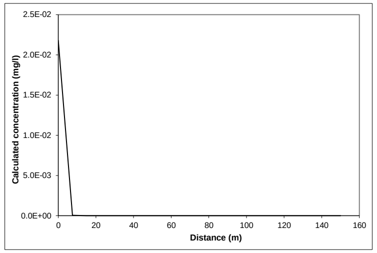
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**2.2E-02**
7.5	**4.35E-05**
15.0	**8.20E-08**
22.5	**1.62E-10**
30.0	**3.30E-13**
37.5	**6.86E-16**
45.0	**1.45E-18**
52.5	**3.08E-21**
60.0	**6.63E-24**
67.5	**1.43E-26**
75.0	**3.12E-29**
82.5	**6.82E-32**
90.0	**1.49E-34**
97.5	**3.29E-37**
105.0	**7.24E-40**
112.5	**1.60E-42**
120.0	**3.54E-45**
127.5	**7.86E-48**
135.0	**1.75E-50**
142.5	**3.88E-53**
150.0	**8.65E-56**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**01-Mar-17**		**Version:**	**3.2**
Contaminant	**Benzene**			
Target Concentration (C_T)	**0.01**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Input Parameters	Variable	Value	Unit	Source
Contaminant		Benzene		from Level 1
Target Concentration	C_T	1.00E-02	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

Parameter	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.42E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+01	days	*See Justification Table*
Calculated decay rate	λ	1.39E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.69E+01	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

Calculated Parameters	Variable	Value	Unit
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	3.04E+02	fraction
Decay rate used	λ	1.39E-02	d^{-1}
Rate of contaminant flow due to retardation	u	8.97E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.48E-67	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.73E+64**	

Remedial Targets

Remedial Target	**3.73E+62**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks			

Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**6.48E-67**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	6.76E+01	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	1.69E+01	l/kg

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

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

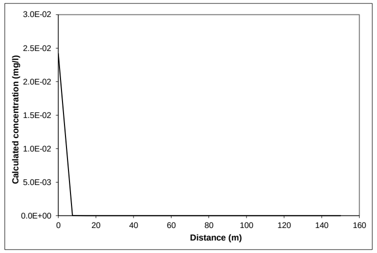
		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-02	

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

Environment Agency



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

Note

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

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

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

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

Site being assessed:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	2.4E-02
7.5	1.34E-05
15.0	6.95E-09
22.5	3.79E-12
30.0	2.13E-15
37.5	1.23E-18
45.0	7.15E-22
52.5	4.22E-25
60.0	2.50E-28
67.5	1.50E-31
75.0	9.00E-35
82.5	5.43E-38
90.0	3.29E-41
97.5	2.00E-44
105.0	1.22E-47
112.5	7.44E-51
120.0	4.55E-54
127.5	2.79E-57
135.0	1.71E-60
142.5	1.05E-63
150.0	6.48E-67

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**01-Mar-17**		**Version:**	**3.2**
Contaminant	**Benzo(a)pyrene**			
Target Concentration (C_T)	**0.00000017**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Benzo(a)pyrene**		from Level 1
Target Concentration	C_T	**1.70E-07**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	7.89E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+04	days	*See Justification Table*
Calculated decay rate	λ	1.39E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.23E+04	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	5.77E+05	fraction
Decay rate used	λ	1.39E-05	d^{-1}
Rate of contaminant flow due to retardation	u	4.71E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.82E-91	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**4.33E+89**	

Remedial Targets

Remedial Target		**7.36E+82**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**1.82E-91**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	1.29E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.23E+04	l/kg

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

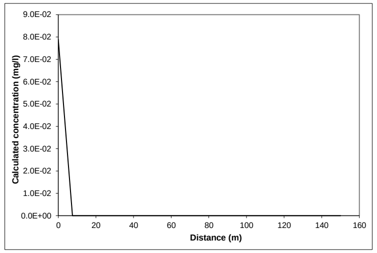
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**7.9E-02**
7.5	**2.43E-06**
15.0	**7.06E-11**
22.5	**2.15E-15**
30.0	**6.76E-20**
37.5	**2.17E-24**
45.0	**7.05E-29**
52.5	**2.32E-33**
60.0	**7.70E-38**
67.5	**2.57E-42**
75.0	**8.62E-47**
82.5	**2.90E-51**
90.0	**9.82E-56**
97.5	**3.33E-60**
105.0	**1.13E-64**
112.5	**3.86E-69**
120.0	**1.32E-73**
127.5	**4.51E-78**
135.0	**1.55E-82**
142.5	**5.30E-87**
150.0	**1.82E-91**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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

Liability: The Environment Agency does not promise that the worksheet will provide any particular facilities or functions. You must ensure that the worksheet meets your needs and you remain solely responsible for the competent use of the worksheet. You are entirely responsible for the consequences of any use of the worksheet and the Agency provides no warranty about the fitness for purpose or performance of any part of the worksheet. We do not promise that the media will always be free from defects, computer viruses, software locks or other similar code or that the operation of the worksheet will be uninterrupted or error free. You should carry out all necessary virus checks prior to installing on your computing system.

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**01-Mar-17**		**Version:**	**3.2**
Contaminant	**Benzo(b)fluoranthene**			
Target Concentration (C_T)	**0.000017**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Benzo(b)fluoranthene**		from Level 1
Target Concentration	C_T	**1.70E-05**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	8.93E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+04	days	*See Justification Table*
Calculated decay rate	λ	1.39E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.63E+04	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	4.70E+05	fraction
Decay rate used	λ	1.39E-05	d^{-1}
Rate of contaminant flow due to retardation	u	5.79E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.71E-82	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**5.23E+80**	

Remedial Targets

Remedial Target		**8.89E+75**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**1.71E-82**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	1.05E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	2.63E+04	l/kg

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

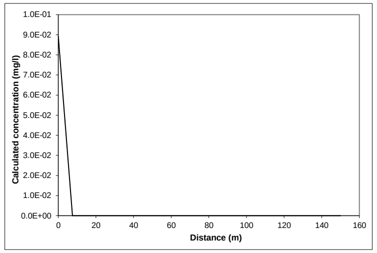
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**8.9E-02**
7.5	**7.68E-06**
15.0	**6.23E-10**
22.5	**5.30E-14**
30.0	**4.65E-18**
37.5	**4.16E-22**
45.0	**3.78E-26**
52.5	**3.47E-30**
60.0	**3.22E-34**
67.5	**3.00E-38**
75.0	**2.81E-42**
82.5	**2.64E-46**
90.0	**2.49E-50**
97.5	**2.36E-54**
105.0	**2.24E-58**
112.5	**2.13E-62**
120.0	**2.03E-66**
127.5	**1.94E-70**
135.0	**1.86E-74**
142.5	**1.78E-78**
150.0	**1.71E-82**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**01-Mar-17**		**Version:**	**3.2**
Contaminant	**Benzo(g,h,i)perylene**			
Target Concentration (C_T)	**0.0000082**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Benzo(g,h,i)perylene**		from Level 1
Target Concentration	C_T	**8.20E-06**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	4.58E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+04	days	*See Justification Table*
Calculated decay rate	λ	1.39E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.04E+05	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	1.87E+06	fraction
Decay rate used	λ	1.39E-05	d^{-1}
Rate of contaminant flow due to retardation	u	1.46E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.80E-164	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**2.54E+162**	

Remedial Targets

Remedial Target		**2.08E+157**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**1.80E-164**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	4.17E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	1.04E+05	l/kg

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

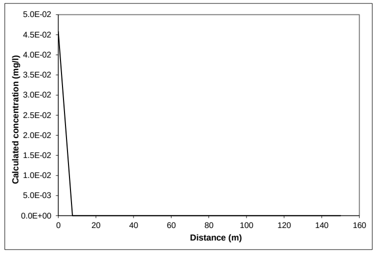
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**4.6E-02**
7.5	**3.24E-10**
15.0	**2.17E-18**
22.5	**1.52E-26**
30.0	**1.10E-34**
37.5	**8.08E-43**
45.0	**6.05E-51**
52.5	**4.58E-59**
60.0	**3.49E-67**
67.5	**2.68E-75**
75.0	**2.07E-83**
82.5	**1.60E-91**
90.0	**1.24E-99**
97.5	**9.70E-108**
105.0	**7.59E-116**
112.5	**5.94E-124**
120.0	**4.67E-132**
127.5	**3.67E-140**
135.0	**2.89E-148**
142.5	**2.28E-156**
150.0	**1.80E-164**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**01-Mar-17**		**Version:**	**3.2**
Contaminant	**Benzo(k)fluoranthene**			
Target Concentration (C_T)	**0.000017**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Benzo(k)fluoranthene**		from Level 1
Target Concentration	C_T	**1.70E-05**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	3.54E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+04	days	*See Justification Table*
Calculated decay rate	λ	1.39E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.70E+04	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	6.62E+05	fraction
Decay rate used	λ	1.39E-05	d^{-1}
Rate of contaminant flow due to retardation	u	4.11E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.68E-98	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.32E+96**	

Remedial Targets

Remedial Target		**2.25E+91**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**2.68E-98**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	1.48E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.70E+04	l/kg

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

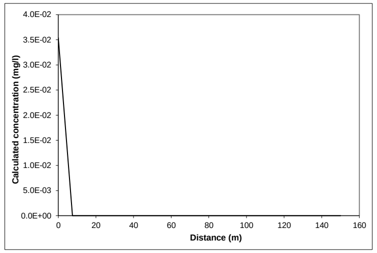
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**3.5E-02**
7.5	**5.17E-07**
15.0	**7.12E-12**
22.5	**1.03E-16**
30.0	**1.53E-21**
37.5	**2.33E-26**
45.0	**3.59E-31**
52.5	**5.60E-36**
60.0	**8.80E-41**
67.5	**1.39E-45**
75.0	**2.21E-50**
82.5	**3.53E-55**
90.0	**5.66E-60**
97.5	**9.11E-65**
105.0	**1.47E-69**
112.5	**2.37E-74**
120.0	**3.84E-79**
127.5	**6.23E-84**
135.0	**1.01E-88**
142.5	**1.64E-93**
150.0	**2.68E-98**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**11-Apr-17**		**Version:**	**3.2**
Contaminant	**Bis(2-ethylhexyl)phthalate**			
Target Concentration (C_T)	**1.30E-03**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Bis(2-ethylhexyl)phthalate		from Level 1
Target Concentration	C_T	1.30E-03	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.76E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+03	days	*See Justification Table*
Calculated decay rate	λ	1.39E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.79E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	3.21E+04	fraction
Decay rate used	λ	1.39E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.49E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.43E-68	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**2.63E+66**	

Remedial Targets

Remedial Target		**3.42E+63**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**1.43E-68**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.05E-02	fraction
Organic carbon partition coefficient	Koc	8.74E+04	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	1.79E+03	l/kg

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

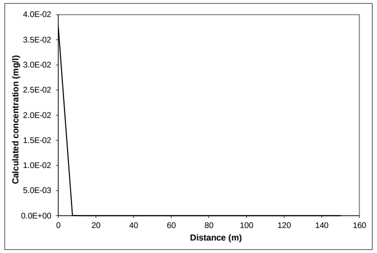
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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:	Kingsway Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	3.8E-02
7.5	1.68E-05
15.0	7.06E-09
22.5	3.11E-12
30.0	1.42E-15
37.5	6.58E-19
45.0	3.10E-22
52.5	1.48E-25
60.0	7.09E-29
67.5	3.43E-32
75.0	1.66E-35
82.5	8.12E-39
90.0	3.98E-42
97.5	1.95E-45
105.0	9.62E-49
112.5	4.75E-52
120.0	2.35E-55
127.5	1.16E-58
135.0	5.77E-62
142.5	2.87E-65
150.0	1.43E-68

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**01-Mar-17**		**Version:**	**3.2**
Contaminant	**>EC5 - 7 Aromatic**			
Target Concentration (C_T)	**0.001**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		>EC5 - 7 Aromatic		from Level 1
Target Concentration	C_T	1.00E-03	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.70E+01	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+01	days	*See Justification Table*
Calculated decay rate	λ	1.39E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.69E+01	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	3.04E+02	fraction
Decay rate used	λ	1.39E-02	d^{-1}
Rate of contaminant flow due to retardation	u	8.97E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.56E-64	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.73E+64**	

Remedial Targets

Remedial Target		**3.73E+61**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**4.56E-64**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	6.76E+01	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	1.69E+01	l/kg

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

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

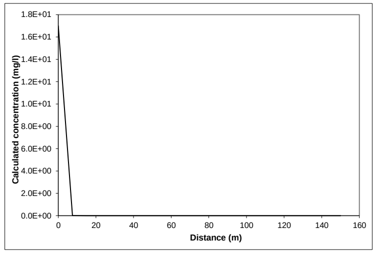
		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-02	

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

Environment Agency



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

Note

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

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

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

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

Site being assessed:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.7E+01**
7.5	**9.38E-03**
15.0	**4.88E-06**
22.5	**2.66E-09**
30.0	**1.50E-12**
37.5	**8.62E-16**
45.0	**5.03E-19**
52.5	**2.96E-22**
60.0	**1.76E-25**
67.5	**1.05E-28**
75.0	**6.32E-32**
82.5	**3.82E-35**
90.0	**2.31E-38**
97.5	**1.41E-41**
105.0	**8.56E-45**
112.5	**5.23E-48**
120.0	**3.20E-51**
127.5	**1.96E-54**
135.0	**1.20E-57**
142.5	**7.40E-61**
150.0	**4.56E-64**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**01-Mar-17**		**Version:**	**3.2**
Contaminant	**Fluoranthene**			
Target Concentration (C_T)	**0.0000063**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Fluoranthene**		from Level 1
Target Concentration	C_T	**6.30E-06**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	6.52E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+04	days	*See Justification Table*
Calculated decay rate	λ	6.93E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	4.55E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	8.14E+04	fraction
Decay rate used	λ	6.93E-05	d^{-1}
Rate of contaminant flow due to retardation	u	3.34E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.97E-77	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.09E+75**	

Remedial Targets

Remedial Target		**6.89E+69**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**5.97E-77**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	1.82E+04	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	4.55E+03	l/kg

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

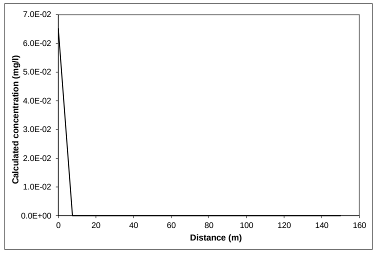
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**6.5E-02**
7.5	**1.08E-05**
15.0	**1.68E-09**
22.5	**2.75E-13**
30.0	**4.64E-17**
37.5	**7.99E-21**
45.0	**1.40E-24**
52.5	**2.47E-28**
60.0	**4.39E-32**
67.5	**7.87E-36**
75.0	**1.42E-39**
82.5	**2.56E-43**
90.0	**4.65E-47**
97.5	**8.48E-51**
105.0	**1.55E-54**
112.5	**2.83E-58**
120.0	**5.19E-62**
127.5	**9.54E-66**
135.0	**1.76E-69**
142.5	**3.23E-73**
150.0	**5.97E-77**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**01-Mar-17**		**Version:**	**3.2**
Contaminant	**Napthalene**			
Target Concentration (C_T)	**0.002**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Napthalene**		from Level 1
Target Concentration	**C_T**	**2.00E-03**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	1.07E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	2.00E+02	days	*See Justification Table*
Calculated decay rate	λ	3.47E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.62E+02	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

	Variable	Value	Unit
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	2.89E+03	fraction
Decay rate used	λ	3.47E-03	d^{-1}
Rate of contaminant flow due to retardation	u	9.41E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.41E-103	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.13E+100**	

Remedial Targets

Remedial Target		**6.27E+97**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**3.41E-103**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	6.46E+02	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	1.62E+02	l/kg

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

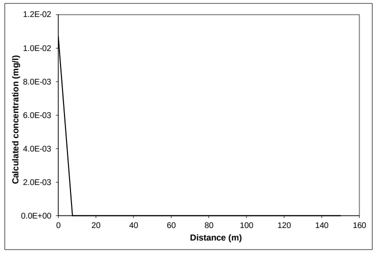
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.1E-02**
7.5	**9.44E-08**
15.0	**7.86E-13**
22.5	**6.85E-18**
30.0	**6.17E-23**
37.5	**5.67E-28**
45.0	**5.28E-33**
52.5	**4.98E-38**
60.0	**4.73E-43**
67.5	**4.52E-48**
75.0	**4.34E-53**
82.5	**4.19E-58**
90.0	**4.06E-63**
97.5	**3.94E-68**
105.0	**3.84E-73**
112.5	**3.75E-78**
120.0	**3.67E-83**
127.5	**3.60E-88**
135.0	**3.53E-93**
142.5	**3.47E-98**
150.0	**3.41E-103**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**18-Nov-19**		**Version:**	**3.2**
Contaminant	**Nickel**			
Target Concentration (C_T)	**0.004**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Nickel		from Level 1
Target Concentration	C_T	4.00E-03	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	5.03E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+09	days	*See Justification Table*
Calculated decay rate	λ	6.93E-10	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.00E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

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+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	2.00E+03	l/kg

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

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

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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

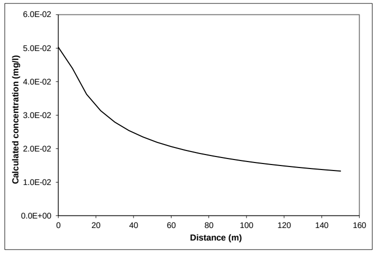
Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	3.58E+04	fraction
Decay rate used	λ	6.93E-10	d^{-1}
Rate of contaminant flow due to retardation	u	7.60E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.33E-02	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.78E+00**	

Remedial Targets

Remedial Target		**1.51E-02**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**1.33E-02**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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



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

Note

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

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

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

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

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

Site being assessed:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**5.0E-02**
7.5	**4.40E-02**
15.0	**3.63E-02**
22.5	**3.13E-02**
30.0	**2.79E-02**
37.5	**2.54E-02**
45.0	**2.35E-02**
52.5	**2.19E-02**
60.0	**2.06E-02**
67.5	**1.95E-02**
75.0	**1.86E-02**
82.5	**1.78E-02**
90.0	**1.71E-02**
97.5	**1.64E-02**
105.0	**1.58E-02**
112.5	**1.53E-02**
120.0	**1.49E-02**
127.5	**1.44E-02**
135.0	**1.40E-02**
142.5	**1.37E-02**
150.0	**1.33E-02**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**13-Nov-19**		**Version:**	**3.2**
Contaminant	**Xylene**			
Target Concentration (C_T)	**0.03**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Xylene**		from Level 1
Target Concentration	C_T	**3.00E-02**	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.80E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	6.00E+03	days	*See Justification Table*
Calculated decay rate	λ	1.16E-04	days^{-1}	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.41E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	2.52E+04	fraction
Decay rate used	λ	1.16E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.08E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.51E-55	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**2.52E+53**	

Remedial Targets

Remedial Target		**7.56E+51**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**1.51E-55**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	5.62E+03	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	1.41E+03	l/kg

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

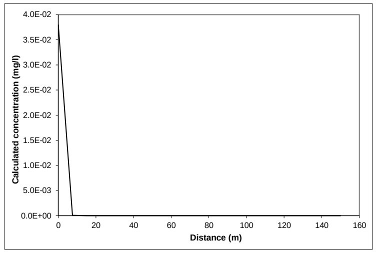
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**3.8E-02**
7.5	**7.59E-05**
15.0	**1.43E-07**
22.5	**2.82E-10**
30.0	**5.75E-13**
37.5	**1.19E-15**
45.0	**2.52E-18**
52.5	**5.38E-21**
60.0	**1.16E-23**
67.5	**2.50E-26**
75.0	**5.44E-29**
82.5	**1.19E-31**
90.0	**2.60E-34**
97.5	**5.73E-37**
105.0	**1.26E-39**
112.5	**2.79E-42**
120.0	**6.18E-45**
127.5	**1.37E-47**
135.0	**3.04E-50**
142.5	**6.77E-53**
150.0	**1.51E-55**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**18-Nov-19**		**Version:**	**3.2**
Contaminant	**Zinc**			
Target Concentration (C_T)	**1.09E-02**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Zinc		from Level 1
Target Concentration	C_T	1.09E-02	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.12E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+09	days	*See Justification Table*
Calculated decay rate	λ	6.93E-10	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.60E+01	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

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

User specified value for partition coefficient

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

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

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

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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

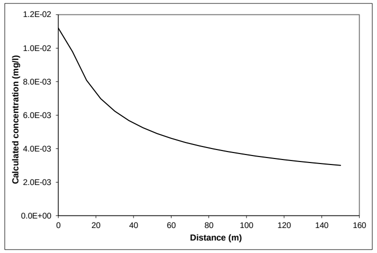
Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	6.45E+02	fraction
Decay rate used	λ	6.93E-10	d^{-1}
Rate of contaminant flow due to retardation	u	4.22E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.00E-03	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.73E+00**	

Remedial Targets

Remedial Target		**4.06E-02**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**3.00E-03**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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



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

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.1E-02**
7.5	**9.80E-03**
15.0	**8.08E-03**
22.5	**6.99E-03**
30.0	**6.23E-03**
37.5	**5.68E-03**
45.0	**5.25E-03**
52.5	**4.90E-03**
60.0	**4.62E-03**
67.5	**4.38E-03**
75.0	**4.17E-03**
82.5	**3.99E-03**
90.0	**3.83E-03**
97.5	**3.69E-03**
105.0	**3.56E-03**
112.5	**3.45E-03**
120.0	**3.34E-03**
127.5	**3.25E-03**
135.0	**3.16E-03**
142.5	**3.08E-03**
150.0	**3.00E-03**

Note

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

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

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

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

Site being assessed:	Kingsway Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Appendix D – Kingsway Junction RTM DQRA Natural Ground

RTM - Hydrogeological Risk Assessment

Project Number	60533462
Project Title	A38 Derby Kingsway Junction
Date	19-Nov-19

Simulation Details	Analysis of potential migration of Contaminants in Natural Ground Groundwater to Bramble Brook.

RTM - Hydrogeological Risk Assessment

LEVEL 3 (GROUNDWATER) ASSESSMENT - INPUTS & JUSTIFICATION

Project Number	60533462	
Project Title	A38 Derby Kingsway Junction	
Date	19-Nov-19	

Simulation Details	Analysis of potential migration of Contaminants in Natural Ground Groundwater to Bramble Brook.

Source	Contaminants in the groundwater onsite		
Parameter	**Units**	**Input Value(s)**	**Source / Justification**
Saturated aquifer thickness	m	2.5	Assuming average Made Ground groundwater level of 6.62m bgl together with average proven base of Made Ground (9.12m)
Width of plume in aquifer	m	360	Length of the landfill perpendicular to the groundwater flow
Plume thickness at source	m	8.92	Average thickness of Made Ground
Bulk density of aquifer materials	g/cm^3	1.79	No site data available majority of strata is Clay, bulk density based on Brady, N.C., 1984. The nature and properties of soils.
Effective porosity of aquifer	fraction	0.1	Effective Porosity for Clay from Domenico & Schwartz, 1989
Hydraulic gradient	fraction	0.14	Calculated from the Groundwater levels in BH14 and BH15 in Made Ground
Hydraulic conductivity of aquifer	m/d	0.1944	Hydraulic conductivity value for Clay (Fetter 1986), most conservative value used
Fraction of Organic Carbon	fraction	25	Mean value from site data of TOC from landfill boreholes from ESG chemical data
Distance to compliance point	m	30	Distance between BK02 and Bramble Brook minus 10m
Time since pollutant entered groundwater	days	9.90E+99	EA RTM recommended value
Longitudinal dispersivity	m	0.3	10% of pathway length
Transverse dispersivity	m	0.03	1% of pathway length

CONTAMINANT SPECIFIC INPUTS

Project Number	60533462
Project Title	A38 Derby Kingsway Junction
Date	19-Nov-19

Simulation Details	Analysis of potential migration of Contaminants in Natural Ground Groundwater to Bramble Brook.

Determinand	Henry's Law Constant	Source	Soil-Water Partition Coefficient	Source	Organic carbon partition coefficient	Source	Half-Life of Contaminant in Groundwater	Source	Initial Contaminant Concentration in Groundwater Plume	Source
	dimensionless		l/kg		l/kg		days		µg/l	
Cadmium	-	-	2560	CLEA UK	-	-	1.00E+09	No degradation	2.74E-01	Maximum concentration recorded during groundwater monitoring
Copper	-	-	35	ce	-	-	1.00E+09	No degradation	1.81E+00	Maximum concentration recorded during groundwater monitoring
Nickel	-	-	2000	CLEA UK	-	-	1.00E+09	No degradation	7.00E-03	Maximum concentration recorded during groundwater monitoring
Bis(2-ethylhexyl)phthalate	5.33E-05	CC	-	-	8.74E+04	cb	5.00E+03	(4)A&H/URS	8.26	Maximum concentration recorded during groundwater monitoring
Fluoranthene	6.29E-05	SR7	-	-	1.82E+04	LQ	10,000	(3) URS/PAHs	1.98E-01	Maximum concentration recorded during groundwater monitoring
Benzo(a)pyrene	1.76E-06	SR7	-	-	1.29E+05	LQ	50,000	(3) URS/PAHs	0.17	Maximum concentration recorded during groundwater monitoring
Benzo(g,h,i)perylene	2.86E-06	LQ	-	-	4.17E+05	LQ	50,000	(3) URS/PAHs	0.17	Maximum concentration recorded during groundwater monitoring
Benzo(b) fluoranthene	2.05E-06	SR7	-	-	1.05E+05	LQ	50,000	(3) URS/PAHs	0.27	Maximum concentration recorded during groundwater monitoring
Benzo(k) fluoranthene	1.74E-06	SR7	-	-	1.48E+05	LQ	50,000	(3) URS/PAHs	0.16	Maximum concentration recorded during groundwater monitoring

Key to sources	
a	Buss et al (2004), A Review of Ammonium Attenuation in Soil and Groundwater
c	US EPA 2003 User's Guide for Evaluating Subsurface Vapour Intrusion into Buildings
cb	www.toxnet.nlm.nih.gov
CC	h calc, compensated to 10C using Clausius-Claeyron relationship
cc	2001, USEPA, Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, Peer Review Draft.
calc	US EPA 2001, Factsheet: Correcting the Henry's Law Constant for Soil Temperature, June 2001
ce	Baes.C.F., Sharp R.D., Sjoreen A.L., Shor R.W., (1984) A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture,
	Oak Ridge National laboratory for the US DoE
k	Review of the Fate and Transport of Selected Contaminants in the Soil Environment, Draft R&D Technical Report P5-079/TR1
LQ	LQM/CIEH 2009, Trremperature corrected to 10oC
SR7	Science Report – SC050021/SR7

EPI The EPI (**Estimation Programs Interface**) Suite^{TM} is a Windows-based suite of physical/chemical property and environmental fate estimation programs developed by the EPA\'s Office of Pollution Prevention Toxics and Syracuse Research Corporation (SRC).

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**18-Nov-19**		**Version:**	**3.2**
Contaminant	**Benzo(a)pyrene**			
Target Concentration (C_T)	**0.00000017**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Benzo(a)pyrene**		from Level 1
Target Concentration	**C_T**	**1.70E-07**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	1.66E-04	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+04	days	*See Justification Table*
Calculated decay rate	λ	1.39E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	3.00E+01	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.23E+04	l/kg	*see options*
Longitudinal dispersivity	ax	3.00E+00	m	*see options*
Transverse dispersivity	az	3.00E-01	m	*see options*
Vertical dispersivity	ay	3.00E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	5.77E+05	fraction
Decay rate used	λ	1.39E-05	d^{-1}
Rate of contaminant flow due to retardation	u	4.71E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.19E-43	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**5.20E+38**	

Remedial Targets

Remedial Target		**8.84E+31**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**30**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**3.19E-43**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	1.29E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.23E+04	l/kg

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

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

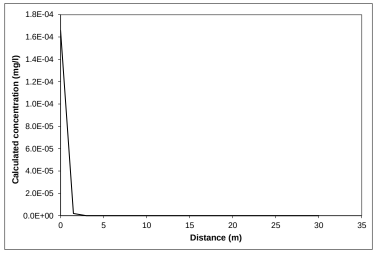
		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	2.13E+00	m
Transverse dispersivity	**az**	0.00E+00	3.00E-01	2.13E-01	m
Vertical dispersivity	**ay**	0.00E+00	3.00E-02	2.13E-02	

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

Environment Agency



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

Note

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

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

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

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

Site being assessed:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.7E-04**
1.5	**1.93E-06**
3.0	**2.25E-08**
4.5	**2.62E-10**
6.0	**3.05E-12**
7.5	**3.55E-14**
9.0	**4.13E-16**
10.5	**4.80E-18**
12.0	**5.58E-20**
13.5	**6.47E-22**
15.0	**7.50E-24**
16.5	**8.68E-26**
18.0	**1.00E-27**
19.5	**1.16E-29**
21.0	**1.34E-31**
22.5	**1.55E-33**
24.0	**1.79E-35**
25.5	**2.07E-37**
27.0	**2.39E-39**
28.5	**2.76E-41**
30.0	**3.19E-43**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**18-Nov-19**		**Version:**	**3.2**
Contaminant	**Benzo(b)fluoranthene**			
Target Concentration (C_T)	**0.000017**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Parameter	Variable	Value	Unit	Source
Contaminant		**Benzo(b)fluoranthene**		from Level 1
Target Concentration	C_T	**1.70E-05**	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 pollutants in all phases (e.g. field derived value**

Parameter	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	2.74E-04	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+04	days	*See Justification Table*
Calculated decay rate	λ	1.39E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	3.00E+01	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.63E+04	l/kg	*see options*
Longitudinal dispersivity	ax	3.00E+00	m	*see options*
Transverse dispersivity	az	3.00E-01	m	*see options*
Vertical dispersivity	ay	3.00E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	4.70E+05	fraction
Decay rate used	λ	1.39E-05	d^{-1}
Rate of contaminant flow due to retardation	u	5.79E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.07E-39	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**5.41E+34**	

Remedial Targets

Remedial Target		**9.19E+29**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**30**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**5.07E-39**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	1.05E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	2.63E+04	l/kg

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

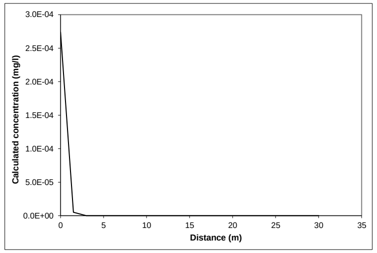
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	2.13E+00	m
Transverse dispersivity	**az**	0.00E+00	3.00E-01	2.13E-01	m
Vertical dispersivity	**ay**	0.00E+00	3.00E-02	2.13E-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 a 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:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**2.7E-04**
1.5	**5.05E-06**
3.0	**9.30E-08**
4.5	**1.71E-09**
6.0	**3.15E-11**
7.5	**5.81E-13**
9.0	**1.07E-14**
10.5	**1.96E-16**
12.0	**3.61E-18**
13.5	**6.62E-20**
15.0	**1.21E-21**
16.5	**2.22E-23**
18.0	**4.07E-25**
19.5	**7.45E-27**
21.0	**1.36E-28**
22.5	**2.49E-30**
24.0	**4.55E-32**
25.5	**8.32E-34**
27.0	**1.52E-35**
28.5	**2.77E-37**
30.0	**5.07E-39**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**01-Mar-17**		**Version:**	**3.2**
Contaminant	**Benzo(g,h,i)perylene**			
Target Concentration (C_T)	**0.0000082**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Benzo(g,h,i)perylene**		from Level 1
Target Concentration	C_T	**8.20E-06**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	1.68E-04	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+04	days	*See Justification Table*
Calculated decay rate	λ	1.39E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	3.00E+01	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.04E+05	l/kg	*see options*
Longitudinal dispersivity	ax	3.00E+00	m	*see options*
Transverse dispersivity	az	3.00E-01	m	*see options*
Vertical dispersivity	ay	3.00E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	1.87E+06	fraction
Decay rate used	λ	1.39E-05	d^{-1}
Rate of contaminant flow due to retardation	u	1.46E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	9.70E-76	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.73E+71**	

Remedial Targets

Remedial Target		**1.42E+66**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**30**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**9.70E-76**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

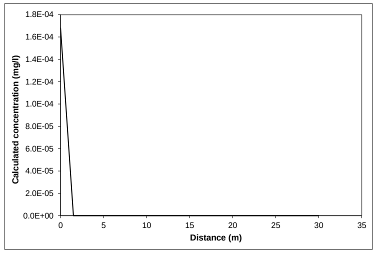
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	4.17E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	1.04E+05	l/kg

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

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

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	2.13E+00	m
Transverse dispersivity	**az**	0.00E+00	3.00E-01	2.13E-01	m
Vertical dispersivity	**ay**	0.00E+00	3.00E-02	2.13E-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 a 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:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.7E-04**
1.5	**4.63E-08**
3.0	**1.27E-11**
4.5	**3.51E-15**
6.0	**9.67E-19**
7.5	**2.66E-22**
9.0	**7.32E-26**
10.5	**2.01E-29**
12.0	**5.53E-33**
13.5	**1.52E-36**
15.0	**4.16E-40**
16.5	**1.14E-43**
18.0	**3.12E-47**
19.5	**8.53E-51**
21.0	**2.33E-54**
22.5	**6.38E-58**
24.0	**1.74E-61**
25.5	**4.76E-65**
27.0	**1.30E-68**
28.5	**3.55E-72**
30.0	**9.70E-76**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**18-Nov-19**		**Version:**	**3.2**
Contaminant	**Benzo(k)fluoranthene**			
Target Concentration (C_T)	**0.000017**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Environment Agency

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Benzo(k)fluoranthene		from Level 1
Target Concentration	C_T	1.70E-05	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.15E-04	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+04	days	*See Justification Table*
Calculated decay rate	λ	1.39E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	3.00E+01	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.70E+04	l/kg	*see options*
Longitudinal dispersivity	ax	3.00E+00	m	*see options*
Transverse dispersivity	az	3.00E-01	m	*see options*
Vertical dispersivity	ay	3.00E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	6.62E+05	fraction
Decay rate used	λ	1.39E-05	d^{-1}
Rate of contaminant flow due to retardation	u	4.11E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.80E-46	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**4.10E+41**	

Remedial Targets

Remedial Target		**6.98E+36**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**30**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**2.80E-46**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	1.48E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.70E+04	l/kg

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

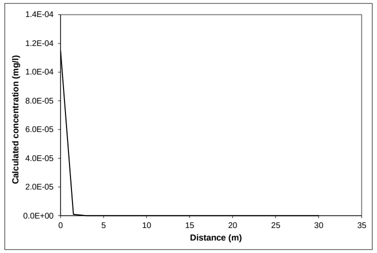
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	2.13E+00	m
Transverse dispersivity	**az**	0.00E+00	3.00E-01	2.13E-01	m
Vertical dispersivity	**ay**	0.00E+00	3.00E-02	2.13E-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 a 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:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.2E-04
1.5	9.59E-07
3.0	8.00E-09
4.5	6.68E-11
6.0	5.57E-13
7.5	4.64E-15
9.0	3.87E-17
10.5	3.22E-19
12.0	2.68E-21
13.5	2.23E-23
15.0	1.85E-25
16.5	1.53E-27
18.0	1.27E-29
19.5	1.05E-31
21.0	8.73E-34
22.5	7.23E-36
24.0	5.98E-38
25.5	4.95E-40
27.0	4.10E-42
28.5	3.39E-44
30.0	2.80E-46

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**11-Apr-17**		**Version:**	**3.2**
Contaminant	**Bis(2-ethylhexyl)phthalate**			
Target Concentration (C_T)	**1.30E-03**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Input Parameters	Variable	Value	Unit	Source
Contaminant		**Bis(2-ethylhexyl)phthalate**		from Level 1
Target Concentration	C_T	**1.30E-03**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	8.26E-03	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+03	days	*See Justification Table*
Calculated decay rate	λ	1.39E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	3.00E+01	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*

Parameters values determined from options

Partition coefficient	Kd	1.79E+03	l/kg	*see options*
Longitudinal dispersivity	ax	3.00E+00	m	*see options*
Transverse dispersivity	az	3.00E-01	m	*see options*
Vertical dispersivity	ay	3.00E-02	m	*see options*

Calculated Parameters

Calculated Parameters	Variable	Value	Unit
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	3.21E+04	fraction
Decay rate used	λ	1.39E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.49E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.69E-31	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**2.24E+28**	

Remedial Targets

Remedial Target		**2.91E+25**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**30**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**3.69E-31**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.05E-02	fraction
Organic carbon partition coefficient	Koc	8.74E+04	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	1.79E+03	l/kg

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

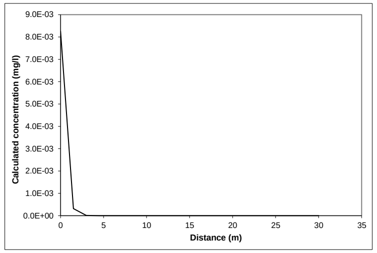
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	2.13E+00	m
Transverse dispersivity	**az**	0.00E+00	3.00E-01	2.13E-01	m
Vertical dispersivity	**ay**	0.00E+00	3.00E-02	2.13E-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 a 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:	Kingsway Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**8.3E-03**
1.5	**3.17E-04**
3.0	**1.22E-05**
4.5	**4.68E-07**
6.0	**1.80E-08**
7.5	**6.90E-10**
9.0	**2.65E-11**
10.5	**1.02E-12**
12.0	**3.89E-14**
13.5	**1.49E-15**
15.0	**5.69E-17**
16.5	**2.17E-18**
18.0	**8.30E-20**
19.5	**3.17E-21**
21.0	**1.21E-22**
22.5	**4.60E-24**
24.0	**1.75E-25**
25.5	**6.68E-27**
27.0	**2.55E-28**
28.5	**9.70E-30**
30.0	**3.69E-31**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**18-Nov-19**		**Version:**	**3.2**
Contaminant	**Cadmium**			
Target Concentration (C_T)	**8.00E-05**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Environment Agency

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Cadmium**		from Level 1
Target Concentration	C_T	**8.00E-05**	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 pollutants in all phases (e.g. field derived value**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.76E-04	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+09	days	*See Justification Table*
Calculated decay rate	λ	6.93E-10	days^{-1}	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	3.00E+01	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.56E+03	l/kg	*see options*
Longitudinal dispersivity	ax	3.00E+00	m	*see options*
Transverse dispersivity	az	3.00E-01	m	*see options*
Vertical dispersivity	ay	3.00E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	4.58E+04	fraction
Decay rate used	λ	6.93E-10	d^{-1}
Rate of contaminant flow due to retardation	u	5.94E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.51E-04	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.10E+00**	

Remedial Targets

Remedial Target		**8.79E-05**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**30**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**2.51E-04**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

User specified value for partition coefficient

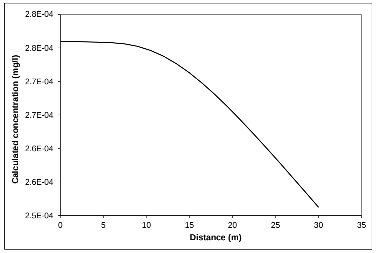
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	2.56E+03	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption 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	2.56E+03	l/kg

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

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

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	2.13E+00	m
Transverse dispersivity	**az**	0.00E+00	3.00E-01	2.13E-01	m
Vertical dispersivity	**ay**	0.00E+00	3.00E-02	2.13E-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 a 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:	Kingsway Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**2.8E-04**
1.5	**2.76E-04**
3.0	**2.76E-04**
4.5	**2.76E-04**
6.0	**2.76E-04**
7.5	**2.76E-04**
9.0	**2.75E-04**
10.5	**2.75E-04**
12.0	**2.74E-04**
13.5	**2.73E-04**
15.0	**2.71E-04**
16.5	**2.70E-04**
18.0	**2.68E-04**
19.5	**2.66E-04**
21.0	**2.64E-04**
22.5	**2.62E-04**
24.0	**2.60E-04**
25.5	**2.58E-04**
27.0	**2.56E-04**
28.5	**2.53E-04**
30.0	**2.51E-04**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**18-Nov-19**		**Version:**	**3.2**
Contaminant	**Copper**			
Target Concentration (C_T)	**0.001**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Environment Agency

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		Copper		from Level 1
Target Concentration	C_T	1.00E-03	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.81E-03	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+09	days	*See Justification Table*
Calculated decay rate	λ	6.93E-10	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	3.00E+01	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.50E+01	l/kg	*see options*
Longitudinal dispersivity	ax	3.00E+00	m	*see options*
Transverse dispersivity	az	3.00E-01	m	*see options*
Vertical dispersivity	ay	3.00E-02	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	6.28E+02	fraction
Decay rate used	λ	6.93E-10	d^{-1}
Rate of contaminant flow due to retardation	u	4.34E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.65E-03	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.09E+00**	

Remedial Targets

Remedial Target	**1.09E-03**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks			

Distance to compliance point		**30**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**1.65E-03**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	3.50E+01	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.50E+01	l/kg

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

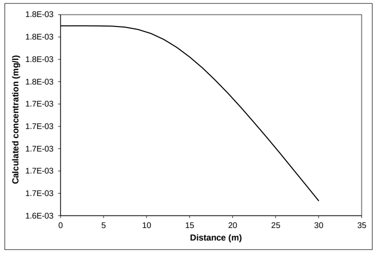
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	2.13E+00	m
Transverse dispersivity	**az**	0.00E+00	3.00E-01	2.13E-01	m
Vertical dispersivity	**ay**	0.00E+00	3.00E-02	2.13E-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 a 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:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.8E-03**
1.5	**1.81E-03**
3.0	**1.81E-03**
4.5	**1.81E-03**
6.0	**1.81E-03**
7.5	**1.81E-03**
9.0	**1.81E-03**
10.5	**1.80E-03**
12.0	**1.80E-03**
13.5	**1.79E-03**
15.0	**1.78E-03**
16.5	**1.77E-03**
18.0	**1.76E-03**
19.5	**1.75E-03**
21.0	**1.74E-03**
22.5	**1.72E-03**
24.0	**1.71E-03**
25.5	**1.70E-03**
27.0	**1.68E-03**
28.5	**1.67E-03**
30.0	**1.65E-03**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**18-Nov-19**		**Version:**	**3.2**
Contaminant	**Fluoranthene**			
Target Concentration (C_T)	**0.0000063**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Fluoranthene**		from Level 1
Target Concentration	C_T	**6.30E-06**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	1.66E-04	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+04	days	*See Justification Table*
Calculated decay rate	λ	6.93E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	3.00E+01	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	4.55E+03	l/kg	*see options*
Longitudinal dispersivity	ax	3.00E+00	m	*see options*
Transverse dispersivity	az	3.00E-01	m	*see options*
Vertical dispersivity	ay	3.00E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	8.14E+04	fraction
Decay rate used	λ	6.93E-05	d^{-1}
Rate of contaminant flow due to retardation	u	3.34E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.06E-36	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.57E+32**	

Remedial Targets

Remedial Target		**9.91E+26**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**30**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**1.06E-36**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	1.82E+04	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	4.55E+03	l/kg

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

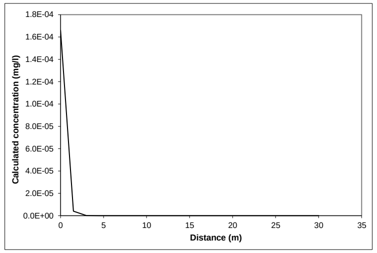
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	2.13E+00	m
Transverse dispersivity	**az**	0.00E+00	3.00E-01	2.13E-01	m
Vertical dispersivity	**ay**	0.00E+00	3.00E-02	2.13E-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 a 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: Kingsway Junction
Completed by: Lucy Full
Date: #######
Version: 3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.7E-04**
1.5	**4.09E-06**
3.0	**1.01E-07**
4.5	**2.49E-09**
6.0	**6.15E-11**
7.5	**1.52E-12**
9.0	**3.73E-14**
10.5	**9.19E-16**
12.0	**2.26E-17**
13.5	**5.55E-19**
15.0	**1.36E-20**
16.5	**3.35E-22**
18.0	**8.20E-24**
19.5	**2.01E-25**
21.0	**4.92E-27**
22.5	**1.20E-28**
24.0	**2.95E-30**
25.5	**7.21E-32**
27.0	**1.76E-33**
28.5	**4.32E-35**
30.0	**1.06E-36**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**18-Nov-19**		**Version:**	**3.2**
Contaminant	**Nickel**			
Target Concentration (C_T)	**0.004**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Nickel**		from Level 1
Target Concentration	C_T	**4.00E-03**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	7.00E-03	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+09	days	*See Justification Table*
Calculated decay rate	λ	6.93E-10	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	3.00E+01	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.00E+03	l/kg	*see options*
Longitudinal dispersivity	ax	3.00E+00	m	*see options*
Transverse dispersivity	az	3.00E-01	m	*see options*
Vertical dispersivity	ay	3.00E-02	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	3.58E+04	fraction
Decay rate used	λ	6.93E-10	d^{-1}
Rate of contaminant flow due to retardation	u	7.60E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.38E-03	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.10E+00**	

Remedial Targets

Remedial Target		**4.39E-03**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**30**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**6.38E-03**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	2.00E+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	2.00E+03	l/kg

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

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

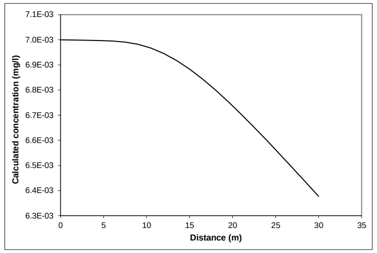
		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	2.13E+00	m
Transverse dispersivity	**az**	0.00E+00	3.00E-01	2.13E-01	m
Vertical dispersivity	**ay**	0.00E+00	3.00E-02	2.13E-02	

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

Environment Agency



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

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**7.0E-03**
1.5	**7.00E-03**
3.0	**7.00E-03**
4.5	**7.00E-03**
6.0	**7.00E-03**
7.5	**6.99E-03**
9.0	**6.98E-03**
10.5	**6.97E-03**
12.0	**6.95E-03**
13.5	**6.92E-03**
15.0	**6.88E-03**
16.5	**6.84E-03**
18.0	**6.80E-03**
19.5	**6.75E-03**
21.0	**6.70E-03**
22.5	**6.65E-03**
24.0	**6.60E-03**
25.5	**6.54E-03**
27.0	**6.49E-03**
28.5	**6.43E-03**
30.0	**6.38E-03**

Note

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

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

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

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

Site being assessed:	Kingsway Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Appendix E – Markeaton Junction RTM DQRA

RTM - Hydrogeological Risk Assessment

Project Number	60533462
Project Title	A38 Derby Markeaton Junction
Date	18-Nov-19

Simulation Details	Analysis of potential migration of Contaminants in Groundwater at Markeaton Junction to Markeaton Lake

RTM - Hydrogeological Risk Assessment

LEVEL 3 (GROUNDWATER) ASSESSMENT - INPUTS & JUSTIFICATION

Project Number	60533462	
Project Title	A38 Derby Markeaton Junction	
Date	18-Nov-19	

Simulation Details	Analysis of potential migration of Contaminants in Groundwater at Markeaton Junction to Markeaton Lake

Source	Contaminants in the groundwater onsite		
Parameter	**Units**	**Input Value(s)**	**Source / Justification**
Saturated aquifer thickness	m	30	Assumed as base of aquifer (bedrock) is not proven
Width of plume in aquifer	m	200	Length of the landfill perpendicular to the groundwater flow
Plume thickness at source	m	25	Assumed 5m less than aquifer thickness
Bulk density of aquifer materials	g/cm^3	2.3	Average from Site Data
Effective porosity of aquifer	fraction	0.1	Effective Porosity for Clay from Domenico & Schwartz, 1989
Hydraulic gradient	fraction	0.04	Calculated from the Groundwater levelsBM05 and BM10
Hydraulic conductivity of aquifer	m/d	0.0648	Average of variable head permeability tests at BM10
Fraction of Organic Carbon	fraction	0.01	Mean value from site data of TOC from boreholes from ESG chemical data
Distance to compliance point	m	290	Distance between BK10 and Markeaton Lake
Time since pollutant entered groundwater	days	9.90E+99	EA RTM recommended value
Longitudinal dispersivity	m	2.9	10% of pathway length
Transverse dispersivity	m	0.29	1% of pathway length

CONTAMINANT SPECIFIC INPUTS

Project Number	60533462
Project Title	A38 Derby Markeaton Junction
Date	18-Nov-19

Simulation Details	Analysis of potential migration of Contaminants in Groundwater at Markeaton Junction to Markeaton Lake

Determinand	Henry's Law Constant	Source	Soil-Water Partition Coefficient	Source	Organic carbon partition coefficient	Source	Half-Life of Contaminant in Groundwater	Source	Initial Contaminant Concentration in Groundwater Plume	Source
	dimensionless		l/kg		l/kg		days		µg/l	
Copper	-	-	3.50E+01	ce	-	-	1.00E+09	No degradation	17	Maximum concentration recorded during groundwater monitoring
Zinc	-	-	3.60E+01	cc calc	-	-	1.00E+09	No degradation	11.2	Maximum concentration recorded during groundwater monitoring
Benzene	1.16E-01	SR7			6.76E+01	SR7	7.50E+02	(3) URS/PAHs	11	Maximum concentration recorded during groundwater monitoring
Chloroform	7.97E-02	CC	-	-	3.98E+01	C	1.00E+09	(3) URS/PAHs	15	Maximum concentration recorded during groundwater monitoring
Anthracene	1.81E-04	LQ	-	-	5.62E+03	LQ	6.00E+03	(3) URS/PAHs	0.215	Maximum concentration recorded during groundwater monitoring
Fluoranthene	6.29E-05	SR7	-	-	1.82E+04	LQ	10,000	(3) URS/PAHs	0.712	Maximum concentration recorded during groundwater monitoring
Benzo(a)pyrene	1.76E-06	SR7	-	-	1.29E+05	LQ	50,000	(3) URS/PAHs	1.550	Maximum concentration recorded during groundwater monitoring
Benzo(g,h,i)perylene	2.86E-06	LQ	-	-	4.17E+05	LQ	50,000	(3) URS/PAHs	2.04	Maximum concentration recorded during groundwater monitoring
Benzo(b) fluoranthene	2.05E-06	SR7	-	-	1.05E+05	LQ	50,000	(3) URS/PAHs	2.990	Maximum concentration recorded during groundwater monitoring
Benzo(k) fluoranthene	1.74E-06	SR7	-	-	1.48E+05	LQ	50,000	(3) URS/PAHs	1.200	Maximum concentration recorded during groundwater monitoring
Phenol	8.35E-06	SR7	-	-	8.32E+01	SR7	5.00E+02	(1) EA	15.3	Maximum concentration recorded during groundwater monitoring

Key to sources	
a	Buss et al (2004), A Review of Ammonium Attenuation in Soil and Groundwater
c	US EPA 2003 User's Guide for Evaluating Subsurface Vapour Intrusion into Buildings
cb	www.toxnet.nlm.nih.gov
CC	h calc, compensated to 10C using Clausius-Claeyron relationship
cc	2001, USEPA, Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, Peer Review Draft.
calc	US EPA 2001, Factsheet: Correcting the Henry's Law Constant for Soil Temperature, June 2001
ce	Baes.C.F., Sharp R.D., Sjoreen A.L., Shor R.W., (1984) A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture,
	Oak Ridge National laboratory for the US DoE
k	Review of the Fate and Transport of Selected Contaminants in the Soil Environment, Draft R&D Technical Report P5-079/TR1
LQ	LQM/CIEH 2009, Trenperature corrected to 10oC
SR7	Science Report – SC050021/SR7

EPI The EPI (**Estimation Programs Interface**) Suite^{TM} is a Windows-based suite of physical/chemical property and environmental fate estimation programs developed by the EPA\'s Office of Pollution Prevention Toxics and Syracuse Research Corporation (SRC).

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Markeaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**13-Nov-19**		**Version:**	**3.2**
Contaminant	**Anthracene**			
Target Concentration (C_T)	**1.00E-04**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Anthracene**		from Level 1
Target Concentration	C_T	**1.00E-04**	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 pollutants in all phases (e.g. field derived value**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.15E-04	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	6.00E+03	days	*See Justification Table*
Calculated decay rate	λ	1.16E-04	days^{-1}	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.00E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	4.00E-02	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	2.90E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.41E+03	l/kg	*see options*
Longitudinal dispersivity	ax	2.90E+01	m	*see options*
Transverse dispersivity	az	2.90E+00	m	*see options*
Vertical dispersivity	ay	2.90E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.59E-02	m/d
Retardation factor	Rf	3.23E+04	fraction
Decay rate used	λ	1.16E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.02E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	6.02E-283	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.57E+278**	

Remedial Targets

Remedial Target		**3.57E+274**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**290**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**6.02E-283**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	5.62E+03	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	1.41E+03	l/kg

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

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

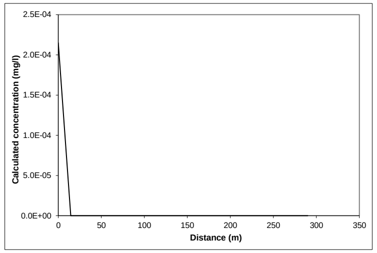
		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	7.31E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	7.31E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.90E-01	7.31E-02	

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

Environment Agency



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

Note

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

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

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

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

Site being assessed: Markeaton Junction
Completed by: Lucy Full
Date: #######
Version: 3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**2.2E-04**
14.5	**2.55E-18**
29.0	**3.02E-32**
43.5	**3.58E-46**
58.0	**4.25E-60**
72.5	**5.03E-74**
87.0	**5.96E-88**
101.5	**7.06E-102**
116.0	**8.36E-116**
130.5	**9.90E-130**
145.0	**1.17E-143**
159.5	**1.38E-157**
174.0	**1.63E-171**
188.5	**1.92E-185**
203.0	**2.27E-199**
217.5	**2.67E-213**
232.0	**3.15E-227**
246.5	**3.70E-241**
261.0	**4.36E-255**
275.5	**5.12E-269**
290.0	**6.02E-283**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Markeaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**13-Nov-19**		**Version:**	**3.2**
Contaminant	**Benzene**			
Target Concentration (C_T)	**1.00E-02**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Benzene**		from Level 1
Target Concentration	C_T	**1.00E-02**	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	1.10E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	6.00E+03	days	*See Justification Table*
Calculated decay rate	λ	1.16E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.00E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	4.00E-02	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	2.90E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.41E+03	l/kg	*see options*
Longitudinal dispersivity	ax	2.90E+01	m	*see options*
Transverse dispersivity	az	2.90E+00	m	*see options*
Vertical dispersivity	ay	2.90E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.59E-02	m/d
Retardation factor	Rf	3.23E+04	fraction
Decay rate used	λ	1.16E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.02E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.08E-281	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.57E+278**	

Remedial Targets

Remedial Target		**3.57E+276**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**290**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**3.08E-281**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	5.62E+03	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	1.41E+03	l/kg

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

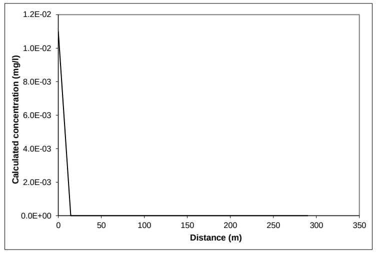
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	7.31E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	7.31E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.90E-01	7.31E-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 a 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: Markeaton Junction
Completed by: Lucy Full
Date: #######
Version: 3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.1E-02**
14.5	**1.30E-16**
29.0	**1.55E-30**
43.5	**1.83E-44**
58.0	**2.17E-58**
72.5	**2.57E-72**
87.0	**3.05E-86**
101.5	**3.61E-100**
116.0	**4.28E-114**
130.5	**5.06E-128**
145.0	**5.99E-142**
159.5	**7.07E-156**
174.0	**8.35E-170**
188.5	**9.85E-184**
203.0	**1.16E-197**
217.5	**1.37E-211**
232.0	**1.61E-225**
246.5	**1.89E-239**
261.0	**2.23E-253**
275.5	**2.62E-267**
290.0	**3.08E-281**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Markeaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**18-Nov-19**		**Version:**	**3.2**
Contaminant	**Benzo(a)pyrene**			
Target Concentration (C_T)	**1.70E-07**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Benzo(a)pyrene**		from Level 1
Target Concentration	C_T	**1.70E-07**	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 pollutants in all phases (e.g. field derived value**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.55E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	6.00E+03	days	*See Justification Table*
Calculated decay rate	λ	1.16E-04	days^{-1}	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.00E+02	m	*See Justification Table*
Plume thickness at source	Sy	3.00E+01	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	4.00E-02	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	2.90E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.41E+03	l/kg	*see options*
Longitudinal dispersivity	ax	2.90E+01	m	*see options*
Transverse dispersivity	az	2.90E+00	m	*see options*
Vertical dispersivity	ay	2.90E-01	m	*see options*

Dispersed plume thickness exceeds aquifer thickness! Reduce vertical dispersivity

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.59E-02	m/d
Retardation factor	Rf	3.23E+04	fraction
Decay rate used	λ	1.16E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.02E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.49E-281	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.45E+278**	

Remedial Targets

Remedial Target		**5.87E+271**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**290**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**4.49E-281**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	5.62E+03	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	1.41E+03	l/kg

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

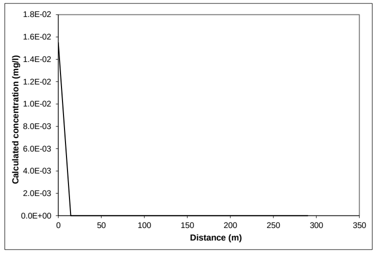
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	7.31E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	7.31E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.90E-01	7.31E-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 a 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:	Markeaton Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.6E-02**
14.5	**1.84E-16**
29.0	**2.18E-30**
43.5	**2.58E-44**
58.0	**3.06E-58**
72.5	**3.63E-72**
87.0	**4.30E-86**
101.5	**5.10E-100**
116.0	**6.04E-114**
130.5	**7.16E-128**
145.0	**8.48E-142**
159.5	**1.00E-155**
174.0	**1.19E-169**
188.5	**1.41E-183**
203.0	**1.66E-197**
217.5	**1.96E-211**
232.0	**2.32E-225**
246.5	**2.74E-239**
261.0	**3.23E-253**
275.5	**3.81E-267**
290.0	**4.49E-281**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Markeaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**18-Nov-19**		**Version:**	**3.2**
Contaminant	**Benzo(b)fluoranthene**			
Target Concentration (C_T)	**1.70E-05**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Environment Agency

Input Parameters (using pull down menu)

Input Parameters	Variable	Value	Unit	Source
Contaminant		**Benzo(b)fluoranthene**		from Level 1
Target Concentration	C_T	**1.70E-05**	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 pollutants in all phases (e.g. field derived value**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.99E-03	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	6.00E+03	days	*See Justification Table*
Calculated decay rate	λ	1.16E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.00E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	4.00E-02	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	2.90E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.41E+03	l/kg	*see options*
Longitudinal dispersivity	ax	2.90E+01	m	*see options*
Transverse dispersivity	az	2.90E+00	m	*see options*
Vertical dispersivity	ay	2.90E-01	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.59E-02	m/d
Retardation factor	Rf	3.23E+04	fraction
Decay rate used	λ	1.16E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.02E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	8.37E-282	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.57E+278**	

Remedial Targets

Remedial Target		**6.07E+273**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**290**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**8.37E-282**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	5.62E+03	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	1.41E+03	l/kg

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

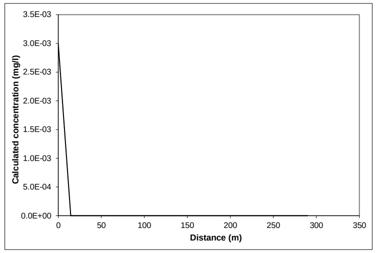
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	7.31E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	7.31E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.90E-01	7.31E-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 a 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:	Markeaton Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**3.0E-03**
14.5	**3.54E-17**
29.0	**4.20E-31**
43.5	**4.98E-45**
58.0	**5.90E-59**
72.5	**7.00E-73**
87.0	**8.29E-87**
101.5	**9.82E-101**
116.0	**1.16E-114**
130.5	**1.38E-128**
145.0	**1.63E-142**
159.5	**1.92E-156**
174.0	**2.27E-170**
188.5	**2.68E-184**
203.0	**3.16E-198**
217.5	**3.72E-212**
232.0	**4.38E-226**
246.5	**5.15E-240**
261.0	**6.06E-254**
275.5	**7.12E-268**
290.0	**8.37E-282**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Markeaton Junction**		
Site Address:	**A38, Derbyshire**		
Completed by:	**Victor Ojambati**		
Date:	**19-Nov-19**	**Version:**	**3.2**
Contaminant	**Benzo(g,h,i)perylene**		
Target Concentration (C_T)	**8.20E-06 mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Benzo(g,h,i)perylene**		from Level 1
Target Concentration	C_T	**8.20E-06**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	2.04E-03	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	6.00E+03	days	*See Justification Table*
Calculated decay rate	λ	1.16E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.00E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	4.00E-02	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	2.90E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.41E+03	l/kg	*see options*
Longitudinal dispersivity	ax	2.90E+01	m	*see options*
Transverse dispersivity	az	2.90E+00	m	*see options*
Vertical dispersivity	ay	2.90E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.59E-02	m/d
Retardation factor	Rf	3.23E+04	fraction
Decay rate used	λ	1.16E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.02E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	5.71E-282	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.57E+278**	

Remedial Targets

Remedial Target		**2.93E+273**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**290**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**5.71E-282**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	5.62E+03	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	1.41E+03	l/kg

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

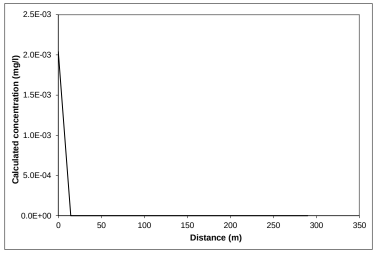
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	7.31E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	7.31E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.90E-01	7.31E-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 a 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: Markeaton Junction
Completed by: Victor Ojambati
Date: #######
Version: 3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**2.0E-03**
14.5	**2.42E-17**
29.0	**2.87E-31**
43.5	**3.40E-45**
58.0	**4.03E-59**
72.5	**4.77E-73**
87.0	**5.66E-87**
101.5	**6.70E-101**
116.0	**7.94E-115**
130.5	**9.39E-129**
145.0	**1.11E-142**
159.5	**1.31E-156**
174.0	**1.55E-170**
188.5	**1.83E-184**
203.0	**2.15E-198**
217.5	**2.54E-212**
232.0	**2.99E-226**
246.5	**3.51E-240**
261.0	**4.13E-254**
275.5	**4.86E-268**
290.0	**5.71E-282**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Markeaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**19-Nov-19**		**Version:**	**3.2**
Contaminant	**Benzo(k)fluoranthene**			
Target Concentration (C_T)	**1.70E-05**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Environment Agency

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Input Parameters	Variable	Value	Unit	Source
Contaminant		**Benzo(k)fluoranthene**		from Level 1
Target Concentration	C_T	**1.70E-05**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	1.20E-03	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	6.00E+03	days	*See Justification Table*
Calculated decay rate	λ	1.16E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.00E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	4.00E-02	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	2.90E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.41E+03	l/kg	*see options*
Longitudinal dispersivity	ax	2.90E+01	m	*see options*
Transverse dispersivity	az	2.90E+00	m	*see options*
Vertical dispersivity	ay	2.90E-01	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.59E-02	m/d
Retardation factor	Rf	3.23E+04	fraction
Decay rate used	λ	1.16E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.02E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.36E-282	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.57E+278**	

Remedial Targets

Remedial Target		**6.07E+273**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**290**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**3.36E-282**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	5.62E+03	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	1.41E+03	l/kg

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

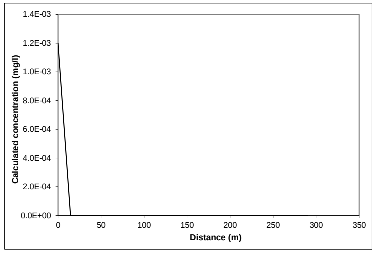
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	7.31E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	7.31E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.90E-01	7.31E-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 a 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:	Markeaton Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.2E-03**
14.5	**1.42E-17**
29.0	**1.69E-31**
43.5	**2.00E-45**
58.0	**2.37E-59**
72.5	**2.81E-73**
87.0	**3.33E-87**
101.5	**3.94E-101**
116.0	**4.67E-115**
130.5	**5.52E-129**
145.0	**6.53E-143**
159.5	**7.71E-157**
174.0	**9.11E-171**
188.5	**1.07E-184**
203.0	**1.27E-198**
217.5	**1.49E-212**
232.0	**1.76E-226**
246.5	**2.07E-240**
261.0	**2.43E-254**
275.5	**2.86E-268**
290.0	**3.36E-282**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Markeaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**13-Nov-19**		**Version:**	**3.2**
Contaminant	**Chloroform**			
Target Concentration (C_T)	**2.50E-03**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Chloroform**		from Level 1
Target Concentration	**C_T**	**2.50E-03**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	1.50E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	6.00E+03	days	*See Justification Table*
Calculated decay rate	λ	1.16E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.00E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	4.00E-02	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	2.90E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.41E+03	l/kg	*see options*
Longitudinal dispersivity	ax	2.90E+01	m	*see options*
Transverse dispersivity	az	2.90E+00	m	*see options*
Vertical dispersivity	ay	2.90E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.59E-02	m/d
Retardation factor	Rf	3.23E+04	fraction
Decay rate used	λ	1.16E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.02E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.20E-281	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.57E+278**	

Remedial Targets

Remedial Target		**8.93E+275**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**290**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**4.20E-281**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	5.62E+03	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	1.41E+03	l/kg

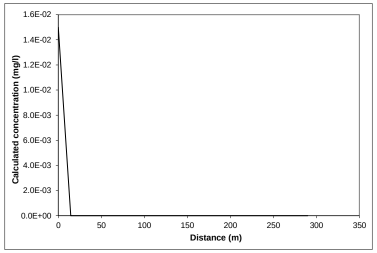
Define dispersivity (click brown cell and use pull down list)

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

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	7.31E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	7.31E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.90E-01	7.31E-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

Environment Agency



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

Note

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

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

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

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

Site being assessed:	Markeaton Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.5E-02**
14.5	**1.78E-16**
29.0	**2.11E-30**
43.5	**2.50E-44**
58.0	**2.96E-58**
72.5	**3.51E-72**
87.0	**4.16E-86**
101.5	**4.93E-100**
116.0	**5.83E-114**
130.5	**6.90E-128**
145.0	**8.16E-142**
159.5	**9.64E-156**
174.0	**1.14E-169**
188.5	**1.34E-183**
203.0	**1.58E-197**
217.5	**1.86E-211**
232.0	**2.20E-225**
246.5	**2.58E-239**
261.0	**3.04E-253**
275.5	**3.57E-267**
290.0	**4.20E-281**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Markeaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**19-Nov-19**		**Version:**	**3.2**
Contaminant	**Copper**			
Target Concentration (C_T)	**1.00E-03**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		**Copper**		from Level 1
Target Concentration	C_T	**1.00E-03**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.70E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+09	days	*See Justification Table*
Calculated decay rate	λ	6.93E-10	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.00E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	4.00E-02	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	2.90E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.50E+01	l/kg	*see options*
Longitudinal dispersivity	ax	2.90E+01	m	*see options*
Transverse dispersivity	az	2.90E+00	m	*see options*
Vertical dispersivity	ay	2.90E-01	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.59E-02	m/d
Retardation factor	Rf	8.06E+02	fraction
Decay rate used	λ	6.93E-10	d^{-1}
Rate of contaminant flow due to retardation	u	3.22E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.57E-02	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.08E+00**	

Remedial Targets

Remedial Target		**1.08E-03**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**290**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**1.57E-02**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	3.50E+01	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc.n}$		l/kg
Sorption coefficient for ionised species	$K_{oc.i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.50E+01	l/kg

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

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

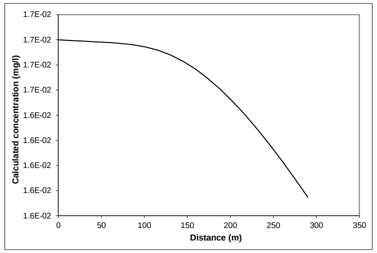
		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	7.31E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	7.31E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.90E-01	7.31E-02	

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

Environment Agency



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

Note

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

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

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

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

Site being assessed:	Markeaton Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.7E-02**
14.5	**1.70E-02**
29.0	**1.70E-02**
43.5	**1.70E-02**
58.0	**1.70E-02**
72.5	**1.70E-02**
87.0	**1.70E-02**
101.5	**1.69E-02**
116.0	**1.69E-02**
130.5	**1.69E-02**
145.0	**1.68E-02**
159.5	**1.68E-02**
174.0	**1.67E-02**
188.5	**1.66E-02**
203.0	**1.65E-02**
217.5	**1.64E-02**
232.0	**1.63E-02**
246.5	**1.62E-02**
261.0	**1.60E-02**
275.5	**1.59E-02**
290.0	**1.57E-02**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Markeaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**19-Nov-19**		**Version:**	**3.2**
Contaminant	**Fluoranthene**			
Target Concentration (C_T)	**6.30E-06**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		**Fluoranthene**		from Level 1
Target Concentration	C_T	**6.30E-06**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	7.12E-04	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+04	days	*See Justification Table*
Calculated decay rate	λ	6.93E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.00E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	4.00E-02	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	2.90E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.41E+03	l/kg	*see options*
Longitudinal dispersivity	ax	2.90E+01	m	*see options*
Transverse dispersivity	az	2.90E+00	m	*see options*
Vertical dispersivity	ay	2.90E-01	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.59E-02	m/d
Retardation factor	Rf	3.23E+04	fraction
Decay rate used	λ	6.93E-05	d^{-1}
Rate of contaminant flow due to retardation	u	8.02E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.67E-219	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.94E+215**	

Remedial Targets

Remedial Target		**1.22E+210**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**290**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**3.67E-219**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

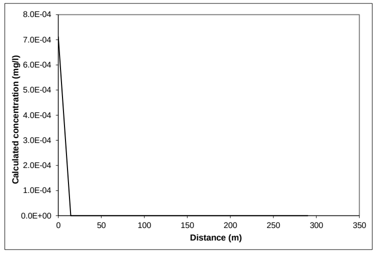
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	5.62E+03	l/kg
Entry for ionic organic chemicals (option)			
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	1.41E+03	l/kg

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

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

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	7.31E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	7.31E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.90E-01	7.31E-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 a 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:	Markeaton Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**7.1E-04**
14.5	**1.23E-14**
29.0	**2.12E-25**
43.5	**3.66E-36**
58.0	**6.32E-47**
72.5	**1.09E-57**
87.0	**1.88E-68**
101.5	**3.25E-79**
116.0	**5.60E-90**
130.5	**9.65E-101**
145.0	**1.66E-111**
159.5	**2.86E-122**
174.0	**4.92E-133**
188.5	**8.45E-144**
203.0	**1.45E-154**
217.5	**2.49E-165**
232.0	**4.27E-176**
246.5	**7.31E-187**
261.0	**1.25E-197**
275.5	**2.14E-208**
290.0	**3.67E-219**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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: **Markeaton Junction**
Site Address: **A38, Derbyshire**

Completed by: **Lucy Full**
Date: **19-Nov-19** **Version:** **3.2**

Contaminant **Phenol**
Target Concentration (C_T) **7.70E-03** **mg/l** **Origin of C_T:** **EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Phenol**		from Level 1
Target Concentration	C_T	**7.70E-03**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	1.53E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	6.00E+03	days	*See Justification Table*
Calculated decay rate	λ	1.16E-04	days^{-1}	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.00E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	4.00E-02	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	2.90E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.41E+03	l/kg	*see options*
Longitudinal dispersivity	ax	2.90E+01	m	*see options*
Transverse dispersivity	az	2.90E+00	m	*see options*
Vertical dispersivity	ay	2.90E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.59E-02	m/d
Retardation factor	Rf	3.23E+04	fraction
Decay rate used	λ	1.16E-04	d^{-1}
Rate of contaminant flow due to retardation	u	8.02E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.28E-281	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.57E+278**	

Remedial Targets

Remedial Target	**2.75E+276**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks			

Distance to compliance point		**290**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**4.28E-281**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	5.62E+03	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	1.41E+03	l/kg

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

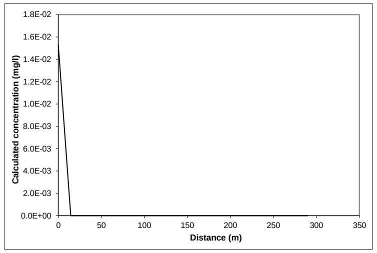
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	7.31E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	7.31E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.90E-01	7.31E-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 a 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:	Markeaton Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.5E-02**
14.5	**1.81E-16**
29.0	**2.15E-30**
43.5	**2.55E-44**
58.0	**3.02E-58**
72.5	**3.58E-72**
87.0	**4.24E-86**
101.5	**5.03E-100**
116.0	**5.95E-114**
130.5	**7.04E-128**
145.0	**8.33E-142**
159.5	**9.84E-156**
174.0	**1.16E-169**
188.5	**1.37E-183**
203.0	**1.61E-197**
217.5	**1.90E-211**
232.0	**2.24E-225**
246.5	**2.64E-239**
261.0	**3.10E-253**
275.5	**3.64E-267**
290.0	**4.28E-281**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Markeaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**19-Nov-19**		**Version:**	**3.2**
Contaminant	**Zinc**			
Target Concentration (C_T)	**1.09E-02**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Zinc**		from Level 1
Target Concentration	C_T	**1.09E-02**	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.12E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+09	days	*See Justification Table*
Calculated decay rate	λ	6.93E-10	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.00E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	4.00E-02	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	2.90E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.60E+01	l/kg	*see options*
Longitudinal dispersivity	ax	2.90E+01	m	*see options*
Transverse dispersivity	az	2.90E+00	m	*see options*
Vertical dispersivity	ay	2.90E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.59E-02	m/d
Retardation factor	Rf	8.29E+02	fraction
Decay rate used	λ	6.93E-10	d^{-1}
Rate of contaminant flow due to retardation	u	3.13E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.04E-02	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.08E+00**	

Remedial Targets

Remedial Target		**1.18E-02**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**290**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**1.04E-02**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

User specified value for partition coefficient

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

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

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

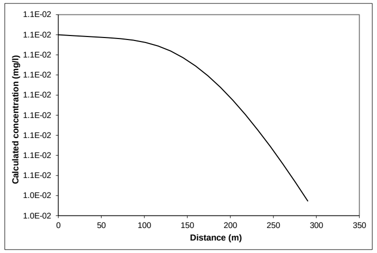
		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	7.31E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	7.31E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.90E-01	7.31E-02	

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

Environment Agency



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

Note

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

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

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

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

Site being assessed:	Markeaton Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.1E-02**
14.5	**1.12E-02**
29.0	**1.12E-02**
43.5	**1.12E-02**
58.0	**1.12E-02**
72.5	**1.12E-02**
87.0	**1.12E-02**
101.5	**1.12E-02**
116.0	**1.11E-02**
130.5	**1.11E-02**
145.0	**1.11E-02**
159.5	**1.10E-02**
174.0	**1.10E-02**
188.5	**1.09E-02**
203.0	**1.09E-02**
217.5	**1.08E-02**
232.0	**1.07E-02**
246.5	**1.06E-02**
261.0	**1.06E-02**
275.5	**1.05E-02**
290.0	**1.04E-02**

Appendix F – Little Eaton Junction RTM DQRA

RTM - Hydrogeological Risk Assessment

Project Number	60533462
Project Title	A38 Derby Junctions (Little Eaton)
Date	19-Nov-19

Simulation Details	Analysis of potential migration of Contaminants in Groundwater to River Derwent.

RTM - Hydrogeological Risk Assessment

LEVEL 3 (GROUNDWATER) ASSESSMENT - INPUTS & JUSTIFICATION

Project Number	60533462	
Project Title	A38 Derby Junctions (Little Eaton)	
Date	19-Nov-19	

Simulation Details	Analysis of potential migration of Contaminants in Groundwater to River Derwent.

Source	Contaminants in the groundwater onsite		
Parameter	**Units**	**Input Value(s)**	**Source / Justification**
Saturated aquifer thickness	m	30	Assumed as base of aquifer (bedrock) is not proven
Width of plume in aquifer	m	1000	Approximate length of investigation area perpendicular to groundwater flow
Plume thickness at source	m	25	Assumed 5m less than aquifer thickness
Bulk density of aquifer materials	g/cm^3	2.3	Average from Site Data
Effective porosity of aquifer	fraction	0.1	Effective Porosity for Clay from Domenico & Schwartz, 1989
Hydraulic gradient	fraction	0.00206	Calculated from the Groundwater levels in BHL03 and BL08C
Hydraulic conductivity of aquifer	m/d	0.0648	Average of variable head permeability tests at BM10
Fraction of Organic Carbon	fraction	0.0141	Mean value from site data of TOC from Little Eaton boreholes from ESG chemical data
Distance to compliance point	m	120	Distance from BL02 to the River Derwent
Time since pollutant entered groundwater	days	9.90E+99	EA RTM recommended value
Longitudinal dispersivity	m	1.2	10% of pathway length
Transverse dispersivity	m	0.12	1% of pathway length

CONTAMINANT SPECIFIC INPUTS

Project Number	60533462
Project Title	A38 Derby Junctions (Little Eaton)
Date	19-Nov-19

Simulation Details	Analysis of potential migration of Contaminants in Groundwater to River Derwent.

Determinand	Henry's Law Constant	Source	Soil-Water Partition Coefficient	Source	Organic carbon partition coefficient	Source	Half-Life of Contaminant in Groundwater	Source	Initial Contaminant Concentration in Groundwater Plume	Source
	dimensionless		l/kg		l/kg		days		µg/l	
Bis(2-ethylhexyl)phthalate	5.33E-05	cc	-	-	8.74E+04	cb	5.00E+03	(4)A&H/URS	3.38	Maximum concentration recorded during groundwater monitoring
Cadmium	-	-	2560	CLEA UK	-	-	1.00E+09	No degradation	5.24	Maximum concentration recorded during groundwater monitoring
Copper	-	-	3.50E+01	ce	-	-	1.00E+09	No degradation	1.62	Maximum concentration recorded during groundwater monitoring
Chromium (II+VI)	-	-	4800	CLEA UK	-	-	1.00E+09	No degradation	1.36E+02	Maximum concentration recorded during groundwater monitoring
Nickel	-	-	2000	CLEA UK	-	-	1.00E+09	No degradation	3.79E+01	Maximum concentration recorded during groundwater monitoring
Anthracene	1.81E-04	LQ	-	-	5.62E+03	LQ	6.00E+03	(3) URS/PAHs	1.15E-01	Maximum concentration recorded during groundwater monitoring
Fluoranthene	6.29E-05	SR7	-	-	1.82E+04	LQ	10,000	(3) URS/PAHs	7.12E-01	Maximum concentration recorded during groundwater monitoring
Benzo(a)pyrene	1.76E-06	SR7	-	-	1.29E+05	LQ	50,000	(3) URS/PAHs	1.55	Maximum concentration recorded during groundwater monitoring
Benzo(g,h,i)perylene	2.86E-06	LQ	-	-	4.17E+05	LQ	50,000	(3) URS/PAHs	1.06	Maximum concentration recorded during groundwater monitoring
Benzo(b) fluoranthene	2.05E-06	SR7	-	-	1.05E+05	LQ	50,000	(3) URS/PAHs	2.46	Maximum concentration recorded during groundwater monitoring
Benzo(k) fluoranthene	1.74E-06	SR7	-	-	1.48E+05	LQ	50,000	(3) URS/PAHs	1.20	Maximum concentration recorded during groundwater monitoring
indeno(1,2,3-c,d)pyrene	2.05E-06	SR7	-	-	8.71E+04	LQ	50,000	(3) URS/PAHs	0.95	Maximum concentration recorded during groundwater monitoring
Dibenzo(a,h)anthracene	5.40E-06	SR7	-	-	1.86E+05	LQ	50,000	(3) URS/PAHs	0.19	Maximum concentration recorded during groundwater monitoring

Key to sources	
a	Buss et al (2004), A Review of Ammonium Attenuation in Soil and Groundwater
c	US EPA 2003 User's Guide for Evaluating Subsurface Vapour Intrusion into Buildings
cb	www.toxnet.nlm.nih.gov
CC	h calc, compensated to 10C using Clausius-Claeyron relationship
cc	2001, USEPA, Supplemental Guidance for Developing Soil Screening Levels for Superfund Sites, Peer Review Draft.
calc	US EPA 2001, Factsheet: Correcting the Henry's Law Constant for Soil Temperature, June 2001
ce	Baes.C.F., Sharp R.D., Sjoreen A.L., Shor R.W., (1984) A Review and Analysis of Parameters for Assessing Transport of Environmentally Released Radionuclides through Agriculture,
	Oak Ridge National laboratory for the US DoE
k	Review of the Fate and Transport of Selected Contaminants in the Soil Environment, Draft R&D Technical Report P5-079/TR1
LQ	LQM/CIEH 2009, Trempерature corrected to 10oC
SR7	Science Report – SC050021/SR7

EPI The EPI (**Estimation Programs Interface**) Suite^{TM} is a Windows-based suite of physical/chemical property and environmental fate estimation programs developed by the EPA\'s Office of Pollution Prevention Toxics and Syracuse Research Corporation (SRC).

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Little Eaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**13-Nov-19**		**Version:**	**3.2**
Contaminant	**Anthracene**			
Target Concentration (C_T)	**1.00E-04**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Anthracene		from Level 1
Target Concentration	C_T	1.00E-04	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	1.15E-04	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	6.00E+03	days	*See Justification Table*
Calculated decay rate	λ	1.16E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.00E+03	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	2.06E-03	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	1.20E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	7.92E+01	l/kg	*see options*
Longitudinal dispersivity	ax	1.20E+01	m	*see options*
Transverse dispersivity	az	1.20E+00	m	*see options*
Vertical dispersivity	ay	1.20E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.33E-03	m/d
Retardation factor	Rf	1.82E+03	fraction
Decay rate used	λ	1.16E-04	d^{-1}
Rate of contaminant flow due to retardation	u	7.32E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.66E-191	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**6.92E+186**	

Remedial Targets

Remedial Target		**6.92E+182**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**120**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**1.66E-191**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.41E-02	fraction
Organic carbon partition coefficient	Koc	5.62E+03	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	7.92E+01	l/kg

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

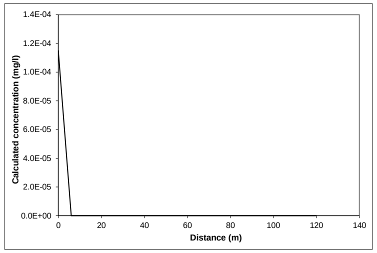
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	4.86E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	4.86E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.20E-01	4.86E-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 a 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:	Little Eaton Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.2E-04**
6.0	**5.23E-14**
12.0	**2.38E-23**
18.0	**1.08E-32**
24.0	**4.93E-42**
30.0	**2.24E-51**
36.0	**1.02E-60**
42.0	**4.64E-70**
48.0	**2.11E-79**
54.0	**9.61E-89**
60.0	**4.37E-98**
66.0	**1.99E-107**
72.0	**9.05E-117**
78.0	**4.12E-126**
84.0	**1.87E-135**
90.0	**8.52E-145**
96.0	**3.88E-154**
102.0	**1.76E-163**
108.0	**8.03E-173**
114.0	**3.65E-182**
120.0	**1.66E-191**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Little Eaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**11-Apr-17**		**Version:**	**3.2**
Contaminant	**Benzo(a)pyrene**			
Target Concentration (C_T)	**1.70E-07**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Benzo(a)pyrene**		from Level 1
Target Concentration	C_T	**1.70E-07**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	1.55E-03	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+04	days	*See Justification Table*
Calculated decay rate	λ	1.39E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.00E+03	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	2.06E-03	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	1.20E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.82E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.20E+01	m	*see options*
Transverse dispersivity	az	1.20E+00	m	*see options*
Vertical dispersivity	ay	1.20E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.33E-03	m/d
Retardation factor	Rf	4.18E+04	fraction
Decay rate used	λ	1.39E-05	d^{-1}
Rate of contaminant flow due to retardation	u	3.19E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	0.00E+00	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**breakthrough at compliance point**	

Remedial Targets

Remedial Target		**No impact**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**120**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**0.00E+00**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.41E-02	fraction
Organic carbon partition coefficient	Koc	1.29E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc.n}$		l/kg
Sorption coefficient for ionised species	$K_{oc.i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	1.82E+03	l/kg

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

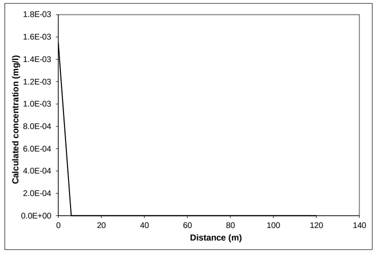
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	4.86E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	4.86E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.20E-01	4.86E-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 a 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:	Little Eaton Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.6E-03**
6.0	**4.16E-19**
12.0	**1.12E-34**
18.0	**2.99E-50**
24.0	**8.03E-66**
30.0	**2.16E-81**
36.0	**5.78E-97**
42.0	**1.55E-112**
48.0	**4.16E-128**
54.0	**1.12E-143**
60.0	**3.00E-159**
66.0	**8.04E-175**
72.0	**2.16E-190**
78.0	**5.79E-206**
84.0	**1.55E-221**
90.0	**4.17E-237**
96.0	**1.12E-252**
102.0	**3.00E-268**
108.0	**8.06E-284**
114.0	**2.16E-299**
120.0	**0.00E+00**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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

Liability: The Environment Agency does not promise that the worksheet will provide any particular facilities or functions. You must ensure that the worksheet meets your needs and you remain solely responsible for the competent use of the worksheet. You are entirely responsible for the consequences of any use of the worksheet and the Agency provides no warranty about the fitness for purpose or performance of any part of the worksheet. We do not promise that the media will always be free from defects, computer viruses, software locks or other similar code or that the operation of the worksheet will be uninterrupted or error free. You should carry out all necessary virus checks prior to installing on your computing system.

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:	**Little Eaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**11-Apr-17**		**Version:**	**3.2**
Contaminant	**Benzo(b)fluoranthene**			
Target Concentration (C_T)	**1.70E-05**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Benzo(b)fluoranthene		from Level 1
Target Concentration	C_T	1.70E-05	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.46E-03	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+04	days	*See Justification Table*
Calculated decay rate	λ	1.39E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.00E+03	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	2.06E-03	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	1.20E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.48E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.20E+01	m	*see options*
Transverse dispersivity	az	1.20E+00	m	*see options*
Vertical dispersivity	ay	1.20E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.33E-03	m/d
Retardation factor	Rf	3.41E+04	fraction
Decay rate used	λ	1.39E-05	d^{-1}
Rate of contaminant flow due to retardation	u	3.92E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.30E-284	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**5.72E+280**	

Remedial Targets

Remedial Target	**9.72E+275**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks			

Distance to compliance point		**120**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**4.30E-284**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.41E-02	fraction
Organic carbon partition coefficient	Koc	1.05E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	1.48E+03	l/kg

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

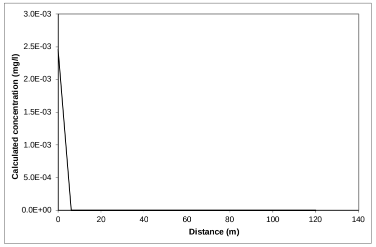
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	1.20E+01	4.86E+00	m
Transverse dispersivity	**az**	0.00E+00	1.20E+00	4.86E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.20E-01	4.86E-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 a 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:	Little Eaton Junction
Completed by:	Victor Ojambati
Date:	########
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**2.5E-03**
6.0	**2.25E-17**
12.0	**2.07E-31**
18.0	**1.89E-45**
24.0	**1.74E-59**
30.0	**1.59E-73**
36.0	**1.46E-87**
42.0	**1.34E-101**
48.0	**1.22E-115**
54.0	**1.12E-129**
60.0	**1.03E-143**
66.0	**9.43E-158**
72.0	**8.64E-172**
78.0	**7.92E-186**
84.0	**7.26E-200**
90.0	**6.65E-214**
96.0	**6.10E-228**
102.0	**5.59E-242**
108.0	**5.12E-256**
114.0	**4.69E-270**
120.0	**4.30E-284**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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: **Little Eaton Junction**
Site Address: **A38, Derbyshire**

Completed by: **Victor Ojambati**
Date: **11-Apr-17** **Version:** **3.2**

Contaminant **Benzo(g,h,i)perylene**
Target Concentration (C_T) **8.20E-06** **mg/l** **Origin of C_T:** **EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Parameter	Variable	Value	Unit	Source
Contaminant		Benzo(g,h,i)perylene		from Level 1
Target Concentration	C_T	8.20E-06	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 pollutants in all phases (e.g. field derived value

Parameter	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.06E-03	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+04	days	*See Justification Table*
Calculated decay rate	λ	1.39E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.00E+03	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	2.06E-03	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	1.20E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	5.88E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.20E+01	m	*see options*
Transverse dispersivity	az	1.20E+00	m	*see options*
Vertical dispersivity	ay	1.20E-01	m	*see options*

Calculated Parameters

Parameter	Variable	Value	Unit
Groundwater flow velocity	v	1.33E-03	m/d
Retardation factor	Rf	1.35E+05	fraction
Decay rate used	λ	1.39E-05	d^{-1}
Rate of contaminant flow due to retardation	u	9.87E-09	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	0.00E+00	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**breakthrough at compliance point**	

Remedial Targets

Remedial Target	**No impact**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks			

Distance to compliance point		**120**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**0.00E+00**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.41E-02	fraction
Organic carbon partition coefficient	Koc	4.17E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	5.88E+03	l/kg

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

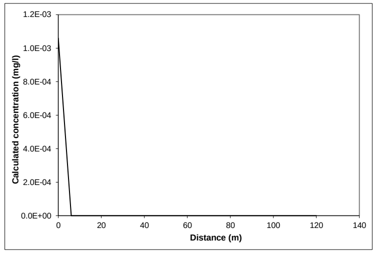
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	4.86E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	4.86E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.20E-01	4.86E-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 a 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:	Little Eaton Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.1E-03
6.0	8.77E-32
12.0	7.26E-60
18.0	6.01E-88
24.0	4.97E-116
30.0	4.12E-144
36.0	3.41E-172
42.0	2.82E-200
48.0	2.33E-228
54.0	1.93E-256
60.0	1.60E-284
66.0	0.00E+00
72.0	0.00E+00
78.0	0.00E+00
84.0	0.00E+00
90.0	0.00E+00
96.0	0.00E+00
102.0	0.00E+00
108.0	0.00E+00
114.0	0.00E+00
120.0	0.00E+00

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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

Liability: The Environment Agency does not promise that the worksheet will provide any particular facilities or functions. You must ensure that the worksheet meets your needs and you remain solely responsible for the competent use of the worksheet. You are entirely responsible for the consequences of any use of the worksheet and the Agency provides no warranty about the fitness for purpose or performance of any part of the worksheet. We do not promise that the media will always be free from defects, computer viruses, software locks or other similar code or that the operation of the worksheet will be uninterrupted or error free. You should carry out all necessary virus checks prior to installing on your computing system.

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:	**Little Eaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**11-Apr-17**		**Version:**	**3.2**
Contaminant	**Benzo(k)fluoranthene**			
Target Concentration (C_T)	**1.70E-05**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Benzo(k)fluoranthene**		from Level 1
Target Concentration	C_T	**1.70E-05**	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 pollutants in all phases (e.g. field derived value**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.20E-03	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+04	days	*See Justification Table*
Calculated decay rate	λ	1.39E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.00E+03	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	2.06E-03	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	1.20E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.09E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.20E+01	m	*see options*
Transverse dispersivity	az	1.20E+00	m	*see options*
Vertical dispersivity	ay	1.20E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.33E-03	m/d
Retardation factor	Rf	4.80E+04	fraction
Decay rate used	λ	1.39E-05	d^{-1}
Rate of contaminant flow due to retardation	u	2.78E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	0.00E+00	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**breakthrough at compliance point**	

Remedial Targets

Remedial Target		**No impact**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**120**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**0.00E+00**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.41E-02	fraction
Organic carbon partition coefficient	Koc	1.48E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc.n}$		l/kg
Sorption coefficient for ionised species	$K_{oc.i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	2.09E+03	l/kg

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

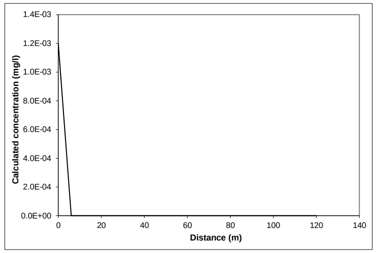
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	4.86E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	4.86E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.20E-01	4.86E-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 a 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:	Little Eaton Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.2E-03**
6.0	**2.47E-20**
12.0	**5.09E-37**
18.0	**1.05E-53**
24.0	**2.16E-70**
30.0	**4.44E-87**
36.0	**9.14E-104**
42.0	**1.88E-120**
48.0	**3.88E-137**
54.0	**7.98E-154**
60.0	**1.64E-170**
66.0	**3.38E-187**
72.0	**6.97E-204**
78.0	**1.43E-220**
84.0	**2.95E-237**
90.0	**6.08E-254**
96.0	**1.25E-270**
102.0	**2.58E-287**
108.0	**5.31E-304**
114.0	**0.00E+00**
120.0	**0.00E+00**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Little Eaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**13/11/2019**		**Version:**	**3.2**
Contaminant	**Bis(2-ethylhexyl) phthalate**			
Target Concentration (C_T)	**1.30E-03**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Bis(2-ethylhexyl) phthalate**		from Level 1
Target Concentration	C_T	**1.30E-03**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	3.38E-03	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+03	days	*See Justification Table*
Calculated decay rate	λ	1.39E-04	days^{-1}	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.00E+03	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	2.06E-03	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	1.20E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.00E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.20E+01	m	*see options*
Transverse dispersivity	az	1.20E+00	m	*see options*
Vertical dispersivity	ay	1.20E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.33E-03	m/d
Retardation factor	Rf	4.60E+04	fraction
Decay rate used	λ	1.39E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.90E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	0.00E+00	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	breakthrough at compliance point	

Remedial Targets

Remedial Target		No impact	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**120**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**0.00E+00**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.41E-02	fraction
Organic carbon partition coefficient	Koc	8.74E+04	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+03	l/kg

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

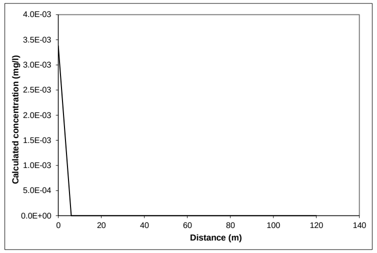
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	4.86E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	4.86E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.20E-01	4.86E-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 a 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:	Little Eaton Junction
Completed by:	Lucy Full
Date:	13/11/2019
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**3.4E-03**
6.0	**4.41E-55**
12.0	**5.76E-107**
18.0	**7.51E-159**
24.0	**9.80E-211**
30.0	**1.28E-262**
36.0	**0.00E+00**
42.0	**0.00E+00**
48.0	**0.00E+00**
54.0	**0.00E+00**
60.0	**0.00E+00**
66.0	**0.00E+00**
72.0	**0.00E+00**
78.0	**0.00E+00**
84.0	**0.00E+00**
90.0	**0.00E+00**
96.0	**0.00E+00**
102.0	**0.00E+00**
108.0	**0.00E+00**
114.0	**0.00E+00**
120.0	**0.00E+00**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Little Eaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**11-Apr-17**		**Version:**	**3.2**
Contaminant	**Cadmium**			
Target Concentration (C_T)	**8.00E-05**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		**Cadmium**		from Level 1
Target Concentration	C_T	**8.00E-05**	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 pollutants in all phases (e.g. field derived value**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	5.24E-03	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+09	days	*See Justification Table*
Calculated decay rate	λ	6.93E-10	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.00E+03	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	2.06E-03	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	1.20E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.56E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.20E+01	m	*see options*
Transverse dispersivity	az	1.20E+00	m	*see options*
Vertical dispersivity	ay	1.20E-01	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	1.33E-03	m/d
Retardation factor	Rf	5.89E+04	fraction
Decay rate used	λ	6.93E-10	d^{-1}
Rate of contaminant flow due to retardation	u	2.27E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.02E-04	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.74E+01**	

Remedial Targets

Remedial Target		**1.39E-03**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**120**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**3.02E-04**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

User specified value for partition coefficient

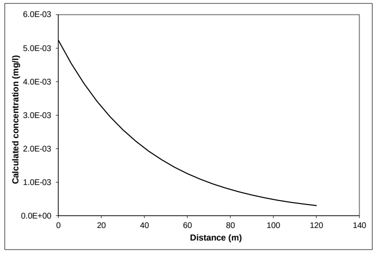
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	2.56E+03	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption 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	2.56E+03	l/kg

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

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

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	4.86E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	4.86E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.20E-01	4.86E-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 a 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:	Little Eaton Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**5.2E-03**
6.0	**4.54E-03**
12.0	**3.94E-03**
18.0	**3.41E-03**
24.0	**2.96E-03**
30.0	**2.57E-03**
36.0	**2.23E-03**
42.0	**1.93E-03**
48.0	**1.67E-03**
54.0	**1.45E-03**
60.0	**1.26E-03**
66.0	**1.09E-03**
72.0	**9.45E-04**
78.0	**8.20E-04**
84.0	**7.11E-04**
90.0	**6.16E-04**
96.0	**5.34E-04**
102.0	**4.63E-04**
108.0	**4.01E-04**
114.0	**3.48E-04**
120.0	**3.02E-04**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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

Liability: The Environment Agency does not promise that the worksheet will provide any particular facilities or functions. You must ensure that the worksheet meets your needs and you remain solely responsible for the competent use of the worksheet. You are entirely responsible for the consequences of any use of the worksheet and the Agency provides no warranty about the fitness for purpose or performance of any part of the worksheet. We do not promise that the media will always be free from defects, computer viruses, software locks or other similar code or that the operation of the worksheet will be uninterrupted or error free. You should carry out all necessary virus checks prior to installing on your computing system.

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:	**Little Eaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**11-Apr-17**		**Version:**	**3.2**
Contaminant	**Chromium**			
Target Concentration (C_T)	**5.00E-02**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Parameter	Variable	Value	Unit	Source
Contaminant		**Chromium**		from Level 1
Target Concentration	C_T	**5.00E-02**	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

Parameter	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	1.36E-01	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+09	days	*See Justification Table*
Calculated decay rate	λ	6.93E-10	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.00E+03	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	2.06E-03	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	1.20E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	4.80E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.20E+01	m	*see options*
Transverse dispersivity	az	1.20E+00	m	*see options*
Vertical dispersivity	ay	1.20E-01	m	*see options*

Calculated Parameters

Parameter	Variable	Value	Unit
Groundwater flow velocity	v	1.33E-03	m/d
Retardation factor	Rf	1.10E+05	fraction
Decay rate used	λ	6.93E-10	d^{-1}
Rate of contaminant flow due to retardation	u	1.21E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.26E-03	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.08E+02**	

Remedial Targets

Remedial Target		**5.41E+00**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**120**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**1.26E-03**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

User specified value for partition coefficient

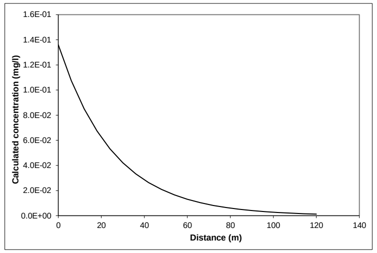
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	4.80E+03	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	[redacted]	fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$	[redacted]	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	4.80E+03	l/kg

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

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

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	4.86E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	4.86E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.20E-01	4.86E-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 a 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:	Little Eaton Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.4E-01**
6.0	**1.08E-01**
12.0	**8.51E-02**
18.0	**6.74E-02**
24.0	**5.33E-02**
30.0	**4.22E-02**
36.0	**3.34E-02**
42.0	**2.64E-02**
48.0	**2.09E-02**
54.0	**1.65E-02**
60.0	**1.31E-02**
66.0	**1.03E-02**
72.0	**8.18E-03**
78.0	**6.47E-03**
84.0	**5.12E-03**
90.0	**4.05E-03**
96.0	**3.21E-03**
102.0	**2.54E-03**
108.0	**2.01E-03**
114.0	**1.59E-03**
120.0	**1.26E-03**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Little Eaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**13/11/2019**		**Version:**	**3.2**
Contaminant	**Copper**			
Target Concentration (C_T)	**1.00E-03**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Copper		from Level 1
Target Concentration	C_T	1.00E-03	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 pollutants in all phases (e.g. field derived value,**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	1.62E-03	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+09	days	*See Justification Table*
Calculated decay rate	λ	6.93E-10	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.00E+03	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	2.06E-03	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	1.20E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.50E+01	l/kg	*see options*
Longitudinal dispersivity	ax	1.20E+01	m	*see options*
Transverse dispersivity	az	1.20E+00	m	*see options*
Vertical dispersivity	ay	1.20E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.33E-03	m/d
Retardation factor	Rf	8.06E+02	fraction
Decay rate used	λ	6.93E-10	d^{-1}
Rate of contaminant flow due to retardation	u	1.66E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.54E-03	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.05E+00**	

Remedial Targets

Remedial Target		**1.05E-03**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**120**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**1.54E-03**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	3.50E+01	l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc		fraction
Organic carbon partition coefficient	Koc		l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.50E+01	l/kg

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

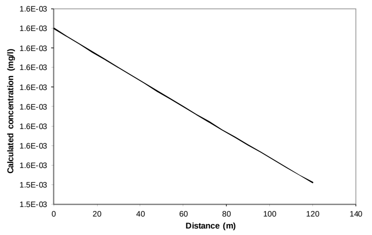
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	1.20E+01	4.86E+00	m
Transverse dispersivity	**az**	0.00E+00	1.20E+00	4.86E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.20E-01	4.86E-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 a 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:	Little Eaton Junction
Completed by:	Lucy Full
Date:	13/11/2019
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.6E-03**
6.0	**1.62E-03**
12.0	**1.61E-03**
18.0	**1.61E-03**
24.0	**1.60E-03**
30.0	**1.60E-03**
36.0	**1.60E-03**
42.0	**1.59E-03**
48.0	**1.59E-03**
54.0	**1.58E-03**
60.0	**1.58E-03**
66.0	**1.58E-03**
72.0	**1.57E-03**
78.0	**1.57E-03**
84.0	**1.56E-03**
90.0	**1.56E-03**
96.0	**1.56E-03**
102.0	**1.55E-03**
108.0	**1.55E-03**
114.0	**1.54E-03**
120.0	**1.54E-03**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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

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

Details to be completed for each assessment

Site Name:	**Little Eaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**11-Apr-17**		**Version:**	**3.2**
Contaminant	**Dibenz(a,h)anthracene**			
Target Concentration (C_T)	**7.50E-05**	**mg/l**	**Origin of C_T:**	**EQS**

This worksheet can be used to determine remedial targets for soils (Worksheets Level 1 Soil, Level 2 and Level 3 Soil) or to determine remedial targets for groundwater (Level 3 Groundwater). For Level 3, parameter values must be entered separately dependent on whether the assessment is for soil or groundwater. For soil, remedial targets are calculated as either mg/kg (for 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.
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It is recommended that a copy of the original worksheet is saved (all data fields in the original copy are blank).

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		Dibenz(a,h)anthracene		from Level 1
Target Concentration	C_T	7.50E-05	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 pollutants in all phases (e.g. field derived value

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.89E-04	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+04	days	*See Justification Table*
Calculated decay rate	λ	1.39E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.00E+03	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	2.06E-03	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	1.20E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.62E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.20E+01	m	*see options*
Transverse dispersivity	az	1.20E+00	m	*see options*
Vertical dispersivity	ay	1.20E-01	m	*see options*

Calculated Parameters

	Variable	Value	Unit
Groundwater flow velocity	v	1.33E-03	m/d
Retardation factor	Rf	6.03E+04	fraction
Decay rate used	λ	1.39E-05	d^{-1}
Rate of contaminant flow due to retardation	u	2.21E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	0.00E+00	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**breakthrough at compliance point**	

Remedial Targets

Remedial Target		No impact	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**120**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**0.00E+00**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.41E-02	fraction
Organic carbon partition coefficient	Koc	1.86E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc.n}$		l/kg
Sorption coefficient for ionised species	$K_{oc.i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	2.62E+03	l/kg

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

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

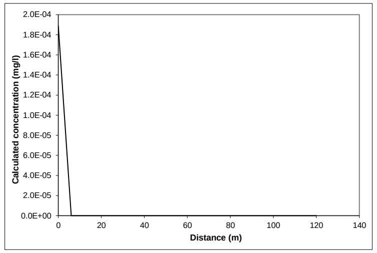
		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	4.86E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	4.86E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.20E-01	4.86E-02	

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

Environment Agency



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

Note

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

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

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

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

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

Site being assessed:	Little Eaton Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.9E-04**
6.0	**3.61E-23**
12.0	**6.89E-42**
18.0	**1.31E-60**
24.0	**2.51E-79**
30.0	**4.79E-98**
36.0	**9.14E-117**
42.0	**1.74E-135**
48.0	**3.33E-154**
54.0	**6.35E-173**
60.0	**1.21E-191**
66.0	**2.31E-210**
72.0	**4.42E-229**
78.0	**8.43E-248**
84.0	**1.61E-266**
90.0	**3.07E-285**
96.0	**5.86E-304**
102.0	**0.00E+00**
108.0	**0.00E+00**
114.0	**0.00E+00**
120.0	**0.00E+00**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Little Eaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Lucy Full**			
Date:	**13-Nov-19**		**Version:**	**3.2**
Contaminant	**Fluoranthene**			
Target Concentration (C_T)	**6.30E-06**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Fluoranthene**		from Level 1
Target Concentration	C_T	**6.30E-06**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	7.12E-04	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+03	days	*See Justification Table*
Calculated decay rate	λ	6.93E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.00E+03	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	2.06E-03	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	1.20E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.00E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.20E+01	m	*see options*
Transverse dispersivity	az	1.20E+00	m	*see options*
Vertical dispersivity	ay	1.20E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.33E-03	m/d
Retardation factor	Rf	4.60E+04	fraction
Decay rate used	λ	6.93E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.90E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	0.00E+00	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**breakthrough at compliance point**	

Remedial Targets

Remedial Target		**No impact**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**120**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**0.00E+00**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.41E-02	fraction
Organic carbon partition coefficient	Koc	1.48E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	2.00E+03	l/kg

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

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

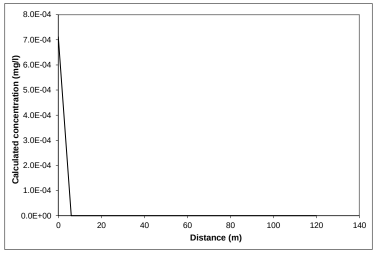
		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	4.86E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	4.86E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.20E-01	4.86E-02	

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

Environment Agency



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

Note

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

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

The measured groundwater concentration should be compared

with the Level 3 remedial target to determine the need for further action.

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

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

Site being assessed:	Little Eaton Junction
Completed by:	Lucy Full
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**7.1E-04**
6.0	**5.03E-120**
12.0	**3.55E-236**
18.0	**0.00E+00**
24.0	**0.00E+00**
30.0	**0.00E+00**
36.0	**0.00E+00**
42.0	**0.00E+00**
48.0	**0.00E+00**
54.0	**0.00E+00**
60.0	**0.00E+00**
66.0	**0.00E+00**
72.0	**0.00E+00**
78.0	**0.00E+00**
84.0	**0.00E+00**
90.0	**0.00E+00**
96.0	**0.00E+00**
102.0	**0.00E+00**
108.0	**0.00E+00**
114.0	**0.00E+00**
120.0	**0.00E+00**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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

Liability: The Environment Agency does not promise that the worksheet will provide any particular facilities or functions. You must ensure that the worksheet meets your needs and you remain solely responsible for the competent use of the worksheet. You are entirely responsible for the consequences of any use of the worksheet and the Agency provides no warranty about the fitness for purpose or performance of any part of the worksheet. We do not promise that the media will always be free from defects, computer viruses, software locks or other similar code or that the operation of the worksheet will be uninterrupted or error free. You should carry out all necessary virus checks prior to installing on your computing system.

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:	**Little Eaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**11-Apr-17**		**Version:**	**3.2**
Contaminant	**Indeno(a)pyrene**			
Target Concentration (C_T)	**1.00E-04**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**Indeno(a)pyrene**		from Level 1
Target Concentration	C_T	**1.00E-04**	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 pollutants in all phases (e.g. field derived value**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	9.51E-04	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+04	days	*See Justification Table*
Calculated decay rate	λ	1.39E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.00E+03	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	2.06E-03	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	1.20E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.23E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.20E+01	m	*see options*
Transverse dispersivity	az	1.20E+00	m	*see options*
Vertical dispersivity	ay	1.20E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	1.33E-03	m/d
Retardation factor	Rf	2.82E+04	fraction
Decay rate used	λ	1.39E-05	d^{-1}
Rate of contaminant flow due to retardation	u	4.73E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.89E-259	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.29E+255**	

Remedial Targets

Remedial Target		**3.29E+251**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**120**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**2.89E-259**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	1.41E-02	fraction
Organic carbon partition coefficient	Koc	8.71E+04	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	1.23E+03	l/kg

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

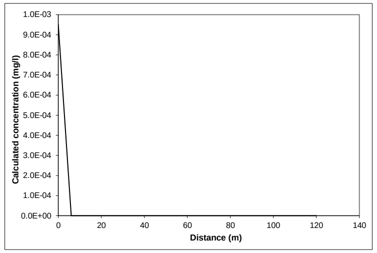
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	4.86E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	4.86E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.20E-01	4.86E-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 a 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:	Little Eaton Junction
Completed by:	Victor Ojambati
Date:	#######
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**9.5E-04**
6.0	**1.59E-16**
12.0	**2.67E-29**
18.0	**4.47E-42**
24.0	**7.49E-55**
30.0	**1.26E-67**
36.0	**2.10E-80**
42.0	**3.52E-93**
48.0	**5.91E-106**
54.0	**9.89E-119**
60.0	**1.66E-131**
66.0	**2.78E-144**
72.0	**4.65E-157**
78.0	**7.80E-170**
84.0	**1.31E-182**
90.0	**2.19E-195**
96.0	**3.67E-208**
102.0	**6.14E-221**
108.0	**1.03E-233**
114.0	**1.72E-246**
120.0	**2.89E-259**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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

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

Details to be completed for each assessment

Site Name:	**Little Eaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Victor Ojambati**			
Date:	**11-Apr-17**		**Version:**	**3.2**
Contaminant	**Nickel**			
Target Concentration (C_T)	**4.00E-03**	**mg/l**	**Origin of C_T:**	**EQS**

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

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		**Nickel**		from Level 1
Target Concentration	C_T	**4.00E-03**	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	3.79E-02	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+09	days	*See Justification Table*
Calculated decay rate	λ	6.93E-10	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	1.00E+03	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	2.06E-03	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	1.20E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	2.00E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.20E+01	m	*see options*
Transverse dispersivity	az	1.20E+00	m	*see options*
Vertical dispersivity	ay	1.20E-01	m	*see options*

Calculated Parameters

Calculated Parameters	Variable	Value	Unit
Groundwater flow velocity	v	1.33E-03	m/d
Retardation factor	Rf	4.60E+04	fraction
Decay rate used	λ	6.93E-10	d^{-1}
Rate of contaminant flow due to retardation	u	2.90E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	3.70E-03	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**1.02E+01**	

Remedial Targets

Remedial Target		**4.09E-02**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**120**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**3.70E-03**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

User specified value for partition coefficient

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd	2.00E+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	2.00E+03	l/kg

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

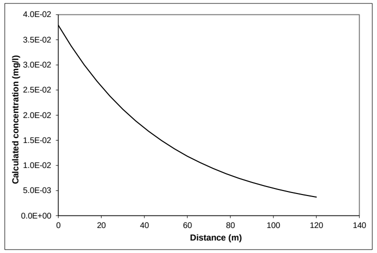
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	#######	4.86E+00	m
Transverse dispersivity	**az**	0.00E+00	#######	4.86E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.20E-01	4.86E-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 a 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: Little Eaton Junction
Completed by: Victor Ojambati
Date: #######
Version: 3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**3.8E-02**
6.0	**3.37E-02**
12.0	**3.00E-02**
18.0	**2.67E-02**
24.0	**2.38E-02**
30.0	**2.12E-02**
36.0	**1.89E-02**
42.0	**1.68E-02**
48.0	**1.49E-02**
54.0	**1.33E-02**
60.0	**1.18E-02**
66.0	**1.05E-02**
72.0	**9.39E-03**
78.0	**8.36E-03**
84.0	**7.44E-03**
90.0	**6.62E-03**
96.0	**5.90E-03**
102.0	**5.25E-03**
108.0	**4.67E-03**
114.0	**4.16E-03**
120.0	**3.70E-03**

Appendix 12: 8.57 – Technical Note on Controlled Waters Quantitative Risk Assessment – 3.2.20 [REP4-019]

A38 Derby Junctions

TR010022

8.57 Technical Note on Controlled Waters Quantitative Risk Assessment

Planning Act 2008

Rule 8 (1)(k)

Infrastructure Planning (Examination Procedure) Rules 2010

Volume 8

February 2020

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010

A38 Derby Junctions
Development Consent Order 202[ ]

Technical Note on Controlled Waters Quantitative Risk Assessment

Regulation Number	Rule 8 (1)(k)
Planning Inspectorate Scheme Reference	TR010022
Application Document Reference	TR010022/APP/8.57
Author	A38 Derby Junctions Project Team, Highways England

Version	Date	Status of Version
1	03 February 2020	Deadline 4 submission

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Project name:
A38 Derby Junctions

Project ref:
60533462

From:
David Evans

Date:
20 January 2020

To:
Mr T. Lowden
Environment Agency

CC:
Simon Wild

Technical Note: A38 Derby Junctions Addendum

Subject: Geology and Soils (Controlled Waters Quantitative Risk Assessment)

On the 9th October 2019 AECOM provided clarification to assist in addressing queries from the Environment Agency regarding groundwater quality in the areas associated with the A38 Derby junctions (referred to as the Scheme herein), namely Kingsway junction, Markeaton junction and Little Eaton junction. This information comprised tables of chemical data and figures presenting borehole locations where exceedances of the Tier 1[1] groundwater generic quantitative risk (GQRA) assessment were recorded. The tables, are not reproduced here, can be found in AECOM Technical Note: A38 Derby Junction 25 November 2019 as can the figures showing the location of the monitoring wells at each of the A38 Derby Junctions.

In November 2019, following the Environment Agency's review of the additional data provided by Highways England, it was clear that the Environment Agency did not agree with the use of UCL95 values within the quantitative risk assessments for controlled waters. As such, the revised Quantitative Risk Assessment (QRA) for Controlled Waters for the Scheme at Kingsway, Markeaton and Little Eaton junctions was undertaken. The revision was undertaken following Environment Agency comments regarding the use of statistical analysis of the datasets in the 2018 Ground Investigation Report which determined a 95th percentile upper confidence limit (UCL95) for the groundwater data for each determinand for comparison with the Generic Assessment Criteria. The Environment Agency disagreed with this approach due to the underlying assumptions in the use of UCL95 values. The revised GQRA and DQRA did not use UCL95 values in the assessments. The revised quantitative risk assessment (QRA) was based on groundwater data only. The GQRA and DQRA in the Ground Investigation Report (2018) were based on the maximum concentrations recorded in either soil leachate or groundwater which was a highly conservative approach. The information submitted to the Environment Agency was also submitted to the A38 DCO Examining Authority (ExA) as document reference [REP3-020].

The summary of the revised DQRA, in the AECOM Technical Note: A38 Derby Junctions 25 November 2019, is as follows:

> *The Tier 1 screening results revealed elevated concentrations of some metals and organic compounds in groundwater within the Made Ground at Kingsway (former Rowditch Tip) and Natural Ground at Kingsway, Markeaton and Little Eaton junctions.*
>
> *A Detailed Quantitative Risk Assessment (DQRA) was carried out using the Environment Agency's Remedial Targets Worksheet for the contaminants identified in groundwater within the Made Ground at Kingsway junction and Natural Ground at Kingsway, Markeaton and Little Eaton junctions. The results of the DQRA indicates that there is negligible*

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[1] Tier 1 GQRA is terminology from CLR11 (EA, 2004); the terminology has been changed in the Contaminated Land: Risk Management (EA, 2019) guidance which refers to GQRA as Tier 2. For consistency with the earlier reports the GQRA will continue to be referred to as Tier 1.

risk to identified receptors from organic contaminants. The theoretical risk from dissolved metals is likely to be influenced by naturally occurring low-level concentrations derived from the strata mineralogy. Therefore, it is considered that there is a very low risk to the identified receptors from the presence of cadmium, copper and/or nickel concentrations recorded in a very small number of samples at each of the three junctions.

No remedial works are considered necessary regarding the concentrations of potential contaminants encountered within groundwater at the three junctions.

Where dewatering of excavations is required during the Scheme construction works, water should be collected, stored, tested and then shall either be:

- *Discharged to foul sewer under a trade effluent consent agreed with the local sewerage undertaker; and/or*
- *Discharged to surface water under a water discharge activity environmental permit (WDA-EP) from the Environment Agency.*

The revised DQRA was reviewed by the Environment Agency during December 2019 (e-mail dated 18.12.19 with the comments repeated in the Environment Agency submission to the ExA [REP3-034] (refer to comment 74e)) . The findings of the DQRA were accepted by the Environment Agency with the exception of the following determinands recorded in Made Ground (former Rowditch Tip) at the Kingsway junction and natural ground at Markeaton junction – see Table 1.

Table 1. Summary of Exceedances Recorded in Made Ground Groundwater at Kingsway Junction

Determinand	Units	DWS	EQS	No. of Samples	Recorded Concentrations	No. of Exceedances DWS	No. of Exceedances EQS
>C10-C12 Aliphatics	µg/L	300	-	9	<10 – 331	1	-
>C12-C16 Aliphatics	µg/L	300	-	9	<10 – 324	2	-
>C16-C21 Aliphatics	µg/L	300	-	9	<10 – 542	5	-
>C21-C35 Aliphatics	µg/L	300	-	9	<10 - 5760	6	-
>EC5-EC7 Aromatics	µg/L	1	10	9	<10 – 17	3	2
>EC8-EC10 Aromatics	µg/L	300	-	6	<10 – 391	1	-
>EC10-EC12 Aromatics	µg/L	90	-	9	<10 – 221	3	-
>EC12-EC16 Aromatics	µg/L	90	-	9	<10 – 352	6	-
>EC16-EC21 Aromatics	µg/L	90	-	9	<10 – 484	6	-
>EC21-EC35 Aromatics	µg/L	90	-	9	<10 – 1,850	6	-

The following determinands were recorded in monitoring well BM05 and BM11 at Markeaton junction – see Table 2.

Table 2. Summary of Exceedances Recorded at Markeaton Junction

Determinand	Units	DWS	EQS	No. of Samples	Recorded Concentrations	No. of Exceedances DWS	No. of Exceedances EQS
>C21-C35 Aliphatics	µg/L	300	-	16	<10 – 1,250	4	-
>EC21-EC35 Aromatics	µg/L	90	-	16	<10 – 591	4	-

These determinands were recorded as exceedances against Drinking Water Standards (DWS), but not Environmental Quality Standards (EQS). These determinands were not taken further than the Generic Quantitative Risk Assessment as it was noted that the receptors at Kingsway junction and Markeaton junction are surface water bodies and not groundwater bodies. The underlying groundwater is not used for potable water supply. Therefore, no further assessment was considered necessary. However, the Environment Agency consider that the total petroleum hydrocarbon (TPH) concentrations recorded may pose a risk to controlled waters and consider that further comment and/or risk assessment is required.

The following are AECOM comments that relate to the TPH fractions recorded as exceedances of the corresponding DWS at the former Rowditch Tip at Kingsway junction:

- Location of BK12, BK13, BK14 and BK15 is presented in Figure 4 Groundwater Exceedances (Kingsway East) (04/10/2019) (this figure was included in the AECOM Technical Note: A38 Derby Junction 25 November 2019).
- Elevated TPH fractions, in comparison to the corresponding DWS, were recorded in BK12 and BK14 only.
- No elevated TPH fractions were recorded at the two other monitoring wells BK13 and BK15 also located at the site of the former Rowditch Tip. Hydrocarbon odours and/or staining were noted within the Made Ground materials on the borehole logs for BK12 and BK13; none recorded in BK14.
- Monitoring wells BK12, BK13 and BK14 are screened within Made Ground materials at depths between:
    - 1.2m and 9.0m below ground level (bgl) in BK12;
    - 7.1m and 12m bgl in BK13; and
    - 4.0m and 8.0m bgl in BK14.
- Monitoring well BK15 is screened in Natural Ground between 8.0m and 14.0m bgl. A strong hydrocarbon odour was noted in the overlying Made Ground between 1.2m and 2.0m bgl. No hydrocarbon odours were noted in the natural ground.
- Water within the Made Ground is considered to be perched water. Water strikes noted on the borehole logs indicate they occurred where gravel formed the Made Ground materials.
- Water in BK15 in Natural Ground was struck within a Siltstone band between 11.7m and 12.18m bgl.
- The groundwater chemical analysis results indicate that the groundwater within the Made Ground is not in continuity with groundwater within the natural ground.
- It is considered that the risk to surface water (Bramble Brook) from the presence of these TPH fractions in perched groundwater within the landfilled materials at the former Rowditch Tip is minimal. However, earthworks are to be undertaken within this area of the former Rowditch Tip [a link road will cross the site through a cutting] and it is considered prudent to undertake Detailed Quantitative Risk Assessment to assess an assumption that in the event that the earthworks created a plausible new pathway for the migration of groundwater whether it would result in a risk to surface water.

The following are AECOM comments that relate to the TPH fractions recorded as exceedances of the corresponding DWS at BM05 and BM11 at Markeaton junction:

- BM05 is screened in natural ground between 1.5m and 7.0m bgl. A strong acrid odour was noted at between 3.0m and 5.36m bgl within natural ground.
- BM11 is screened between 1.0m and 25.0m bgl in natural ground. No odours noted in the borehole log.
- Location of BM05 and BM11 is presented in Figure 2 Groundwater Exceedances (Markeaton) (13/11/2019) (this figure was included in the AECOM Technical Note: A38 Derby Junction 25 November 2019). BM05 is located to the south of the existing petrol station adjacent to the northbound carriageway of the A38. BM11 is located to the north west of the existing Markeaton junction adjacent to the northbound A38 carriageway.
- Elevated TPH fractions, in comparison to the corresponding DWS, were recorded in BM05 and BM11 only at Markeaton junction.
- It is considered that there is a potential risk to surface water (Markeaton Lake) from the presence of these TPH fractions in groundwater encountered in natural ground, in the event that the works cause a groundwater migration pathway. Therefore it is considered prudent to undertake Detailed Quantitative Risk Assessment to determine whether the concentrations of the TPH fractions recorded at BM05 and BM11 could impact Markeaton Lake.

Detailed Quantitative Risk Assessment

Following the Tier 1 risk assessment as detailed in the preceding section, elevated concentrations of TPH fractions which were detected in groundwater samples, at isolated locations at Kingsway junction and Markeaton junction warrant further detailed assessment. The detailed quantitative risk assessment (DQRA) has been undertaken in accordance with current guidance to assess the potential risk posed to the receptors by the elevated contaminants identified in groundwater.

The risk assessment is based on the guidance contained within the Environment Agency (2006) Remedial Target Methodology - Hydrogeological Risk Assessment for Land Contamination' (RTM) and the associated Remedial Targets

Worksheet (Release 3.2). The RTM document provides guidance on the method to derive remedial targets from soil, leachate and groundwater data.

A Level 3 groundwater assessment was undertaken for each of the three junctions. The Level 3 assessment simulates the migration of contaminants that have already reached the underlying groundwater, taking into account the potential attenuation as the contaminated groundwater moves to the receptor(s) as follows:

- Kingsway junction – Bramble Brook
- Markeaton junction – Markeaton Lake/ Pond

The assessment does not take into consideration dilution at the receptor.

Remedial Target Methodology

The site-specific remedial target concentrations with respect to the elevated contaminants in groundwater were computed in accordance with the Environment Agency's Risk Assessment Methodology (RTM). The Remedial Target Worksheet (Release 3.2) for the hydrogeological risk assessment for land contamination was utilised. The input parameters were derived from data from the ground investigation at the site and the various databases for related soil types and geochemical inputs.

Risk Assessment Simulation Overview

The risk assessment simulations assume a continuous groundwater body present beneath the site. It is assumed that the underlying groundwater flows towards each of the receptors. There was no on-site measurement of redox potential and dissolved oxygen during the groundwater monitoring at the sites. As such, anaerobic biodegradation rates for the organic contaminants have been used where available. This is a conservative approach.

The specific input parameters for each simulation in RTM worksheet and the physical properties of the various contaminants are included in Appendices A and B.

Made Ground at Kingsway Junction

Table 3 details the results of the DQRA (full results are included in Appendix A), the simulated remedial target values and the predicted maximum concentrations of the various contaminants at the compliance point (Bramble Brook). The results summarise the predicted concentrations of the contaminant after the contaminant reaches the receptor. A Remedial Target Value (RTV) is given in Red or Green. Red corresponds to an RTV value less than the maximum concentration recorded in groundwater which indicates that mitigation measures may be required, and Green corresponds to an RTV value more than the maximum concentration recorded in groundwater which indicates that mitigation measures are not required.

Table 3. Results of Detailed Quantitative Risk Assessment in Made Ground at Kingsway Junction

Determinand	Target Concentration (DWS) (µg/L)	Maximum Concentration in Groundwater (µg/L)	Predicted Concentration at Receptor (µg/L)	Remedial Target Value (µg/L)
>C10-C12 Aliphatics	300	331	<0.00001	**>10,000**
>C12-C16 Aliphatics	300	324	<0.00001	**>10,000**
>C16-C21 Aliphatics	300	542	<0.00001	**>10,000**
>C21-C35 Aliphatics	300	5760	<0.00001	**>10,000**
>EC5-EC7 Aromatics	1	17	<0.00001	**>10,000**
>EC8-EC10 Aromatics	300	391	<0.00001	**>10,000**
>EC10-EC12 Aromatics	90	221	<0.00001	**>10,000**
>EC12-EC16 Aromatics	90	352	<0.00001	**>10,000**
>EC16-EC21 Aromatics	90	484	<0.00001	**>10,000**
>EC21-EC35 Aromatics	90	1,850	<0.00001	**>10,000**

Determinand	Target Concentration (DWS) (µg/L)	Maximum Concentration in Groundwater (µg/L)	Predicted Concentration at Receptor (µg/L)	Remedial Target Value (µg/L)

XX RTV less than maximum concentration in groundwater

XX RTV greater than maximum concentration in groundwater

The results of the DQRA for groundwater sampled from made ground materials at the former Rowditch Tip at Kingsway junction suggest that there will be negligible risks from petroleum hydrocarbon determinands present in groundwater to the identified critical receptor (Bramble Brook).

Natural Ground at Markeaton Junction

Table 4 details the results of the DQRA (full results are included in Appendix B), the simulated remedial target values and the predicted maximum concentrations of the various contaminants at the compliance point (Markeaton Lake). The results summarise the predicted concentrations of the contaminant after the contaminant reaches the receptor. A RTV is given in Red or Green. Red corresponds to an RTV value less than the maximum concentration recorded in groundwater which indicates that mitigation measures may be required, and Green corresponds to an RTV value more than the maximum concentration recorded in groundwater which indicates that mitigation measures are not required.

Table 4. Results of Detailed Quantitative Risk Assessment at in Natural Ground at Markeaton Junction

Determinand	Target Concentration (DWS) (µg/L)	Maximum Concentration in Groundwater (µg/L)	Predicted Concentration at Receptor (µg/L)	Remedial Target Value (µg/L)
>C21-C35 Aliphatics	300	1,250	<0.00001	**>10,000**
>EC21-EC35 Aromatics	90	591	<0.00001	**>10,000**

XX RTV less than maximum concentration in groundwater

XX RTV greater than maximum concentration in groundwater

The results of the DQRA for groundwater sampled at locations BM05 and BM11 at Markeaton junction suggest that there will be negligible risks from petroleum hydrocarbon determinands present in groundwater to the identified critical receptor (Markeaton Lake/ Pond).

Conclusion

A Detailed Quantitative Risk Assessment (DQRA) was carried out using the Environment Agency’s Remedial Targets Worksheet for the TPH fractions, noted in Table 1, in groundwater within the Made Ground at Kingsway junction and Natural Ground at Markeaton junction. The results of the DQRA indicates that there is negligible risk to identified receptors from the TPH fractions.

No remedial works are considered necessary regarding the concentrations of potential contaminants encountered within groundwater at these junctions.

Where dewatering of excavations is required during the Scheme construction works, water should be collected, stored, tested and then shall either be:

- Discharged to foul sewer under a trade effluent consent agreed with the local sewerage undertaker; and/or
- Discharged to surface water under a water discharge activity environmental permit (WDA-EP) from the Environment Agency.

Appendix A – Kingsway Junction RTM DQRA Made Ground [TPH Fractions]

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Gabriella Barnes**			
Date:	**10-Jan-20**		**Version:**	**3.2**
Contaminant	**>EC10 - 12 Aliphatics**			
Target Concentration (C_T)	**0.3**	**mg/l**	**Origin of C_T:**	**DWS**

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.

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Parameter	Variable	Value	Unit	Source
Contaminant		**>EC10 - 12 Aliphatics**		from Level 1
Target Concentration	C_T	**3.00E-01**	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

Parameter	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.31E-01	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+03	days	*See Justification Table*
Calculated decay rate	λ	6.93E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	*See Justification Table*
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	*See Justification Table*
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	6.00E+04	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	2.40E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	6.00E+04	l/kg

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

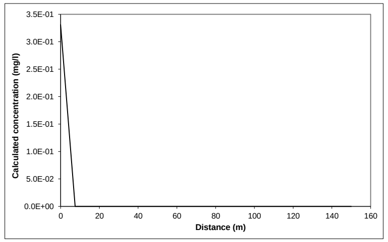
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	1.50E+01	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	1.50E+00	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**3.3E-01**
7.5	**3.94E-45**
15.0	**4.42E-89**
22.5	**5.19E-133**
30.0	**6.30E-177**
37.5	**7.80E-221**
45.0	**9.81E-265**
52.5	**0.00E+00**
60.0	**0.00E+00**
67.5	**0.00E+00**
75.0	**0.00E+00**
82.5	**0.00E+00**
90.0	**0.00E+00**
97.5	**0.00E+00**
105.0	**0.00E+00**
112.5	**0.00E+00**
120.0	**0.00E+00**
127.5	**0.00E+00**
135.0	**0.00E+00**
142.5	**0.00E+00**
150.0	**0.00E+00**

Note

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

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

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

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

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	1.07E+06	fraction
Decay rate used	λ	6.93E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.54E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	0.00E+00	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	breakthrough at compliance point	

Remedial Targets

Remedial Target		No impact	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**0.00E+00**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

Site being assessed:	Kingsway Junction
Completed by:	Gabriella Barnes
Date:	10/01/2020
Version:	3.2

Environment Agency

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**		
Site Address:	**A38, Derbyshire**		
Completed by:	**Gabriella Barnes**		
Date:	**10-Jan-20**	**Version:**	**3.2**
Contaminant	**>EC12 - 16 Aliphatics**		
Target Concentration (C_T)	**0.3 mg/l**	**Origin of C_T:**	**DWS**

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.

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Input Parameters	Variable	Value	Unit	Source
Contaminant		>EC12 - 16 Aliphatics		from Level 1
Target Concentration	C_T	3.00E-01	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.24E-01	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+03	days	*See Justification Table*
Calculated decay rate	λ	6.93E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	*See Justification Table*
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	*See Justification Table*
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.34E+06	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	5.37E+06	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	1.34E+06	l/kg

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

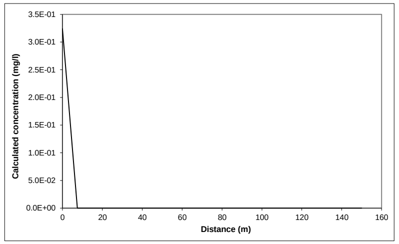
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	1.50E+01	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	1.50E+00	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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.

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**3.2E-01**
7.5	**3.11E-209**
15.0	**0.00E+00**
22.5	**0.00E+00**
30.0	**0.00E+00**
37.5	**0.00E+00**
45.0	**0.00E+00**
52.5	**0.00E+00**
60.0	**0.00E+00**
67.5	**0.00E+00**
75.0	**0.00E+00**
82.5	**0.00E+00**
90.0	**0.00E+00**
97.5	**0.00E+00**
105.0	**0.00E+00**
112.5	**0.00E+00**
120.0	**0.00E+00**
127.5	**0.00E+00**
135.0	**0.00E+00**
142.5	**0.00E+00**
150.0	**0.00E+00**

Note

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

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

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

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

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	2.40E+07	fraction
Decay rate used	λ	6.93E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.13E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	0.00E+00	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	breakthrough at compliance point	

Site being assessed:	Kingsway Junction
Completed by:	Gabriella Barnes
Date:	10/01/2020
Version:	3.2

Remedial Targets

Remedial Target		No impact	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**0.00E+00**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Gabriella Barnes**			
Date:	**10-Jan-20**		**Version:**	**3.2**
Contaminant	**>EC16 - 21 Aliphatics**			
Target Concentration (C_T)	**0.3**	**mg/l**	**Origin of C_T:**	**DWS**

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.

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		>EC16 - 21 Aliphatics		from Level 1
Target Concentration	C_T	3.00E-01	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	5.42E-01	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	3.00E+03	days	*See Justification Table*
Calculated decay rate	λ	2.31E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	*See Justification Table*
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	*See Justification Table*
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.58E+08	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	2.82E+09	fraction
Decay rate used	λ	2.31E-04	d^{-1}
Rate of contaminant flow due to retardation	u	9.64E-11	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	0.00E+00	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**breakthrough at compliance point**	

Remedial Targets

Remedial Target		No impact	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**0.00E+00**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	6.31E+08	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	1.58E+08	l/kg

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

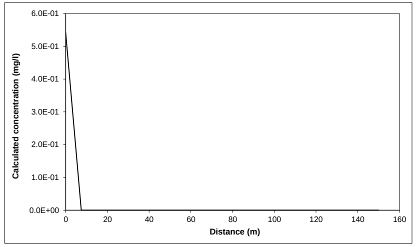
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	1.50E+01	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	1.50E+00	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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: Kingsway Junction
Completed by: Gabriella Barnes
Date: 10/01/2020
Version: 3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	5.4E-01
7.5	0.00E+00
15.0	0.00E+00
22.5	0.00E+00
30.0	0.00E+00
37.5	0.00E+00
45.0	0.00E+00
52.5	0.00E+00
60.0	0.00E+00
67.5	0.00E+00
75.0	0.00E+00
82.5	0.00E+00
90.0	0.00E+00
97.5	0.00E+00
105.0	0.00E+00
112.5	0.00E+00
120.0	0.00E+00
127.5	0.00E+00
135.0	0.00E+00
142.5	0.00E+00
150.0	0.00E+00

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Gabriella Barnes**			
Date:	**10-Jan-20**		**Version:**	**3.2**
Contaminant	**>EC21 - 35 Aliphatics**			
Target Concentration (C_T)	**0.3**	**mg/l**	**Origin of C_T:**	**DWS**

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.

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		>EC21 - 35 Aliphatics		from Level 1
Target Concentration	C_T	3.00E-01	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	5.76E+00	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+04	days	*See Justification Table*
Calculated decay rate	λ	6.93E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	*See Justification Table*
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	*See Justification Table*
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.90E+09	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	3.40E+10	fraction
Decay rate used	λ	6.93E-05	d^{-1}
Rate of contaminant flow due to retardation	u	8.01E-12	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	0.00E+00	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**breakthrough at compliance point**	

Remedial Targets

Remedial Target		No impact	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**0.00E+00**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	7.59E+09	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	1.90E+09	l/kg

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

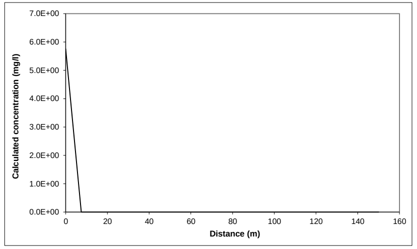
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	1.50E+01	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	1.50E+00	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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:	Kingsway Junction
Completed by:	Gabriella Barnes
Date:	10/01/2020
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	5.8E+00
7.5	0.00E+00
15.0	0.00E+00
22.5	0.00E+00
30.0	0.00E+00
37.5	0.00E+00
45.0	0.00E+00
52.5	0.00E+00
60.0	0.00E+00
67.5	0.00E+00
75.0	0.00E+00
82.5	0.00E+00
90.0	0.00E+00
97.5	0.00E+00
105.0	0.00E+00
112.5	0.00E+00
120.0	0.00E+00
127.5	0.00E+00
135.0	0.00E+00
142.5	0.00E+00
150.0	0.00E+00

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Gabriella Barnes**			
Date:	**10-Jan-20**		**Version:**	**3.2**
Contaminant	**>EC5 - 7 Aromatic**			
Target Concentration (C_T)	**0.001**	**mg/l**	**Origin of C_T:**	**DWS**

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.

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		>EC5 - 7 Aromatic		from Level 1
Target Concentration	C_T	1.00E-03	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 pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.70E+01	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+01	days	*See Justification Table*
Calculated decay rate	λ	1.39E-02	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.69E+01	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	3.04E+02	fraction
Decay rate used	λ	1.39E-02	d^{-1}
Rate of contaminant flow due to retardation	u	8.97E-04	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	4.56E-64	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.73E+64**	

Remedial Targets

Remedial Target		**3.73E+61**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**4.56E-64**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	6.76E+01	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	1.69E+01	l/kg

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

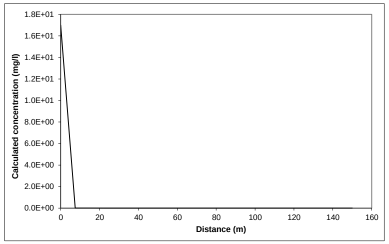
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	1.50E+01	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	1.50E+00	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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:	Kingsway Junction
Completed by:	Lucy Full
Date:	########
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**1.7E+01**
7.5	**9.38E-03**
15.0	**4.88E-06**
22.5	**2.66E-09**
30.0	**1.50E-12**
37.5	**8.62E-16**
45.0	**5.03E-19**
52.5	**2.96E-22**
60.0	**1.76E-25**
67.5	**1.05E-28**
75.0	**6.32E-32**
82.5	**3.82E-35**
90.0	**2.31E-38**
97.5	**1.41E-41**
105.0	**8.56E-45**
112.5	**5.23E-48**
120.0	**3.20E-51**
127.5	**1.96E-54**
135.0	**1.20E-57**
142.5	**7.40E-61**
150.0	**4.56E-64**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Gabriella Barnes**			
Date:	**10-Jan-20**		**Version:**	**3.2**
Contaminant	**>EC8 - 10 Aromatics**			
Target Concentration (C_T)	**0.3**	**mg/l**	**Origin of C_T:**	**DWS**

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.

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		>EC8 - 10 Aromatics		from Level 1
Target Concentration	C_T	3.00E-01	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

				Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.91E-01	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	5.00E+02	days	*See Justification Table*
Calculated decay rate	λ	1.39E-03	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	*See Justification Table*
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	*See Justification Table*
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.96E+02	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	av	1.50E-01	m	*see options*

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	7.09E+03	fraction
Decay rate used	λ	1.39E-03	d^{-1}
Rate of contaminant flow due to retardation	u	3.84E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.15E-100	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.39E+99**	

Remedial Targets

Remedial Target	**1.02E+99**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks			
Distance to compliance point	**150**	**m**	
Concentration of contaminant at compliance point (C_{ED}/C_0)	**1.15E-100**	**mg/l**	Ogata Banks
after	**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	1.58E+03	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.96E+02	l/kg

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

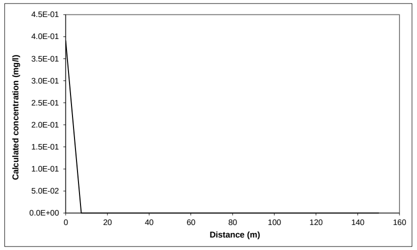
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	1.50E+01	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	1.50E+00	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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: Kingsway Junction
Completed by: Gabriella Barnes
Date: 10/01/2020
Version: 3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**3.9E-01**
7.5	**3.86E-06**
15.0	**3.59E-11**
22.5	**3.50E-16**
30.0	**3.52E-21**
37.5	**3.61E-26**
45.0	**3.76E-31**
52.5	**3.96E-36**
60.0	**4.21E-41**
67.5	**4.49E-46**
75.0	**4.83E-51**
82.5	**5.21E-56**
90.0	**5.63E-61**
97.5	**6.12E-66**
105.0	**6.66E-71**
112.5	**7.27E-76**
120.0	**7.95E-81**
127.5	**8.70E-86**
135.0	**9.55E-91**
142.5	**1.05E-95**
150.0	**1.15E-100**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Gabriella Barnes**			
Date:	**10-Jan-20**		**Version:**	**3.2**
Contaminant	**>EC10 - 12 Aromatics**			
Target Concentration (C_T)	**0.09**	**mg/l**	**Origin of C_T:**	**DWS**

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.

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Input Parameters	Variable	Value	Unit	Source
Contaminant		>EC10 - 12 Aromatics		from Level 1
Target Concentration	C_T	9.00E-02	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	2.21E-01	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+03	days	*See Justification Table*
Calculated decay rate	λ	6.93E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	*See Justification Table*
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	*See Justification Table*
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	6.28E+02	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

Calculated Parameters	Variable	Value	Unit
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	1.12E+04	fraction
Decay rate used	λ	6.93E-04	d^{-1}
Rate of contaminant flow due to retardation	u	2.42E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	8.24E-90	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**2.68E+88**	

Remedial Targets

Remedial Target	**2.41E+87**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks			

Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**8.24E-90**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	2.51E+03	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	6.28E+02	l/kg

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

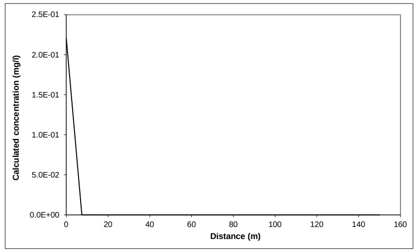
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	1.50E+01	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	1.50E+00	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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:	Kingsway Junction
Completed by:	Gabriella Barnes
Date:	10/01/2020
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**2.2E-01**
7.5	**7.82E-06**
15.0	**2.61E-10**
22.5	**9.14E-15**
30.0	**3.30E-19**
37.5	**1.22E-23**
45.0	**4.55E-28**
52.5	**1.72E-32**
60.0	**6.56E-37**
67.5	**2.51E-41**
75.0	**9.70E-46**
82.5	**3.75E-50**
90.0	**1.46E-54**
97.5	**5.69E-59**
105.0	**2.22E-63**
112.5	**8.70E-68**
120.0	**3.42E-72**
127.5	**1.34E-76**
135.0	**5.29E-81**
142.5	**2.09E-85**
150.0	**8.24E-90**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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: **Kingsway Junction**
Site Address: **A38, Derbyshire**

Completed by: **Gabriella Barnes**
Date: **10-Jan-20** **Version:** **3.2**

Contaminant **>EC12 - 16 Aromatics**
Target Concentration (C_T) **0.09** **mg/l** **Origin of C_T:** **DWS**

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.

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		>EC12 - 16 Aromatics		from Level 1
Target Concentration	C_T	9.00E-02	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	3.52E-01	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+03	days	*See Justification Table*
Calculated decay rate	λ	6.93E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	*See Justification Table*
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	*See Justification Table*
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.25E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	2.24E+04	fraction
Decay rate used	λ	6.93E-04	d^{-1}
Rate of contaminant flow due to retardation	u	1.21E-05	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	9.98E-127	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**3.53E+125**	

Remedial Targets

Remedial Target	**3.18E+124**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks			

Distance to compliance point **150** **m**

Concentration of contaminant at compliance point	C_{ED}/C_0	**9.98E-127**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

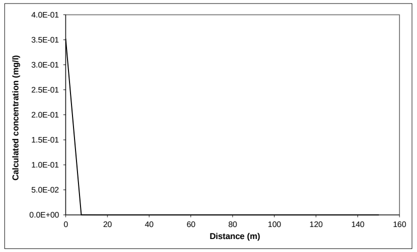
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	5.01E+03	l/kg
Entry for ionic organic chemicals (option)			
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	1.25E+03	l/kg

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

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

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	1.50E+01	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	1.50E+00	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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:	Kingsway Junction
Completed by:	Gabriella Barnes
Date:	10/01/2020
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	3.5E-01
7.5	1.74E-07
15.0	8.08E-14
22.5	3.94E-20
30.0	1.98E-26
37.5	1.02E-32
45.0	5.30E-39
52.5	2.79E-45
60.0	1.48E-51
67.5	7.93E-58
75.0	4.26E-64
82.5	2.30E-70
90.0	1.24E-76
97.5	6.76E-83
105.0	3.68E-89
112.5	2.01E-95
120.0	1.10E-101
127.5	6.01E-108
135.0	3.30E-114
142.5	1.81E-120
150.0	9.98E-127

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Gabriella Barnes**			
Date:	**10-Jan-20**		**Version:**	**3.2**
Contaminant	**>EC16 - 21 Aromatics**			
Target Concentration (C_T)	**0.09**	**mg/l**	**Origin of C_T:**	**DWS**

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.

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

Input Parameters (using pull down menu)	Variable	Value	Unit	Source
Contaminant		>EC16 - 21 Aromatics		from Level 1
Target Concentration	C_T	9.00E-02	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	4.84E-01	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	3.00E+03	days	*See Justification Table*
Calculated decay rate	λ	2.31E-04	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	*See Justification Table*
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	*See Justification Table*
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.53E+03	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	1.41E+04	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.53E+03	l/kg

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

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

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	1.50E+01	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	1.50E+00	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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

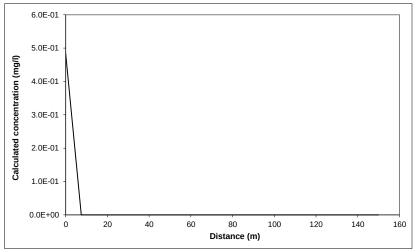
Calculated Parameters

Calculated Parameters	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	6.32E+04	fraction
Decay rate used	λ	2.31E-04	d^{-1}
Rate of contaminant flow due to retardation	u	4.31E-06	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	1.11E-122	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**4.35E+121**	

Remedial Targets

Remedial Target		**3.91E+120**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**1.11E-122**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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



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

Note

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

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

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

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

Site being assessed:	Kingsway Junction
Completed by:	Gabriella Barnes
Date:	10/01/2020
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	4.8E-01
7.5	3.74E-07
15.0	2.73E-13
22.5	2.09E-19
30.0	1.65E-25
37.5	1.33E-31
45.0	1.09E-37
52.5	8.97E-44
60.0	7.47E-50
67.5	6.26E-56
75.0	5.28E-62
82.5	4.46E-68
90.0	3.79E-74
97.5	3.23E-80
105.0	2.76E-86
112.5	2.36E-92
120.0	2.02E-98
127.5	1.74E-104
135.0	1.50E-110
142.5	1.29E-116
150.0	1.11E-122

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Gabriella Barnes**			
Date:	**10-Jan-20**		**Version:**	**3.2**
Contaminant	**>EC21 - 35 Aromatics**			
Target Concentration (C_T)	**0.09**	**mg/l**	**Origin of C_T:**	**DWS**

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.

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		>EC21 - 35 Aromatics		from Level 1
Target Concentration	C_T	9.00E-02	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	**Source of parameter value**
Initial contaminant concentration in groundwater at plume core	C_0	1.85E+00	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+04	days	*See Justification Table*
Calculated decay rate	λ	6.93E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	3.60E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.30E+00	m	*See Justification Table*
Saturated aquifer thickness	da	2.50E+00	m	*See Justification Table*
Bulk density of aquifer materials	ρ	1.79E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	1.40E-01	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	1.94E-01	m/d	*See Justification Table*
Distance to compliance point	x	1.50E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	*See Justification Table*
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	*See Justification Table*
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.15E+04	l/kg	*see options*
Longitudinal dispersivity	ax	1.50E+01	m	*see options*
Transverse dispersivity	az	1.50E+00	m	*see options*
Vertical dispersivity	ay	1.50E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.72E-01	m/d
Retardation factor	Rf	5.63E+05	fraction
Decay rate used	λ	6.93E-05	d^{-1}
Rate of contaminant flow due to retardation	u	4.83E-07	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	2.36E-200	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**7.82E+199**	

Remedial Targets

Remedial Target		**7.04E+198**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**150**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**2.36E-200**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

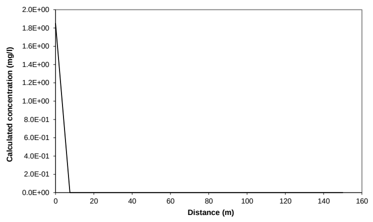
Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	1.26E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.15E+04	l/kg

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

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

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	1.50E+01	5.42E+00	m
Transverse dispersivity	**az**	0.00E+00	1.50E+00	5.42E-01	m
Vertical dispersivity	**ay**	0.00E+00	1.50E-01	5.42E-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 a 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:	Kingsway Junction
Completed by:	Gabriella Barnes
Date:	10/01/2020
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration mg/l
0	1.9E+00
7.5	1.75E-10
15.0	1.56E-20
22.5	1.46E-30
30.0	1.41E-40
37.5	1.39E-50
45.0	1.38E-60
52.5	1.40E-70
60.0	1.42E-80
67.5	1.46E-90
75.0	1.50E-100
82.5	1.55E-110
90.0	1.61E-120
97.5	1.68E-130
105.0	1.75E-140
112.5	1.84E-150
120.0	1.93E-160
127.5	2.02E-170
135.0	2.13E-180
142.5	2.24E-190
150.0	2.36E-200

Appendix B – Markeaton Junction RTM DQRA [TPH Fractions]

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Markeaton Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Gabriella Barnes**			
Date:	**10-Jan-20**		**Version:**	**3.2**
Contaminant	**>EC21 - 35 Aliphatics**			
Target Concentration (C_T)	**0.3**	**mg/l**	**Origin of C_T:**	**DWS**

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.

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		**>EC21 - 35 Aliphatics**		from Level 1
Target Concentration	**C_T**	**3.00E-01**	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	5.76E+00	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+04	days	*See Justification Table*
Calculated decay rate	λ	6.93E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.00E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	4.00E-02	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	2.90E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	*See Justification Table*
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	*See Justification Table*
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	1.90E+09	l/kg	*see options*
Longitudinal dispersivity	ax	2.90E+01	m	*see options*
Transverse dispersivity	az	2.90E+00	m	*see options*
Vertical dispersivity	ay	2.90E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.59E-02	m/d
Retardation factor	Rf	4.36E+10	fraction
Decay rate used	λ	6.93E-05	d^{-1}
Rate of contaminant flow due to retardation	u	5.94E-13	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	0.00E+00	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	**breakthrough at compliance point**	

Remedial Targets

Remedial Target		**No impact**	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**290**	**m**	
Concentration of contaminant at compliance point	**C_{ED}/C_0**	**0.00E+00**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	7.59E+09	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	1.90E+09	l/kg

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

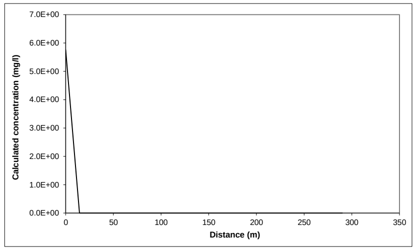
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	2.90E+01	7.31E+00	m
Transverse dispersivity	**az**	0.00E+00	2.90E+00	7.31E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.90E-01	7.31E-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 a 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:	Markeaton Junction
Completed by:	Gabriella Barnes
Date:	10/01/2020
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	**Concentration**
	mg/l
0	**5.8E+00**
14.5	**0.00E+00**
29.0	**0.00E+00**
43.5	**0.00E+00**
58.0	**0.00E+00**
72.5	**0.00E+00**
87.0	**0.00E+00**
101.5	**0.00E+00**
116.0	**0.00E+00**
130.5	**0.00E+00**
145.0	**0.00E+00**
159.5	**0.00E+00**
174.0	**0.00E+00**
188.5	**0.00E+00**
203.0	**0.00E+00**
217.5	**0.00E+00**
232.0	**0.00E+00**
246.5	**0.00E+00**
261.0	**0.00E+00**
275.5	**0.00E+00**
290.0	**0.00E+00**

Hydrogeological risk assessment for land contamination

Remedial Targets Worksheet , Release 3.2

First released: 2006. Version 3.2: January 2013

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

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

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:	**Kingsway Junction**			
Site Address:	**A38, Derbyshire**			
Completed by:	**Gabriella Barnes**			
Date:	**10-Jan-20**		**Version:**	**3.2**
Contaminant	**>EC21 - 35 Aromatics**			
Target Concentration (C_T)	**0.09**	**mg/l**	**Origin of C_T:**	**DWS**

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.

R&D Publication 20 Remedial Targets Worksheet, Release 3.2

Level 3 - Groundwater

See Note

Input Parameters (using pull down menu)

	Variable	Value	Unit	Source
Contaminant		>EC21 - 35 Aromatics		from Level 1
Target Concentration	C_T	9.00E-02	mg/l	from Level 1

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

Ogata Banks — **Equations in HRA publication**

Approach for simulating vertical dispersion: **Simulate vertical dispersion in 1 direction**

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

Approach for simulating degradation of pollutants: **Apply degradation rate to pollutants in all phases (e.g. field derived value**

	Variable	Value	Unit	Source of parameter value
Initial contaminant concentration in groundwater at plume core	C_0	1.85E+00	mg/l	*Maximum concentration in GW*
Half life for degradation of contaminant in water	$t_{1/2}$	1.00E+04	days	*See Justification Table*
Calculated decay rate	λ	6.93E-05	$days^{-1}$	
Width of plume in aquifer at source (perpendicular to flow)	Sz	2.00E+02	m	*See Justification Table*
Plume thickness at source	Sy	2.50E+01	m	*See Justification Table*
Saturated aquifer thickness	da	3.00E+01	m	*See Justification Table*
Bulk density of aquifer materials	ρ	2.30E+00	g/cm^3	*See Justification Table*
Effective porosity of aquifer	n	1.00E-01	fraction	*See Justification Table*
Hydraulic gradient	i	4.00E-02	fraction	*See Justification Table*
Hydraulic conductivity of aquifer	K	6.48E-02	m/d	*See Justification Table*
Distance to compliance point	x	2.90E+02	m	*See Justification Table*
Distance (lateral) to compliance point perpendicular to flow direction	z	0.00E+00	m	*See Justification Table*
Distance (depth) to compliance point perpendicular to flow direction	y	0.00E+00	m	*See Justification Table*
Time since pollutant entered groundwater	t	9.90E+99	days	*time variant options only*
Parameters values determined from options				
Partition coefficient	Kd	3.15E+04	l/kg	*see options*
Longitudinal dispersivity	ax	2.90E+01	m	*see options*
Transverse dispersivity	az	2.90E+00	m	*see options*
Vertical dispersivity	av	2.90E-01	m	*see options*

Calculated Parameters

	Variable		
Groundwater flow velocity	v	2.59E-02	m/d
Retardation factor	Rf	7.24E+05	fraction
Decay rate used	λ	6.93E-05	d^{-1}
Rate of contaminant flow due to retardation	u	3.58E-08	m/d
Contaminant concentration at distance x, assuming one-way vertical dispersion	C_{ED}	0.00E+00	mg/l
Attenuation factor (one way vertical dispersion, CO/CED)	**AF**	breakthrough at compliance point	

Remedial Targets

Remedial Target		No impact	**mg/l**	For comparison with measured groundwater concentration.
Ogata Banks				
Distance to compliance point		**290**	**m**	
Concentration of contaminant at compliance point	C_{ED}/C_0	**0.00E+00**	**mg/l**	Ogata Banks
after		**9.9E+99**	**days**	

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

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

Calculate for non-polar organic chemicals

Entry if specify partition coefficient (option)			
Soil water partition coefficient	Kd		l/kg
Entry for non-polar organic chemicals (option)			
Fraction of organic carbon in aquifer	foc	2.50E-01	fraction
Organic carbon partition coefficient	Koc	1.26E+05	l/kg
Entry for ionic organic chemicals (option)			
Sorption coefficient for related species	$K_{oc,n}$		l/kg
Sorption coefficient for ionised species	$K_{oc,i}$		l/kg
pH value	pH		
acid dissociation constant	pKa		
Fraction of organic carbon in aquifer	foc		fraction
Soil water partition coefficient	Kd	3.15E+04	l/kg

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

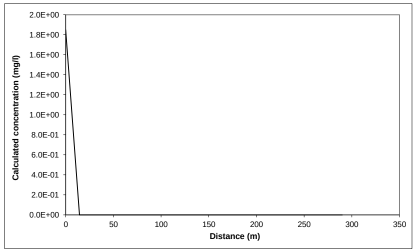
Dispersivities 10%, 1%, 0.1% of pathway length

		Enter value	Calc value	Xu & Eckstein	m
Longitudinal dispersivity	**ax**	0.00E+00	2.90E+01	7.31E+00	m
Transverse dispersivity	**az**	0.00E+00	2.90E+00	7.31E-01	m
Vertical dispersivity	**ay**	0.00E+00	2.90E-01	7.31E-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.

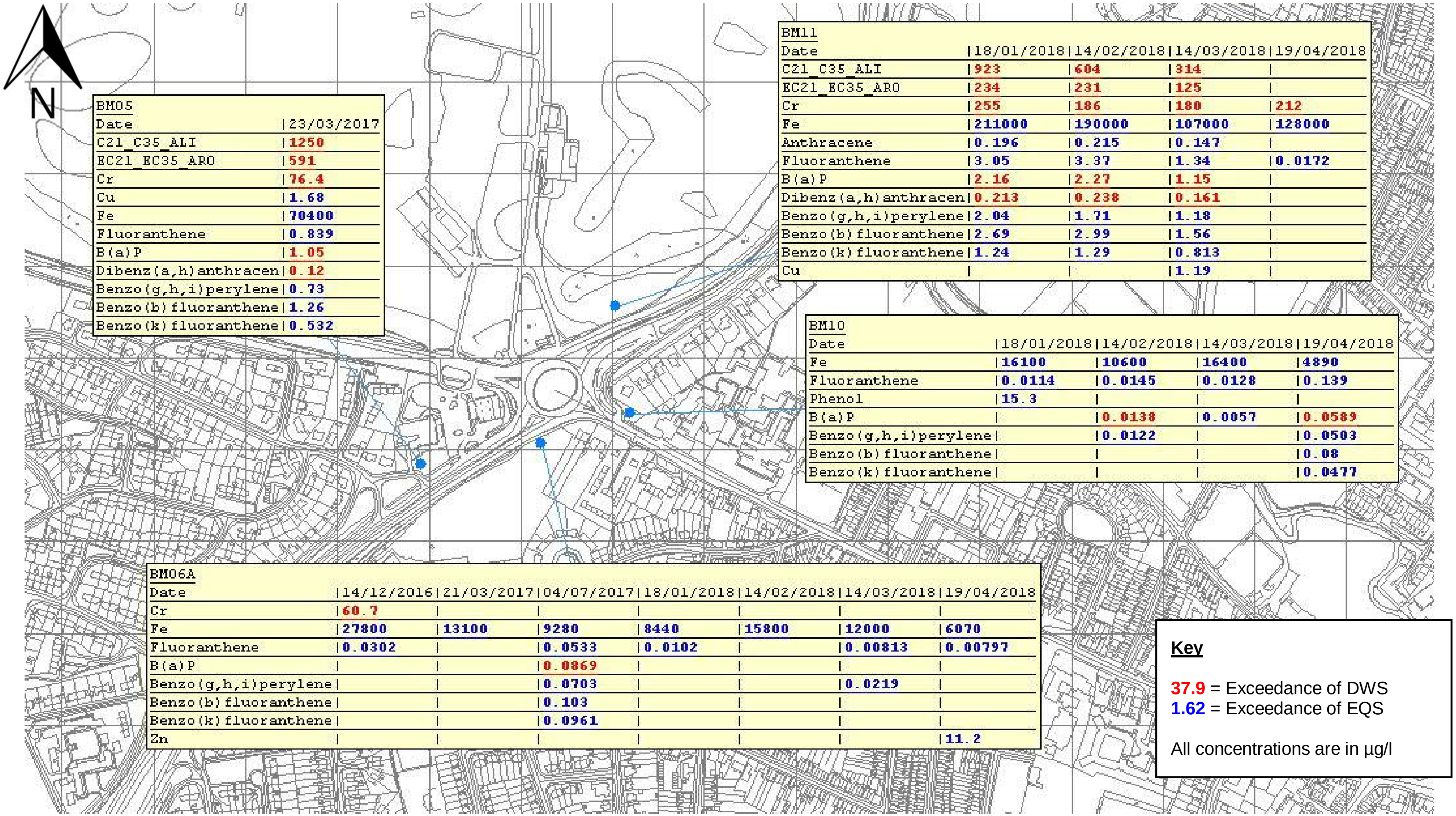
This worksheet should be used if pollutant transport and degradation is best described by a first order reaction. If degradation is best desribed by an electron limited degradation such as oxidation by O2, NO3, SO4 etc than an alternative solution should be used

Site being assessed:	Kingsway Junction
Completed by:	Gabriella Barnes
Date:	10/01/2020
Version:	3.2

Calculated concentrations for distance-concentration graph

Ogata Banks
From calculation sheet

Distance	Concentration
	mg/l
0	1.9E+00
14.5	8.41E-52
29.0	3.83E-103
43.5	1.74E-154
58.0	7.91E-206
72.5	3.60E-257
87.0	0.00E+00
101.5	0.00E+00
116.0	0.00E+00
130.5	0.00E+00
145.0	0.00E+00
159.5	0.00E+00
174.0	0.00E+00
188.5	0.00E+00
203.0	0.00E+00
217.5	0.00E+00
232.0	0.00E+00
246.5	0.00E+00
261.0	0.00E+00
275.5	0.00E+00
290.0	0.00E+00



BM05

Date	23/03/2017
C21_C35_ALI	1250
EC21_EC35_ARO	591
Cr	76.4
Cu	1.68
Fe	70400
Fluoranthene	0.839
B(a)P	1.05
Dibenz(a,h)anthracen	0.12
Benzo(g,h,i)perylene	0.73
Benzo(b)fluoranthene	1.26
Benzo(k)fluoranthene	0.532

BM11

Date	18/01/2018	14/02/2018	14/03/2018	19/04/2018
C21_C35_ALI	923	604	314	
EC21_EC35_ARO	234	231	125	
Cr	255	186	180	212
Fe	211000	190000	107000	128000
Anthracene	0.196	0.215	0.147	
Fluoranthene	3.05	3.37	1.34	0.0172
B(a)P	2.16	2.27	1.15	
Dibenz(a,h)anthracen	0.213	0.238	0.161	
Benzo(g,h,i)perylene	2.04	1.71	1.18	
Benzo(b)fluoranthene	2.69	2.99	1.56	
Benzo(k)fluoranthene	1.24	1.29	0.813	
Cu			1.19	

BM10

Date	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Fe	16100	10600	16400	4890
Fluoranthene	0.0114	0.0145	0.0128	0.139
Phenol	15.3			
B(a)P		0.0138	0.0057	0.0589
Benzo(g,h,i)perylene		0.0122		0.0503
Benzo(b)fluoranthene				0.08
Benzo(k)fluoranthene				0.0477

BM06A

Date	14/12/2016	21/03/2017	04/07/2017	18/01/2018	14/02/2018	14/03/2018	19/04/2018
Cr	60.7						
Fe	27800	13100	9280	8440	15800	12000	6070
Fluoranthene	0.0302		0.0533	0.0102		0.00813	0.00797
B(a)P			0.0869				
Benzo(g,h,i)perylene			0.0703			0.0219	
Benzo(b)fluoranthene			0.103				
Benzo(k)fluoranthene			0.0961				
Zn							11.2

Key

37.9 = Exceedance of DWS
1.62 = Exceedance of EQS

All concentrations are in µg/l

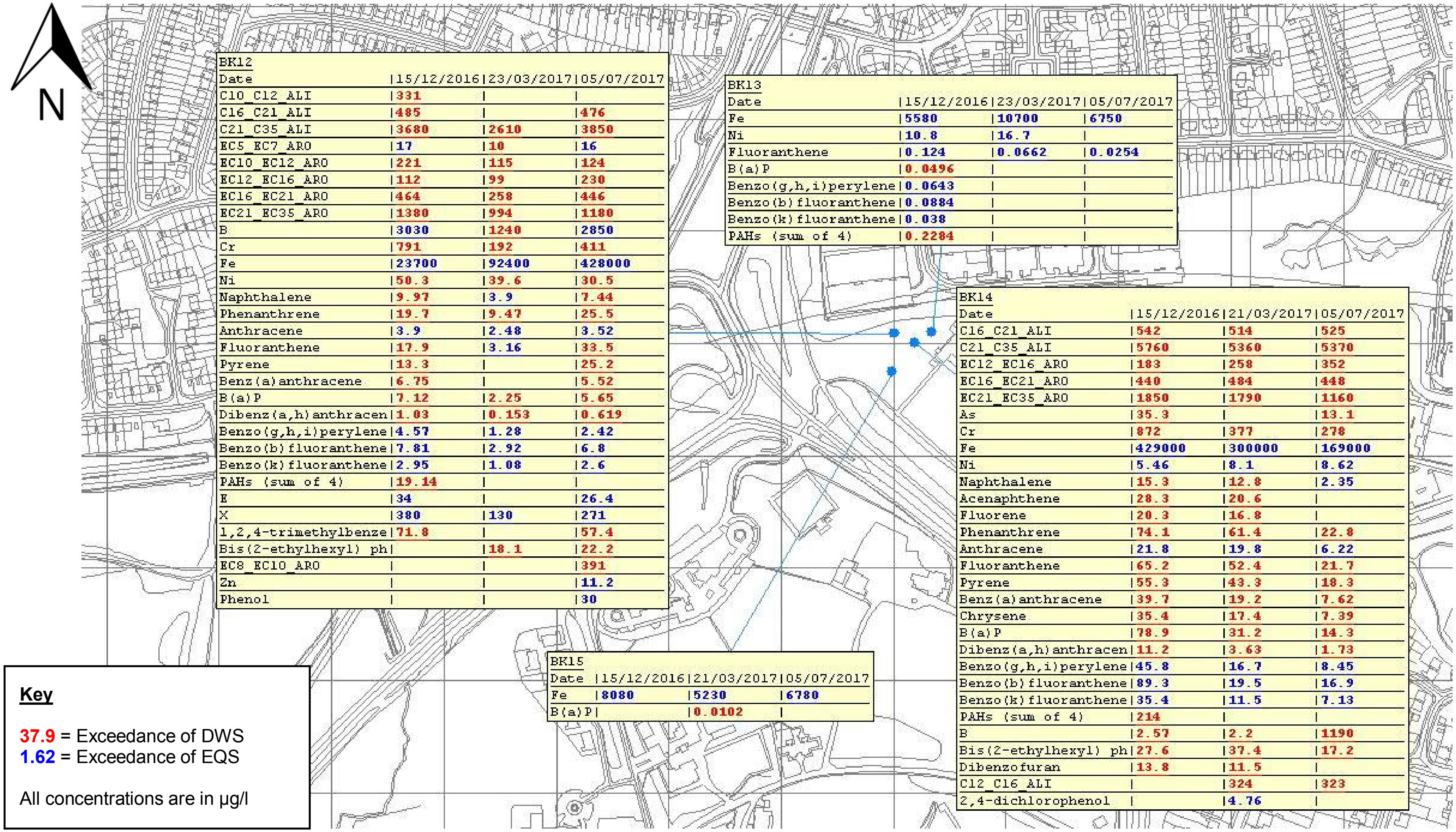
Figure 2 : Groundwater Exceedances (Markeaton)

Project : A38 Derby Junctions

Project Number : 60533462

Date : 13/11/2019

AECOM



BK12

Date	15/12/2016	23/03/2017	05/07/2017
C10_C12_ALI	331		
C16_C21_ALI	485		476
C21_C35_ALI	3680	2610	3850
EC5_EC7_ARO	17	10	16
EC10_EC12_ARO	221	115	124
EC12_EC16_ARO	112	99	230
EC16_EC21_ARO	464	258	446
EC21_EC35_ARO	1380	994	1180
B	3030	1240	2850
Cr	791	192	411
Fe	23700	92400	428000
Ni	50.3	39.6	30.5
Naphthalene	9.97	3.9	7.44
Phenanthrene	19.7	9.47	25.5
Anthracene	3.9	2.48	3.52
Fluoranthene	17.9	3.16	33.5
Pyrene	13.3		25.2
Benz(a)anthracene	6.75		5.52
B(a)P	7.12	2.25	5.65
Dibenz(a,h)anthracen	1.03	0.153	0.619
Benzo(g,h,i)perylene	4.57	1.28	2.42
Benzo(b)fluoranthene	7.81	2.92	6.8
Benzo(k)fluoranthene	2.95	1.08	2.6
PAHs (sum of 4)	19.14		
E	34		26.4
X	380	130	271
1,2,4-trimethylbenze	71.8		57.4
Bis(2-ethylhexyl) ph		18.1	22.2
EC8_EC10_ARO			391
Zn			11.2
Phenol			30

BK13

Date	15/12/2016	23/03/2017	05/07/2017
Fe	5580	10700	6750
Ni	10.8	16.7	
Fluoranthene	0.124	0.0662	0.0254
B(a)P	0.0496		
Benzo(g,h,i)perylene	0.0643		
Benzo(b)fluoranthene	0.0884		
Benzo(k)fluoranthene	0.038		
PAHs (sum of 4)	0.2284		

BK14

Date	15/12/2016	21/03/2017	05/07/2017
C16_C21_ALI	542	514	525
C21_C35_ALI	5760	5360	5370
EC12_EC16_ARO	183	258	352
EC16_EC21_ARO	440	484	448
EC21_EC35_ARO	1850	1790	1160
As	35.3		13.1
Cr	872	377	278
Fe	429000	300000	169000
Ni	5.46	8.1	8.62
Naphthalene	15.3	12.8	2.35
Acenaphthene	28.3	20.6	
Fluorene	20.3	16.8	
Phenanthrene	74.1	61.4	22.8
Anthracene	21.8	19.8	6.22
Fluoranthene	65.2	52.4	21.7
Pyrene	55.3	43.3	18.3
Benz(a)anthracene	39.7	19.2	7.62
Chrysene	35.4	17.4	7.39
B(a)P	78.9	31.2	14.3
Dibenz(a,h)anthracen	11.2	3.63	1.73
Benzo(g,h,i)perylene	45.8	16.7	8.45
Benzo(b)fluoranthene	89.3	19.5	16.9
Benzo(k)fluoranthene	35.4	11.5	7.13
PAHs (sum of 4)	214		
B	2.57	2.2	1190
Bis(2-ethylhexyl) ph	27.6	37.4	17.2
Dibenzofuran	13.8	11.5	
C12_C16_ALI		324	323
2,4-dichlorophenol		4.76	

BK15

Date	15/12/2016	21/03/2017	05/07/2017
Fe	8080	5230	6780
B(a)P		0.0102	

Key

37.9 = Exceedance of DWS
1.62 = Exceedance of EQS

All concentrations are in µg/l

Figure 4 : Groundwater Exceedances (Kingsway East)

Project : A38 Derby Junctions

Project Number : 60533462

Date : 04/10/2019

AECOM

Appendix 13: 8.45 – Little Eaton Junction Existing & Proposed Rights of Way Plan – 19.12.19 [REP3-016]

A38 Derby Junctions
TR010022
Volume 2
8.45 Little Eaton Junction Existing & Proposed Rights of Way Plan

Rule 8 (1)(c)(ii)

Planning Act 2008

Infrastructure Planning (Applications: Prescribed
Forms and Procedure) Regulations 2009

December 2019

Infrastructure Planning

Planning Act 2008

**The Infrastructure Planning
(Applications: Prescribed Forms
and Procedure) Regulations 2009**

A38 Derby Junctions

Development Consent Order 202[ ]

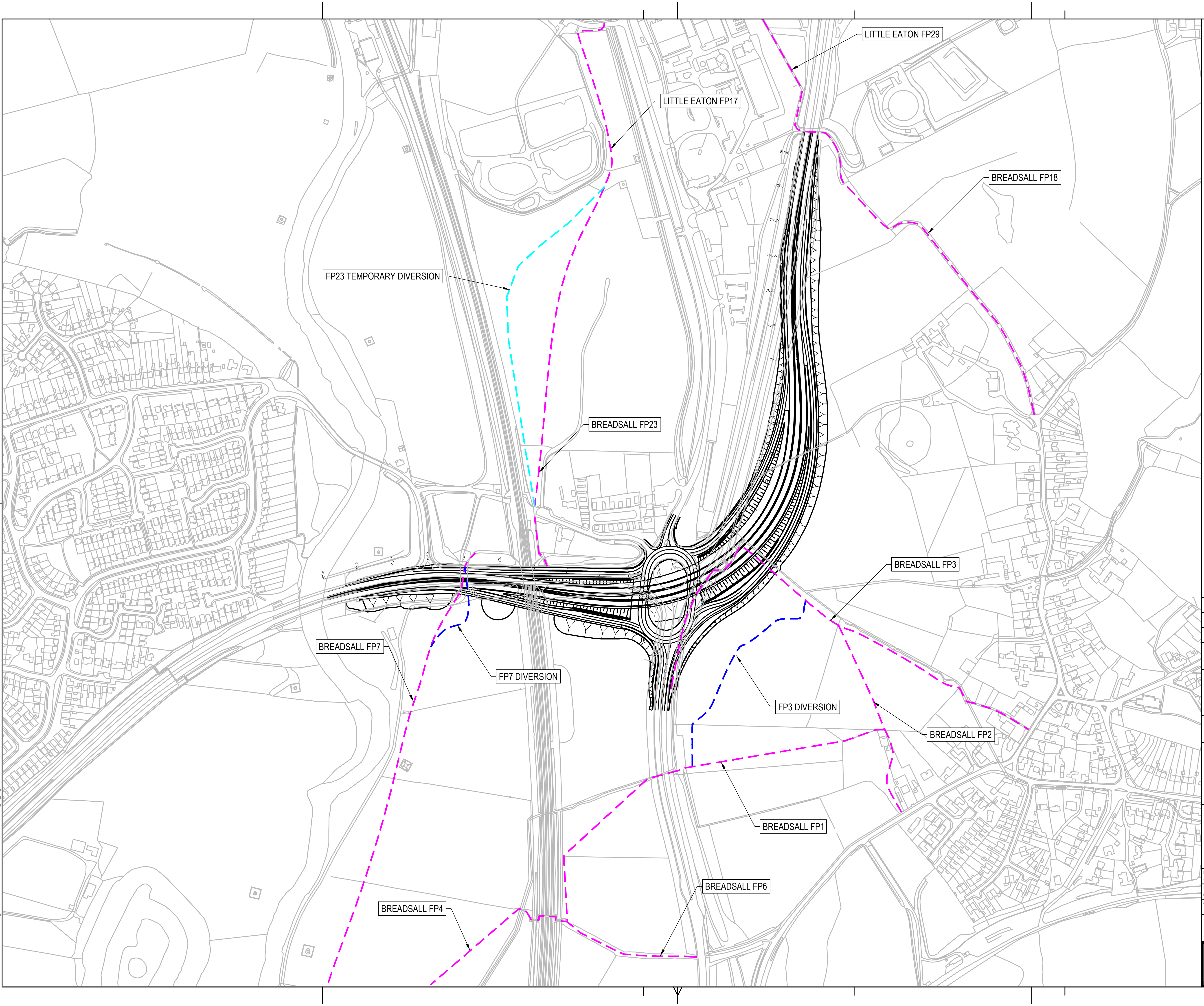
Little Eaton Junction Existing & Proposed Rights of Way Plan

Regulation Number	Rule 8 (1)(c)(ii)
Planning Inspectorate Scheme Reference	TR010022
Application Document Reference	8.45
Author	A38 Derby Junctions Project Team, Highways England

Version	Date	Status of Version
1	December 2019	Deadline 3 Submission

Schedule of Plans included in this Application Document

Drawing Number	**Drawing Title**	**Revision**
HE514503-ACM-HKF-Z3_ZZ_ZZ_ZZ-DR-CH-0001	Little Eaton Junction Existing & Proposed Rights of Way Plan	C01



NOTES

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KEY:

– –	EXISTING RIGHT OF WAY
– –	PROPOSED RIGHT OF WAY DIVERSION
– –	PROPOSED TEMPORARY RIGHT OF WAY DIVERSION

Revision Details	By / Check	Date	Suffix
First Issue	LE / GS	16/12/19	C01

Purpose of issue

DCO APPLICATION

Client

Highways England
Floor 5
Two Colmore Square
38 Colmore Circus
Birmingham
B4 6BN

Development Consent Order Number

TR010022

Project Title

A38
DERBY JUNCTIONS

Drawing Title

LITTLE EATON JUNCTION EXISTING & PROPOSED RIGHTS OF WAY PLAN

Designed	Drawn	Checked	Approved	Date
GS	LE	SW	GS	16/12/19

Internal Project No. 60533462	Suitability D7
Scale @ A1 1:2500	Zone A38/A61 Little Eaton

Drawing Number
Highways England PIN | Originator | Volume
HE514503 -ACM -HKF -
Z3_ZZ_ZZ_ZZ -DR-CH-0001
Location | Type | Role | Number

Rev
C01

Plot Date : 16 December 2019 16:13:42
File Name C:\PWWORKING\AECOM_EU\LUKE.M.EVANS\D0244568\HE514503-ACM-HKF-Z3_ZZ_ZZ_ZZ-DR-CH-0001

Appendix 14: 8.58 – Floodplain Compensation Area – Contours Before and After Excavation Works – 3.2.20 [REP4-020]

A38 Derby Junctions

TR010022

8.58 Floodplain Compensation Area – Contours Before and After Excavation Works

Planning Act 2008

Rule 8 (1)(k)

Infrastructure Planning (Examination Procedure) Rules 2010

Volume 8

February 2020

Infrastructure Planning

Planning Act 2008

The Infrastructure Planning (Examination Procedure) Rules 2010

A38 Derby Junctions

Development Consent Order 202[ ]

Floodplain Compensation Area – Contours Before and After Excavation Works

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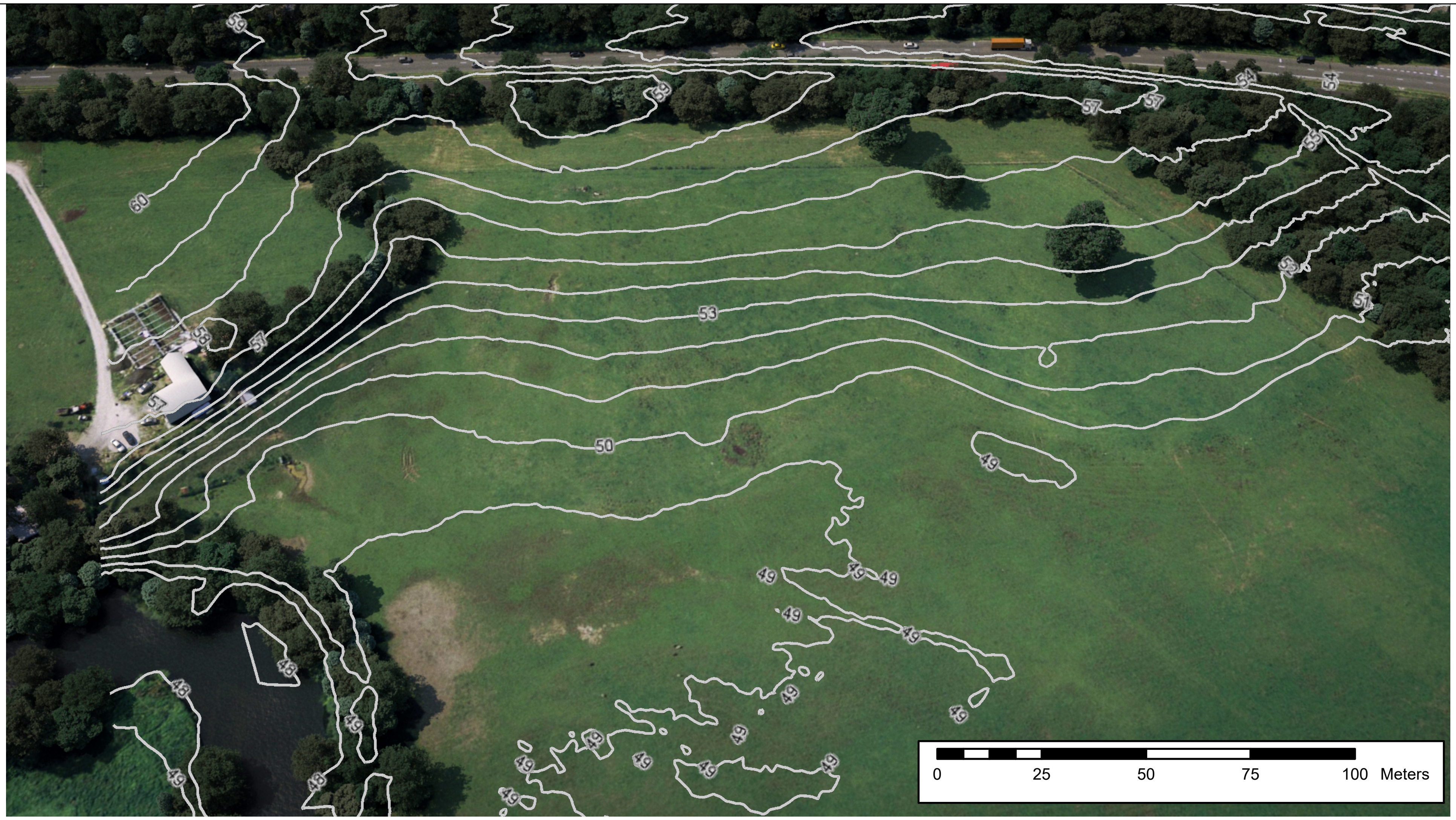
Regulation Number	Rule 8 (1)(k)
Planning Inspectorate Scheme Reference	TR010022
Application Document Reference	TR010022/APP/8.58
Author	A38 Derby Junctions Project Team, Highways England

Version	**Date**	**Status of Version**
1	03 February 2020	Deadline 4 submission

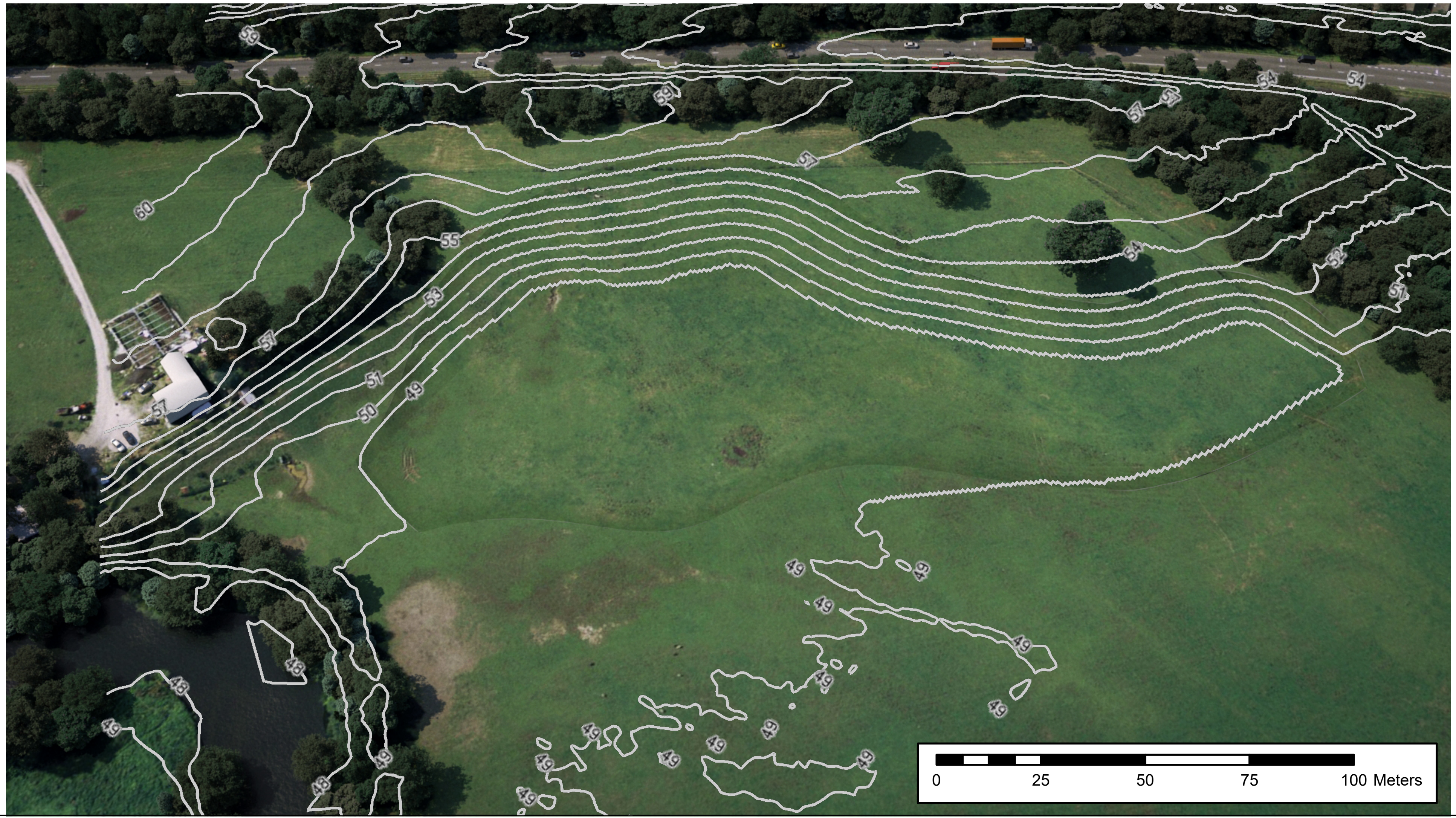
Schedule of Plans included in this Examination Document

Drawing Number	**Drawing Title**	**Revision**
HE514503-ACM-EGN-A38_SW_PR_ZZ-DR-LE-0001	FLOODPLAIN COMPENSATION AREA – CONTOURS BEFORE AND AFTER EXCAVATION WORKS	P01

Before excavation works



After excavation works (illustrative)



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LEGEND

— CONTOUR

FIRST ISSUE	BO / HP	17/01/20	P01
Revision Details	By / Check	Date	Suffix

Purpose of Issue

DCO APPLICATION

Client

Highways England
Major Projects
The Cube
199 Wharfside Street
Birmingham
B1 1RN

Development Consent Order Number

TR010022

Project Title

A38
DERBY JUNCTIONS

Drawing Title

FLOODPLAIN COMPENSATION AREA - CONTOURS BEFORE AND AFTER EXCAVATION WORKS

Designed	Drawn	Checked	Approved	Date
SW	BO	AR	HP	17/01/20

Internal Project No 60533462	Suitability S2
Scale @ A3 1:1000	Zone A38

Drawing Number
Highways England Pin | Originator | Volume
HE514503 -ACM -EGN-
A38_SW_PR_ZZ -DR-LE-0001
Location | Type | Role | Number

Rev
P01

Filename: O:\GIS\02_Maps\00 Environmental Statement\DCO Template\Floodplain_Visualisations.aprx